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JUL 1 1 2011

Ms. Jennifer Tufts
U.S. Environmental Protection Agency, Region 4
61 Forsyth Street
Atlanta, Georgia 30303

PPPO-02-1212927-11B

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

Dear Ms. Tufts and Mr. Winner:

TRANSMITTAL OF THE WORK PLAN FOR THE SURFACE WATER OPERABLE UNIT REMEDIAL INVESTIGATION/FEASIBILITY STUDY AT THE PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY (DOE/LX/07-0361&D1)

Enclosed for your review and approval is the *Work Plan for the Surface Water Operable Unit Remedial Investigation/Feasibility Study at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-0361&D1.

If you have any questions or require additional information, I can be reached at (270) 441-6825.

Sincerely,

Reinhard Knerr
Paducah Site Lead
Portsmouth/Paducah Project Office

Enclosures:

1. Certification Page
2. Work Plan for the SWOU RI/FS

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CERTIFICATION

Document Identification: ***Work Plan for the Surface Water Operable Unit Remedial Investigation/Feasibility Study at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,*** **DOE/LX/07-0361&D1, dated July 2011**

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

LATA Environmental Services of Kentucky, LLC

Mark J. Duff, Paducah Project Manager — 7-11-11 — Date Signed

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

U.S. Department of Energy

Reinhard Knerr, Paducah Site Lead
Portsmouth/Paducah Project Office — 7/11/11 — Date Signed

DOE/LX/07-0361&D1
Primary Document

Work Plan for the Surface Water Operable Unit Remedial Investigation/Feasibility Study at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

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Primary Document

Work Plan for the Surface Water Operable Unit Remedial Investigation/Feasibility Study at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Date Issued—July 2011

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

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

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PREFACE

This *Work Plan for the Surface Water Operable Unit Remedial Investigation/Feasibility Study at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-0361&D1, was prepared in accordance with the requirements under the Comprehensive Environmental Response, Compensation, and Liability Act. This document provides the required information as specified under the *Federal Facility Agreement for the Paducah Gaseous Diffusion Plant* (FFA), which was entered into by the U.S. Department of Energy, U.S. Environmental Protection Agency, and the Commonwealth of Kentucky (EPA 1998). This Remedial Investigation/Feasibility Study work plan qualifies as a primary document as defined by the FFA.

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TABLES

QAPP WORKSHEETS

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FIGURES

ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
ACO	Administrative Consent Order
AHA	activity hazard analysis
ALARA	as low as reasonably achievable
amsl	above mean sea level
ANSI	American National Standards Institute
AOC	area of concern
ARAR	applicable or relevant and appropriate requirement
AT123D	Analytical Transient 1-,2-,3-Dimensional
AUF	area use factor
AWQC	ambient water quality criteria
BAF	bioaccumulation factor
BERA	baseline ecological risk assessment
BGOU	Burial Grounds Operable Unit
bgs	below ground surface
BHHRA	baseline human health risk assessment
BRA	baseline risk assessment
CAAS	criticality accident alarm system
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
COC	contaminant of concern
COE	U.S. Army Corps of Engineers
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
cpm	counts per minute
CRZ	contamination reduction zone
CSM	conceptual site model
CSOU	Comprehensive Site Operable Unit
CZ	construction zone
DMC	Document Management Center
DMIP	data management implementation plan
DO	dissolved oxygen
DOE	U.S. Department of Energy
DOECAP	DOE Consolidated Audit Program
DQI	data quality indicator
DQO	data quality objective
EE/CA	Engineering Evaluation/Cost Analysis
EDD	electronic data deliverable
ELCR	excess lifetime cancer risk
EM	environmental management
EMS	Environmental Management System
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ER	environmental restoration
ER-L	effects range-low
ES&H	Environment, Safety, and Health
EU	exposure unit
EZ	exclusion zone

FCM	food chain model
FFA	Federal Facility Agreement
FIDLER	Field Instrument for the Detection of Low Energy Radiation
FS	feasibility study
FSP	field sampling plan
FTM	Field Team Manager
GDP	gaseous diffusion plant
GIS	geographic information system
GPS	Global Positioning System
GWOU	Groundwater Operable Unit
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HI	hazard index
HQ	hazard quotient
HSWA	Hazardous and Solid Waste Amendments
HU	hydrostratigraphic unit
IDW	investigation-derived waste
ISMS	Integrated Safety Management System
KDEP	Kentucky Department for Environmental Protection
KDFWR	Kentucky Department of Fish and Wildlife Resources
KOW	Kentucky Ordnance Works
KPDES	Kentucky Pollutant Discharge Elimination System
LOAEL	lowest observed adverse effect level
LUC	land use controls
MBI	Macroinvertebrate Bioassessment Index
MDC	minimum detectable concentration
MDL	method detection limit
MS	matrix spike
MSU	Moist Soils Unit
NA	not applicable
NaI	sodium iodide
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NFA	no further action
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NOAEL	no observed adverse effect level
NPL	National Priorities List
NSDD	North-South Diversion Ditch
OA	observational approach
OREIS	Oak Ridge Environmental Information System
ORFP	Ohio River floodplain
OSHA	Occupational Safety and Health Administration
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PEMS	Project Environmental Measurements System
PGDP	Paducah Gaseous Diffusion Plant
PM	project manager
PPE	personal protective equipment

ppm	parts per million
PRG	preliminary remediation goals
PSS	Plant Shift Superintendent
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QL	quantitation limit
RCRA	Resource Conservation and Recovery Act
RCT	Radiological Control Technician
RFD	Request for Disposal
RFI	RCRA Facility Investigation
RGA	Regional Gravel Aquifer
RI	remedial investigation
RPD	relative percent difference
RTL	ready-to-load
RWP	Radiological Work Permit
S&H	safety and health
SADA	Spatial Analysis and Decision Assistance
SAP	Sampling and Analysis Plan
SERA	screening-level ecological risk assessment
SESOIL	Seasonal Soil Compartment Model
SHR	Safety & Health Representative
SI	site investigation
SMO	Sample Management Office
SMP	site management plan
SOP	standard operating procedure
SOU	Soils Operable Unit
SOW	statement of work
SRM	standard reference materials
SWMM	Storm Water Management Model
SZ	support zone
T&E	threatened and endangered species
TSCA	Toxic Substances Control Act
TRV	toxicity reference value
TOC	total organic carbon
TNT	trinitrotoluene
TLD	thermoluminescent dosimeter
TCLP	Toxicity Characteristic Leaching Procedure
TCE	trichloroethene
TVA	Tennessee Valley Authority
UCL	upper confidence limit
UCRS	Upper Continental Recharge System
UF_6	uranium hexafluoride
USEC	United States Enrichment Corporation
USGS	U.S. Geological Survey
USRADS	Ultrasonic Ranging and Data System
VOC	volatile organic compound
WAC	waste acceptance criteria
WAG	waste area group
WKWMA	West Kentucky Wildlife Management Area
WMP	waste management plan

XRF	X-ray fluorescence
YWL	Yellow Water Line

EXECUTIVE SUMMARY

The Paducah Gaseous Diffusion Plant (PGDP) is an active uranium enrichment facility that is owned by the U.S. Department of Energy (DOE). DOE is conducting environmental restoration activities at PGDP in accordance with the requirements of the Paducah Federal Facility Agreement (FFA), which coordinated the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) cleanup requirements. PGDP was placed on the National Priorities List in 1994. DOE, the U.S. Environmental Protection Agency (EPA), and the Commonwealth of Kentucky entered into an FFA in 1998 (EPA 1998).

This Remedial Investigation/Feasibility Study (RI/FS) Work Plan has been developed to outline the RI/FS requirements for the Surface Water Operable Unit (SWOU) at PGDP. The solid waste management units (SWMUs) and areas of concern (AOCs) associated with the SWOU are listed in Appendix 4 of the Paducah Site Management Plan (SMP) (DOE 2011a). The SWMUs/AOCs being addressed under this work plan are 58, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 92, 93, 97, 102, 105, 106, 107, 108, 109, 113, 129, 168, 175, 185, 199, 205, 526, 549, and 550.

PROJECT OBJECTIVES AND GOALS

The goals for the SWOU are consistent with those established in the Paducah FFA and the Paducah SMP (DOE 2011a) negotiated among DOE, EPA, and Kentucky. The primary objectives for the SWOU presented in the SMP are to protect human health and the environment by taking actions necessary to prevent both on-site[1] and off-site human exposure that presents an unacceptable risk and implement actions that provide the greatest opportunities to achieve significant risk reduction before PGDP shutdown. The SWOU is being implemented in a phased approach consisting of a series of sequenced remedial and removal actions designed to accomplish the following goals:

(1) Prevent human exposure to contaminated sediments presenting an unacceptable risk to on-site workers and off-site recreational users of surface water;

(2) Prevent or minimize further off-site migration of contaminated sediments and surface water;

(3) Reduce, control, or minimize contaminant sources contributing to sediment and surface water contamination; and

(4) Evaluate and select long-term solutions for potential PGDP-related off-site surface water contamination to protect recreational users and ecological receptors.

The SWOU consists of the specific SWMUs and AOCs identified in Appendix 4 (Source Area By Operable Unit) of the Paducah SMP (DOE 2011a), and includes the soils/sediments and storm water corresponding with the points of discharge from facility piping to ditches, outfalls and Bayou and Little Bayou Creeks. Metals, radionuclides, volatiles, and polychlorinated biphenyls (PCBs) are the likely contaminants of interest for the SWOU. Remediation of Outfalls 005, 006, 017, 019, and their associated ditches is planned to occur during post-gaseous diffusion plant (GDP) shutdown for the GDP Lagoons and Ditches Operable Unit unless the parties agree early action is warranted.

[1] For the purposes of this document, on-site includes the Limited Area, industrial areas outside of the Limited Area, and restricted areas outside of the Limited Area. All other areas within this study are considered off-site. See Figure 1.2.

The goals of this RI/FS are as follows:

Goal 1: Characterize Nature of Contamination—characterize the nature of contaminants using existing data and, if required, by collecting additional data;

Goal 2: Define Extent of Contamination in Soil and Sediment—define the extent (vertical and lateral) and magnitude of contamination and perform an evaluation of sediment, soils, surface water, and ecological receptors to ensure that all exposure pathways for the subject units are assessed adequately to support cleanup decisions;

Goal 3: Determine Transport Mechanisms and Pathways—gather existing data and, if necessary, collect additional data to analyze contaminant transport mechanisms;

Goal 4: Complete a baseline human health risk assessment and screening-level ecological risk assessment for each SWOU;

Goal 5: Complete a sitewide baseline ecological risk assessment; and

Goal 6: Complete an Evaluation of Remedial Alternatives—determine if the existing data are sufficient to evaluate alternatives that will reduce risk to human health and the environment and support a no further action (NFA).

The RI will be conducted in a progressive phased-approach addressing human health and ecological risk. Additionally, the investigation in Bayou and Little Bayou Creeks will include an investigation of sediment stability prior to human health and ecological activities (Pre-Phase 1), Phase 1 and Phase 2 human health and Phase 1 and Phase 2 ecological. Activities begin inside the Limited Area and progress methodically downstream, for both Bayou and Little Bayou Creeks, to the Ohio River floodplain. Historical data for internal ditches will be used for characterization, while additional ditch sampling will focus primarily on areas between the outfalls and their confluence with the receiving creek. Decisions will be required in each segment of the investigation area concerning carrying receptors and chemicals forward from phase-to-phase. Data quality objective steps formulate a set of criteria that will achieve the desired control of uncertainty, thus allowing the decisions to be made with acceptable confidence.

This document utilizes a compilation of sampling information collected on and around PGDP over the course of the last 20 years. Table ES.1 identifies the previously completed reports and/or investigations primarily used to prepare this document.

Table ES.1. Summary of Historical Information

Year	Title	SWMUs/AOCs
1980s	Site Assessment Reports	64, 65, 93, 105, 106, 107, 108, 109, 113, 129
1987	Preliminary Assessment	185
1991	Results of the Site Investigation, Phase I (CH2M HILL 1991a)	64, 65, 185
1992	Site Assessment Report	175
1992	Results of the Site Investigation, Phase II (CH2M HILL 1992)	64, 65, 93, 105, 106, 107, 108, 109, 113, 129, 175
1992	Incident Report	108

Table ES. 1. Summary of Historical Information (Continued)

Year	Title	SWMUs/AOCs
1993	Site Assessment Report	185
1994	Site Assessment Report	199
1994	RFI Work Plan for Waste Area Group 13 at the Paducah Gaseous Diffusion Plant (DOE 1994a)	185
1994	Waste Area Group 13 and 6 Reprioritization and Special Requests (KDEP 1994)	185
1994	PCB Sediment Survey and Risk Calculation	64, 65
1996	Watershed Monitoring Report	64, 65
1996	Site Assessment Report	199
1997	Preliminary Risk Calculation Paducah Gaseous Diffusion Plant Big Bayou Creek and Little Bayou Creek, PCB Sediment Evaluation (COE 1996a)	205
1997	Remedial Investigation Report for Waste Area Group 17 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky (DOE 1997)	93, 105, 106, 107, 108, 109, 113, 129, 175
1999	Remedial Investigation/Feasibility Study Work Plan for the Surface Water Operable Unit at PGDP (DOE 1999)	64, 65, 93, 105, 106, 107, 108, 109, 113, 129, 175, 185, 199, 205
2003	Site Assessment Reports	549, 550
2008	Surface Water Operable Unit (On-Site) Site Investigation and Baseline Risk Assessment Report at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky (DOE 2008a)	58, 60, 61, 62, 63, 66, 67, 68, 69, 92, 97, 102, 168, 526
2010	Removal Action Report For Contaminated Sediment Associated With The Surface Water Operable Unit (On-Site) at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky (DOE 2010a)	58, 63, 66, 67, 92, 97

During development of this work plan, existing data were evaluated relative to the data quality objectives defined in this work plan. The evaluation shows what data gaps exist for each SWMU/AOC. The SWMUs/AOCs were divided into three types to assist in sampling plan development. These types are creeks, rubble areas, and miscellaneous.

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1. INTRODUCTION

The Paducah Gaseous Diffusion Plant (PGDP), located within the Jackson Purchase region of western Kentucky, is an active uranium enrichment complex that is owned by the U.S. Department of Energy (DOE). On July 1, 1993, the United States Enrichment Corporation assumed management and operation of the PGDP enrichment complex under a lease agreement with DOE. DOE, however, still owns the enrichment complex and is responsible for environmental restoration (ER) activities associated with legacy operation of PGDP (CERCLIS #KY8-890-008-982). DOE is the lead agency for remedial actions, and the U.S. Environmental Protection Agency (EPA) and the Kentucky Department for Environmental Protection (KDEP) have regulatory oversight responsibilities.

In 1988, off-site groundwater contamination was detected in groundwater wells north of PGDP. In 1994, PGDP was placed on the National Priorities List (NPL), a list of sites designated by EPA as having the highest priority for site remediation. Additionally, Section 120 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires that NPL sites enter into a Federal Facility Agreement (FFA). An FFA was finalized among DOE, EPA, and the Commonwealth of Kentucky (Kentucky) in 1998.

Source units and areas of contamination at PGDP have been combined into operable units (OUs) for evaluation of remedial actions. These OUs include the Surface Water Operable Unit (SWOU), the Burial Grounds Operable Unit (BGOU), the Soils Operable Unit (SOU), the Groundwater Operable Unit (GWOU), and the Decontamination and Decommissioning OU. Each OU is designed to remediate contaminated media associated with PGDP. The Paducah Site Management Plan (SMP) discusses enforceable completion dates for media-specific OUs associated with the strategic cleanup initiatives. These initiatives include a series of prioritized response actions, ongoing site characterization activities to support future response action decisions, and decontamination and decommissioning of the currently operating gaseous diffusion plant (GDP) once it ceases operation. After completion of these activities, the Comprehensive Site OU evaluation will be conducted, with implementation of additional actions, as needed, to ensure long-term protectiveness.

For the SWOU, a phased approach is used to meet the primary objectives. A phased approach is used because the complex contamination problems at the site (i.e., ongoing operational activities, multiple sources of contamination, and the potential for a complicated contaminant fate and transport process) prevent implementation of one complete, remedy at this time. Additionally, the phased approach allows the site to use information gained in earlier phases of the cleanup to refine and implement subsequent cleanup objectives and actions in support of final cleanup status. The following steps, illustrated in Figure 1.1, are being used at PGDP to implement the phased approach for the SWOU [adapted from the Paducah SMP (DOE 2011a)]:

(1) Prevent human exposure to contaminated sediments presenting an unacceptable risk to on-site[1] workers and off-site recreational users of surface water;

(2) Prevent or minimize further off-site migration of contaminated sediments and surface water;

(3) Reduce, control, or minimize contaminant sources contributing to sediment and surface water contamination; and

[1] For the purposes of this document, on-site includes the Limited Area, industrial areas outside of the Limited Area, and restricted areas outside of the Limited Area. All other areas within this study are considered off-site. See Figure 1.2.

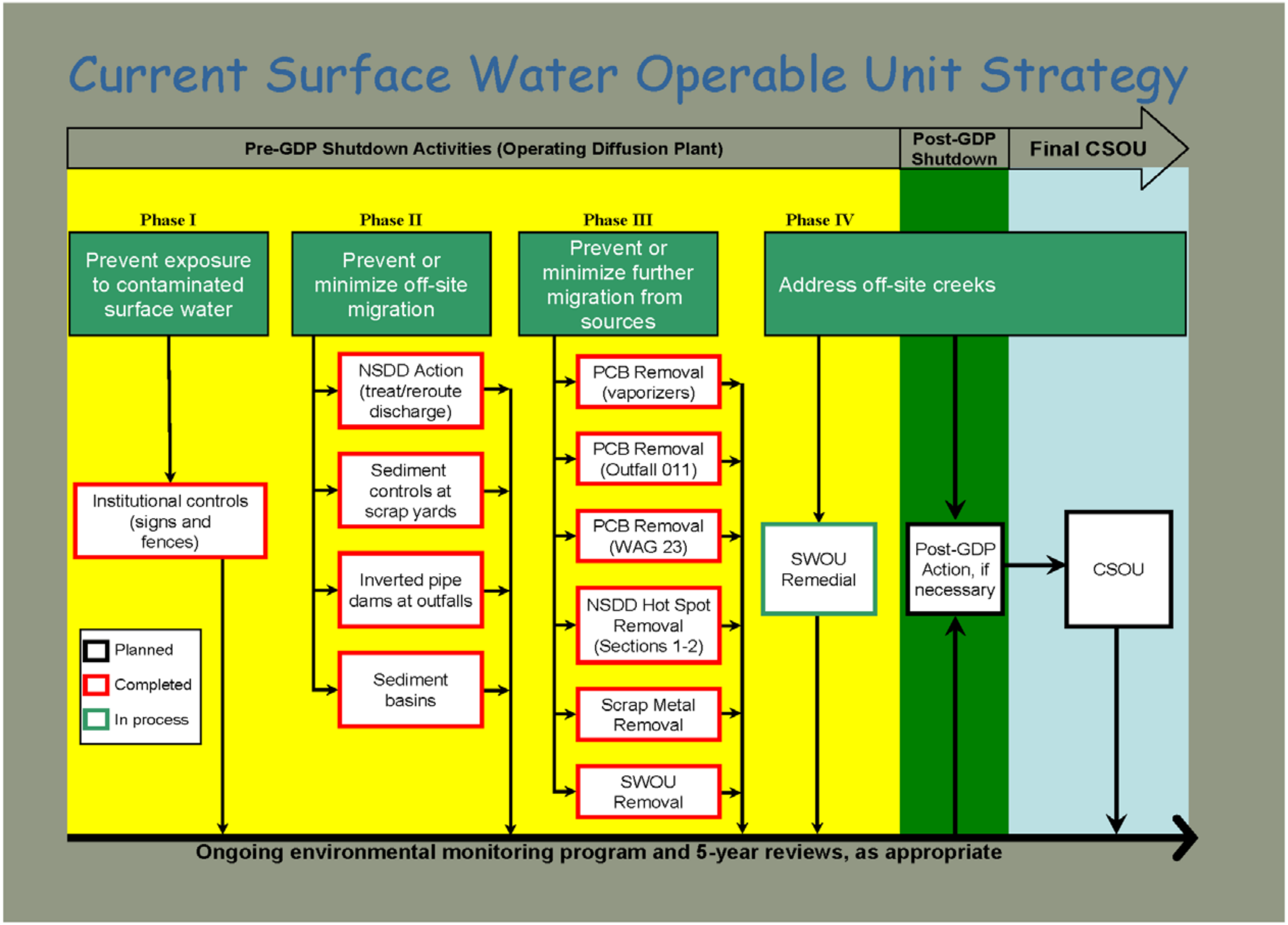


Figure taken from SMP (DOE 2011)

Figure 1.1. SWOU Strategy

(4) Evaluate and select long-term solutions for potential PGDP-related off-site surface water contamination to protect recreational users and ecological receptors.

A series of actions, both on-site and off-site, already have been completed toward meeting these goals, as depicted in Figure 1.1.

The SWOU consists of the specific solid waste management units (SWMUs) and areas of concern (AOCs) identified in Appendix 4 (*Source Area By Operable Unit*) of the Paducah SMP (DOE 2011a). Metals, radionuclides, volatiles, and polychlorinated biphenyls (PCBs) are the likely contaminants of interest for the SWOU. Remediation of Outfalls 005, 006, 017, and 019 and their associated ditches is planned to occur during post-GDP shutdown for the GDP Lagoons and Ditches OU unless the parties agree early action is warranted.

Historical radiological data presented in this work plan is the obtained results and is not expressed in relationship to action levels (e.g., background radioactivity, No Action Levels, Remediation Goals, etc.).

Data collected during the Remedial Investigation/Feasibility Study (RI/FS) may be incorporated with the GWOU and SOU data after the completion of these activities and used in development of complex-wide models (e.g., complex-wide surface water flow models), as appropriate. In addition, data from the baseline ecological risk assessment to be performed as part of this OU may be considered when determining appropriate actions for other OUs.

1.1 PROJECT SCOPE

According to the Paducah SMP, the scope of this project includes an RI/FS [baseline risk assessment (BRA), including human health and ecological risks]; remedy selection; and implementation of any necessary response actions for on- and off-site areas, including Bayou Creek, Little Bayou Creek, and Outfalls 001, 002, 008, 009, 010, 011, 012, 013, 015, and 016, as well as scoping for and completion of a baseline ecological risk assessment for PGDP (DOE 2011a). The PGDP Operational Lagoons are not included as components of the SWOU, according to the Paducah SMP, and as such will not be a part of this RI. These lagoons are listed as components of and will be investigated during the GDP Lagoons & Ditches OU which will be active during post-GDP shutdown activities.

The timing and sequence of any remedial actions will require coordination with ongoing plant operations to prevent recontamination and consideration of ongoing permitted discharges. The SWOU will address contaminated media [e.g., surface water and sediments) associated with ditches and creeks as part of the RI/FS consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and EPA guidance. Though remediation of Outfalls, 005, 006, 017, and 019 and their associated ditches is not planned until after GDP shutdown, data associated with them [e.g., creek data upstream and downstream of the point of discharge, Kentucky Pollutant Discharge Elimination System (KPDES) monitoring data, and information on ecological receptors] will be included in the RI/FS and sitewide baseline ecological risk assessment associated with the SWOU during the pre-shutdown phase.

This RI/FS Work Plan has been prepared to implement required investigations for the SWOU and to provide information to fill data gaps. The SWOU RI/FS Work Plan follows the outline prescribed in the Paducah FFA. The document utilizes a compilation of sampling information collected at and around PGDP over the course of the last 20 years. Data were compiled and screened against significant chemicals of potential concern (COPCs) listed in the *Methods for Conducting Risk Assessments and Risk*

Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Volume 1, *Human Health,* and Volume 2, *Ecological* (DOE 2011b; DOE 2010b).

The RI/FS process is an interactive one in which DOE, EPA, and Kentucky evaluate and conduct or revise work conducted during various stages of the investigation. To facilitate implementation of the SWOU RI/FS Work Plan, flexibility will be included in the sampling plans for each SWMU/AOC to allow some adjustments to be made in the field.

The scope of the SWMU/AOC evaluation includes an RI; baseline human health risk assessment (BHHRA); baseline ecological risk assessment (BERA); evaluation of remedial alternatives; remedy selection; and implementation of actions (i.e., early removal, radiological postings), as necessary, for protection of human health and the environment. During the SWOU Site Investigation (SI) (DOE 2008a), the SWMU/AOC evaluation includes SWMUs 58, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 92, 93, 97, 102, 105, 106, 107, 108, 109, 113, 129, 168, 175, 185, 199, 205, 526, 549, and 550. SWMUs 58, 60, 61, 62, 63, 66, 67, 68, 69, 92, 97, 102, 168, and 526 previously were evaluated. The result of the SWOU (On-Site) Site Investigation determined that there were no unacceptable levels of risk to current and anticipated future receptors that warranted inclusion of SWMU 60 (Outfall 002) or SWMU 102 (PGDP Storm Sewer Systems associated with C-333-A, C-337-A, C-340, C-535, and C-537). Subsequently, SWMUs 58, 63, 66, 67, 92, and 97 were addressed, as described in the *Removal Action Report For Contaminated Sediment Associated With The Surface Water Operable Unit (On-Site) At The Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0357&D1. Completion of this removal action reduced the risk to current and future workers, excavation workers, and recreators from direct contact by removing known sources of contamination. Under this action, hot spots[1] were removed and cleanup was verified by post-excavation sampling that showed that removal goals established in the SWOU (On-site) Engineering Evaluation/Cost Analysis (EE/CA) (DOE 2008b) and Action Memorandum (DOE 2009a) have been achieved. The SWMUs listed in Table 1.1 and the portions of the SWMUs not included in the SWOU On-Site SI or Removal Action Report will be evaluated during this investigation.

[1] In the SWOU Site Investigation, a potential "hot spot" was defined as an area in which one or more indicator chemicals exceeded an indicator level or one or more analytes exceeded an analyte's characterization level as established in the Sampling and Analysis Plan (SAP). Please see the SAP for a complete explanation of the derivation of indicator and characterization levels.

Table 1.1. SWMUs/AOCs within the SWOU

SURFACE WATER				
Operable Unit	**Subproject**		**SWMU No.**	**Description**
SWOU	NSDD		59	NSDD (Inside)
	SWOU Remedial Action	Removal Action	58	NSDD (Outside)
			60	C-375-E2 Effluent Ditch (KPDES 002)[2]
			61	C-375-E5 Effluent Ditch (KPDES 013)[1]
			62	C-375-S6 SW Ditch (KPDES 009)[1]
			63	C-375-W7 Oil Skimmer Ditch (KPDES 008)
			66	C-375-E3 Effluent Ditch (KPDES 010)
			67	C-375-E4 Effluent Ditch (C-340 Ditch
			68	C-375-W8 Effluent Ditch (KPDES 015)
			69	C-375-W9 Effluent Ditch (KPDES 001)
			92	Fill area for dirt from the C-420 PCB Spill Site
			97	C-601 Diesel Spill
			102	Plant Storm Sewer associated with C-333-A, C-337-A, C-340, C-535, and C-537[1]
			168	KPDES Outfall Ditch 012[1]
			526	Internal Plant Drainage Ditches
			64	Little Bayou Creek
			65	Bayou Creek
			93	Concrete Disposal Area East of Plant Security Area
			105	Concrete Rubble Pile (3)
			106	Concrete Rubble Pile (4)
			107	Concrete Rubble Pile (5)
			108	Concrete Rubble Pile (6)
			109	Concrete Rubble Pile (7)
SWOU	SWOU Remedial Action		113	Concrete Rubble Pile (11)
			129	Concrete Rubble Pile (27)
			175	Concrete Rubble Pile (28)
			185	C-611-4 Horseshoe Lagoon
			199	Bayou Creek Monitoring Station
			205	Eastern Portion of Yellow Water Line
			549	Concrete Rubble Pile by Outfall 8
			550	Concrete Culvert Sections, west of Outfall 001 ditch

[2] The results of the SWOU (On-Site) Site Investigation determined that there were no unacceptable levels of risk to current and anticipated future receptors that warranted inclusion of SWMU 60 (Outfall 002), SWMU 168 (Outfall 012), or SWMU 102 (PGDP storm sewer systems associated with C-333-A, C-337-A, C-340, C-535, and C-537). As a result no action will be taken for these SWMUs as originally planned under the SWOU removal action. These SWMUs will be evaluated further as part of the SWOU remedial action. It also should be noted that during development of the Sampling and Analysis Plan (SAP) for SWOU (On-Site) Removal Action, Outfall 009 and Outfall 013 were evaluated. This assessment of the outfalls, which included a review of historical data, indicated that Outfall 009 and Outfall 013 did not require an early action, and further assessment of Outfall 009 and Outfall 013 would be addressed during the Comprehensive Site Operable Unit (CSOU). Based upon current site strategy, Outfall 009 and Outfall 013 also will be addressed as part of the SWOU remedial action.

Figure 1.2 shows the location of the SWMUs/AOCs listed in Table 1.1. The RI will be conducted in a progressive phased approach addressing human health and ecological risk. Additionally, the investigation in Bayou and Little Bayou Creeks will include an investigation of sediment stability prior to human health and ecological activities. Activities begin inside the Limited Area and progress methodically downstream, for both Bayou and Little Bayou Creeks, to the Ohio River floodplain. Historical data for internal ditches will be used for characterization, while additional ditch sampling will focus primarily on areas between the outfalls and their confluence with the receiving creek. Decisions will be required in each segment of the investigation area concerning carrying receptors and chemicals forward from phase to phase. Data quality objective (DQO) steps formulate a set of criteria that will achieve the desired control of uncertainty, thus allowing the decisions to be made with acceptable confidence.

Important project uncertainties could affect the scope and schedule presented in this work plan. Some of note are unexpected levels, types, or extent of contamination resulting in the need to revise the RI characterization strategy (e.g., additional sampling) and identification of remedial actions not anticipated as part of project scoping (e.g., use of treatment technologies such as soil washing). The Paducah SMP includes a planning date for a D1 Record of Decision of the third quarter 2015 (DOE 2011a).

If interim remedial or removal actions are implemented at any of the SWMUs/AOCs addressed in this work plan before the development of a final remedy, the actions will be consistent with the anticipated final action for the SWOU and will contribute to the final remediation of the site. Remedial alternatives will be screened at the time the remedial action objectives for the SWOU are developed.

1.2 PROJECT OBJECTIVES AND GOALS

The FFA requires that DOE identify, investigate, and remediate (if necessary) all AOCs and SWMUs that potentially could pose a threat to human health and the environment. The goals of this RI/FS are as follows:

Goal 1: Characterize Nature of Contamination—characterize the nature of contaminants using existing data and, if required, by collecting additional data;

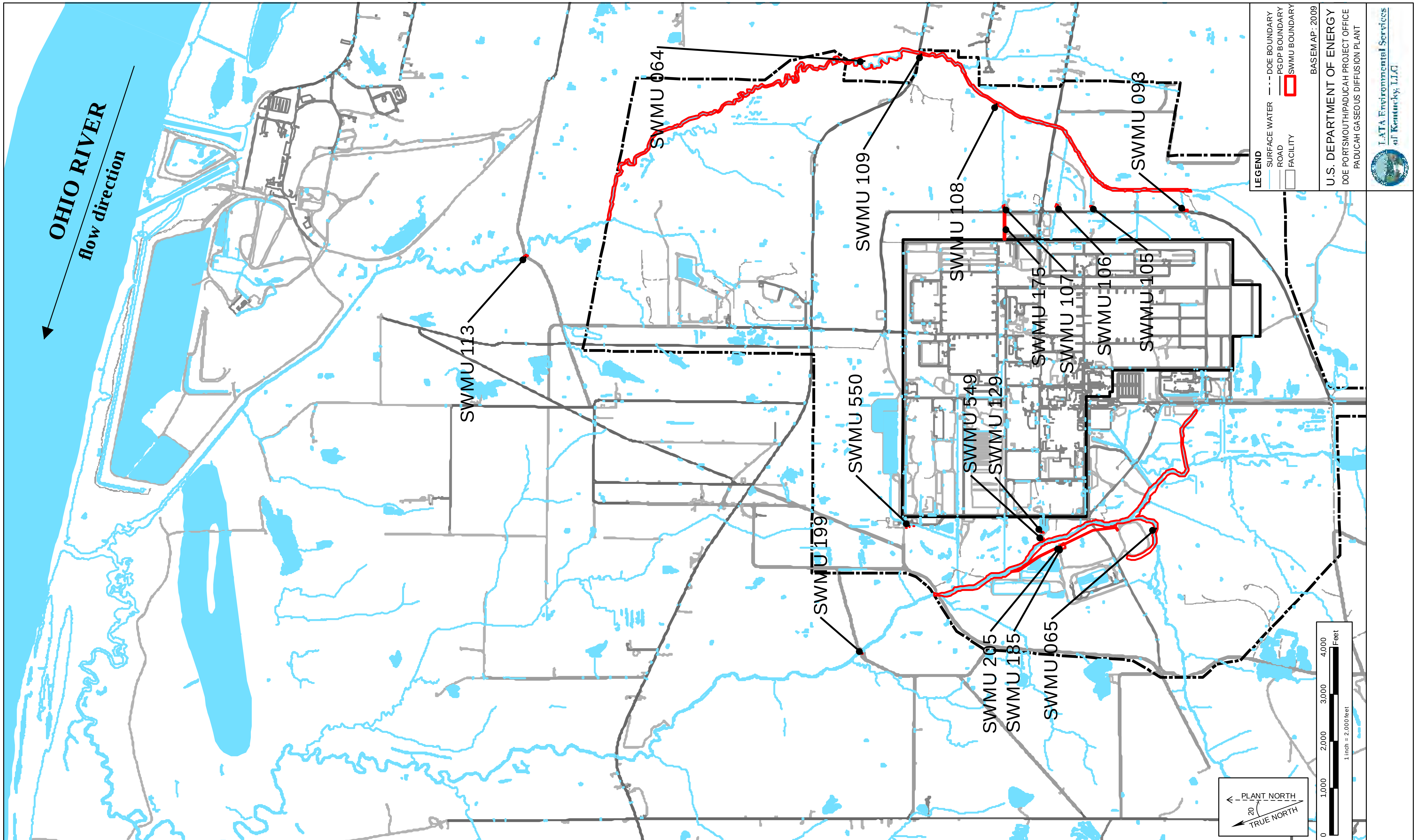
Goal 2: Define Extent of Contamination in Soil and Sediment—define the extent (vertical and lateral) and magnitude of contamination and perform an evaluation of sediment, soils, surface water, and ecological receptors to ensure that all exposure pathways for the subject units are assessed adequately to support cleanup decisions;

Goal 3: Determine Transport Mechanisms and Pathways—gather existing data and, if necessary, collect additional data to analyze contaminant transport mechanisms;

Goal 4: Complete a baseline human health risk assessment and screening-level ecological risk assessment (SERA) for each investigation area;

Goal 5: Complete a sitewide BERA; and

Goal 6: Complete an Evaluation of Remedial Alternatives—determine if the existing data are sufficient to evaluate alternatives that will reduce risk to human health and the environment and support a no further action (NFA).



OHIO RIVER
flow direction
SWMU 064
SWMU 109
SWMU 108
SWMU 093
SWMU 113
SWMU 175
SWMU 107
SWMU 106
SWMU 105
SWMU 550
SWMU 549
SWMU 129
SWMU 199
SWMU 205
SWMU 185
SWMU 065
LEGEND
SURFACE WATER
ROAD
FACILITY
DOE BOUNDARY
PGDP BOUNDARY
SWMU BOUNDARY
BASEMAP: 2009
U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT
LATA Environmental Services of Kentucky, LLC
PLANT NORTH
TRUE NORTH
0
1,000
2,000
3,000
4,000
Feet
1 inch = 2,000 feet

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1.3 PROJECT DATA QUALITY OBJECTIVES

The DQO process is a planning tool, based on the scientific method, that identifies an environmental problem and defines the data collection process needed to support decisions regarding that problem [Guidance on Systematic Planning Using the DQO Process EPA QA/G-4 (2006)]. The steps outlined in the DQO process have been used in the development of the SWOU RI/FS Work Plan. These steps formulate a set of criteria that will achieve the desired control of uncertainty, allowing the decision to be made with acceptable confidence.

Figure 1.3 shows a generic DQO process chart. In order to facilitate discussion, the seven steps of the DQO process have been initiated, in accordance with the above-referenced guidance (EPA 2006), and the set of decision rules and questions shown in Figure 1.3 were utilized as a guide to complete the DQO process for the SWOU RI/FS Work Plan. As part of the process, several scoping meetings were held among DOE, EPA, and Kentucky. Text provided within the Field Sampling Plan (FSP) portions of Chapters 6 through 14 satisfies the intent of this process.

1.4 OBSERVATIONAL APPROACH

The Observational Approach (OA) is a method for identifying and managing uncertainties. The OA emphasizes determining what to do next by evaluating existing information and iterating between collecting new data and taking further action. The name "Observational Approach" is derived from observing parameters during implementation. OA should be encouraged in situations where the uncertainty is large, the vision of what is expected or required is poor, and the cost of obtaining more certainty is very high.

The philosophy of OA, when applied to waste site remediation is that a remedial action can be expedited. The approach provides a logical decision framework through which planning, design, and implementation of remedial actions can proceed with increased confidence. OA incorporates the concepts of data sufficiency, identification of reasonable deviations, preparation of contingency plans, observation of the systems for deviations, and implementation of the contingency plans. Determinations of performance measures and the quality of new data are completed as the steps are implemented.

The iterative steps of site characterization, developing and refining a site conceptual model, and identifying uncertainties in the conceptual model are similar to traditional approaches. The concept of addressing uncertainties as reasonable deviations is unique to OA and offers a qualitative description of data sufficiency for proceeding with site remediation.

To deal with uncertainties identified in the SWOU, OA has been used to design the sampling strategy for the SWOU RI/FS. The FSPs, discussed in Chapters 6 through 15 of this document, present the methods by which the most probable site conditions will be investigated. It also presents a contingency plan to deal with deviations from the most probable site conditions.

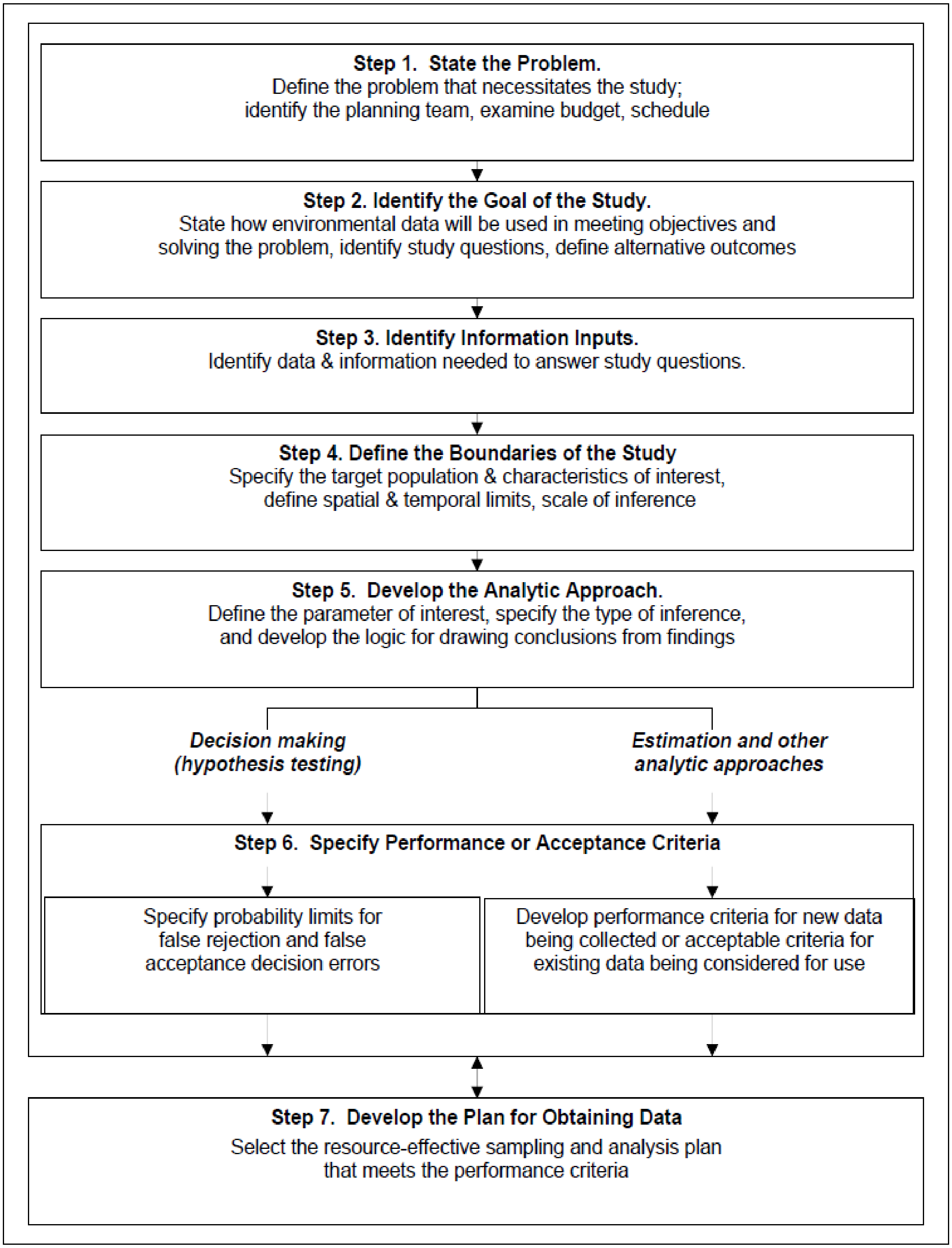

Figure 1.3. DQO Process

2. PROJECT ORGANIZATION AND MANAGEMENT PLAN

This section presents the project organization for this SWOU RI/FS. The topics addressed in this section include project organization, project coordination, and project schedule.

2.1 PROJECT ORGANIZATION, RESPONSIBILITIES, AND STAFFING

The organization chart shown in Figure 2.1 outlines the management structure that will be used for implementing the SWOU RI/FS. The responsibilities of key personnel are described in the following paragraphs.

2.1.1 DOE Project Manager

The DOE Project Manager (PM) will provide technical and management oversight for DOE for the SWOU RI/FS. This individual also will be the primary interface between EPA and Kentucky regulators and the DOE Prime Contractor.

2.1.2 DOE Prime Contractor ER Manager

The DOE Prime Contractor ER Manager will have overall programmatic responsibility for the Contractor for the technical, financial, and scheduling of matters related to the SWOU RI/FS. This individual will interface with DOE and the regulators, as appropriate.

2.1.3 DOE Prime Contractor Data Manager

The DOE Prime Contractor Data Manager is responsible for long-term storage of project data and for transmitting data to external agencies according to DOE 1998 and the Paducah Data Management Policy. The DOE Prime Contractor Data Manager ensures compliance to policies and procedures relating to data management with respect to the project.

2.1.4 DOE Prime Contractor Lab Coordinator

The DOE Prime Contractor Lab Coordinator is responsible for contracting any fixed-base laboratory utilized during the SWOU sampling activities. The DOE Prime Contractor Lab Coordinator also provides coordination for sample shipment to the laboratory, reviews the contractual screening section of data assessment packages, and transmits data packages to the Paducah Document Management Center (DMC).

2.1.5 DOE Prime Contractor RI PM

The RI PM will have overall responsibility for implementing the investigation, including all plans and field activities conducted as part of the RI/FS, including monitoring the work plan implementation, including sampling and waste management activities. This individual will serve as the RI technical lead and the principal point of contact. The RI PM will track the project budget and schedules and will delegate specific responsibilities to project team members. This individual also is responsible for the preparation of any field change orders.

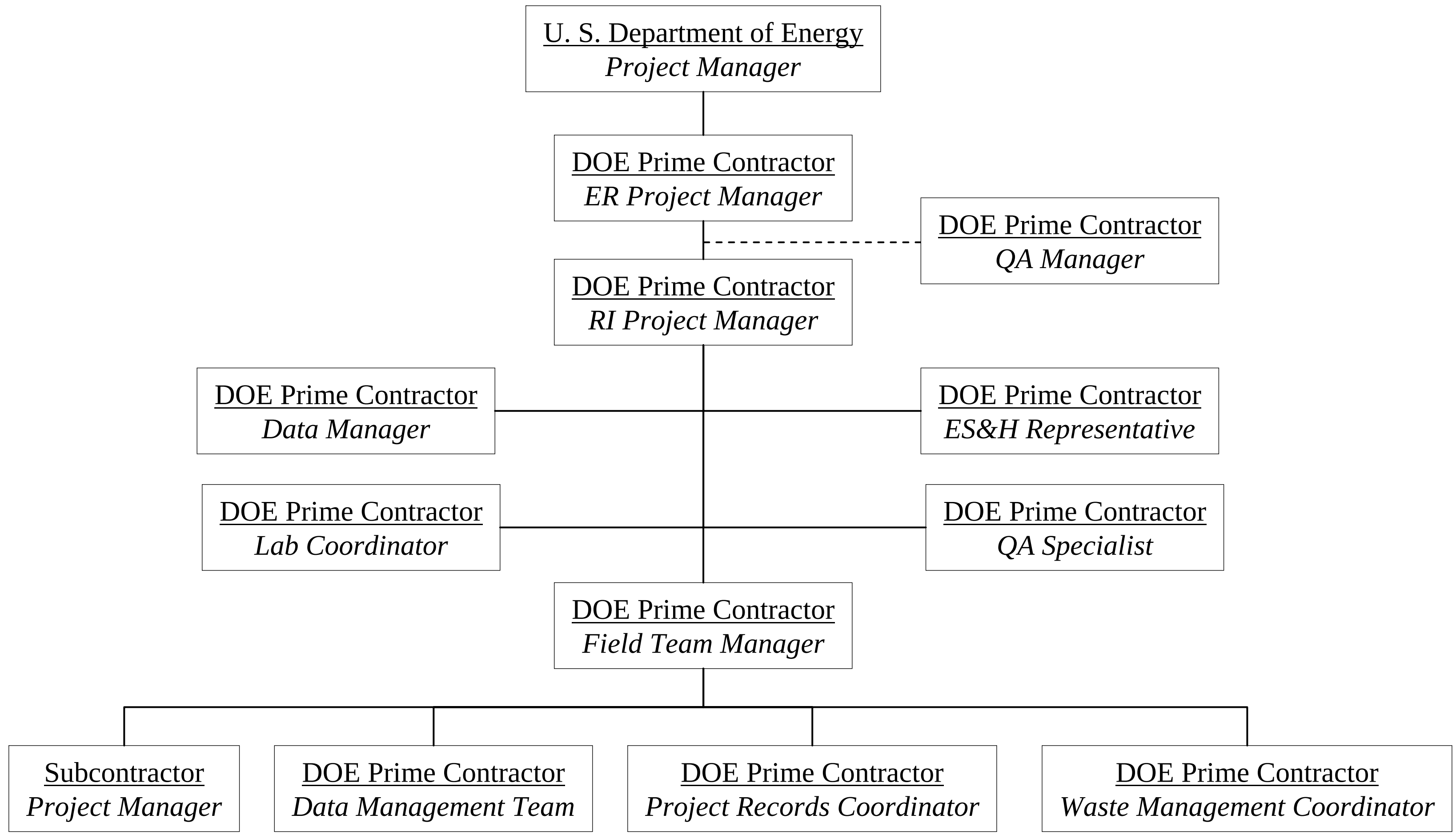

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Figure 2.1. SWOU Project Organizational Chart

2.1.6 DOE Prime Contractor Safety and Health Representative

The Safety and Health Representative (SHR), oversees that health and safety procedures designed to protect project personnel are maintained throughout the field effort for this project. This individual will also ensure the implementation of an Integrated Safety Management System (ISMS) for all aspects of the assessment. ISMS is dedicated to the concept that all accidents are preventable. Accordingly, the DOE Prime Contractor, the RI Team, and all subcontractors will be expected to achieve and sustain “Zero-Accident Performance” through continuous improvement practices. “Zero-Accident Performance” includes zero unpermitted discharges or releases with respect to protection of the environment.

2.1.7 DOE Prime Contractor Quality Assurance Specialist

The Quality Assurance (QA) Specialist will provide oversight. This individual also may conduct audits and surveillances and approve any field changes that may impact project quality.

2.1.8 DOE Prime Contractor Field Team Manager

The Field Team Manager (FTM) provides technical oversight for all field team activities during the investigation.

2.1.9 DOE Prime Contractor Project Records Coordinator

The Project Records Coordinator will be responsible for all activities relating to identification, acquisition, classification, indexing, and storage of project records related to the investigation. The project records will include data documentation materials, plans, procedures, and all project file requirements.

2.1.10 DOE Prime Contractor Waste Management Coordinator

The Waste Management Coordinator will be responsible for ensuring adherence to the Waste Management Plan (WMP) that is described in Chapter 20 of this document and for documenting and tracking field-related activities, including waste generation and handling, waste characterization sampling, waste transfer, and waste labeling.

2.1.11 DOE Prime Contractor Data Management Team

The Data Management Team will be responsible for the coordination of all investigation-sampling activities, including coordination with the DOE Prime Contractor Sample Management Office (SMO). This group will ensure all quality control (QC) sampling requirements are met, chain-of-custody forms are properly generated, and that compliance with off-site shipping requirements is achieved. The Data Management Team also will be responsible for managing data generated during the investigation in accordance with the Data Management Implementation Plan (DMIP) described in Chapter 19 of this document.

2.1.12 DOE Prime Contractor Risk Assessor

The risk assessor (ecological and human health) provides oversight during the field work and throughout reporting in order to ensure data of appropriate quality are obtained to achieve project objectives.

2.2 PROJECT COORDINATION

Coordination and liaison between the DOE Prime Contractor and Subcontractor personnel will occur at various levels and among personnel appropriate to each level. Routine reports, such as monthly reports, will be prepared by the Subcontractor PM and then submitted to the DOE Prime Contractor RI PM, Contracts Procurement Office, Contracts Coordinator, or other designated recipient.

The DOE, regulatory agencies, and DOE Prime Contractor will communicate via telephone, e-mail, and face-to-face meetings, as appropriate, during the field activities to document any deviations or changes in the sampling approach that might arise during field work.

2.3 PROJECT TASKS AND IMPLEMENTATION PLAN

The RI/FS Implementation Plan for this project is shown in Figure 2.2. This plan represents a logical approach to implementation of the project, as described below.

(1) The first step in this process was initial scoping of the project internally and with EPA and Kentucky. During this process, existing data were evaluated to develop the conceptual models. In turn, the conceptual models were used to identify site unknowns, and a sampling strategy was designed to meet the Paducah FFA requirements and to address these unknowns.

(2) The next step was preparation of the SWOU RI/FS Work Plan. The SWMU and ecological sampling approaches developed from scoping meetings, as well as information evaluations as a result of scoping meeting discussions were used to develop the work plan.

(3) Implementation of the work plan will begin with procurement of subcontract services, such as sampling and surveying.

(4) Field activities will consist of several discrete activities, as outlined in this work plan, including sampling, sample handling, decontamination, waste management, and documentation. In addition, Environment, Safety, and Health (ES&H) and field QA coordination will occur concurrently with the other activities.

(5) Field and laboratory data will be reduced, validated, verified, and assessed. Data validation will be conducted by an independent third party and will be initiated once the first sample delivery group of data has been received and checked for completeness. Each of these steps will be handled separately and will follow prescribed procedures to ensure that defensible data are obtained. The data will be formatted for incorporation into the PGDP database and archived for future use.

(6) Technical exchange meetings will be conducted among personnel from EPA, Kentucky, DOE, and DOE Prime Contractor to evaluate the existing and collected data and determine future actions.

(7) Non-field-related tasks that also will be performed during the RI/FS include coordination of community relations during the project, evaluation of SERAs, preparation of a BERA, preparation of a BHHRA, implementation of the QA program, and evaluation of remedial technologies.

(8) An RI report, followed by an FS report, will be prepared and issued after samples and data have been processed. Early removal and/or remedial actions will be considered and implemented, if appropriate.

(9) Project management, tracking, and reporting will be conducted concurrently with all activities.

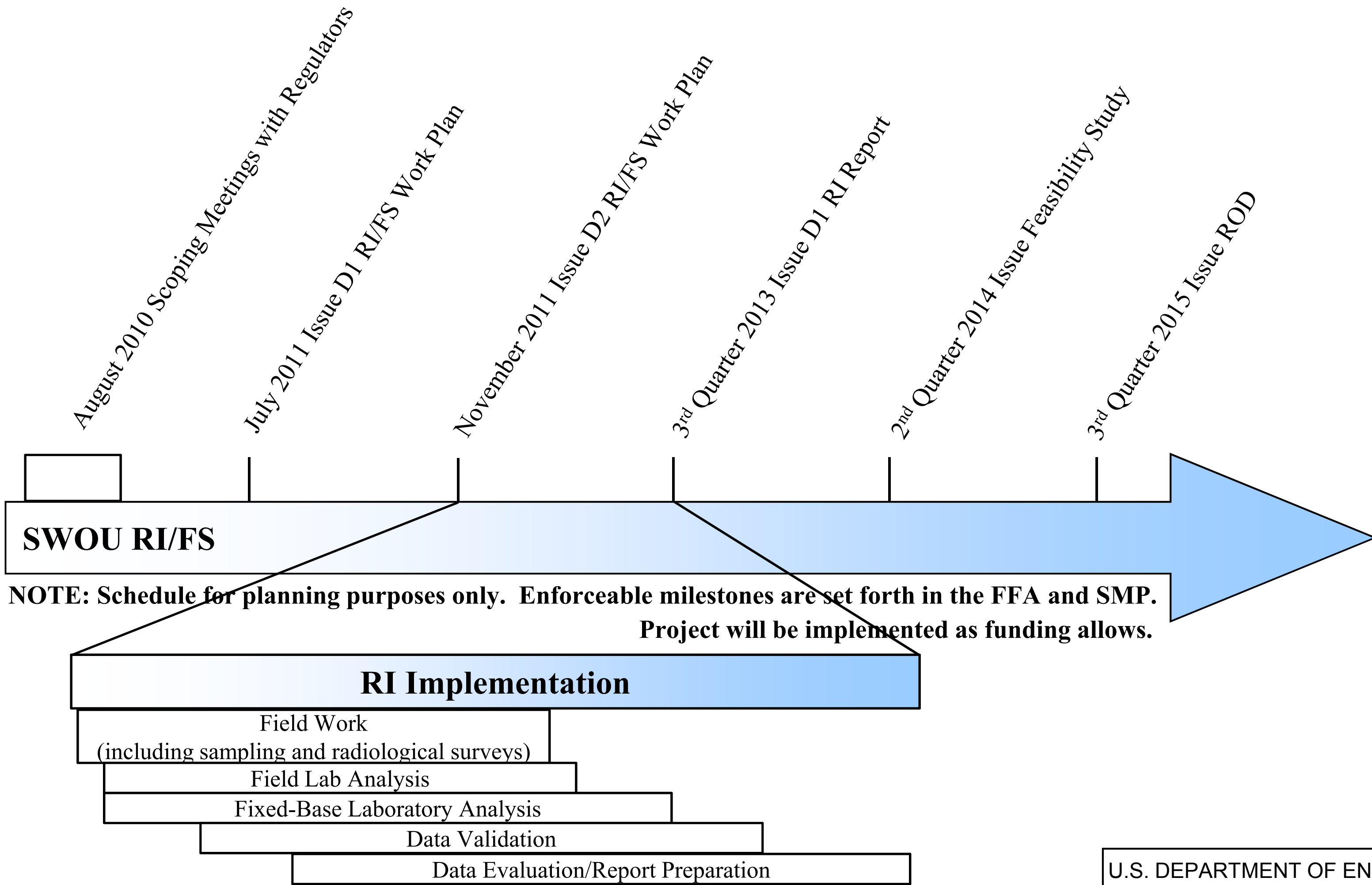

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Figure 2.2. Implementation Plan Schedule

2.4 PROJECT SCHEDULE

Figure 2.2 provides a schedule of the activities proposed for the SWOU RI/FS Work Plan implementation. These schedules are estimates for planning and are included here for informational purposes only and are not intended to establish enforceable schedules or milestones. Enforceable milestones are contained in Appendix C of the Paducah FFA and Appendix 5 of the Paducah SMP (DOE 2011a).

2.5 RI/FS WORK PLAN ACTIVITIES

2.5.1 Field Preparation Activities

The FTM will ensure that a field planning meeting occurs before the internal field review and before work begins at the site so that all involved personnel, including employees of the subcontractors, DOE Prime Contractor, and DOE, as appropriate, will be informed of the requirements of the fieldwork associated with the project.

In addition, an internal field review will be held in accordance with DOE Prime Contractor procedures. Any contingency items identified during the review must be completed prior to the DOE Prime Contractor providing a notice to proceed to the subcontractor for initiating fieldwork activities.

2.5.2 Field Investigation

Activities to be conducted during the field investigation include mobilization, implementation of ES&H procedures, sampling, waste management, and implementation of QA procedures. In addition, surveying activities will be performed to provide horizontal and vertical references for characterizing of locations.

2.5.3 Data and Analytical Activities

Activities concerning the data and analytical assessments are discussed in Chapters 5 through 15. Additionally, the following chapters support the data and analytical assessments to be conducted during this RI/FS:

- Data Quality Analysis—Chapter 15
- Quality Assurance Project Plan—Chapter 17
- Data Management Implementation Plan—Chapter 18
- Historical Data Summary—Appendix D

3. REGULATORY SETTING

The sections that follow provide a condensed version of the regulatory framework for PGDP. The summary in this chapter is intended to provide readers with general knowledge of the facility and the regulatory protocol that guides environmental management activities at PGDP. Detailed descriptions can be found in the current SMP (DOE 2011a).

3.1 ADMINISTRATIVE CONSENT ORDER

Kentucky, EPA, and DOE entered into the ACO effective November 23, 1988, after the discovery of contamination in residential wells north of PGDP. The ACO is a legally binding agreement for the participating parties that initiated the investigation into the nature and extent of the contamination in these wells. Contaminants originated as process-derived wastes or commonly used materials employed during the operational history of PGDP.

The ACO initiated the investigative activities designed to determine the extent and sources of off-site contamination surrounding PGDP. The site investigation (SI) was completed in 1992 under the guidelines of the ACO. The prior requirements of the ACO were superseded by the execution of the Paducah FFA.

3.2 ENVIRONMENTAL PROGRAMS

Environmental sampling at PGDP is a multimedia (air, water, soil, sediment, direct radiation, and biota) program of chemical, radiological, and ecological monitoring and environmental monitoring that consists of two activities: effluent monitoring and environmental surveillance. 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 ER activities, SWMUs and AOCs both on and off DOE property have been identified. Characterization and/or remediation of these sites will continue pursuant to the CERCLA, and the Hazardous and Solid Waste Amendments (HSWA) corrective action conditions of the Resource Conservation and Recovery Act (RCRA) Permit. RCRA and CERCLA requirements are coordinated by DOE, EPA, and Kentucky through the Paducah FFA.

3.3 RESOURCE CONSERVATION AND RECOVERY ACT

The primary purpose of RCRA is to protect human health and the environment through the proper management of hazardous wastes at operating sites.

RCRA requirements for PGDP are contained in PGDP's Hazardous Waste Management Permit (KY8-890-008-982, originally issued July 1991, reissued September 2004). This permit originally was issued by both Kentucky and EPA. EPA's portion of the RCRA permit was limited to the HSWA provisions of RCRA, which include corrective action requirements for SWMUs. Kentucky became authorized in 1996 for corrective actions. The RCRA permit contains regulatory provisions for treatment, storage, and disposal units, as well as provisions requiring corrective action for SWMUs.

3.4 TOXIC SUBSTANCES CONTROL ACT

The Toxic Substances Control Act (TSCA) became law on October 11, 1976. The Act authorized EPA to secure information on all new and existing chemical substances, as well as to control any of the substances that were determined to cause unreasonable risk to public health or the environment. The current PCB regulations were published pursuant to this act. Current PCB regulations can be found in at 40 *CFR* § 761.

In addition, on February 20, 1992 the EPA signed a Federal Facilities Compliance Agreement with the United States Department of Energy. This agreement governs the management of PCBs for specific DOE facilities including the Paducah Gaseous Diffusion Plant. *Attachment I, 1.B. On-Site Disposal Investigations* of the agreement clarified that management of identified sites historically used for the disposal of PCB contaminated wastes that are managed under separate permits, agreements, or orders will satisfy the EPA (PCB) historical spill cleanup policy.

3.5 CERCLA/NATIONAL PRIORITIES LIST

PGDP was placed on the NPL on May 31, 1994. In accordance with Section 120 of CERCLA, DOE entered into an FFA with EPA and Kentucky. The FFA established one set of consistent requirements for achieving comprehensive site remediation in accordance with RCRA and CERCLA, including stakeholder involvement.

Section XVIII of the FFA requires DOE to submit an annual SMP, which details the strategic approach for achieving cleanup under the FFA.

3.6 NATIONAL ENVIRONMENTAL POLICY ACT

The intent of the National Environmental Policy Act (NEPA) is to promote a decision making process that results in minimization of adverse impacts to human health and the environment. On June 13, 1994, the Secretary of Energy issued a Secretarial Policy (Policy) on NEPA that addresses NEPA requirements for actions taken under CERCLA. Section II.E of the Policy indicates that to facilitate meeting the environmental objectives of CERCLA and respond to concerns of regulators consistent with the procedures of most other federal agencies, DOE hereafter will rely on the CERCLA process for review of actions to be taken under CERCLA and will address NEPA values. In a similar fashion, DOE integrates the natural resource damage assessment values into the CERCLA process, including this work plan. As such, it is the expectation that the sampling data generated by this work plan, in addition to the historical data available, will be sufficient to support the natural resource damage assessment process. DOE CERCLA documents will incorporate NEPA values, such as analysis of cumulative, off-site, ecological, and socioeconomic impacts, to the extent practicable.

3.7 INVESTIGATIVE OVERVIEW

The SWOU RI/FS Work Plan defines the additional sampling necessary to obtain sufficient data to complete the RI, the BHHRA, SERAs, BERA, and the FS for the SWOU. The RI will be conducted in a progressive phased approach addressing human health and ecological risk. Additionally, the investigation in Bayou and Little Bayou Creeks will include an investigation of sediment stability prior to human health and ecological activities. Activities begin inside the Limited Area and progress methodically downstream, for both Bayou and Little Bayou Creeks, to the Ohio River floodplain. Historical data for internal ditches will be used for characterization, while additional ditch sampling will focus primarily on areas between the outfalls and their confluence with the receiving creek. Decisions will be required in each segment of the investigation area concerning carrying receptors and chemicals forward from phase to phase. DQO steps formulate a set of criteria that will achieve the desired control of uncertainty, thus allowing the decisions to be made with acceptable confidence.

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4. PHYSICAL CHARACTERISTICS OF THE STUDY AREA

The sections that follow provide a condensed version of the environmental setting for PGDP. This summary provides an overview of information pertaining to location, demography, geology, hydrogeology, ecology, and climatology.

4.1 LOCATION AND DESCRIPTION

PGDP is located ~10 miles west of Paducah, Kentucky (population ~26,000), and 3.5 miles south of the Ohio River in the western part of McCracken County (Figure 4.1). The DOE site is composed of approximately 650 acres within a fenced security area, approximately 800 acres outside the security fence, and 1,986 acres are licensed to Kentucky as part of the West Kentucky Wildlife Management Area (WKWMA). Bordering the PGDP reservation to the northeast, between the plant and the Ohio River, is a Tennessee Valley Authority (TVA) reservation on which the Shawnee Fossil Plant is located (Figure 4.2).

4.2 DEMOGRAPHY AND LAND USE

PGDP is surrounded by WKWMA and some sparsely populated agricultural lands. The closest communities to the plant are Heath, Grahamville, and Kevil, all of which are located within three miles of DOE Reservation boundaries. The closest municipalities are Paducah, Kentucky; Cape Girardeau, Missouri, which is ~40 miles west of the plant; and the cities of Metropolis and Joppa, Illinois, which are located across the Ohio River from PGDP. Figure 4.3 shows the locations of sensitive subpopulations such as schools and churches and their relative locations to PGDP.

Historically, the economy of western Kentucky has been based on agriculture, although there has been increased industrial development in recent years. The population of McCracken County is estimated to be ~65,000 with a population density of 885 to 3,188 persons per square mile and Ballard County has ~8,300 with a population density of 72 to 254 persons per square mile according to the 2000 U.S. Census, 2007 estimates.

In addition to the residential population surrounding the plant, WKWMA draws thousands of visitors each year for recreational purposes. This area is used by visitors, primarily for hunting and fishing, but other activities include horseback riding, hiking, and bird watching. According to WKWMA management, an estimated 5,000 fishermen visit the area each year.

4.3 SURFACE FEATURES

The dominant topographic features are nearly level to gently sloping dissected plains with shallow, narrow valleys and ridge tops and with steep ridge slopes and valley sides. The elevations of the stream valleys in the dissected plains are up to 100 ft lower than the adjoining uplands.

Local elevations range from 290 ft above mean sea level (amsl) along the Ohio River to 450 ft amsl southwest of PGDP near Bethel Church Road. Generally, the topography in the PGDP area slopes toward the Ohio River at an approximate gradient of 27 ft per mile (CH2M HILL 1992). Ground surface elevations vary from 360 to 390 ft amsl within the PGDP plant boundary.

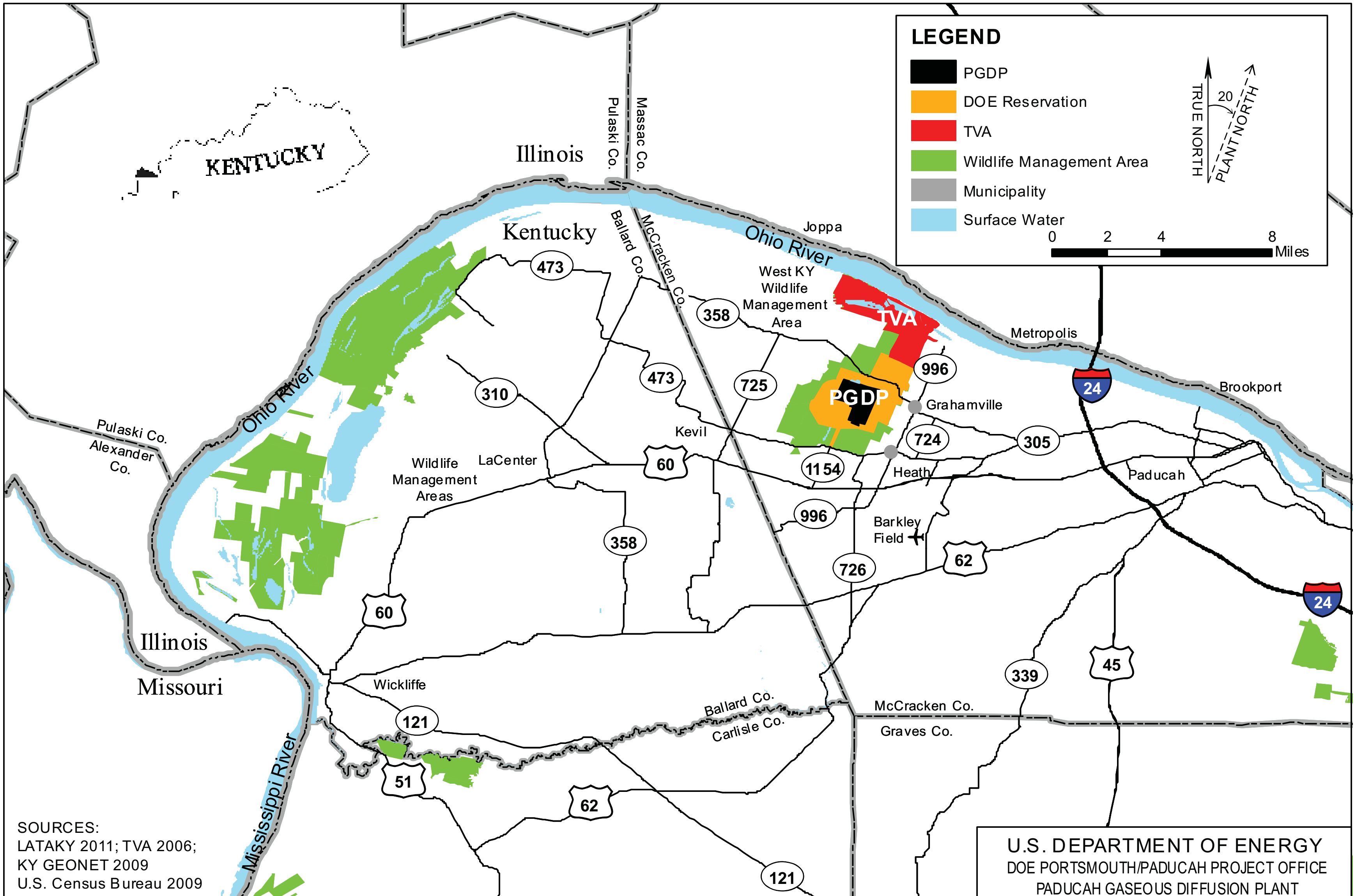

Figure 4.1. PGDP Site Location

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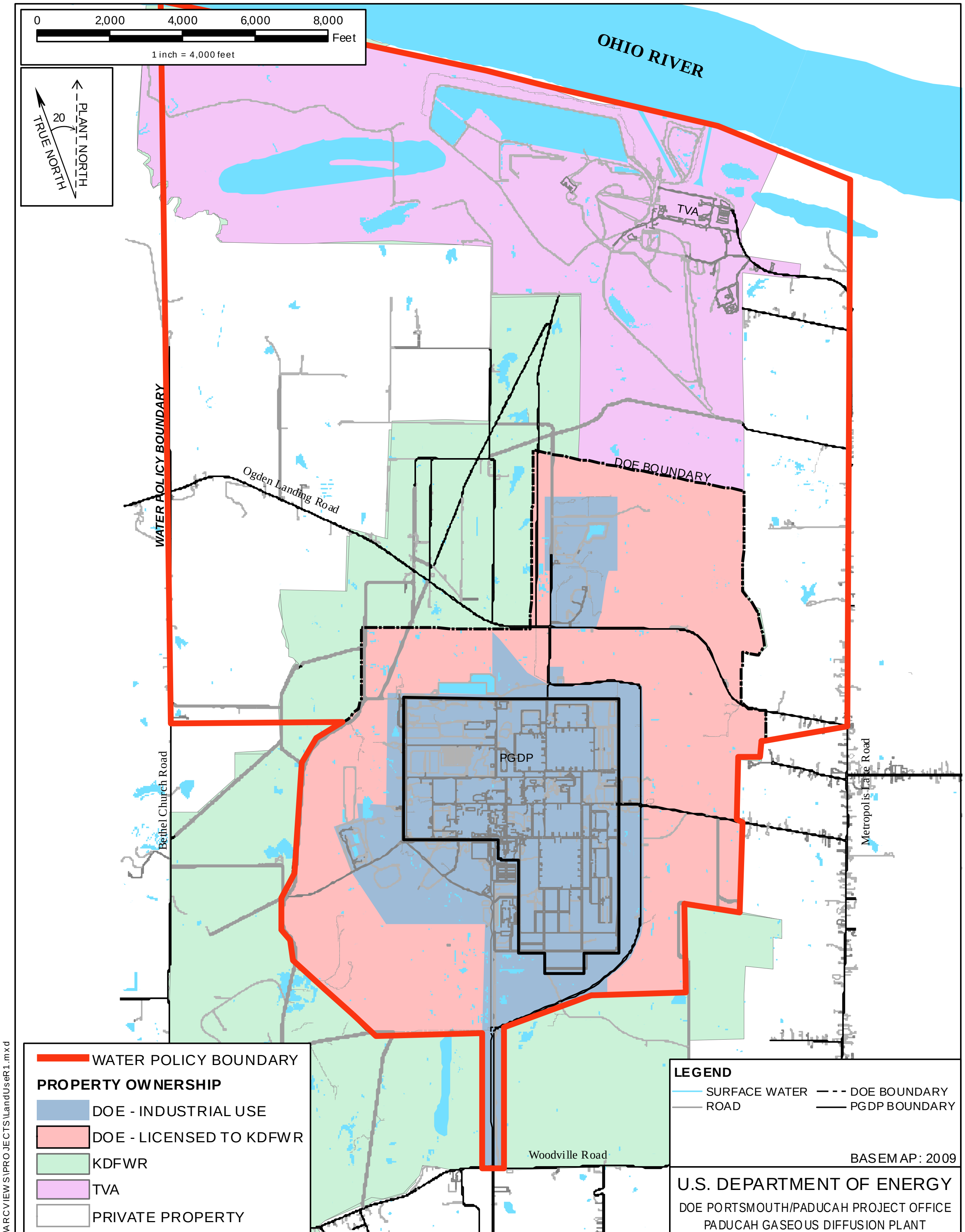

Figure 4.2. Land Ownership in Proximity to DOE Site

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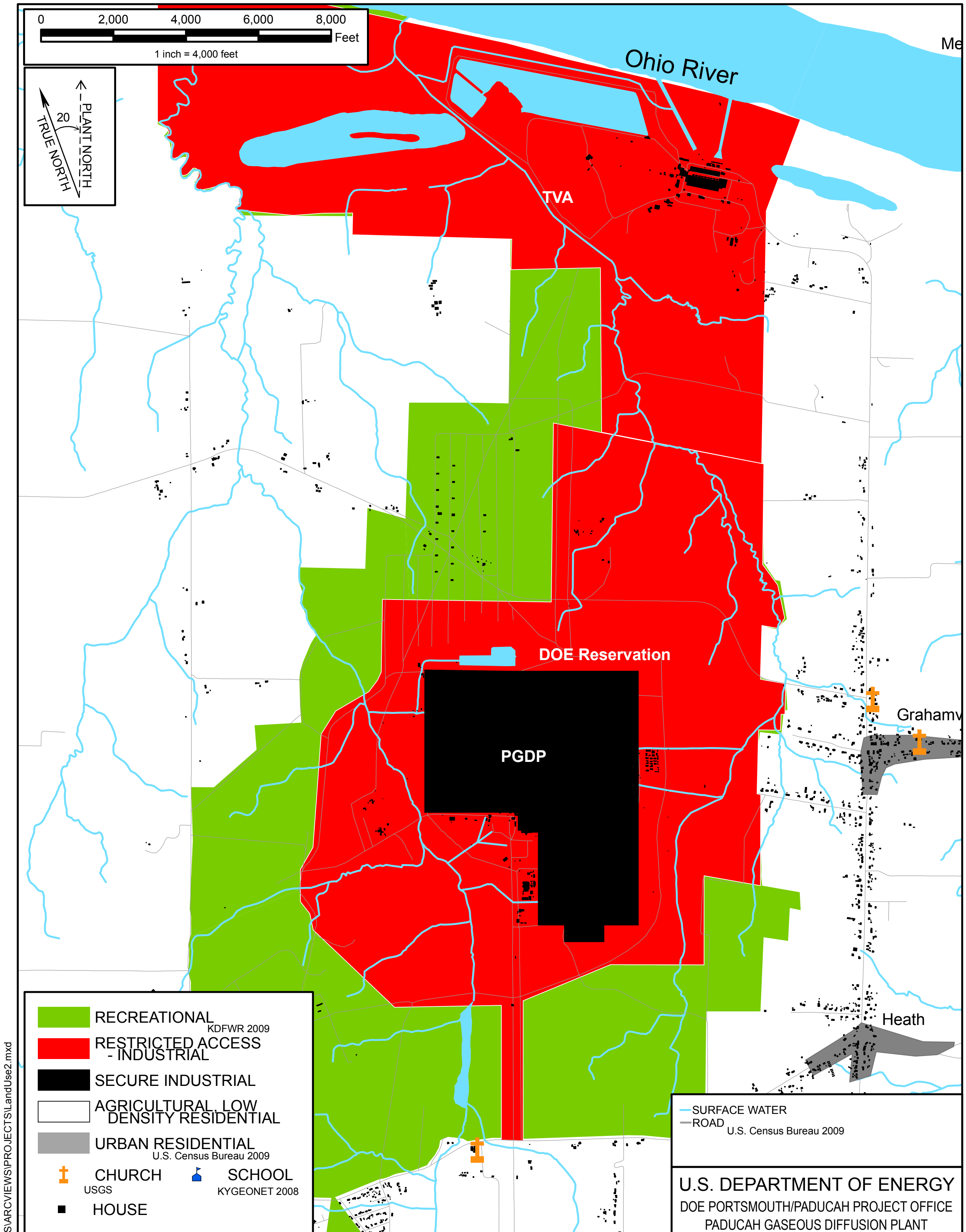

Figure 4.3. Sensitive Subpopulations in Proximity to DOE Site

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4.4 METEOROLOGY

The climate of the region may be broadly classified as humid-continental. The term "humid" refers to the surplus of precipitation versus evapotranspiration that normally is experienced throughout the year. The "continental" nature of the local climate refers to the dominating influence of the North American landmass. Continental climates typically experience large temperature changes between seasons.

Current and historical meteorological information regarding temperature, precipitation, and wind speed/direction was obtained from the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center. Additional data were obtained from the National Weather Service office at Barkley Regional Airport.

The 22-year average monthly temperature is 58.0°F, with the coldest month being January with an average temperature of 35.1°F and the warmest month being July with an average temperature of 79.2°F.

The 22-year average monthly precipitation is 4.00 inches, varying from an average of 2.73 inches in August (the monthly average low) to an average of 4.58 inches in April (the monthly average high). The total precipitation for 2005 was 37.45 inches, compared to the normal of 49.24 inches.

Prevailing winds at PGDP are generally from the south-southwest to north-northeast at an average of 6 mph. Other than PGDP, stack emissions are generated locally from NewPage Paper, Electric Energy, Inc., and TVA–Shawnee Fossil Plant. NewPage is located approximately 12 miles west-southwest of PGDP site; Electric Energy, Inc., is located approximately 8 miles northwest of the PGDP site and TVA–Shawnee is located approximately 3 miles north-northeast of the PGDP site. The potential for contamination of the investigation area from local stack emissions has not historically been established and is considered unlikely when accounting for the source locations. Historically the site has not experienced impacts that could be attributed to air emissions. The investigation site traverses a portion of the TVA–Shawnee property; consequently, airborne coal dust within this area may be a possibility, although unlikely.

4.5 SURFACE WATER HYDROLOGY

PGDP is located in the western portion of the Ohio River basin, approximately 15 miles downstream of the confluence of the Ohio River with the Tennessee River and approximately 35 miles upstream of the confluence of the Ohio River with the Mississippi River. Multiple groundwater aquifers underlie the PGDP. The shallowest aquifers occur in the Continental Deposits and the McNairy Formation, both of which discharge into the Ohio River north of PGDP. Surface water/groundwater relationships vary significantly across the SWOU. A large, downward, vertical hydraulic gradient across the shallow groundwater system typically limits the amount of groundwater discharge to the ditches of the PGDP and adjacent creeks. Gaining reaches in the creeks are found on Bayou Creek south of PGDP and on Little Bayou Creek to the north of PGDP near the Ohio River. Bayou Creek also is a gaining stream north of the plant near the Ohio River.

Locally, PGDP is within the drainage areas of the Ohio River, Bayou Creek (also known as Big Bayou Creek) and Little Bayou Creek. The Ohio River is located approximately 3.5 miles north of the PGDP. It is the most significant surface water feature in the region, carrying over 25 billion gal/day of water through its banks. Several dams regulate flow in the Ohio River. The Ohio River stage near PGDP is measured at Metropolis, Illinois, by a United States Geological Survey (USGS) gauging station. River stage typically varies between 293 and 335 ft amsl over the course of a year. Water levels on the lower Ohio River generally are highest in late winter and early spring and lowest in late spring and early summer. A floodplain analysis performed by the U.S. Army Corps of Engineers (COE) (COE 1994) found that many of the built-up portions of the plant lie outside the 100- and 500-year floodplains of these streams. In addition, this analysis reports that ditches within the plant area can contain the expected 100- and 500-year discharge.

The plant is situated on the divide between Little Bayou and Bayou Creeks (Figure 4.4). Surface flow is east-northeast toward Little Bayou Creek and west-northwest toward Bayou Creek. Bayou Creek is a perennial stream on the western boundary of the plant that flows generally northward, from approximately 2.5 miles south of the plant site to the Ohio River along a 9-mile course. An 11,910-acre drainage basin supplies Bayou Creek. Little Bayou Creek becomes a perennial stream at the east outfalls of PGDP. The Little Bayou Creek drainage originates within WKWMA and extends northward and joins Bayou Creek near the Ohio River along a 6.5-mile course within a 6,000-acre drainage basin. Drainage areas for both creeks are generally rural; however, they receive surface drainage from numerous swales that drain residential and commercial properties, including WKWMA, PGDP, and the TVA Shawnee Fossil Plant. The confluence of the two creeks is approximately 3 miles north of the plant site, just upstream of the location at which the combined flow of the creeks discharge into the Ohio River.

The USGS has maintained gauging stations on Bayou Creek at 4.1 and 7.3 miles upstream of the Ohio River and a gauging station on Little Bayou Creek at 2.2 miles upstream from its confluence with Bayou Creek. The mean monthly discharges vary from 20.5 to 38.8 million gal/day on Bayou Creek and from 0.7 to 20.5 million gal/day on Little Bayou Creek.

Most of the flow within Bayou and Little Bayou Creeks is from process effluents or surface water runoff from PGDP. Contributions from PGDP comprise approximately 85% of flow within Bayou Creek and 100% of flow within Little Bayou Creek. A network of ditches discharges effluent and surface water runoff from PGDP to the creeks. Plant discharges are monitored at the KPDES outfalls prior to discharge into the creeks. Outfalls 002, 010, 011, 012, 013, and 018 receive water from the eastern-most portion of the plant and discharge to Little Bayou Creek. Water from the western portion of the plant drains to Bayou Creek through Outfalls 001, 006, 008, 009, 014, 015, 016, and 017. Outfall 019/020 monitors runoff discharge to the North-South Diversion Ditch (NSDD) from the C-746-U Landfill, located north of PGDP.

Several major surface water impoundments are located within the plant property and are utilized for various sanitary or process water management needs. The C-616 Lagoons are located near the northwest corner of the plant. Effluent from the plant's phosphate water processing facility is discharged into the C-616-F Lagoon, where sludge is allowed to settle. These lagoons discharge through Outfall 001 to Bayou Creek. The C-611 Lagoons are located to the southwest of the main plant complex. These lagoons serve as settling basins for effluent from the C-611 Sanitary Water Processing Plant. Water from the Ohio River is brought into the water plant where it is treated, primarily with water softening agents, and fed to PGDP for multiple uses. These lagoons discharge through Outfalls 006 and 014 to Bayou Creek. The C-617 Lagoon is located on the east side of the plant. This lagoon collects water from Outfalls 010, 011, 012, and 013. The lagoon discharges treated water through Outfall 010 to Little Bayou Creek.

In the fall of 2002 and winter of 2003, DOE constructed a sedimentation basin (C-613 Northwest Storm Water Control Facility) near the northwest corner of the plant to support removal and disposition of scrap metal. Effluent from the C-613 basin discharges through Outfall 001 to Bayou Creek. In March 2004, DOE completed construction of a detention basin in Section 2 of the NSDD (north central area of the plant). This detention basin contains storm-water runoff to the NSDD until it can be transferred to the C-616-F Lagoon for treatment, via the C-616-C Lift Station. Prior to the detention basin's construction, three culverts were plugged (Fall 2003) at the north security fence to prevent runoff from exiting the plant

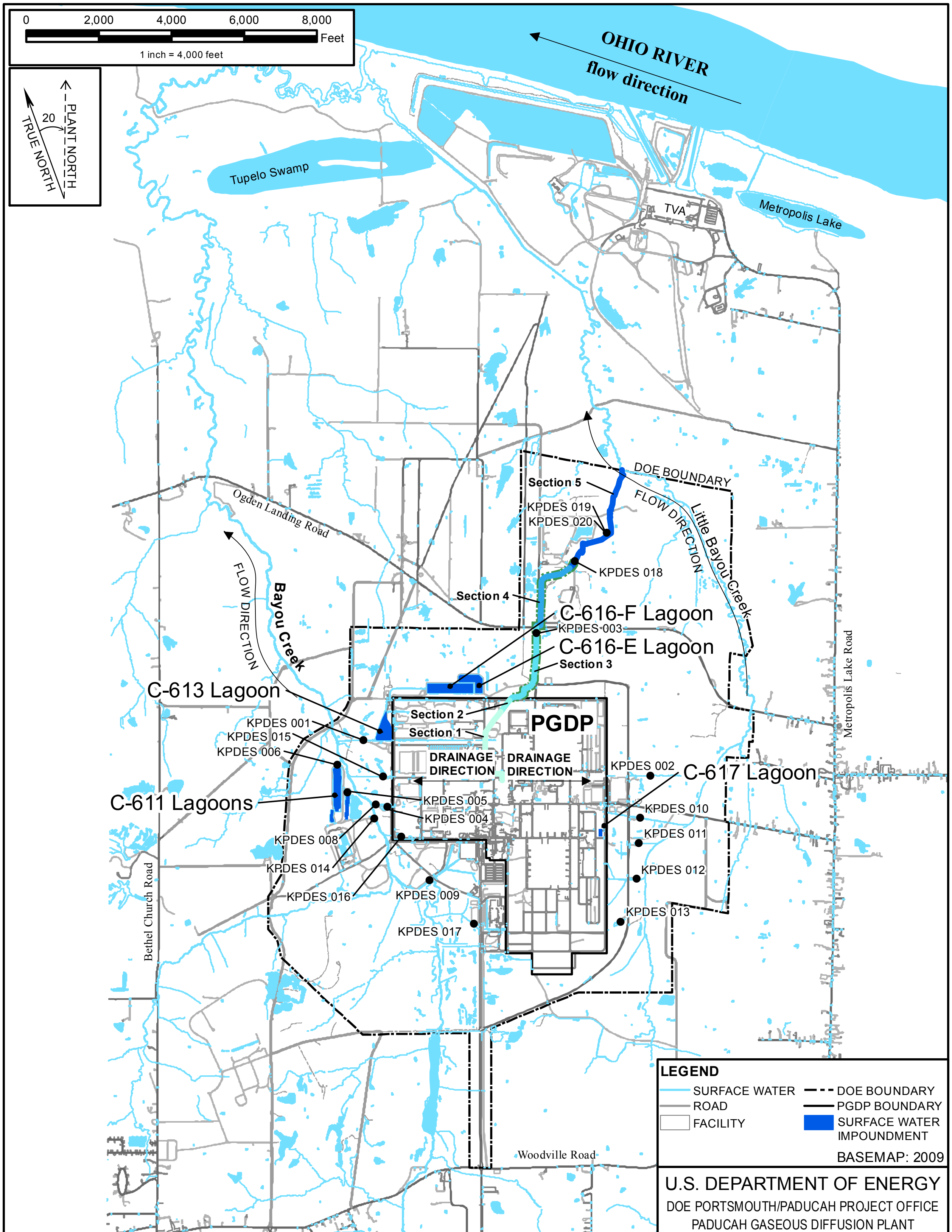

Figure 4.4. Surface Water Features in the Vicinity of the DOE Site

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6/28/2011 G:\GISARCVIEWS\PROJECTS\SWFeaturesR2.mxd via the NSDD; therefore, no effluents from the industrialized areas of PGDP currently flow through Sections 3, 4, and 5 of the NSDD. Additionally, basins have been constructed to control runoff at Outfall 017 and the C-746-U Landfill.

Other surface water bodies in the vicinity of PGDP include the following: Metropolis Lake, located east of the Shawnee Fossil Plant; a marsh area located immediately south of the confluence of Bayou Creek and Little Bayou Creek; and several small ponds, clay and gravel pits, and settling basins scattered throughout the area. Metropolis Lake and the marsh at the confluence of Bayou and Little Bayou Creeks are near the Ohio River and within the river's floodplain. The Ohio River commonly floods both Metropolis Lake and the marsh for a few weeks each year. During non-flood periods, water levels in these surface water bodies respond to the river level (i.e., water levels rise and fall with seasonal trends of the river stage; the wetted area of the marsh is significantly reduced during low-river periods).

Metropolis Lake is located outside the Bayou Creek and Little Bayou Creek drainage basins and is not influenced by the creeks. The marsh at the confluence of Bayou Creek and Little Bayou Creek gains water from Bayou Creek during periods of high flow, but is isolated from both creeks during normal and low-flood periods.

Groundwater derived from the PGDP area flows northward to the Ohio River, passing east of the marsh at the confluence of Bayou and Little Bayou Creeks, but likely flows under Metropolis Lake. Sample results from monitoring wells located south of Metropolis Lake demonstrate that the lake is not being impacted by PGDP-derived groundwater contamination.

Smaller surface water bodies in the vicinity of PGDP are located in the upper and intermediate reaches of the drainage basins of Bayou Creek and Little Bayou Creek where they are recharged by local, shallow groundwater flow systems. PGDP operations have not influenced these surface water and groundwater systems. These surface water bodies are expected to have only localized effects on the regional groundwater flow pattern.

4.6 GEOLOGY OF PGDP

PGDP is located in the Jackson Purchase region of western Kentucky, which represents the northern tip of the Mississippi Embayment portion of the Coastal Plain Province. The Jackson Purchase region is an area of land that includes all of Kentucky west of the Tennessee River. The stratigraphic sequence in the region consists of Cretaceous, Tertiary, and Quaternary sediments unconformably overlying Paleozoic bedrock.

Information presented herein regarding the geologic setting at PGDP was derived from the *Report of the Paducah Gaseous Diffusion Plant Groundwater Investigation Phase III* (Clausen et al. 1992). Subsequent sections will briefly discuss the formations represented in Figure 4.5 to acquaint the reader with PGDP geology.

4.6.1 Bedrock

The entire PGDP area is underlain by Mississippian carbonates, consisting of dark gray limestone with some interbedded chert and shale.

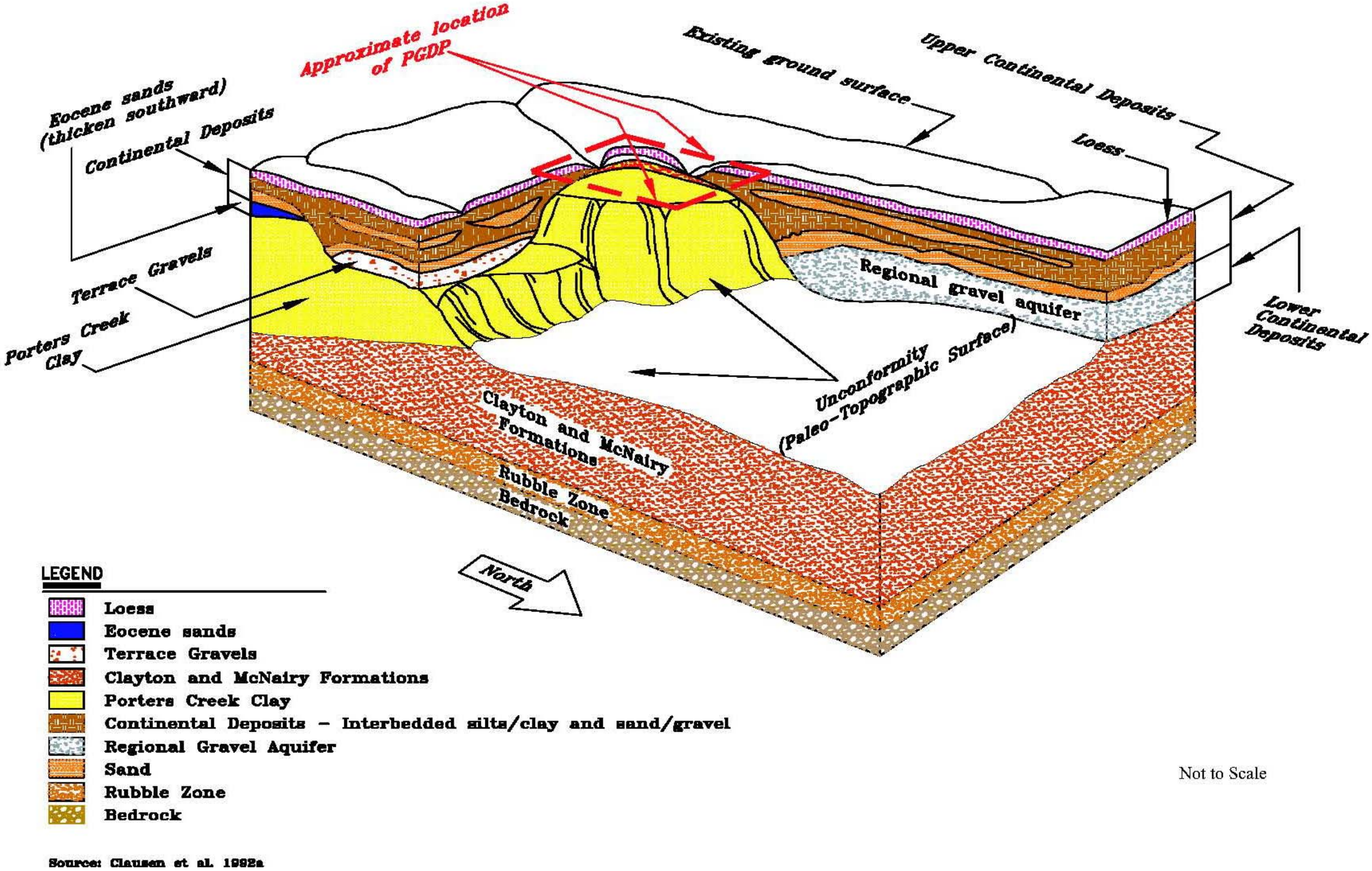

Figure 4.5. Conceptual Site Model for Geologic Formations at PGDP

4.6.2 Rubble Zone

A rubble zone of chert gravel commonly is encountered in soil borings at the top of the bedrock. The age and continuity of the rubble zone remain undefined.

4.6.3 McNairy Formation

The McNairy Formation consists of Upper Cretaceous sediments of grayish-white to dark-gray micaceous silt and clay with interbedded, gray to yellow to reddish-brown, very fine- to medium-grained sand. A basal sand member also is present at PGDP.

4.6.4 Porters Creek Clay/Porters Creek Terrace

The Paleocene Porters Creek Clay occurs in the southern portions of the area and consists of dark gray to black silt with varying amounts of clay and fine-grained, micaceous, commonly glauconitic, sand. The Porters Creek Clay subcrops along a buried terrace slope that extends east–west across the area. Erosion into the Paleocene Porters Creek Clay, after the deposition of overlying Eocene through Pleistocene sediments (Eocene sands and terrace gravels), resulted in an important hydrogeologic feature known as the Porters Creek terrace. The Porters Creek terrace lies immediately south of PGDP; the terrace slope extends northward toward the southern boundary of the PGDP fenced security area. The Porters Creek terrace is hydrogeologically important because it is the southern extent of the lower continental deposits and the Regional Gravel Aquifer (RGA).

4.6.5 Eocene Sands

Eocene sands are found in the southern portions of the area above the Porters Creek Clay. These sands are believed to be composed of undifferentiated sediments of the Claiborne Group and Wilcox Formation. Olive (1980) describes the sands as predominantly clear quartz with minor amounts of gray quartz and chert with interbedded and interlensing silts and clays. The Eocene sands thicken south of PGDP and may serve as a significant water-bearing unit south of the plant.

4.6.6 Continental Deposits

Continental sediments [Pliocene(?) to Pleistocene—a question mark indicates uncertain age] unconformably overlie the Cretaceous through Eocene strata throughout the area. These continental sediments were deposited on an irregular erosional surface exhibiting steps or terraces. The thicker sequences represent valley fill sediments that comprise a fining-upward cycle. The continental sediments have been divided into the two distinct facies described below.

(1) Lower Continental Deposits. The lower continental deposits are a gravel facies consisting of chert pebbles to cobbles in a matrix of poorly sorted sand and silt. The lower continental deposits have been found at three distinct horizons in the PGDP area.

    The first horizon consists of the terrace gravel [consisting of a Pliocene(?) gravel ranging in thickness from 0 to 30 ft], occurring in the southern portion of PGDP area at elevations greater than 350 ft amsl, and overlying the Eocene sands and Porters Creek Clay. The terrace gravel is a potential source of the sediments forming the RGA.

The second gravel horizon is terrace gravels located in the southeastern and eastern portions of the DOE boundary on an erosional surface at approximately 320 to 345 ft amsl. The thickness of this unit ranges from 15 to 20 ft.

The third and most prominent of the three horizons consists of a Pleistocene gravel deposit resting on an erosional surface at approximately 280 ft amsl. This gravel is found throughout the plant area and to the north, but pinches out to the south along the slope of the Porters Creek terrace. The gravel deposit averages approximately 30 ft in thickness, but some thicker deposits (as much as 50 ft) exist in deeper scour channels that trend east–west across the area.

(2) Upper Continental Deposits. The upper facies is composed of fine-grained clastics varying in thickness from 15 to 55 ft. These upper continental deposits have been differentiated into three general horizons: (1) an upper silt and clay interval, (2) an inner-bedded sand and gravel interval, and (3) a lower silt and clay interval. The sand and gravel interval appears relatively discontinuous in cross-sections, but portions may be inner-connected.

4.7 SOILS

The surficial deposits found in the vicinity of the PGDP area are Pleistocene to Recent in age and consist of loess and alluvium. Both units are composed of clayey silt or silty clay and range in color from yellowish-brown to brownish-gray or tan, making field differentiation difficult.

The loess (wind-blown) deposits overlie the upper continental deposits over the entire PGDP area. Loess deposition probably occurred in upland areas during all stages of the glaciation that extended into the Ohio and Mississippi River Valleys.

The general soil map for Ballard and McCracken counties indicates that three soil associations are found within the vicinity of PGDP (USDA 1976), the Rosebloom-Wheeling-Dubbs association, the Grenada-Calloway association, and the Calloway-Henry association. The predominant soil association in the vicinity of PGDP is the Calloway-Henry association, which consists of nearly level, somewhat poorly drained, medium-textured soils on upland positions.

Although the soil over most of PGDP may be Henry silt loam with a transition to Calloway, Falaya-Collins, and Vicksburg away from the site, many of the characteristics of the original soil have been lost due to industrial activity that has occurred over the past 50+ years. Activities that have disrupted the original soil classifications include filling, mixing, and grading.

4.8 HYDROGEOLOGY OF PGDP

Information presented herein regarding the groundwater setting was derived from the *Report of the Paducah Gaseous Diffusion Plant Groundwater Investigation Phase III* (Clausen et al. 1992). The discussion provides the reader with an overview of the groundwater flow regime for PGDP. The local groundwater flow system at the PGDP site occurs within the sands of the Cretaceous McNairy Formation, Pliocene terrace gravel, Pleistocene lower continental gravel deposits and upper continental deposits, and Holocene alluvium. Four specific components have been identified for the groundwater flow system and are defined in the following paragraphs.

(1) **McNairy Flow System.** This component consists of the interbedded and interlensing sand, silt, and clay of the Cretaceous McNairy Formation. Sand facies account for 40–50% of the total formation's thickness of approximately 225 ft. Groundwater flow is predominantly north.

(2) **Terrace Gravel.** This component consists of Pliocene(?)-aged gravel deposits and later reworked sand and gravel deposits found at elevations higher than 320 ft amsl in the southern portion of the plant site; they overlie the Paleocene Porters Creek Clay and Eocene sands. These deposits usually lack sufficient thickness and saturation to constitute an aquifer.

(3) **RGA.** This component consists of the Quaternary sand and gravel facies of the lower continental deposits and Holocene alluvium found adjacent to the Ohio River and is of sufficient thickness and saturation to constitute an aquifer. These deposits are commonly thicker than the Pliocene(?) gravel deposits, having an average thickness of 30 ft, and range up to 50 ft along an axis that trends east-west through the plant site. The RGA is the primary local aquifer. Groundwater flow is predominantly north toward the Ohio River.

(4) **Upper Continental Recharge System (UCRS).** This component consists of the surficial alluvium and upper continental deposits. Sand and gravel lithofacies appear relatively discontinuous in cross-section, but portions may be interconnected. The most prevalent sand and gravel deposits occur at an elevation of approximately 345 to 351 ft amsl; less prevalent deposits occur at elevations of 337 to 341 ft amsl. Groundwater flow is predominantly downward into the RGA from the UCRS, which has a limited horizontal component in the vicinity of PGDP.

Five hydrostratigraphic units (HUs) proposed by Douthitt and Phillips (1991) explain groundwater flow at the PGDP site. In descending order, the HUs are as described below.

Upper Continental Deposits

- HU 1 (UCRS): Loess that covers the entire site.
- HU 2 (UCRS): Discontinuous, sand and gravel lenses in a clayey silt matrix.
- HU 3 (UCRS): Relatively impermeable clay layer that acts as the upper semiconfining-to-confining layer for the RGA. The lithologic composition of this unit varies from clay to sand, but is predominantly clay or silt.
- HU 4 (RGA): Predominantly continuous sand unit with a clayey silt matrix that directly overlies the RGA. This unit is in hydraulic connection with HU 5 and is included as part of the RGA.

Lower Continental Deposits

- HU 5 (RGA): Gravel, sand, and silt.

4.9 ECOLOGICAL SETTING OF PGDP

The following sections give an overview of the terrestrial and aquatic systems at PGDP. A more detailed description, including identification and discussion of sensitive habitats and threatened/endangered species, is contained in the *Investigation of Sensitive Ecological Resources Inside the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (CDM 1994) and *Environmental Investigations at the Paducah Gaseous Diffusion Plant and Surrounding Area, McCracken County, Kentucky, Volume V: Floodplain*

Investigation, Part A: Results of Field Survey (COE 1994). While the expectation is that the results from the 1994 studies remain valid for current conditions, it is also recognized that some minor changes are likely as a result of increased human access to the area due to local interest and natural changes.

4.9.1 Terrestrial Systems

The terrestrial component of the PGDP ecosystem includes the plants and animals that use the upland habitats for food, reproduction, and protection. The upland vegetative communities consist primarily of grassland, forest, and thicket habitats with agricultural areas. Important crops grown in the PGDP area include soybeans, corn, tobacco, and sorghum.

Most of the area in the vicinity of PGDP has been cleared of vegetation at some time, and much of the grassland habitat near the Limited Area currently is mowed by PGDP personnel. A large percentage of the adjacent WKWMA is managed to promote native prairie vegetation by burning, mowing, and various other techniques. These areas have the greatest potential for restoration and for establishment of a sizeable prairie preserve in the Jackson Purchase area (KSNPC 1991).

Dominant overstory species of the forested areas include oaks, hickories, maples, elms, and sweetgum. Understory species include snowberry, poison ivy, trumpet creeper, Virginia creeper, and Solomon's seal.

Thicket areas consist predominantly of maples, black locust, sumac, persimmon, and forest species in the sapling stage with herbaceous ground cover similar to that of the forest understory.

Wildlife commonly found in the PGDP area consists of species indigenous to open grassland, thicket, and forest habitats. The species documented to occur in the area are discussed in the following paragraphs.

Small mammal surveys conducted on WKWMA documented the presence of southern short-tailed shrew, prairie vole, house mouse, rice rat, and deer mouse (KSNPC 1991). Large mammals commonly present in the area include coyote, eastern cottontail, opossum, groundhog, whitetail deer, raccoon, and gray squirrel.

Typical birds of the area include European starling, cardinal, red-winged blackbird, mourning dove, bobwhite quail, turkey, killdeer, American robin, eastern meadowlark, eastern bluebird, bluejay, red-tail hawk, and great horned owl.

Amphibians and reptiles present include cricket frog, Fowler's toad, common snapping turtle, green tree frog, chorus frog, southern leopard frog, eastern fence lizard, and red-eared slider (KSNPC 1991).

Mist netting activities in the area have captured red bat, little brown bat, Indiana bat, northern long-eared bat, evening bat, and eastern pipistrelle (KSNPC 1991).

4.9.2 Aquatic Systems

The aquatic communities in and around the PGDP area that could be impacted by plant discharges include two perennial streams (Bayou Creek and Little Bayou Creek), the NSDD, a marsh located at the confluence of Bayou Creek and Little Bayou Creek, and other smaller drainage areas. The dominant taxa in all surface waters include several species of sunfish, especially bluegill and green sunfish, as well as bass and catfish. Shallow streams, characteristic of the two main area creeks, are dominated by bluegill, green and longear sunfish, and stonerollers.

4.9.3 Wetlands and Floodplains

Wetlands were identified during the 1994 COE environmental investigations of 11,719 acres surrounding PGDP. These investigations identified 1,083 separate wetland areas and grouped them into 16 vegetative cover types encompassing forested, scrub/shrub, and emergent wetlands (COE 1994). Wetland vegetation consists of species such as sedges, rushes, spike rushes, and various other grasses and forbs in the emergent portions; red maple, sweet gum, oaks, and hickories in the forested portions; and black willow and various other saplings of forested species in the thicket portions.

At the PGDP, three bodies of water cause most area flooding: the Ohio River, Bayou Creek, and Little Bayou Creek. A floodplain analysis performed by COE (1994) found that much of the built-up portions of the plant lie outside the 100- and 500-year floodplains of these streams. In addition, this analysis reports that ditches within the plant area can contain the expected 100- and 500-year discharge. It should be noted that precipitation frequency estimates for the 100- and 500-year events were updated in 2004 in the NOAA Atlas 14. For example, the mean precipitation estimate for the 100-year, 24-hour event in Atlas 14 for the Paducah area is 10.1% to 15% greater than the mean estimate in previous publications. As stated in Atlas 14, in many cases, the mean precipitation estimate used previously still is within the confidence limits of that provided in Atlas 14; therefore, it is assumed the plant ditches still will contain the 100- and 500-year discharges.

5. CHARACTERIZATION OF SITE/PREVIOUS ANALYTICAL DATA

Several documents have been produced containing data pertinent to the various SWMUs/AOCs within the SWOU. Additionally, data were downloaded from the Paducah Oak Ridge Environmental Information System (OREIS) database in March 2008. These data were binned for several statistical comparison scenarios. Only data collected since January 2000 were included for consideration. Historical data is intended to supplement RI data, but not replace planned sampling.

The historical data set was used to compile various risk-screening tables required by the 2001 *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* Volume 1, *Human Health,* and Volume 2: *Ecological* (DOE 2001) for scoping activities. Historical data are provided in Appendix D of this document. Historical information summarized in this section highlights the background of each SWMU/AOC. Historical summaries in Appendix D are compared to PGDP background values and action/no action levels available in the Paducah Risk Methods Document (DOE 2001). These summaries are presented for information only. Historical data have been used in these summaries according to data quality as defined by criteria presented in Section 15.

Risk assessment results, which are included in the Previous Risk Assessment Discussion/Summary subsections, are documented as they were originally reported, consistent with the 2001 Paducah Risk Methods Document (DOE 2001).

Operational and risk exposure conceptual site models (CSMs) are discussed within each of the following chapters describing the various SWMUs/AOCs within the SWOU. These CSMs are displayed in Figures 5.1 and 5.2, respectively.

The primary focus of the SWOU RI/FS Work Plan will be to collect field and analytical data necessary to determine the nature and extent of soil/sediment contamination at SWOU SWMUs/AOCs. Following field implementation of the SWMU/AOC evaluation, data will be used to complete SERAs, a BERA, a BHHRA, and to evaluate appropriate remedial alternatives for each targeted area.

The following decisions will be made using the results of the SERAs and BERA:

- If concentrations of contaminants result in adverse effects to any appropriate receptor populations (e.g., terrestrial plants, mammalian herbivores, etc.) through exposure to contaminated media as indicated by available lines of evidence (media concentration data, toxicity testing data, community survey data), then a risk management decision will be made.

- If concentrations of the contaminants are greater than those expected to occur naturally in the environment, then evaluate actions that will mitigate risk; otherwise pursue a "no further action" decision.

Decisions to be made during the RI/FS process include a determination of whether there have been releases, the extent of the effect from the releases, whether the site will require remediation, and, if so, what type will be necessary. Risk-based analysis of data generated during the investigation will result in one of the following three decisions for human health and the environment.

(1) A determination for "no further action" will be made for those sites at which no contamination is present or contamination is present but determined to be at concentrations that do not pose unacceptable risk to human health and the environment.

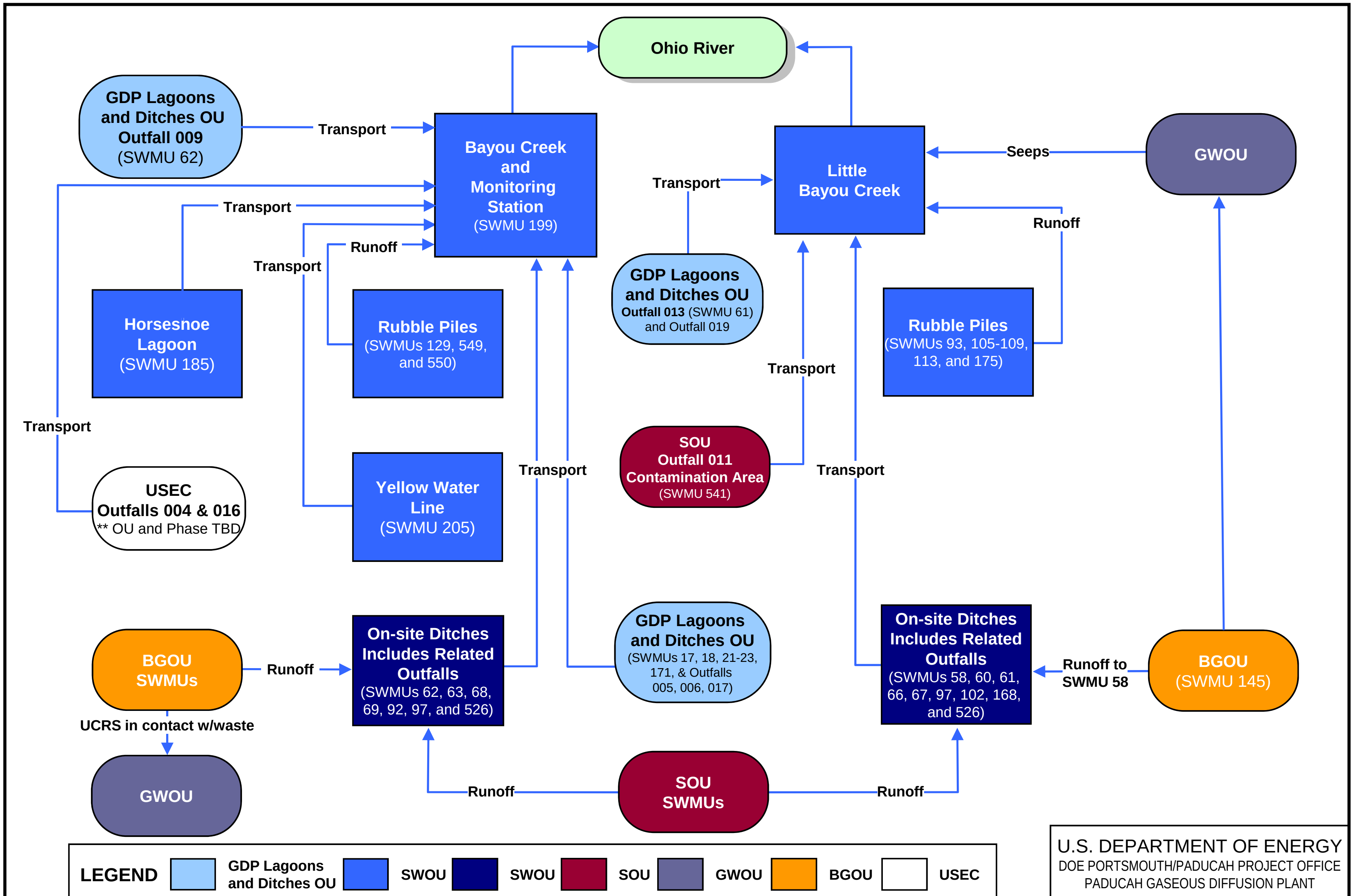

Figure 5.1. SWOU Operational Conceptual Site Model

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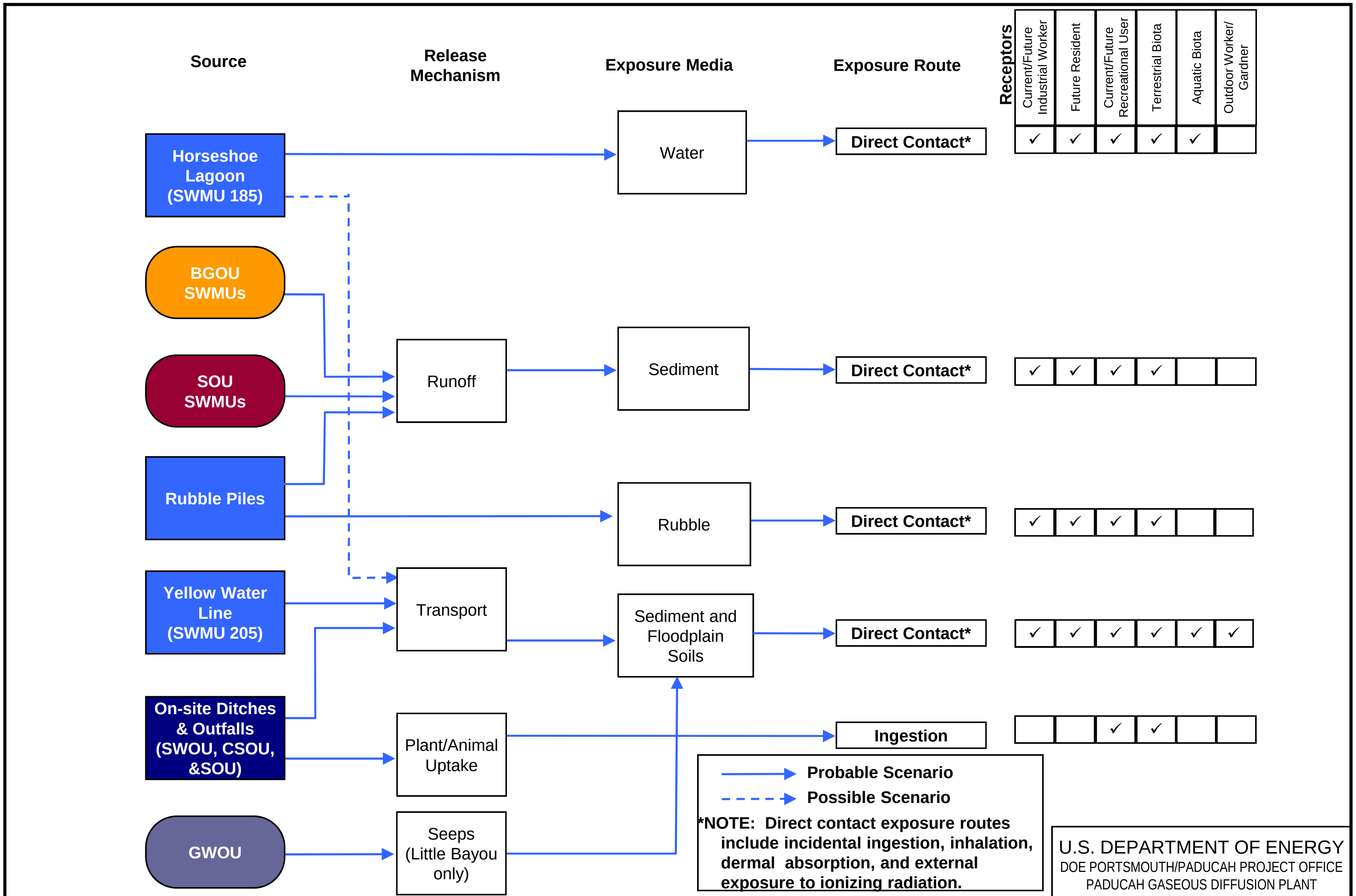

Figure 5.2 SWOU Risk Exposure Conceptual Site Model

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(2) A determination for early implementation of removal and/or remedial actions will be considered if contamination presenting imminent, immediate, unacceptable risks to human health and the environment is found. The remedial measures may include engineering and institutional control measures (signs, fences, etc.) and/or temporary stabilization to prevent further contaminant migration and/or degradation.

(3) An FS will be performed if contamination that presents unacceptable risks to human health and the environment is found, but the risks are not imminent or immediate. An FS also will be performed for SWMUs at which interim remedial/removal actions are needed.

The following sections describe how the field sampling strategy was adapted to each SWMU based upon the current conditions anticipated. If field conditions encountered differ from those anticipated, the sampling strategy will be discussed with the regulatory agencies, and revisions to the work plan will be made, as needed. The sections also describe decision rules required to assess risks to human health and the environment, as appropriate to the SWMU/AOC. These decision rules will be utilized for determining the appropriate path forward for the various SWMUs/AOCs. Ecological decision rules are intended to address only the ecological requirements for making decisions and will not be used to address human health risks, whereas, the decision rules for human health risks will be used to address both types of risk. For example, one general decision rule for initial creek reach sampling presented in the SWOU Sampling Plan states that if all samples are nondetects or detected concentrations are consistent with background, then the recommendation will be that no further sampling would be needed in a given creek reach. This decision rule would be observed for ecological risk as well as human health risks, and no additional sampling would be required during the next phase of ecological sampling.

Sections 6 through 14 contain information for each of the SWMUs/AOCs within the SWOU that fulfills the intent of the FFA for an RI/FS work plan, including items such as the following.

Location
Operational History
Operational CSM
Nature & Extent
Previous Risk Assessment Discussion/Summary
Previous Actions Taken
Risk Exposure CSM
Remaining Problems
Characterization and Inventory of Wastes or Characterization and Inventory of Potential Exposure Media
Information Status of Key Assessment Factors
Release Potential from Contaminant Sources
Remedial Alternatives Development Summary
Data Needs
Field Sampling Plan
Sampling Strategy
Sampling Media and Methods
Sample Analysis
Sampling Procedures
Documentation
Sample Location Survey
Maps/Locations

6. BAYOU CREEK

Bayou Creek is a perennial stream located west of PGDP that flows north, converging with Little Bayou Creek north of the site and ultimately discharging into the Ohio River. The portion of Bayou Creek within the DOE boundary also has been designated as SWMU 65.

For the purposes of this Work Plan, Bayou Creek is broken down into five distinct areas that move progressively from the Limited Area to the Ohio River. Those areas are industrial area exposure units, outfall ditches downstream of the weirs, creek reaches, floodplain soils, and Ohio River floodplain.

6.1 LOCATION

Bayou Creek flows along the western boundary of the plant from approximately 2.5 miles south of the plant to the Ohio River. Bayou Creek and a primary tributary (generally referred to as the unnamed tributary) are included in this RI/FS (Figure 6.1). The 500-year floodplain typically ranges between 700 and 1,800 ft wide along Bayou Creek and between 300 to 500 ft wide along the unnamed tributary.

6.2 OPERATION HISTORY

Bayou Creek is used to discharge wastes and storm water from the plant site to the Ohio River. Discharges to Bayou Creek occur through KPDES outfalls 001, 004, 005, 006, 008, 009, 014, 015, 016, and 017, as shown in Figure 6.1. Historical releases of contaminants from PGDP facilities are believed to be the source of the majority of contamination present in Bayou Creek. Additional sources include PGDP facilities located outside the PGDP security fence and adjacent to Bayou Creek and the unnamed tributary, in particular, the C-746-K Landfill (SWMU 8) and the C-611 Water Treatment Plant. The former Kentucky Ordnance Works (KOW), a World War II-era munitions plant, which encompassed the area south of the PGDP plant site, the current PGDP plant site, and areas north to the Ohio River, likely is contributing contamination to the unnamed tributary and Bayou Creek. Contaminants associated with the manufacture of trinitrotoluene (TNT) at the former KOW include nitroaromatic compounds (particularly TNT, TNB, and 2,4-DNT); metals; acids (nitric and sulfuric); nitrates; and sulfates.

6.3 OPERATIONAL CONCEPTUAL SITE MODEL

The operational CSM is illustrated in Figure 5.1. Bayou Creek has inputs from many areas as it flows northward converging with Little Bayou Creek and ultimately flowing into the Ohio River.

6.4 INDUSTRIAL AREA UNITS

The Industrial Area comprises of two ecological units within the security fence, the Little Bayou Creek watershed and Bayou Creek watershed, each of which contains multiple SWMUs. As a result of previous investigations, most of the SWMUs/AOCs within the Limited Area have completed SERAs. Many of the SERA conclusions from these earlier SERAs can be compiled to complete the SERA for the Industrial Area.

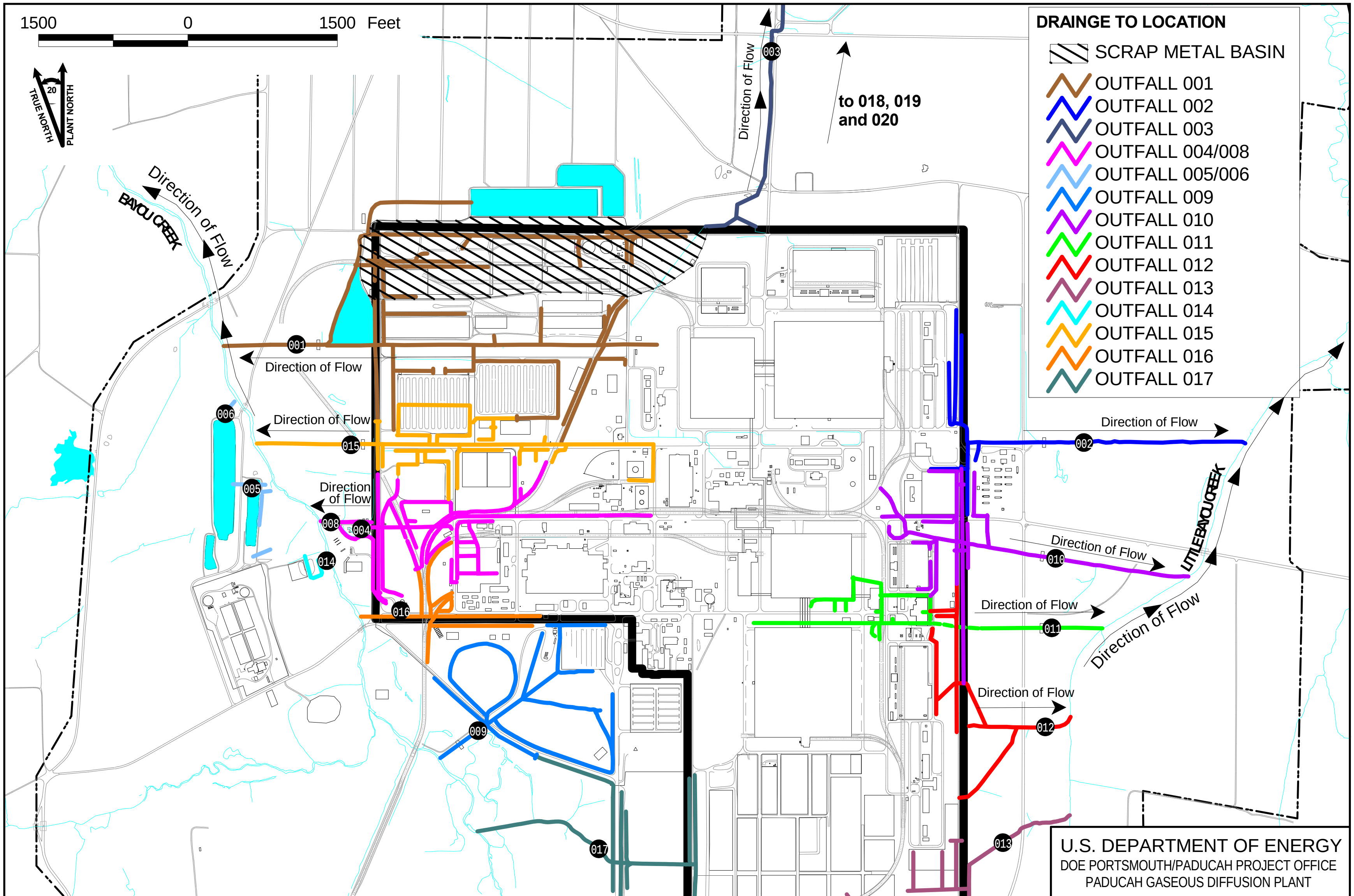

Figure 6.1. Location of Bayou and Little Bayou Creeks and PGDP Outfalls

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Decision Rules—Ecological:

Steps 1 through 3a (only activities 1-4 of Step 3a) of the ecological risk assessment will be performed on the two ecological units to develop a SERA. The SERA approach will be adjusted to account for the fact that the PGDP is an active, industrial facility. This will affect the following:

- Selection of assessment endpoints (e.g., protection of benthic invertebrates in the on-site ditches will not be evaluated);

- Selection of exposure inputs into food chain models appropriate for an active industrial facility; and

- Interpretation of findings (e.g., impacts to some receptors may not be considered realistic due to lack of habitat and/or human presence, etc.).

Ecological chemicals of potential ecological concerns (COPECs) will be identified. A spatial evaluation will be performed of any areas that have elevated concentrations of any COPECs that are recommended for further evaluation as a result of the SERAs. Any SWMU that contains one or more of these COPECs at elevated concentrations may be recommended for further evaluation for the protection of the environment. All other SWMUs within the two ecological units will not be addressed further for ecological risk. The expectation is that a management decision will be made that no further action will be taken beyond reporting of the findings; therefore, no explicit decision rules for determining follow-up steps are currently provided.

6.5 OUTFALL DITCHES DOWNSTREAM OF THE WEIRS

The scope for outfall ditches under the SWOU includes the areas between the outfall weirs and drainage into Bayou Creek for outfall ditches 001, 004, 008, 009, 014, 015, 016, and 017. Outfall 004 (manhole associated with Outfall 008) will be considered as a part of Outfall 008. Outfall 014 will be considered a portion of Horseshoe Lagoon (SWMU 185). Outfalls 005 and 006 are associated with the C-611 Water Treatment Plant lagoons and, as such, will not be addressed in this sampling effort. Though remediation of Outfalls, 005, 006, 017, and 019 and their associated ditches is not planned until after GDP shutdown, data associated with them (e.g., creek data upstream and downstream of the point of discharge, KPDES monitoring data, and information on ecological receptors) will be included in the RI/FS and sitewide baseline ecological risk assessment associated with the SWOU during the pre-shutdown phase.

6.5.1 Nature and Extent

As documented in the SWOU SI (DOE 2008a), sampling was conducted of Outfalls 001, 002, 008, 010, 011, 012, and 015 and their associated internal ditches and Sections 3, 4, and 5 of the NSDD to determine if contamination is migrating from internal ditch source areas to the receiving creeks surrounding the industrialized portion of PGDP. During this SI, the potential migration pathways and mechanisms for transport of chemical and radiological substances found in surface soils and sediments at PGDP were evaluated. Results of the Storm Water Management Model (SWMM) modeling, which were based on a 30-year simulation period, indicate that predicted Total PCB concentrations within the creeks and at the creek integrator points did not exceed no action screening-levels. SWMM modeling also indicated that, as with Total PCBs, predicted uranium-238 activity concentrations within the creeks and at creek integrator points did not exceed no action screening-levels. These data were used to develop source terms to support transport modeling and to develop exposure point characterization (EPC) for each industrial unit. These areas were characterized using the following strategy:

(1) Identify areas of elevated contaminant concentrations (i.e., identify "hot spots") in surface soil and sediment along Outfalls 001, 002, 008, 010, 011, and 015 and associated internal ditches and areas and with Sections 3, 4, and 5 of the NSDD and identify the extent of contamination in these areas.

(2) Further delineate hot spots in soils and sediment found in Outfalls 001, 002, 008, 010, 011, and 015 and associated internal ditches and areas and Sections 3, 4, and 5 of the NSDD.

(3) Determine the potential for migration of contamination through Outfalls 001, 002, 008, 010, 011, and 015 from their associated internal ditches and areas and from the storm water sewers associated with C-333-A, C-337-A, and C-340.

As documented in the Action Memorandum for Contaminated Sediment Associated with the SWOU (On-Site) (DOE 2009a), a non-time-critical removal action for the SWOU (On-Site) was warranted. Completion of this removal action reduced the risk to current and future workers, excavation workers, and recreators from direct contact by removing known sources of contamination. Under this action, hot spots were removed and excavated areas were backfilled with clean soil and restored. Cleanup was verified by post-excavation sampling and it was determined that the cleanup levels for all contaminants of concern (COCs) had been achieved. In achieving these cleanup goals, this ensures that direct contact risk at the on-site ditches for the current industrial worker falls within the EPA risk range and that direct contact risk at the NSDD for both the current industrial worker and recreational user falls within the EPA risk range (DOE 2008b).

Maps of historical sampling for Outfalls 008 and 017 downstream of their weirs are shown in Figures 6.2 and 6.3. No historical sampling data are available for Outfalls 001, 009, 015, and 016 downstream of the weirs within the criteria set for the SWOU (see Section 15).

6.5.2 Previous Risk Assessment Discussion/Summary

It should be noted that previous risk assessments utilized different decision rules than those that will be used for this RI/FS. If risk estimates were recalculated using current methods, exposure parameters, and toxicity information (DOE 2011b), the results could differ markedly; however, the assessments did indicate the contaminants and media that needed to be considered during the scoping of this work plan.

No previous risk assessments have been performed specifically for the outfall ditches below the weirs; however, data collected during the PGDP SI, Phase II, subsequently were evaluated and presented in Results of the Site Investigation, Phase II (CH2M HILL 1992). The risk assessment included an evaluation of exposure scenarios for both Bayou and Little Bayou Creeks and was completed using sampling results likely not consistent with current conditions. Refer to Section 6.6.2 for a summary of the previous risk results for Bayou Creek.

6.5.3 Previous Actions Taken

As stated in the preceding section, no previous risk assessments have been performed specifically for the outfall ditches below the weirs; consequently, no previous actions have been taken for this investigation area.

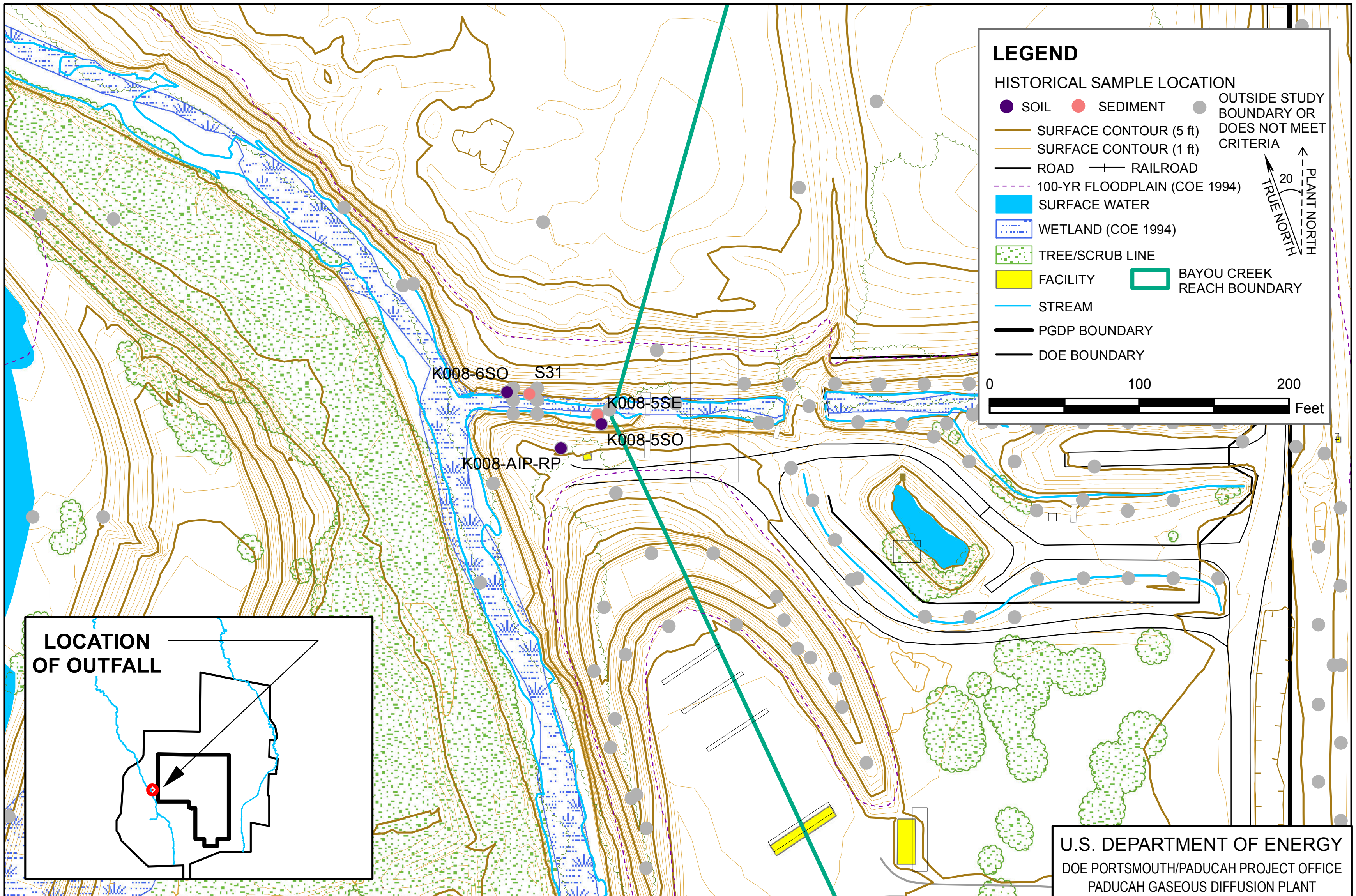

Figure 6.2. Historical Sampling near Outfall 008

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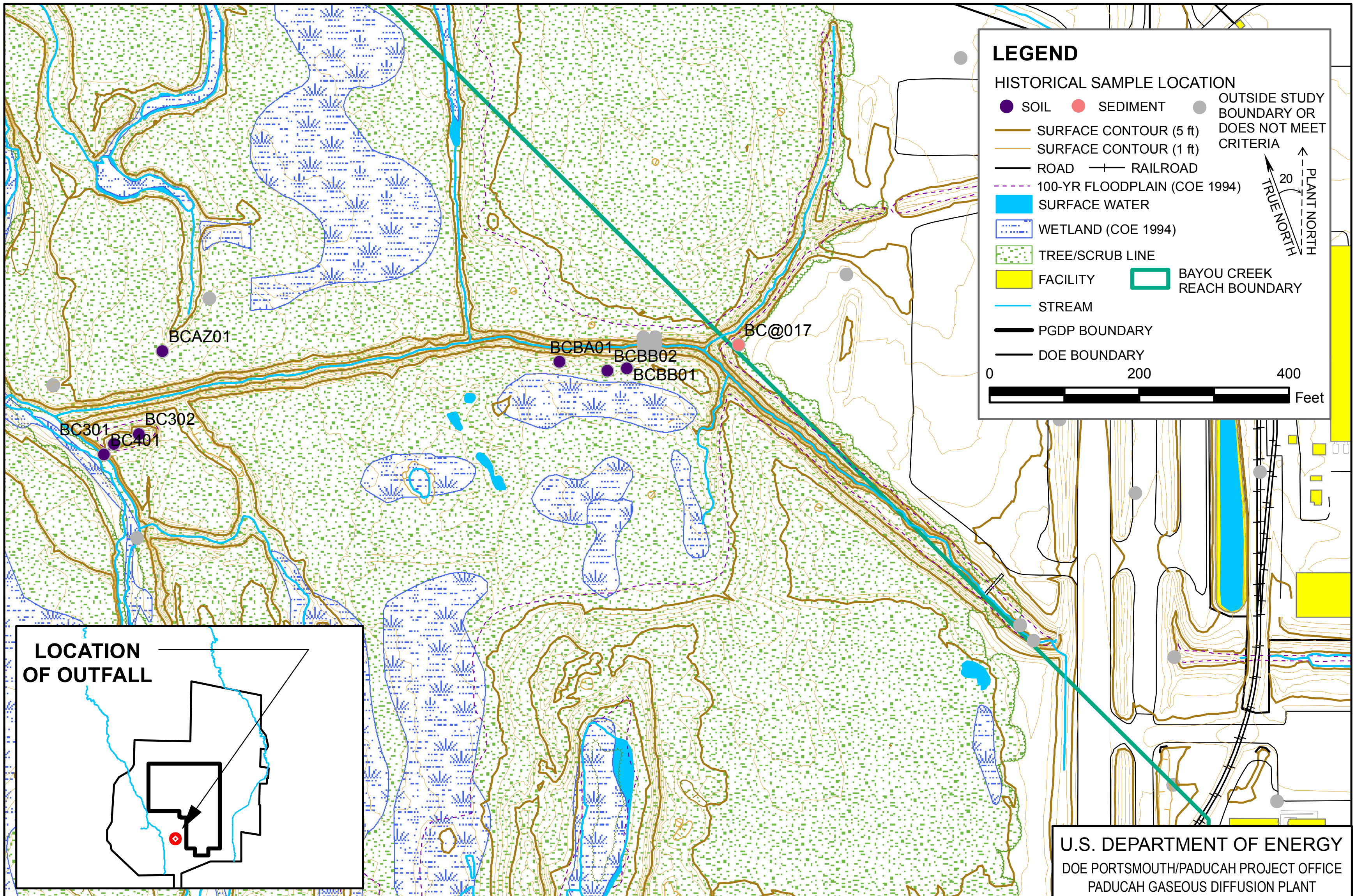

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Figure 6.3. Historical Sampling near Outfall 017

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6.5.4 Risk Exposure CSM

The risk exposure CSM is illustrated in Figure 5.2. Outfall ditches below the weirs have a direct contact and incidental ingestion risk for water, sediment, and soil to the current/future industrial worker, future resident, current/future recreational users, terrestrial and aquatic biota.

6.5.5 Remaining Problems

Remaining problems for the outfall ditches below the weirs are discussed further within this section.

6.5.5.1 Characterization and inventory of wastes

There currently is no waste for this unit.

6.5.5.2 Information status of key assessment factors

Table 6.1 identifies the status of key assessment factors.

Table 6.1. Status of Key Assessment Factors for Outfall Ditches Downstream of the Weirs Leading to Bayou Creek

SWMU	Description	Waste Handling Practices	Contamination		Migration of Contamination	
			Presence	Extent	Surface Runoff	Infiltration
69	Outfall 001	W	A	W	W	A
63	Outfall 008	W	A	W	W	A
63	Outfall 009	W	A	A	A	A
68	Outfall 015	W	A	A	A	A
n/a	Outfall 016	W	A	A	A	A
n/a	Outfall 017	W	A	A	A	A

A—Factor is adequately defined. Current information is adequate to design a targeted sampling plan, but data gaps and uncertainties are such that the goals and objectives of the RI/FS cannot be met.
W—Factor is well defined. Current information is adequate to meet the goals and objectives of the RI/FS.
Information provided in this table is taken from DOE 1999.

6.5.5.3 Release potential from contaminant sources

The primary migration pathway is considered to be sediment and surface water contaminant migration in the ditches to the creek, although unlikely. The sediments in the outfall ditches below the weirs may be contaminated based on historical data and process knowledge regarding the upstream outfall ditch sections. If the sediments are mobilized, the contamination could migrate to downstream locations. Based on the SWOU On-Site Removal Action experience, however, dissolved contaminant releases from sediment are not expected in the downstream locations.

6.5.6 Remedial Alternatives Development Summary

Potential response actions can be found in Appendix C.

6.5.7 Data Needs

Data will be collected below the weir for outfall ditches 001, 008, 009, 015, and 016, and above the weir for Outfall 016. The primary data needs for the outfall ditches below the weir is to determine if contaminants are present and, if so, determine extent of contamination and if it might have an adverse effect on human health or ecological receptors; therefore, sediment samples will be collected from within the outfall ditches.

6.5.8 Field Sampling Plan

The sampling strategy discussed in the following subsections is modeled after the on-site ditch approach (DOE 2005).

6.5.8.1 Sampling strategy

The expected condition is that hot spots exist and the outfall ditches have PGDP-related contaminants in them. Each outfall ditch will be divided into multiple exposure units (EUs), with a maximum EU size of between 0.5 and 0.75 acre, and is delineated within the apparent uppermost topographical contour of each bank of the ditch as shown on the 2009 PGDP base map. The EU size is allowed to take into account surface topography. Sampling will consist of Activity 1, Activity 2, and ecological sampling as described in the paragraphs that follow. A schematic of the sampling approach is shown in Figure 6.4.

Samples will be collected as follows:

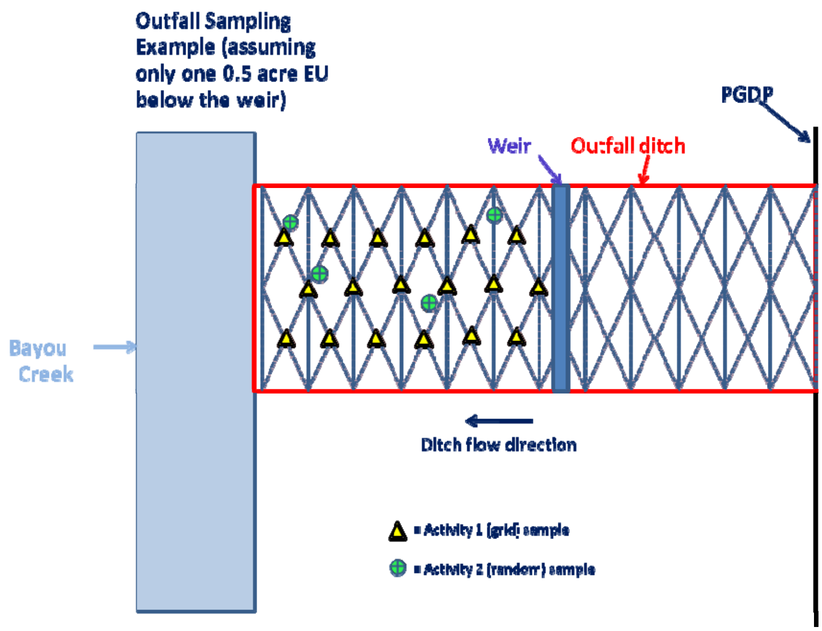

Figure 6.4. Outfall Sampling Example

Activity 1—Grid Sampling (Purpose is to identify areas of elevated contaminant concentrations and extent of contamination.) Each outfall ditch will be divided into multiple EUs with a maximum EU size between of 0.5 and 0.75 acre. The range allows for variations in the surface topography. Generally, there will be 28 sample locations per half-acre EU (30-ft diameter, or 707 ft^2–based on triangular grid with random starting location, extending from bank to bank).

Activity 2—Definitive Sampling (Purpose is to characterize the average contamination or source of contamination.) Collection of surface sediment sample, sediment sample at the sediment/soil interface, and a soil sample at one ft below the sediment/soil interface at four random sample locations per EU (independent of the Activity 1 locations).

Ecological (Purpose is to address directly the receptors and contaminants that are carried forward from Activity 1 and Activity 2.) Ecological data collection for ecological risk assessment will include collection of site-specific toxicity and/or uptake values, as well as abiotic samples. Data from other EUs may be available and could be applied to the ditches EUs (e.g., toxicity or uptake studies from other areas of PGDP).

Decision Rules:

If any analytical sample result within an EU exceeds the Creek Reaches Phase 1 action level,[5] the sample location is identified as a hot spot.

If soil analytical results within an EU are above any action level, then the need for an early action to excavate contamination may be evaluated and pursued.

Extent of potential hot spot will be determined by adjacent sample results below the action level (contingency sampling possible). Additional sampling may be needed to further delimit the potential hot spot.

If results averaged within an EU [EPC equals the 95% upper confidence limit (UCL) on the mean] exceed a cumulative human health excess lifetime cancer risk (ELCR) of 1×10^{-6} or a hazard index (HI) of 1, then that EU will be evaluated in the FS.

Decision Rules—Ecological:

If contaminant concentrations in the outfall ditch downstream of its weir are similar to those in the associated creek reach, data may be combined with the reach data. Note that this approach may require a separate risk assessment for each outfall ditch. Area use factors (AUFs) less than 1 may be considered for the ditches, but should be used judiciously. For example, the Commonwealth of Kentucky prefers that chemicals not be eliminated as COPECs solely because a small AUF resulted in hazard quotients (HQs) < 1.

Complete Steps 1 through 3a (Activities 1–4 only of Step 3a) of the ecological risk assessment process (DOE 2011b; DOE 2010b) on available data. The ditch will be carried forward to an ecological sampling, if the following conditions are met for chemicals determined to be COPECs (i.e., maximum detected

[5] Action levels, which are being used for this early action decision only, will be the most current risk-based soil/sediment action levels for the teen recreator receptor (see most recently approved Human Health Methods Document); ecological action levels for PCBs and uranium also may be used if they are available for ecological receptors based on early sampling toxicity studies.

concentrations exceed screening values, and the detected concentration range is determined to exceed background and/or reference concentrations):

- Endpoint receptors (benthic invertebrates) will be carried forward for further evaluation under ecological sampling if a comparison of detected concentrations to available toxicity benchmarks for the given medium (sediment or surface water) is exceeded and a weight-of-evidence discussion concludes that adverse effects to these communities is a realistic possibility.

- Measurement endpoints (e.g., the green heron) will be carried forward for further evaluation under ecological if their food chain model (FCM) HQ, based on upper-bound exposure input values (e.g., use of 95% UCLs for the exposure point concentrations) and lowest observed adverse effect level (LOAEL) toxicity reference values (TRV), exceeds a value of 1, with the exception of the little brown bat, which represents a threatened and endangered (T&E) species. The bat receptor will be carried forward if its FCM HQ, based on upper-bound inputs and no observed adverse effect level (NOAEL) TRVs, exceeds a value of 1. Site-specific uptake factors developed during the early sediment-stability sampling will be considered.

- The COPEC will be carried forward to ecological sampling if the weight-of-evidence evaluation suggests that it is a site-related contaminant that has a reasonable possibility for causing adverse impacts to populations for one or more measurement endpoint. The following weight of evidence considerations should be considered:

  — The chemical is considered to be potentially site-related based on known historical processes occurring at PGDP and fate-and-transport pathways that exist at the site.

  — An evaluation of chemical-specific properties (e.g., chemical form/bioavailability of chemical used in toxicity studies, vs. expected form/bioavailability of the COPEC), including the possible consideration of alternative TRVs, uptake factors, etc., confirms that the exceedance of HQ threshold values in the risk characterization is realistic.

  — A review of available historical data/results, particularly field studies, confirms the potential for adverse effects.

  — Results from any toxicity studies performed during the early sediment stability confirm the predicted risk results of the SERA.

6.5.8.1.1 Sampling media and methods

One type of sampling and data collection activity will be performed—intrusive media sampling, (sediment, soil, and plant tissue). Investigation activities will use DOE Prime Contractor-approved procedures that are consistent with EPA procedures and protocols.

Intrusive Sampling

Various media samples will be collected to characterize areas that have been evaluated as having data gaps. The samples will be collected using DOE Prime Contractor-approved procedures and will be analyzed using field test methods, and selected samples will be submitted to a DOE Consolidated Audit Program (DOECAP)-accredited analytical laboratory for analysis.

Field Analytical Methods. Field analytical methods will include metals analysis by *ex situ* X-ray fluorescence (XRF) using a Niton analyzer (or equivalent), PCBs by Hach (or equivalent) immunoassay/colorimetric test kits, and cesium-137 using a Field Instrument for the Detection of Low Energy Radiation (FIDLER).

To support field XRF analysis, three types of QC samples will be analyzed with each batch of 20 samples. These will include (1) blanks, (2) duplicates, and (3) standard reference materials (SRMs). The XRF blanks will be vendor-provided. Three SRMs will be analyzed daily before use and at four-hour intervals to calibrate and to monitor XRF accuracy. The SRMs represent low [National Institute of Standards and Technology (NIST) 2709], moderate (NIST 2711), and high (NIST 2710) level standards for soil analysis for metals. In the event that readings of standards exceed +/- 20% of the true value, the detector will be recalibrated, and standards will be reanalyzed according to manufacturer's instructions.

To ensure PCB data can be fully evaluated, the system will be calibrated daily. The PCB measurements are colorimetric in nature and acquire semiquantitative results by employing a field grade photometer. As a result, calibration standards and calibration verification standards and blanks will be prepared weekly and stored in accordance with the procedure. Calibration standards and blanks will be analyzed daily or at the end of a sample group, whichever is more frequent, to monitor instrument drift during analysis. They will be analyzed sequentially: (1) calibration verification and (2) blank and will follow the 20^{th} natural sample analyzed or at the end of a group of samples, whichever is more frequent.

If other models, vendors, or contractor procedures are employed for field methods, the procedure for those operations will be implemented. All field methods shall be completed by a properly trained/qualified technician and those producing quantifiable results (i.e., PCB test kits and XRF) will meet detection limits detailed in Section 17, QAPP Worksheets 15-7 and 15-8.

The FIDLER is a 5-inch diameter by 1/16-inch thick sodium iodide (NaI) scintillation probe. It is good for detecting low energy photons (10–150 keV) because photons above 150 keV are energetic enough to pass right through the scintillation material. Uranium-238 and daughters emit 13, 63, and 93 keV photons that will be easily detected. Large open areas and smooth surfaces can be scanned relatively easily. The end window is prone to damage, as it is constructed of 0.001-inch thick beryllium.

Sediment/Soil Sampling. Sediment/soil shall be collected at depths of 0-6 inches below ground surface (bgs) (see Note 1), at the sediment/soil interface (see Note 2), and at one ft below the sediment/soil interface with the use of a stainless-steel sampler, hand auger, spoon, trowel, spade, or scoop.

Note 1: If no sediment is encountered, select a new location, if possible. If no sediment is encountered at the new location or if no new location is available, collect soil samples 0-6 inches bgs and 1 ft bgs.

Note 2: If the sediment/soil interface cannot be identified, collect a sample at 1 ft bgs. If the 1 ft bgs sample is sediment, collect an additional sample 2 ft bgs, if the media at 2 ft bgs is soil.

Ecological Sampling. Plant tissue will be collected in accordance with acceptable EPA guidance documents (Chapter 17).

6.5.8.1.2 Sample analysis

Analytical techniques will be modified to take advantage of knowledge of field techniques for grid samples (i.e., the Activity 1 samples from on-site SWOU investigation). The analytical list may be broadened based on analysis of Phase 1 sampling in creeks. Sample analysis will be as follows:

Activity 1. Field analytical methods will be performed for PCBs, uranium, and cesium-137 with 10% also being analyzed at a fixed-based laboratory for the Activity 2 analytical suite.

Activity 2. Metals, radionuclides, polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs) [trichloroethene (TCE) only], and PCBs will be analyzed at a fixed-base laboratory. If PCBs are detected in any of the samples, a congener evaluation will be performed on 10% of the PCB samples. The decision on which sample to be run for the congener analysis will be made with consideration of and in conjunction with other outfall samples; however, the evaluation will only be run on a sample that has a positive detection for PCBs. The selection of sample also will be assigned randomly within each EU containing a sample that has a positive detection for PCBs. In order to perform the congener evaluation on the same sample that has a detection of PCB, the fixed-base laboratory will need to hold the extract from the PCB analysis until the RI PM or designee has determined upon which samples to perform a congener evaluation.

Ecological. Sediment samples will be analyzed for 10-day *H. azteca* survival and growth toxicity test, and 28-day *L. variegatus* bioaccumulation test. Plant tissue will be analyzed for plant (aquatic or terrestrial, or both) bioaccumulation test.

All bioaccumulation tests will be analyzed for metals, radionuclides, PAHs, geotechnical (10% of surface samples), and PCBs. Geotechnical parameters include Total Organic Carbon (TOC), grain size, bulk density, % solids, pH, and moisture content. The analytical list may be reduced based on analysis of Activity 1 and Activity 2 (previously discussed in Section 6.5.8.1).

6.5.8.1.3 Sampling procedures

Sampling procedures are described in the Quality Assurance Project Plan (QAPP) for this work plan (Section 17).

6.5.8.1.4 Documentation

Requirements for documentation are located in the QAPP for this work plan (Section 17).

6.5.8.2 Sample location survey

Global positioning system (GPS) coordinates in 1602 Kentucky State Plane South Zone with submeter accuracy will be obtained for all sampling locations. Additionally, depths for each sample obtained also will be recorded. Where possible, flags or wooden or metal stakes will be used to mark sampling locations. Each sampling location will be described with field maps and photographs. This will enable reestablishment of the sampling locations if the markers are disturbed or cannot be placed.

6.5.8.3 Maps/locations

Figures 6.5 through 6.10 illustrate proposed sampling for the outfall ditches below the weirs.

6.6 CREEK REACHES

For the purpose of this investigation, Bayou Creek has been subdivided into eight reaches to facilitate data analysis and interpretation. The reaches are illustrated on Figure 6.11.

6.6.1 Nature and Extent

A two-phased SI assessed the impact of PGDP upon Bayou Creek (CH2M HILL 1991a; CH2M HILL 1991b; CH2M HILL 1992). Both sediment and surface water were found to be contaminated with metals,

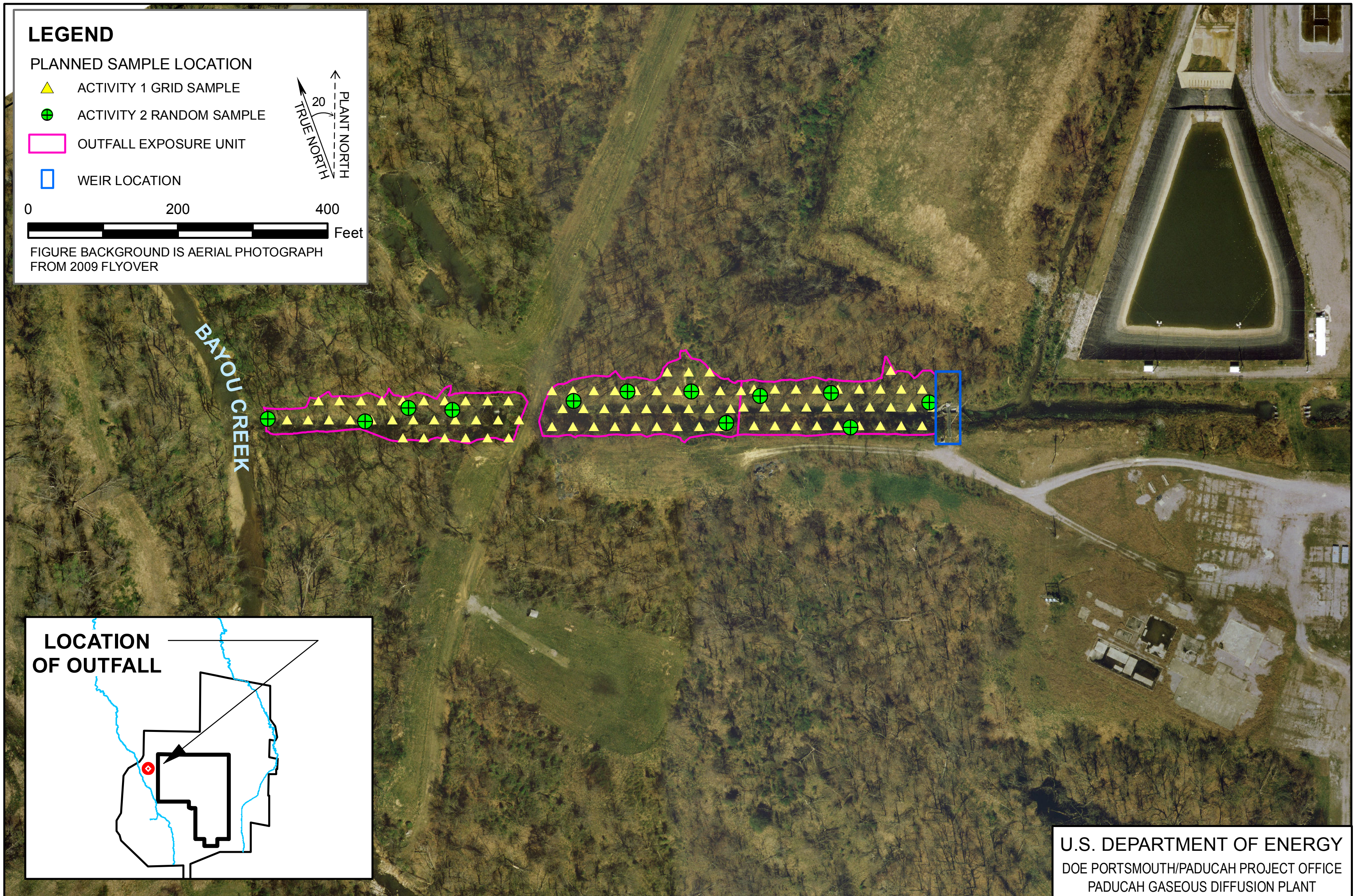

Figure 6.5. Planned Sampling at Outfall 001

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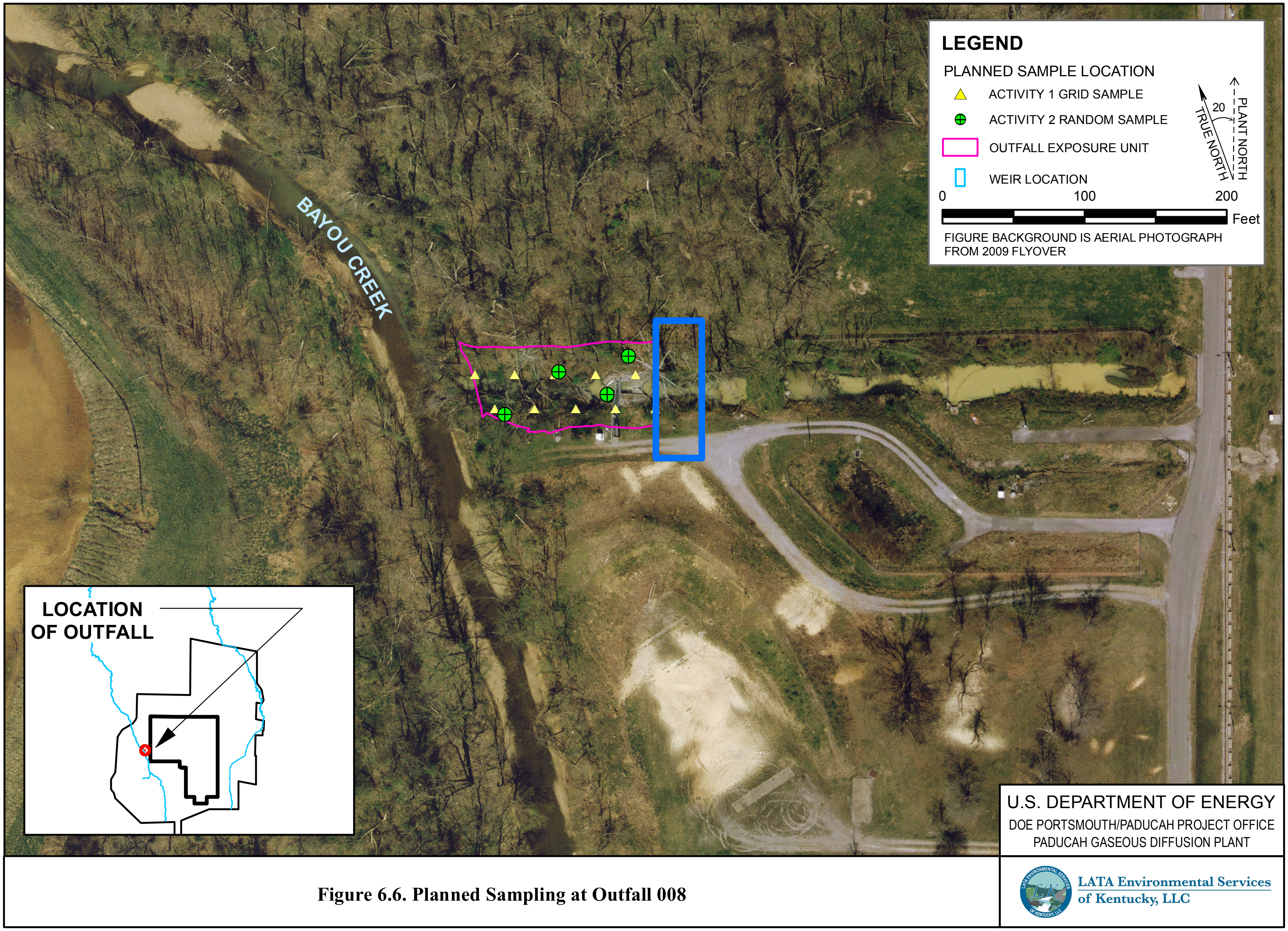

Figure 6.6. Planned Sampling at Outfall 008

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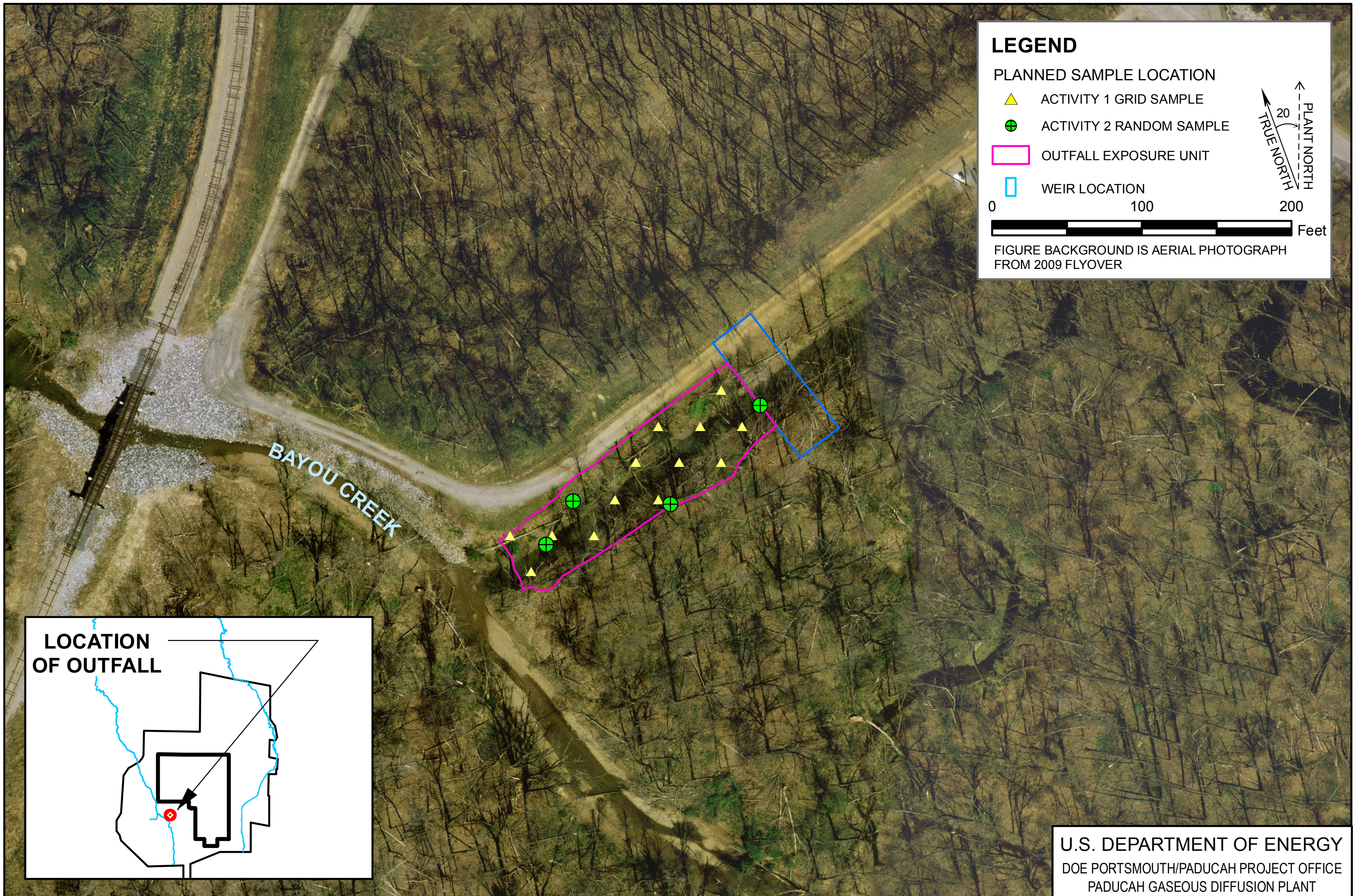

Figure 6.7. Planned Sampling at Outfall 009

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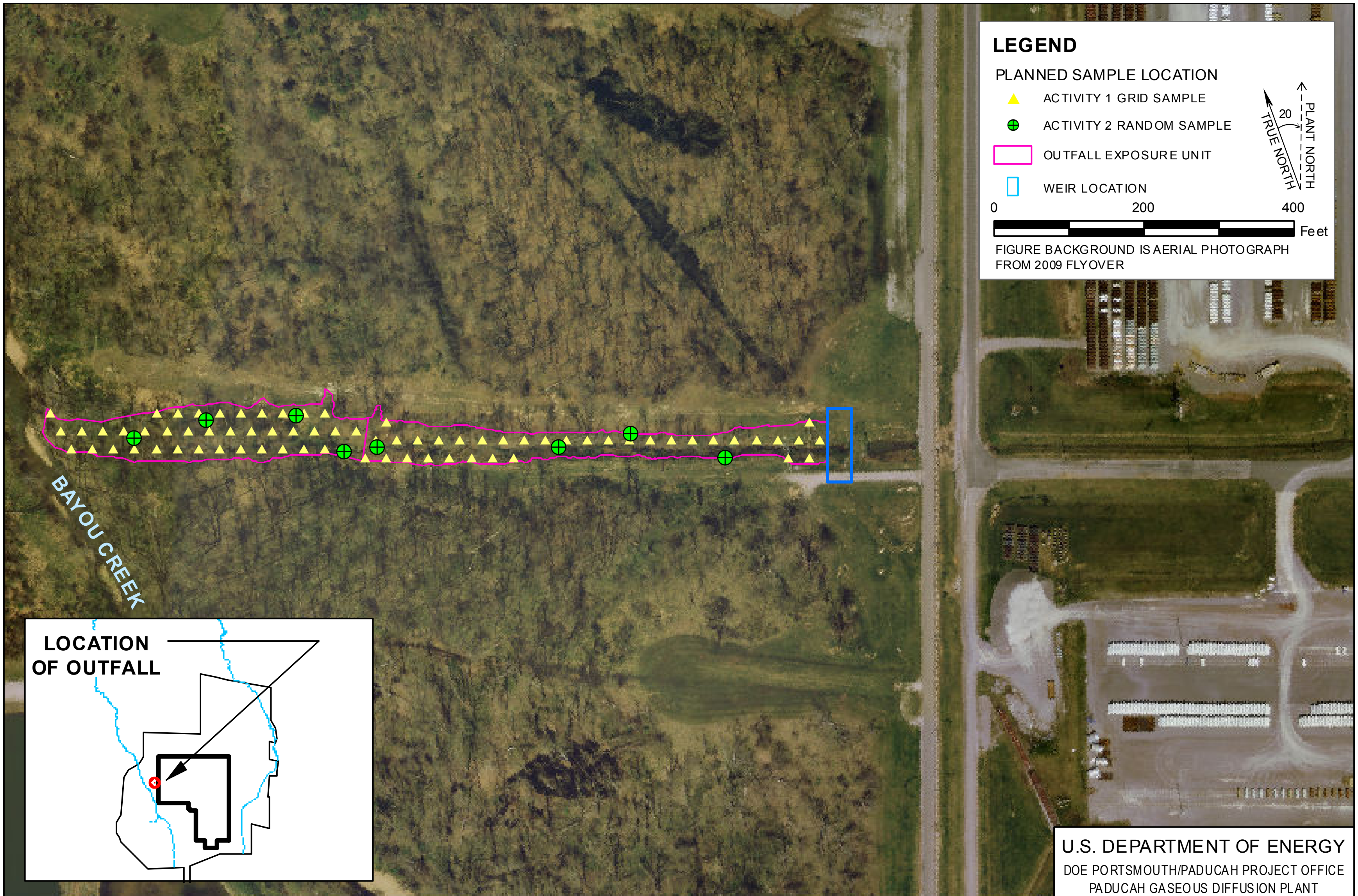

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Figure 6.8. Planned Sampling at Outfall 015

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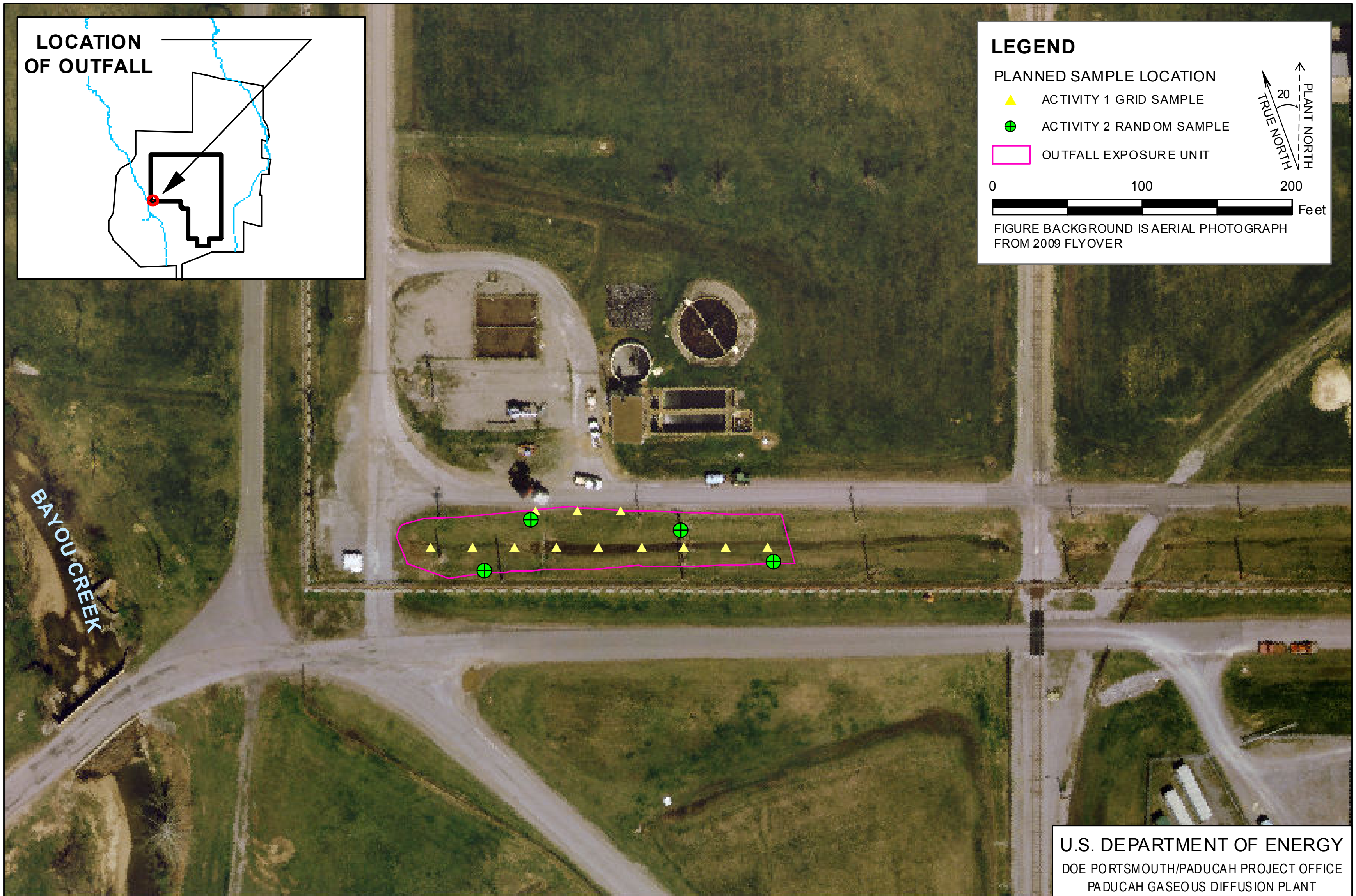

Figure 6.9. Planned Sampling at Outfall 016

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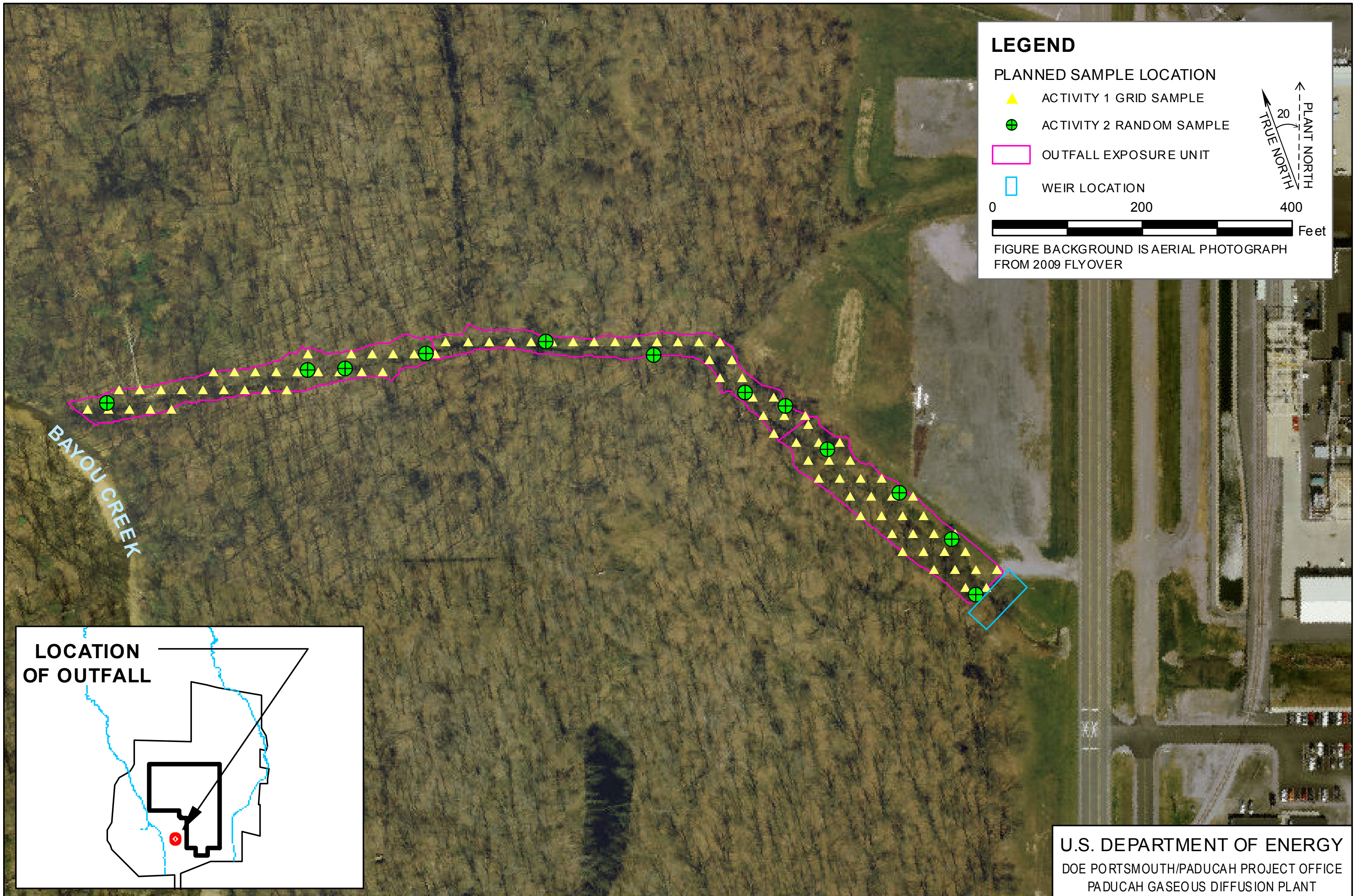

Figure 6.10. Planned Sampling at Outfall 017

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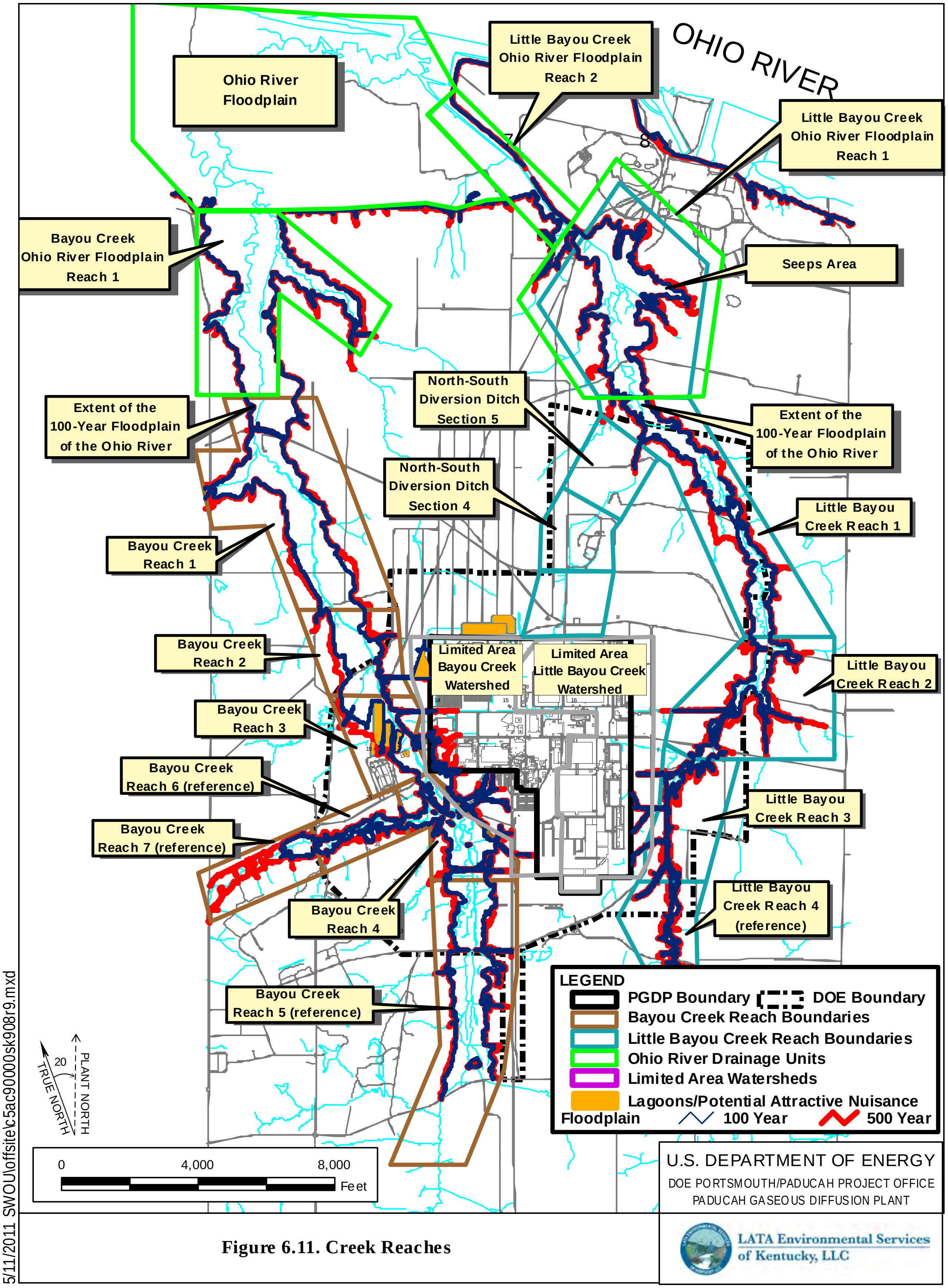

Figure 6.11. Creek Reaches

PCBs, organics and radionuclides. The COE completed a PCB sediment sampling project in May 1994 (COE 1996a; COE 1996b) The COE also sampled Bayou Creek near the former location of the KOW during a KOW sampling project (Maxim 1997).

Maps of historical sampling for each Bayou Creek Reach are shown in Figures 6.12 through 6.17. No historical sampling data are available for Bayou Creek Reach 7 or for the Bayou Creek floodplain Reach 1.

6.6.2 Previous Risk Assessment Discussion/Summary

It should be noted that previous risk assessments utilized different decision rules than those that will be used for this RI/FS. If risk estimates were recalculated using current methods, exposure parameters, and toxicity information (DOE 2011b), the results could differ markedly; however, the assessments did indicate the contaminants and media that needed to be considered during the scoping of this work plan.

PGDP SI, Phase I

Data collected during the PGDP SI, Phase I, subsequently were evaluated and presented in Results of the Site Investigation, Phase I (CH2M HILL 1991a). The risk assessment included an evaluation of exposure scenarios for both Bayou and Little Bayou Creeks. COPCs included organics, inorganics, and radionuclides. The following exposure routes were evaluated for adults and 2-6 year old children:

- Ingestion of surface water and incidental ingestion of sediment during swimming (organics and inorganics);
- Ingestion of surface water while swimming (radionuclides);
- Ingestion of sediment while swimming, wading, fishing, etc. (radionuclides); and
- Ingestion of fish (organics, inorganics, and radionuclides).

Chemical-specific toxicity values were selected, and an estimate of ELCR and noncarcinogenic HQs was calculated for each of the organic and inorganic COPCs. Risk of cancer incidence and risk of cancer death were calculated for the radionuclide data. Results of the PGDP SI, Phase I, contain ELCRs and HQs for both an average exposure and a reasonable maximum exposure (CH2M HILL 1991a).

The ELCR for ingestion of surface water for an average exposure was 4×10^{-11} with an HI <1 and for a maximum exposure was 2×10^{-10} with an HI <1. The ELCRs for average and maximum exposure for ingestion of sediment were 0 with HIs <1.

The fish collected in Bayou Creek were evaluated for human ingestion during the risk assessment conducted for the PGDP SI, Phase I (CH2M HILL 1991a). No organic contaminants were detected in the fish tissues; however, the inorganic contaminants arsenic, barium, beryllium, cadmium, chromium, manganese, mercury, nickel, and selenium were identified as COCs. Arsenic posed a significant risk with an ELCR of 1×10^{-4}.

The other inorganic contaminants contributed to a total pathway HI of 4.5 for fish ingestion. The only radionuclide detected and evaluated during the risk assessment was technetium-99 (Tc-99) at a maximum activity concentration of 5.95 pCi/g. The risk of cancer incidence from ingestion of fish tissue indicates that this radionuclide also is a COC with an ELCR of 3.16×10^{-6}.

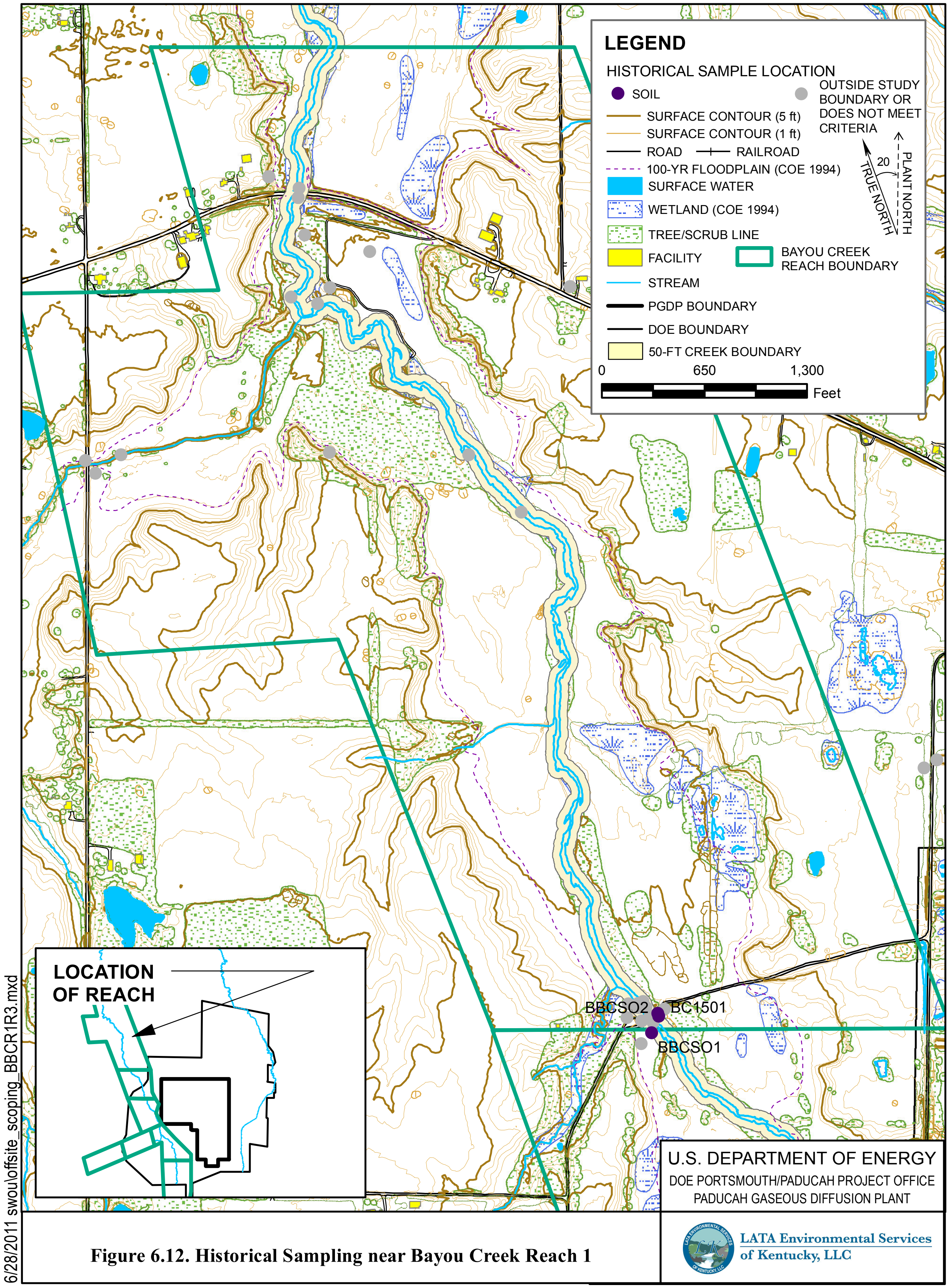

Figure 6.12. Historical Sampling near Bayou Creek Reach 1

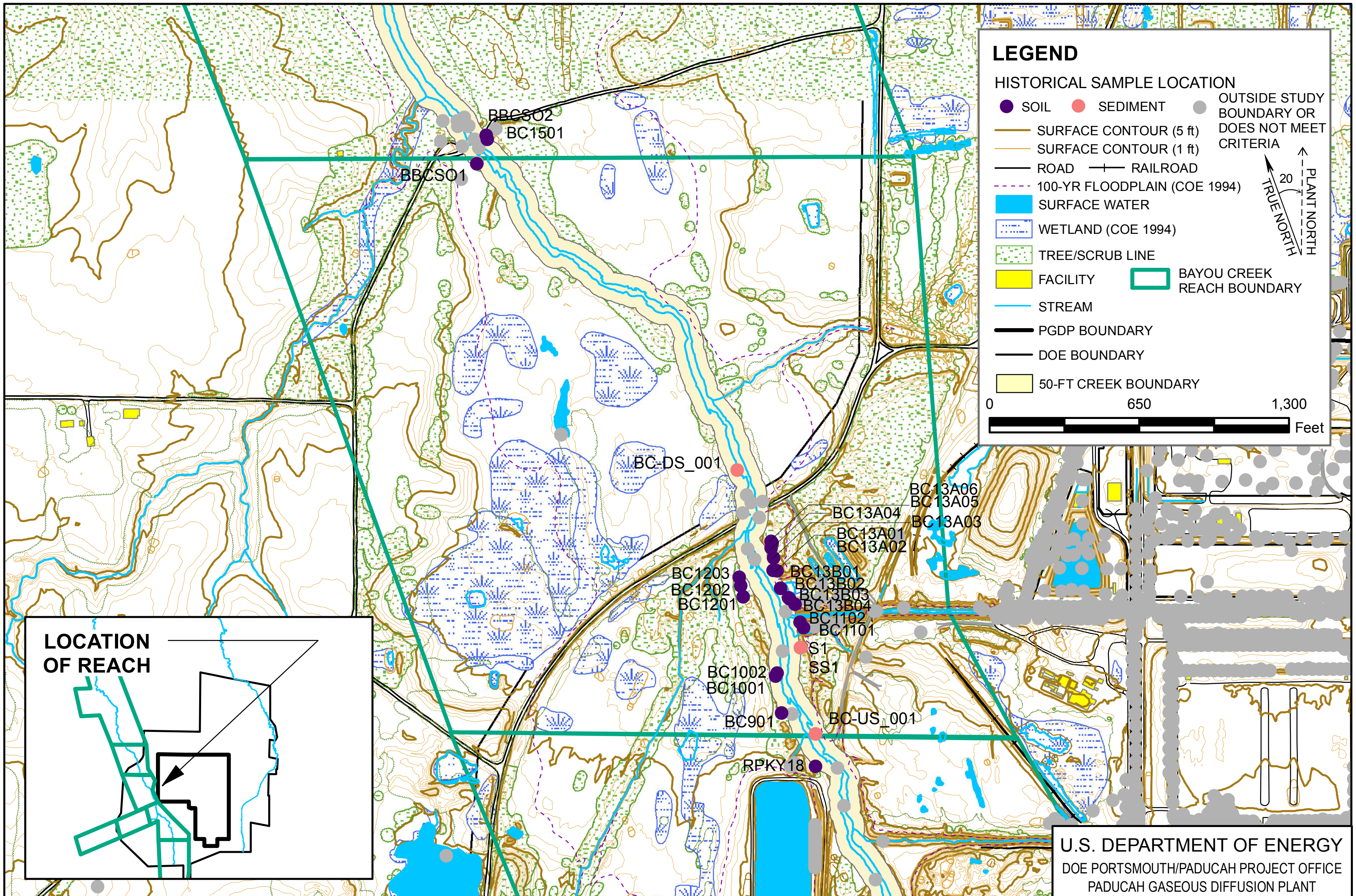

Figure 6.13. Historical Sampling near Bayou Creek Reach 2

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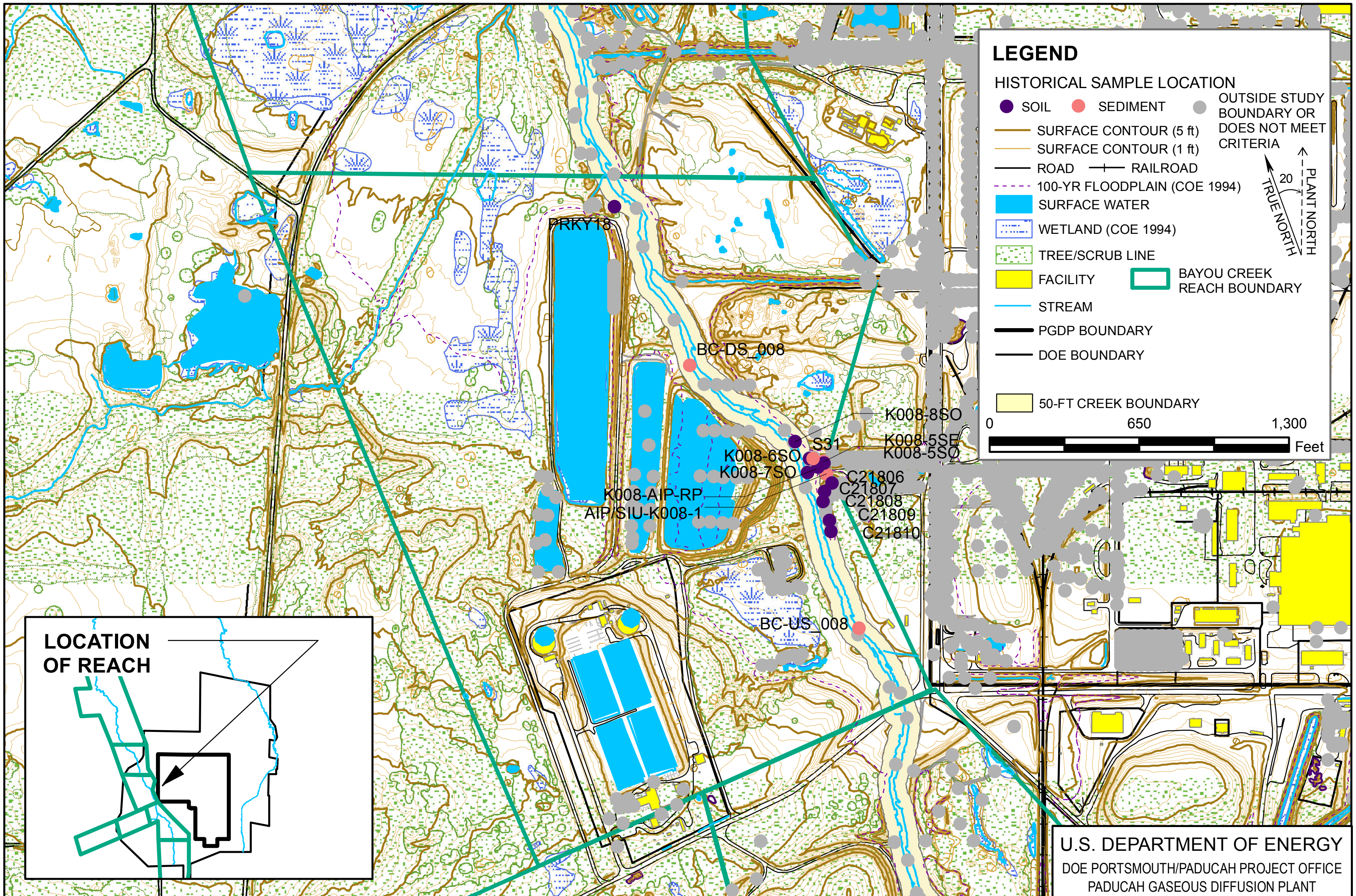

Figure 6.14. Historical Sampling near Bayou Creek Reach 3

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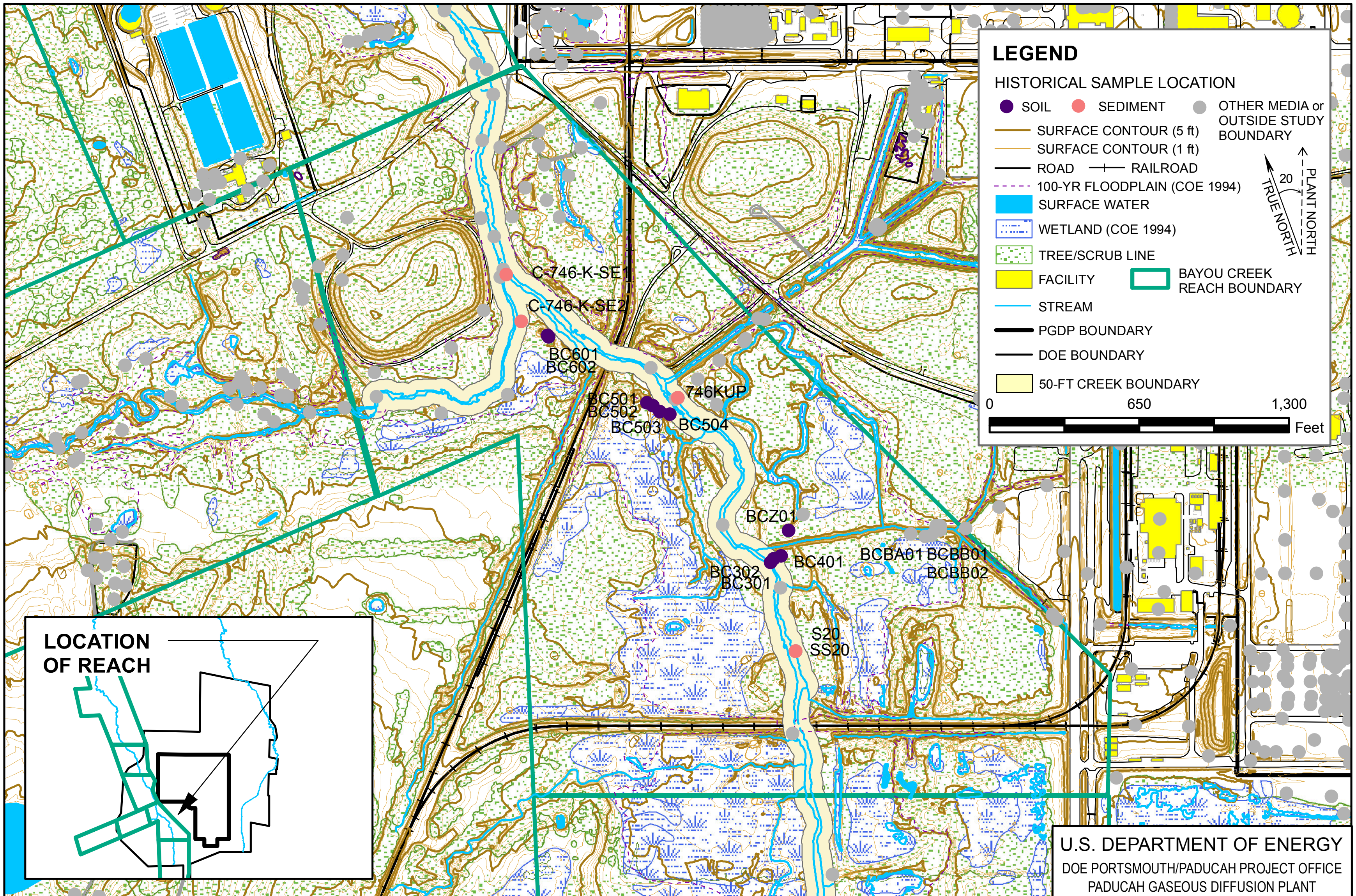

Figure 6.15. Historical Sampling near Bayou Creek Reach 4

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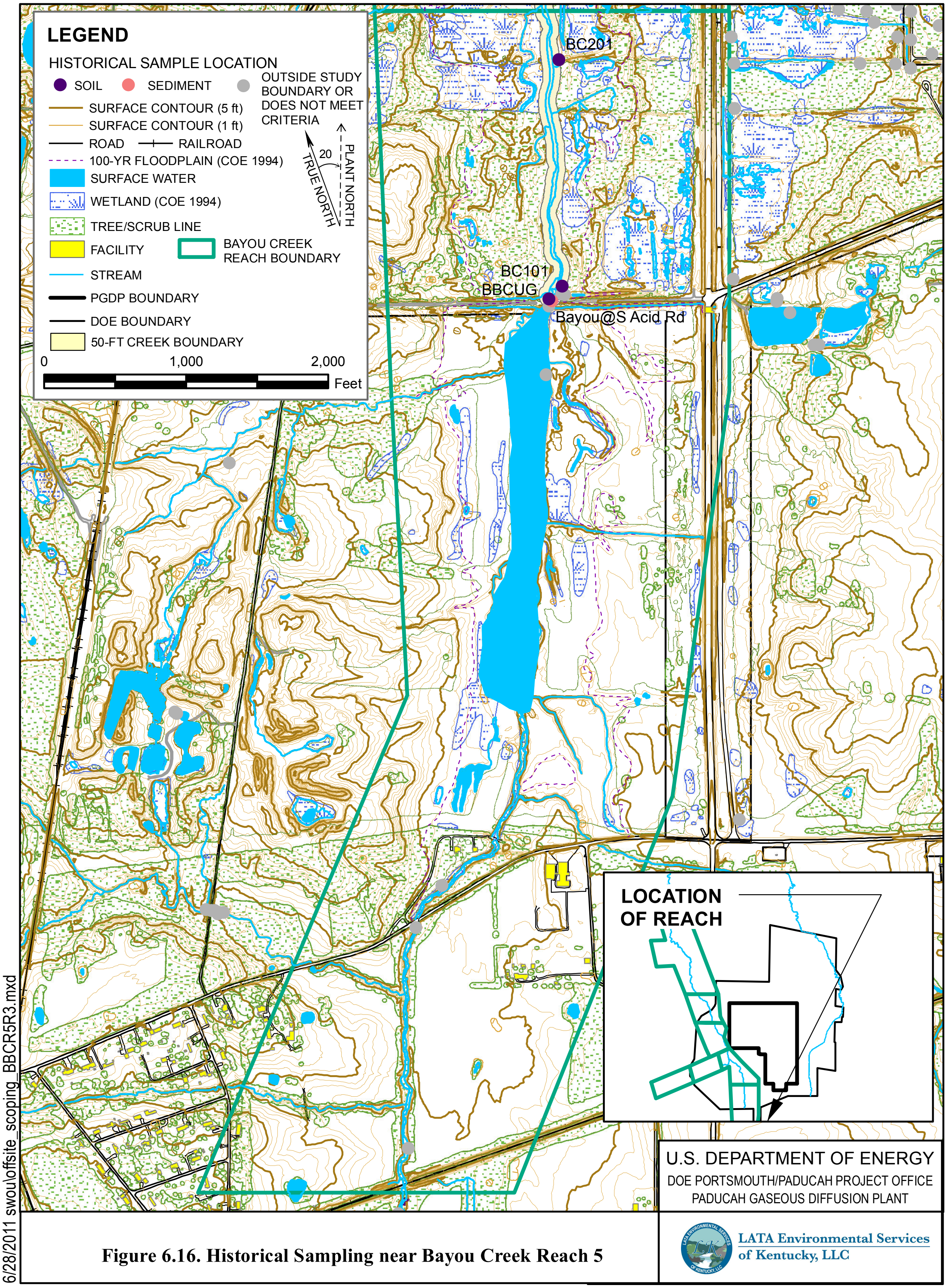

Figure 6.16. Historical Sampling near Bayou Creek Reach 5

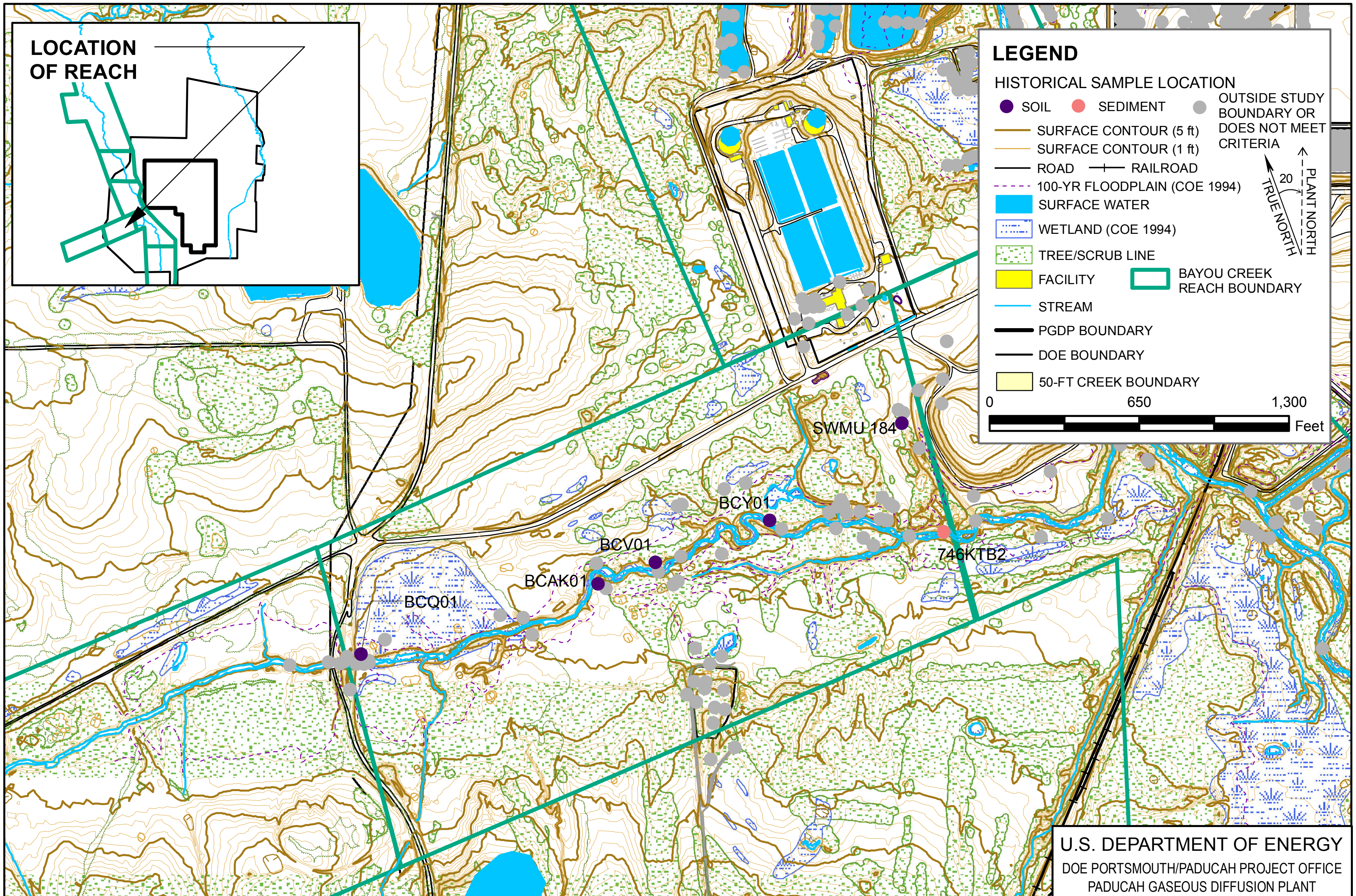

Figure 6.17. Historical Sampling near Bayou Creek Reach 6

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PGDP SI, Phase II

Data collected during the PGDP SI, Phase II, subsequently were evaluated and presented in The Public Health and Ecological Assessment, Phase II risk assessment (CH2M HILL 1991b). The following exposure routes for off-site residents, on-site worker, and worker/intruder were evaluated:

- Direct contact with surface soil,
- Ingestion of surface water,
- Ingestion of sediment,
- Ingestion of biota, and
- Ingestion of crops.

The PGDP SI, Phase II evaluated exposure to an individual swimming in the Bayou Creek (CH2M HILL 1991b). One of the exposure pathways was ingestion of surface water and incidental ingestion of soil/sediment. No COCs were identified for this exposure scenario. Chemical carcinogenic ELCRs from exposure to contaminated sediments did not exceed 2×10^{-5}. The COCs were determined as PCBs, arsenic, and beryllium. Fish ingestion was identified as unacceptable to human health in the Bayou Creek for ELCR. In this assessment, antimony, arsenic, cadmium, chromium, zinc, and mercury were identified as the COCs presenting systemic toxicity hazard to ingestion of fish.

During the PGDP SI, Phase II, no radiological COCs were identified for the incidental ingestion of surface water while swimming (CH2M HILL 1991b). No radiological COCs were identified for the incidental ingestion of radiologically contaminated sediments in Bayou Creek during recreational exposure (e.g., swimming, wading, and fishing).

A radiation survey using a portable sodium iodide (NaI) detector was performed during the PGDP SI, Phase II to evaluate the exposure pathway for external gamma radiation. Maximum exposure rates for Bayou Creek indicate that the exposure to external gamma radiation poses an ELCR of 5.8×10^{-5}. The PGDP Phase I SI (CH2M HILL 1991a) further states that for most of the creek sections, uranium-234 and uranium-238 are the primary contributors to risk. Survey locations along Bayou Creek begin near the southwest corner of the Limited Area and extend to a point approximately 1,500 ft upstream of the Ogden Landing Road crossing. This area is common with Bayou Creek reaches 1, 2, and 3 as defined in this work plan.

A screening ecological assessment was conducted for Bayou Creek as part of the PGDP SI, Phase II (CH2M HILL 1991b). The assessment evaluated potential risks to aquatic organisms from exposure to contaminants in surface water and sediment. The SI sampling program did not detect any metals or organics above detection limits in surface water from stations in Bayou Creek; however, PCBs could not be excluded as a potential concern due to detection limits ranging between 0.2 µg/L and 1.1 µg/L for surface water and up to 210 µg/kg for sediment and PCBs were detected (Birge et al. 1990) in stream water from PGDP monitoring stations in the effluent-receiving section of Bayou Creek (CH2M HILL 1991b). No contaminants were identified as COPECs in sediment from stations in Bayou Creek. Toxicity tests were performed using water from outfalls, but not with water from the Bayou Creek monitoring stations[6]. Concentrations of metals and PCBs in fish and insect tissue were higher in the sections of Bayou Creek that receive PGDP effluent discharges than they were for upstream stations. The C-746-K Landfill (SWMU 8), an ash landfill near Bayou Creek, subsequently was confirmed as a source of metals

[6] Locations along Bayou Creek used to monitor surface water discharges from the PGDP under the KPDES program.

to Bayou Creek and since has been under interim corrective measures to control contaminant releases to surface water.

COE PCB Sediment Study

The *Preliminary Risk Calculation, Paducah Gaseous Diffusion Plant, Big Bayou Creek, PCB Sediment Evaluation* found that although dermal absorption of PCBs in surface water and soil contributes to the calculated risk (COE 1996a). The study found that total risk is mainly due to the ingestion of PCBs from fish caught at Bayou Creek.

The *Paducah Gaseous Diffusion Plant PCB Sediment Survey, Big Bayou Creek and Little Bayou Creek* determined that PCBs were detected in low levels in outfall ditches 001, 008, 009, and 015 (COE 1996b). PCBs were not detected in any of the Bayou Creek sampling points corresponding to these or any other KPDES outfalls. The absence of PCB values above the detection limit in sediments collected during this study coupled with the detection of PCBs in outfalls and fish tissue (Biological Monitoring Program) indicate that PCBs may be present in Bayou Creek at levels below detection limits.

6.6.3 Previous Actions Taken

The DOE completed an interim corrective measure to restrict casual public access to creeks, outfalls, and lagoons in August 1993 (DOE 1993). This corrective measure included the installation of fencing and the posting warning signs at various off-site locations at PGDP, one of which is within Bayou Creek. At KPDES Outfall 001 and New Water Line Road, warning signs were installed stating that the ditch is contaminated and should not be used for drinking, recreation, or fishing. Additional corrective measures on Bayou Creek were included in the 1992 Interim Corrective Measure Work Plan (DOE 1992). Kentucky and EPA deferred action at these Bayou Creek locations on November 24, 1992 until additional characterization could be performed to determine the need for any actions and instructed to hold all proposed fencing along Bayou Creek until further notice. On January 14, 1993, Kentucky and EPA determined that an advisory on fish consumption and recreational use on Bayou Creek was not warranted. No other response actions have been taken to address contamination in Bayou Creek, although response actions have been taken in outfall ditches above the weirs and within PGDP, including SWMU 8 as previously discussed, to remove and/or prevent contamination from entering the creek.

6.6.4 Risk Exposure CSM

The risk exposure CSM is illustrated in Figure 5.2. Bayou Creek reaches have a direct contact and incidental ingestion ELCRs for water, sediment, and soil to the current/future industrial worker, future resident, current/future recreational users, terrestrial and aquatic biota.

6.6.5 Remaining Problems

Remaining problems for the creek reaches are discussed further within this section.

6.6.5.1 Characterization and inventory of wastes

There currently is no waste for this unit.

6.6.5.2 Information status of key assessment factors

Table 6.2 identifies the status of key assessment factors.

Table 6.2. Status of Key Assessment Factors for Bayou Creek

SWMU	Description	Waste Handling Practices	Contamination		Migration of Contamination	
			Presence	Extent	Surface Runoff	Infiltration
65	Bayou Creek	A	P	P	A	A

A—Factor is adequately defined. Current information is adequate to design a targeted sampling plan, but data gaps and uncertainties are such that the goals and objectives of the RI/FS cannot be met.
P—Factor is poorly defined. Current information is inadequate to design a targeted sampling plan, and data gaps and uncertainties are such that the goals and objectives of the RI/FS cannot be met.
Information provided in this table is taken from DOE 1999.

6.6.5.3 Release potential from contaminant sources

Bayou Creek has been assessed using available data to define its potential as a pathway for contaminated material. Water and sediments within the creek may be contaminated. Subsurface soils within the 500-year floodplain of Bayou Creek also may be contaminated.

6.6.6 Remedial Alternatives Development Summary

Potential response actions can be found in Appendix C.

6.6.7 Data Needs

Bayou Creek at the DOE property boundary and Outfalls 001 and 008 have been the subjects of extensive sampling. The sampling data from this approximately 10-year time frame will be considered in accordance with decisions rules presented in Chapter 15 concerning the use of historical data. The primary data need for the creek reaches is to determine the nature and extent of contamination; therefore, sediment, soil, surface water, and ecological samples will be collected. The data will be used to perform human health and ecological risk assessments for the Bayou Creek reaches to determine if remedial actions are necessary.

6.6.8 Field Sampling Plan

The sampling strategy is to perform the investigation in three pieces: early sampling, Phase 1, and Phase 2. Each set of samples will be used to confirm the strategy and refine the sampling plan for the subsequent phases to establish sampling and analytical needs; therefore, this sampling plan should be considered dynamic with respect to the actual sample locations and analysis described. Decision points are discussed within the sampling strategy below.

6.6.8.1 Sampling strategy

Early Sampling. The purpose of the early sampling is to determine sediment stability, to assist with further decisions about sampling approach, and to initiate information gathering for the ecological risk assessment. The approach is as follows:

Collect samples from 10 locations using the following methodology: (a) at 6-inch depth increments in the top 1 ft, and (b) at 1-ft depth increments to the interface of the sediment and the native soil. Sample locations will be based upon field reconnaissance.

Reconnaissance criteria are to target areas where substantially thick areas of deposition and contamination are expected, [i.e., downgradient of potential source areas and in quiescent areas (e.g., interior curve of creek bend)].

Sediment stability sampling will be performed only in the creek above the Ohio River 100-year floodplain due to the overwhelming influence of Ohio River hydrodynamics.

Decision Rules:

If a sediment core from any location within a creek system comes back stratified, then it must be assumed that the entire creek system is stratified even if all other cores come back mixed.

If sediment is not stable (mixed), then contamination is likely to be homogeneous and sample location selection is not as important (i.e., any sample depth works as well as anywhere else). This is the expected condition.

If sediment is stable (stratified), then contaminant heterogeneity and hot spots could be present, which implies that sample depth selection may be of much greater importance than it would be otherwise. (Note that historically, there were correlations between soil pile contamination and the part of the creeks from which the contamination came; therefore, there is some evidence that spatial correlation occurs in the creek systems.)

Early Sampling—Ecological. The purpose of the ecological early sampling is to collect samples to better understand outcomes of Steps 1 and 2 of the BERA (DOE 2011b; DOE 2010b). Collection of these samples will provide data to understand better the uncertainties related to no-effect concentrations for screening purposes and preliminary information to assist in determining body burdens for use in the food chain model (bioaccumulation/uptake factors). Before conducting toxicity tests, field methods will be used to analyze for PCB concentrations and uranium activities to determine if there is a useful range of concentrations for the toxicity tests. Sediment depth for ecological evaluation of 0–6 inches below the bottom of the creek bed is appropriate because it reflects the zone of ecological exposure. The assumption upon which the strategy below is based is that sediments are well mixed and concentration gradients are not present. Historical benthic community data that meet the approved historical data use decision rules for some or all of these locations will be used instead of collecting new data.

The following sampling and ecological tests will be performed at the selected locations:

Sediment samples (0–6 inches below the creek bottom grab samples/split with field method sample), co-located with the 20 core sample locations used for sediment stability analysis plus three replicates from two reference locations.

Benthic invertebrate toxicity tests (five sample locations per creek and two reference location samples). The assumption upon which this is based is that 50% of sediment locations are appropriate for conducting ecological tests. Sample locations will be based on professional judgment, considering such factors as field kit concentrations and sediment bed characteristics.

Community studies will be used to determine if benthic invertebrate assemblages are different significantly from reference samples. This determination will be based on the Commonwealth of Kentucky's Macroinvertebrate Bioassessment Index (MBI) as described in their guidance Methods for Assessing Biological Integrity of Surface Waters in Kentucky. This is a set of descriptions of water quality including Excellent, Very Good, Good, Fair, Poor, or Very Poor. If the target location is determined to be in a lower (i.e., worse) water quality category than the reference reach, then benthic invertebrate communities will be considered to be impacted.

Decision Rules—Ecological:

If Early Sampling identifies elevated concentrations that are present at subsurface depths, risk managers will need to discuss what additional steps, if any, are necessary for protection of ecological receptors, given the lack of exposure to concentrations that are currently entombed.

- The highest detected PCB concentrations and uranium activity concentrations from all samples exhibiting no significant toxicity AND no adverse community impacts will be considered as site-specific alternate sediment benchmark concentrations for the protection of aquatic communities (food chain impacts may still need to be considered for PCBs) during Step 3a of the ecological risk assessment for Little Bayou Creek and Bayou Creek.

- If the toxicity and/or community tests reflect adverse impacts, no conclusions can be made regarding causality due to the limited analytical suite (i.e., observed toxicity may or may not be PCB- or uranium-related). No COCs will be identified, nor will any alternative benchmarks be proposed. Uptake tests, 28-day L. variegatus bioaccumulation test, will be used to develop site-specific bioaccumulation factors (BAF) for PCBs and uranium that can be incorporated in the food chain modeling for the Little Bayou Creek and Bayou Creek systems. These BAFs will provide a more accurate determination regarding daily doses of these chemicals that exceed toxicity reference values for receptors of concern.

Phase 1: Early Action Determination/Nature of Contamination Sampling. The purposes of the Phase 1 sampling are to better understand the nature of contamination, allow for early action evaluation based upon biased sampling, and to answer the following questions:

- Are site-related constituents present in the sediment of the creek at levels exceeding surface soil background and/or appropriate reference concentrations/radiological activity?

- Are site-related constituents present in the sediment of any EU along the creek at average levels that exceed background and a risk-based value for the most reasonable receptor derived using 1×10^{-6} ELCR or a HI of 1 (e.g., teen recreator or wildlife management area worker)?

- Are site-related constituents present in any reach of the creek at levels that exceed risk thresholds for the ecological receptors of concern?

The approach to sampling is based on the assumption that the sediment is not stable (i.e., it is well mixed). As previously stated, the creek system has been divided into reaches for the purpose of the investigation to account for known spatial heterogeneity (Figure 6.11). Three transects will be sampled per reach and will be located where depositional areas are found based on professional judgment. A schematic diagram of this is shown on (Figure 6.18). Transects will be located close to target areas downgradient and upgradient of source inputs (e.g., outfall ditches) and in areas of maximum sediment deposition. Eight sample locations are planned in each transect. This will consist of two creek bed locations, two bank locations (i.e., within creek bank wall if present, or within two ft of creek corridor in the riparian zone), and four floodplain locations (two on each side of the creek). Each creek sample location will have one surface (0-6 inches) sample and one sample at the sediment/native soil interface. Each floodplain sample location will have one surface soil (0-6 inches bgs) sample. Note that this may change if the assumption of stability is not valid; therefore, this approach is pending the outcome of sediment stability study. If the study indicates that the sediment is stable (i.e., not mixed), then additional sampling depths may be required at each creek location (up to 96 grab sediment samples). Results of the sediment stability study will be assessed in regard to the mixing of sediment to determine if additional depth samples are required.

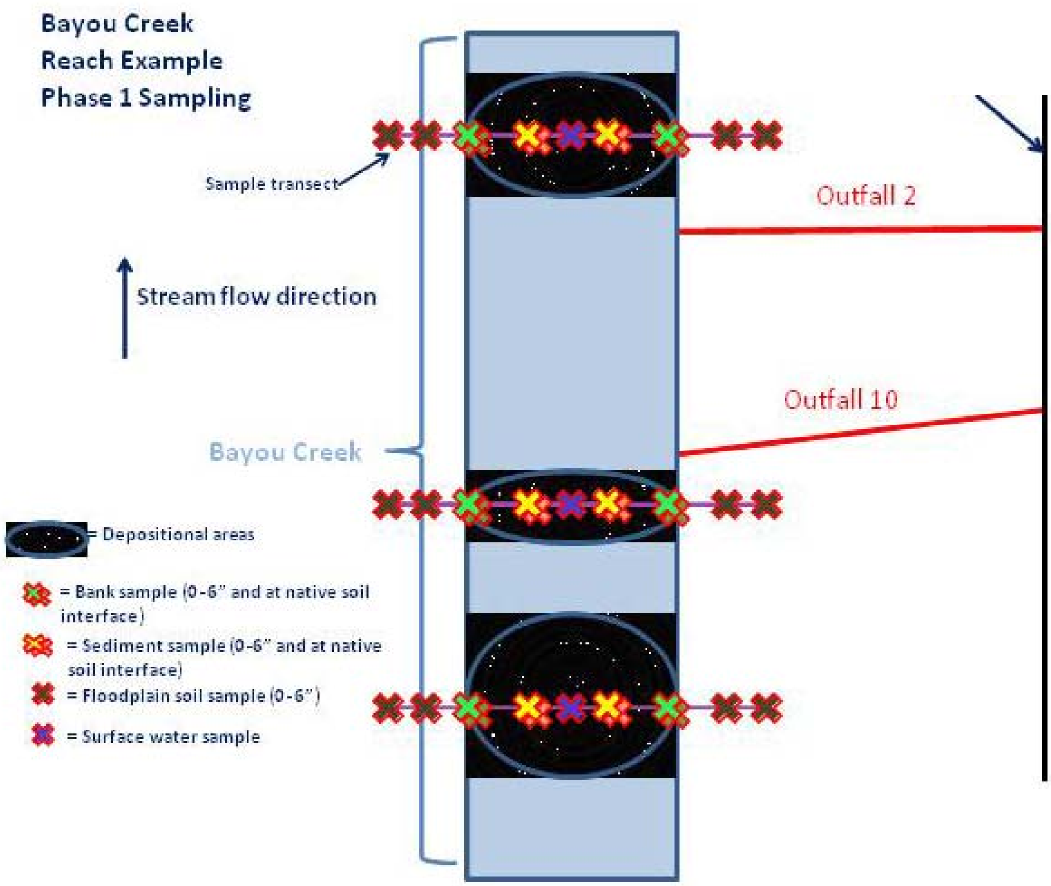

Figure 6.18. Example Phase 1 Sampling of Creek Reach

One surface water sample location will be collected per transect. Samples of unfiltered and filtered water will be collected to understand uncertainties and the potential effects of suspended sediment. At each location, water samples will be collected using an auto-sampler, semipermeable membrane sampling device, or alternate method using the SWOU SI Phase 1 approach (DOE 2008a) (approximately three samples over a six-week period) to understand water chemistry variability. In addition to the automated sample data, at each location, one grab sample will be collected during low flow conditions, and one grab sample will be collected during high flow. Low-flow and high-flow conditions will be documented in the field, based on observed conditions. A low-flow sample typically will be collected during a period of no rainfall, while a high-flow sample typically will be collected after a significant rainfall event.

Decision Rules—Sediment:

If any analytical sample result within a reach is above any action level,[7] then evaluate if a recommendation to FFA Managers that a removal action be considered with associated nature and extent

[7] Action levels, which are being used for this early action decision only, will be the most current risk-based soil/sediment action levels for the teen recreator receptor (DOE 2011b); ecological action levels for PCBs and uranium also may be used if they are available for ecological receptors, based on early sampling toxicity studies.

sampling. Both human health and ecological risk should be considered to establish the appropriate cleanup levels for a removal action, if selected.

If sediment analytical results within a reach are below all action levels, then complete the following steps:

- Compile data for each reach, segregated by each sample depth, as appropriate.
- If all samples within a reach are nondetects or detected consistent with background,[8] recommendation will be for no further sampling within that reach (no contamination to characterize for extent).
- Complete Steps 1 through 3a (Activities 1–4 only of Step 3a) of the ecological risk assessment process for each reach, and data evaluation for human health (COPC selection via comparison to background and no action level screening values, in addition to consideration to upgradient reference sediment concentrations).
- Ecological-based scientific/management decision point (SMDP): continue to Phase 2 sampling if COPECs identified in a particular reach that have a realistic potential to cause adverse impacts to populations of selected receptors.
- Human health-based decision point: continue to Phase 2 if estimated cumulative risk to teen recreator or wildlife management area worker exceeds ELCR of 1 x 10^{-6} or HI of 1 for each reach under reasonable use exposure scenario. Concentration used in this calculation is the 95% UCL of the mean (DOE 2011b; DOE 2010b).
- Identify ecological- and human health-based COPCs or COPECs for Phase 2.
- Any COPC or COPEC identification in any given reach results in carrying that reach forward to Phase 2.

Decision Rules—Floodplain Soils:

If any analytical sample result within a reach is above any action level, then evaluate if a recommendation to FFA Managers that a removal action be considered with associated nature and extent sampling. Both human health and ecological risk should be considered to establish the appropriate cleanup levels for a removal action, if selected.

If soil analytical results within a reach are below all action levels then complete the following steps:

- Compile data for each bank of each reach. The two banks of a reach will be assessed independently of each other.
- If all samples on a bank within a reach are non-detects or detected consistent with background, recommendation will be for no further sampling within that bank of the reach (no contamination to characterize for extent).
- Complete Steps 1 through 3a (Activities 1–4 only of Step 3a) of the ecological risk assessment process (DOE 2011b; DOE 2010b) for each bank of the reach, and data evaluation for human health

[8] Results will be compared to surface soil background (DOE 2011b).

(COPC selection via comparison to background and no action screening-levels, in addition to consideration of upgradient reference sediment concentrations).

- Ecological-based SMDP: continue to Phase 2 sampling if COPECs identified in a particular reach that have a realistic potential to cause adverse impacts to populations of selected receptors.

- Human health-based decision point: continue to Phase 2 if estimated cumulative risk to teen recreator or wildlife management area worker exceeds ELCR of 1 x 10-6 or HI of 1 for each bank of the reach under reasonable use exposure scenario. Concentration used in this calculation is the 95% UCL of the mean.

- Identify ecological- and human health-based COPECs or COPCs, respectively for Phase 2.

- Any COPEC identification in any given reach results in carrying that reach forward to Phase 2.

Decision Rules—Ecological:

The creek reach (creek channel EU or either creek floodplain soil bank EU) will be carried forward to an ecological Phase 2 sampling if the following conditions are met for chemicals determined to be COPECs (i.e., maximum detected concentrations exceed screening values, and the detected concentration range is determined to exceed background and/or reference concentrations).

Endpoint receptors (benthic invertebrates, terrestrial plants, or earthworms) will be carried forward for further evaluation under Phase 2 if a comparison of detected concentrations to available toxicity benchmarks for the given medium (soil, sediment, or surface water) are exceeded, and a weight-of-evidence discussion concludes that adverse effects to these communities is a realistic possibility.

Measurement endpoints (e.g., the shrew) will be carried forward for further evaluation under Phase 2 if their FCM HQ, based on upper-bound exposure input values (e.g., use of 95% UCLs for the exposure point concentrations) and LOAEL TRV exceeds a value of 1, with the exception of the little brown bat, which represents a T&E species. The bat receptor will be carried forward if its FCM HQ, based on upper-bound inputs and NOAEL TRVs, exceeds a value of 1. Site-specific uptake factors developed during the early sediment-stability sampling will be considered.

The COPEC will be carried forward to Phase 2 if the weight-of-evidence evaluation suggests that it is a site-related chemical that has a reasonable possibility for causing adverse impacts to populations for one or more measurement endpoint. This recommendation for Steps 1 through 3a (Activities 1–4 only of Step 3a) of the ecological risk assessment for each reach will be submitted as a separate technical document according to the Ecological Risk Methods Document (DOE 2011b; DOE 2010b).

The following weight of evidence considerations should be considered:

- The chemical is considered to be potentially site-related based on known historical processes occurring at PGDP and fate-and-transport pathways that exist at the site.

- An evaluation of chemical-specific properties (e.g., chemical form/bioavailability of chemical used in toxicity studies, vs. expected form/bioavailability of the COPEC), including the possible consideration of alternative TRVs, uptake factors, etc., confirms that the exceedance of HQ threshold values in the risk characterization is realistic.

- A review of available historical data/results, particularly field studies, confirms the potential for adverse effects.

- Results from any toxicity studies performed during the early sediment stability confirm the predicted risk results of the SERA.

Phase 2 Extent Sampling. This phase applies only to reaches selected for additional sampling at the conclusion of Phase 1. The purposes of phase 2 sampling are to better understand the extent of contamination, allow for early action evaluation based upon spatially uniform/grid sampling, and to answer the following questions:

- Are site-related constituents present in the sediment of the creek at levels exceeding surface soil background and/or appropriate reference concentrations/radiological activity?

- Are site-related constituents present in the sediment of any EU along the creek at average levels that exceed background and a risk-based value for the most reasonable receptor derived using 1×10^{-6} ELCR or a HI of 1 (e.g., teen recreator or wildlife management area worker)?

- Are site-related constituents present in any reach of the creek at levels that exceed risk thresholds for the ecological receptors of concern?

The approach for Phase 2 is to divide the reaches carried forward from Phase 1 into EUs of 0.5 acres each and to sample sediment and soil. There is one creek EU and two floodplain soil EUs (one on either side of the creek) laterally across the reach referred to as a "triplet," as shown on the schematic in Figures 6.19 and 6.20. The size of an individual floodplain EU (i.e., west bank EU1) is 25 ft wide and 870 ft long, on average. (Field observations may alter the width, therefore, the length of the EU.) This area may be adjusted depending on conditions such as the overall length of the reach, and observed field conditions in the floodplain. The creek EU is the width of creek x 870 ft long (these will generally be less than 0.5 acres since the creek width is generally less than 25 ft).

Six of the total number of triplets per reach will be sampled. These will be randomly selected. The size of the EU will be manipulated, if necessary, to ensure a minimum of six triplets per reach. For each EU within a triplet selected, samples will be collected from six locations based upon a triangular grid with random starting position (Figures 6.19 and 6.20).

In each of the selected floodplain EUs, six composite soil samples from a depth of 0–6 inches will be collected (three grab samples will make up a composite).

In each of the selected creek EUs, the samples will be collected as follows:

If the sediment is determined to be mixed based on the early sampling, then six locations will be selected and grab samples will be collected at those six locations up to three depths. One surface sediment sample will be collected from a depth of 0–6 inches, one sediment sample will be collected at the sediment/soil interface, and one sediment sample will be collected at an intermediate depth.

If the sediment is determined not to be mixed based on the early sampling, then grab samples will be collected at each of the six randomly generated locations and samples will be collected at 0–6 inches, and then at 1-ft increments to native soil.

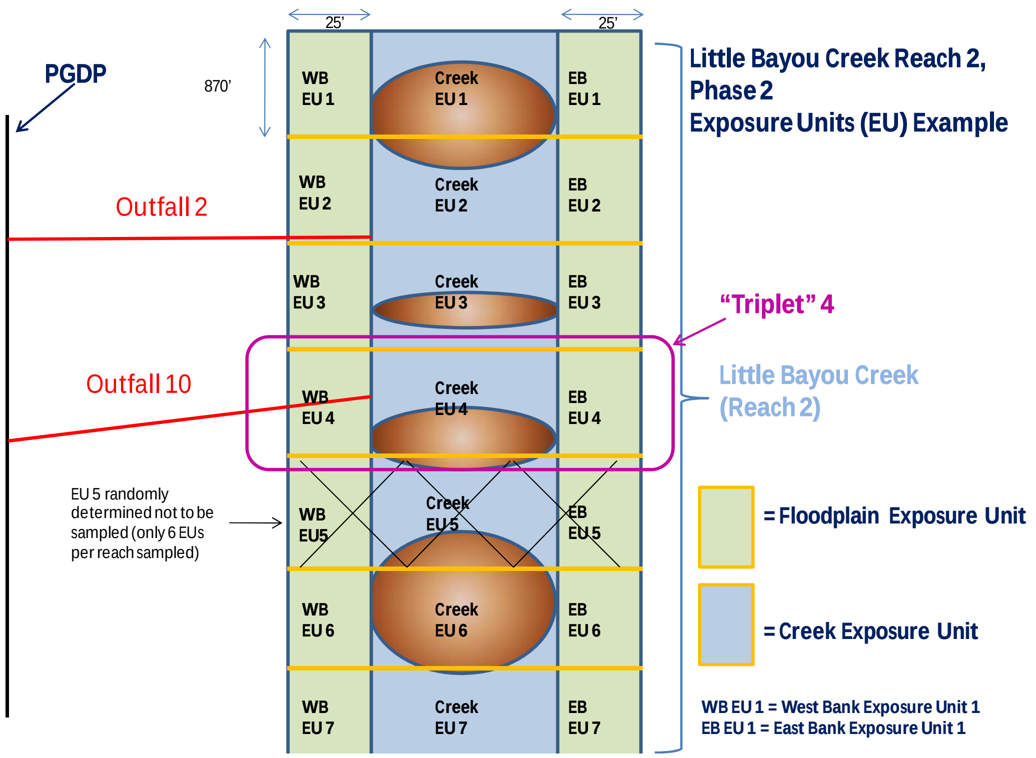

Figure 6.19. Example of Phase 2 Exposure Unit Sampling

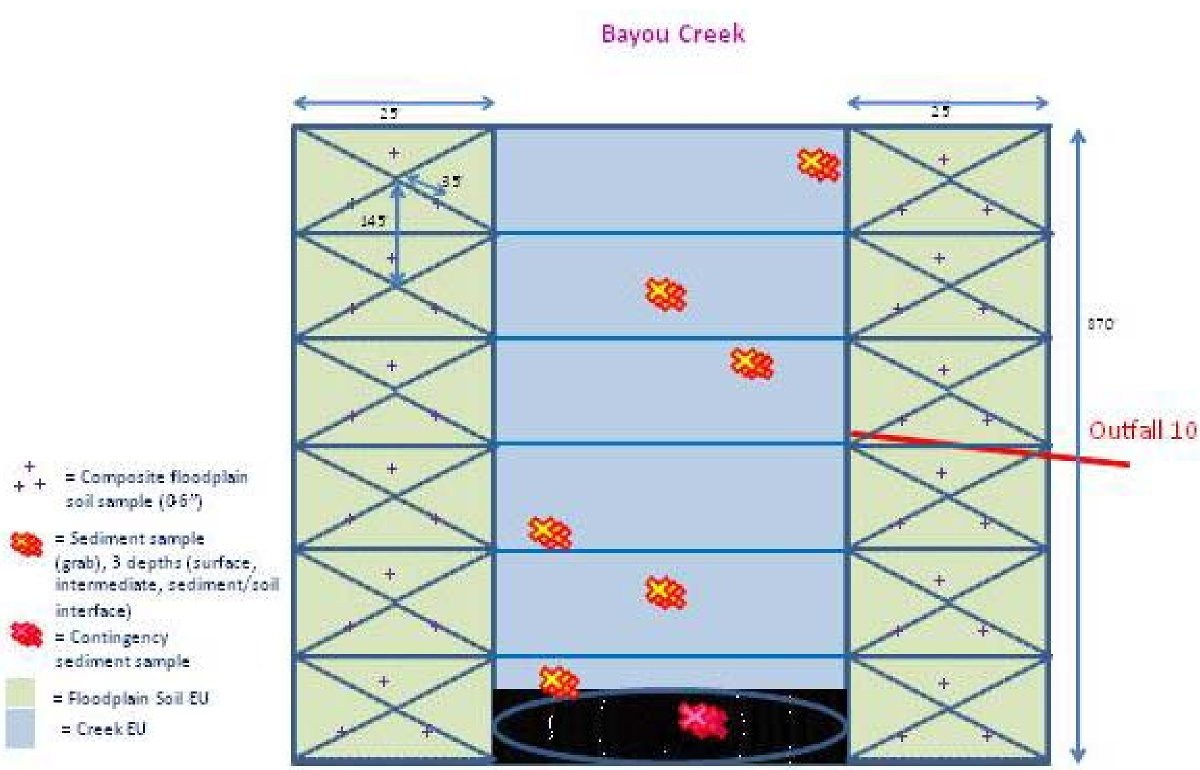

Figure 6.20. Example of Phase 2 Triplet Sampling

Additional contingency samples may be collected within a given EU if the following conditions occur:

- There is a failure to sample a predetermined location (e.g., a lack of sediment or sampler refusal).
- Field observations indicate that additional samples are needed (e.g., staining, significantly deep sediment bed, etc.).
- There is a need to delineate the extent of a hot spot within an EU.
- There is a need to delineate the extent of contamination within the floodplain associated with the contaminated reach, up to the 500-year floodplain extent.
- The ecological risk results indicate that additional sampling is needed (Phase 3, Steps 4–7 of the ecological risk assessment process).

Phase 2—Ecological. Biological data will be obtained to address COPECs carried forward from Phase 1.

Terrestrial uptake and toxicity tests will be performed on earthworms and/or plants, if COPECs in the floodplain soil samples are identified.

Aquatic uptake and toxicity tests will be performed on benthic invertebrates and/or fish, if COPECs in creek channel sediment or surface water samples are identified.

Community studies will be performed on benthic invertebrates and/or fish, if COPECs in creek channel sediment or surface water samples are identified.

Decision Rules:

If results for COPCs averaged across EUs (exposure point concentration equals the 95% UCL on the mean) in floodplain soil on either bank reach exceed ELCR of 1 x 10-6 or an HI of 1, then that bank reach moves to the FS for decision making (i.e., accept the null hypothesis that bank reach is dirty). Note: the banks on either side of the creek are evaluated separately.

If results for COPCs averaged across EUs (exposure point concentration equals the 95% UCL on the mean) within sediment of a creek reach exceed cumulative human health ELCR of 1 x 10-6 or an HI of 1, then that creek reach moves to the FS for decision making (i.e., accept the null hypothesis that creek reach is dirty).

If any sample within floodplain soil or sediment EU exceeds the Phase 1 action level, the sample location is identified as a hot spot. If hot spots are identified as part of Phase 2 sampling, then the area immediately adjacent to the location containing the hot spot also will be sampled using Phase 2 methods. When performing this contingency sampling, the size of the adjacent location sampled will be limited to a 35 ft by 35 ft area (1,225 ft^2). Within this area, two Phase 2 contingency samples will be collected. Extent of hot spot will be determined by adjacent sample results below the action level.

Decision Rules—Ecological:

Phase 2 essentially comprises Steps 3b through 8 of the 8-step ecological risk assessment process (DOE 2011b; DOE 2010b).

COPECs within the creek reach will be identified as COCs and proposed for further action if the following conditions are met:

Toxicity studies indicate that growth is significantly different and/or mortality is significantly greater than reference and controls. A relative percent difference (RPD) of 20% or more from reference and control samples is recommended as the threshold for biologically significant results (Suter et al. 2000).

Community benthic invertebrate and fish studies show significant differences from reference samples. This will be accomplished for benthic invertebrates using the Commonwealth of Kentucky's MBI as described in their guidance Methods for Assessing Biological Integrity of Surface Waters in Kentucky, which provides descriptions for water quality as being Excellent, Very Good, Good, Fair, Poor, or Very Poor. If the target reach is determined to be in a lower (i.e., worse) water quality category than the reference reach, then benthic invertebrate communities will be carried forward for further evaluation.

Fish will be evaluated using the Index of Biotic Integrity, which provides narrative descriptions of water quality as being Excellent, Very Good, Good, Fair, Poor, or Very Poor. If the target reach is determined to be in a lower (i.e., worse) water quality category than the reference reach, then fish will be carried forward for further evaluation.

Measurement endpoints (e.g., the shrew) reevaluated in an FCM using site-specific uptake values have an HQ greater than 1 based on upper-bound exposure input values (e.g., use of 95% UCLs for the exposure point concentrations) and LOAEL TRVs, with the exception of the little brown bat, which represents a T&E species. The bat receptor will be evaluated based on upper-bound inputs and NOAEL TRVs.

6.6.8.1.1 Sampling media and methods

One type of sampling and data collection activity will be performed—intrusive media sampling (water, sediment, soil, plant, and fish tissue). Investigation activities will use DOE Prime Contractor-approved procedures that are consistent with EPA procedures and protocols.

Intrusive Sampling

Various media samples will be collected to characterize areas that have been evaluated as having data gaps. The samples will be collected using DOE Prime Contractor-approved procedures and will be analyzed using field test methods, and selected samples will be submitted to a DOECAP-accredited analytical laboratory for analysis.

Surface/Sediment Soil Sampling. Sediment/soil shall be collected at the following depths with the use of a stainless-steel sampler, hand auger, spoon, trowel, spade, or scoop.

Sediment Stability: 6-inch depth increments in the top 1 ft and 1-ft depth increments to the interface of the sediment and the native soil.

Phase 1: 0–6 inches bgs and sediment/native soil interface.

Phase 2: if sediment is determined to be mixed, samples will be collected at 0–6 inches bgs, an intermediate depth, sediment/native soil interface. If sediment is determined not to be mixed, then samples will be collected at 0–6 inches bgs and 1-ft depth increments from 1 ft to the interface.

Surface Water Sampling. Surface water samples will be collected as filtered and unfiltered samples at a location collocated with the creek bed samples using an auto-sampler (approximately 3 samples over a 6-week period) and a grab sample at low flow and high flow.

Ecological Sampling. Benthic invertebrate, plant tissue, and fish tissue samples will be collected in accordance with acceptable EPA procedures.

6.6.8.1.2 Sample Analysis

Early Sampling. The analytical strategy for the early sampling is to target site-specific chemicals consistent with SWOU SI (DOE 2008a) and historical sampling results for the creek. PCBs and uranium were indicated as the primary COCs. All samples will be analyzed at a fixed-based laboratory because high quality data are desired for decision making and the data may be used for both human health and ecological risk assessment.

Sediment samples will be analyzed for PCBs, uranium, barium, and geotechnical parameters. It should be noted that barium is not site-related, but is chosen as a reference for comparison [i.e., The sampling strategy for Phase 1 and 2 will be based on the distribution of sediment as to whether it is stable (layering) or unstable (mixed). Naturally occurring barium should be evenly distributed within the sediment (homogenous), but contaminants would be expected to show layering if the sediment is stable (heterogeneous)].

Early Sampling—Ecological. Sediment samples will be analyzed for PCBs and uranium by field analytical methods prior to conducting toxicity tests. Sediment samples also will be analyzed at a fixed-based laboratory for PCBs, uranium, geotechnical parameters, 10-day *H. azteca* survival and growth toxicity test, 28-day *L. variegatus* bioaccumulation test, and benthic invertebrate community test. The bioaccumulation test will be analyzed for PCBs and uranium.

Phase 1 Sampling. These data will be used to define the nature of contamination and in human health and ecological risk assessments; therefore, a fixed-base laboratory will be used to provide definitive data.

Sediment and soil samples will be analyzed for metals, radionuclides, PAHs, geotechnical parameters (10% of all floodplain surface samples), and PCBs. If PCBs are detected in any of the samples, a congener evaluation will be performed on 10% of the PCB samples. The decision on which sample to be run for the congener analysis will be made with consideration of and in conjunction with other creek samples; however, the evaluation will be run only on a sample that has a positive detection for PCBs. In order to perform the congener evaluation on the same sample that has a detection of PCB, the fixed-base laboratory will need to hold the extract from the PCB analysis until the RI PM or designee has determined the samples on which to perform a congener evaluation.

Surface water samples will be analyzed for metals, radionuclides, and physical parameters (e.g., pH, hardness, dissolved oxygen, conductivity, temperature, and turbidity).

Phase 2 Sampling. Sediments and soils only will be analyzed during Phase 2. Samples will be analyzed for PCBs, uranium, and Cs-137 by field analytical methods.

Ten percent of the total Phase 2 samples will be analyzed at a fixed-based laboratory, with the analyte list contingent upon results of Phase 1 sampling. The preliminary list of analytes is metals, radionuclides, PAHs, geotechnical parameters, and PCBs including 10% congener evaluation as described in Phase 1.

Phase 2 Sampling—Ecological. Analytical requirements for ecological sampling will be dependent upon COCs carried forward from Phase 1.

Sediment samples will be analyzed for 10-day *H. azteca* survival and growth toxicity test, 28-day *L. variegatus* bioaccumulation test, 28-day *E. fetida* bioaccumulation test, and benthic invertebrate community test.

Soils samples will be analyzed for metals, radionuclides, PAHs, and PCBs.

Surface water samples will be analyzed for metals, radionuclides, PAHs, PCBs, and fathead minnow (*P. promelas*) larval survival and growth toxicity test.

Plant tissue will be analyzed for plant toxicity test (e.g., seeding germination), plant community test, and plant (aquatic or terrestrial, or both) bioaccumulation test.

Fish tissue will be analyzed for fish bioaccumulation test and fish community study.

All bioaccumulation tests will be analyzed for metals, radionuclides, PAHs, and PCBs.

6.6.8.1.3 Sampling procedures

Sampling procedures are described in the QAPP for this work plan (Section 17).

6.6.8.1.4 Documentation

Requirements for documentation are located in the QAPP for this work plan (Section 17).

6.6.8.2 Breakout by reach

Bayou Creek (SWMU 65) has been divided into eight reaches for the purposes of this investigation (Figure 6.11). One of the reaches lies within the 100-year floodplain of the Ohio River; the remaining seven reaches are upstream.

6.6.8.2.1 Sample location survey

GPS coordinates in 1602 Kentucky State Plane South Zone with submeter accuracy will be obtained for all sampling locations. Additionally, depths for each sample obtained also will be recorded. Where possible, flags or wooden or metal stakes will be used to mark sampling locations. Each sampling location will be described with field maps and photographs. This will enable reestablishment of the sampling locations if the markers are disturbed or cannot be placed.

6.6.8.2.2 Maps/locations

Figures 6.21 through 6.28 illustrate proposed sampling for the eight reaches of Bayou Creek.

6.7 FLOODPLAIN SOILS

Floodplain soils are included within the creek reaches section.

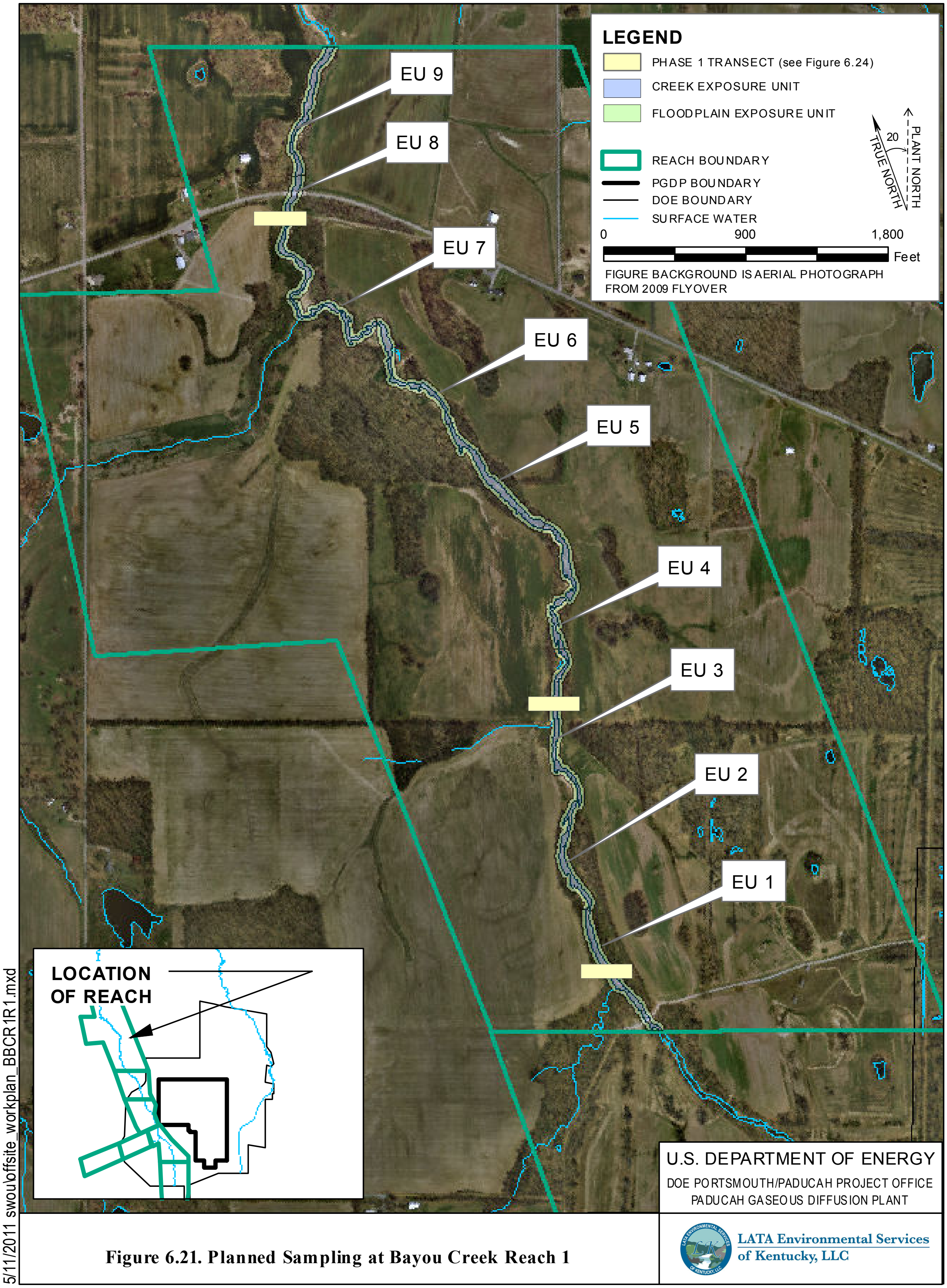

Figure 6.21. Planned Sampling at Bayou Creek Reach 1

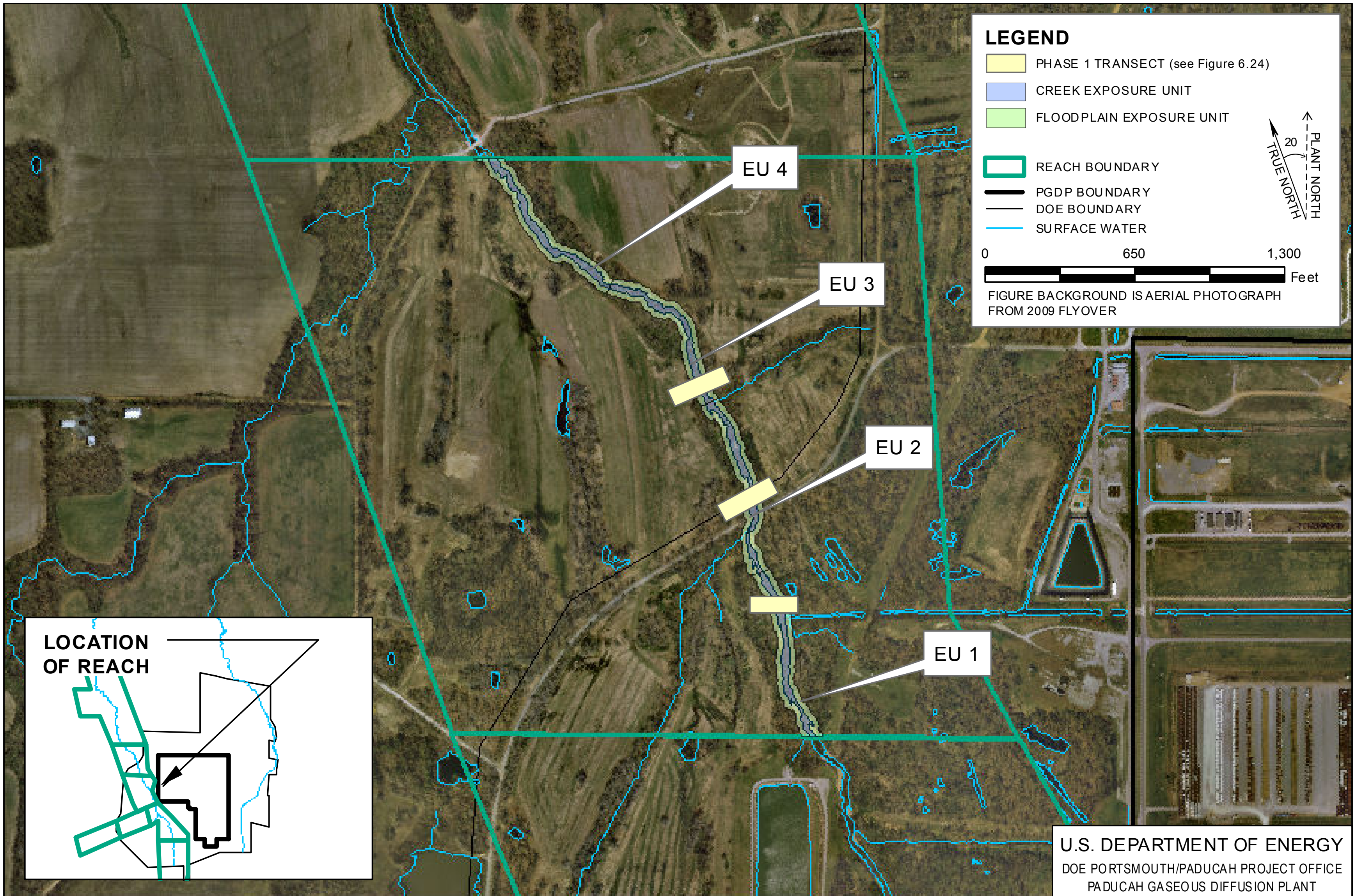

Figure 6.22. Planned Sampling at Bayou Creek Reach 2

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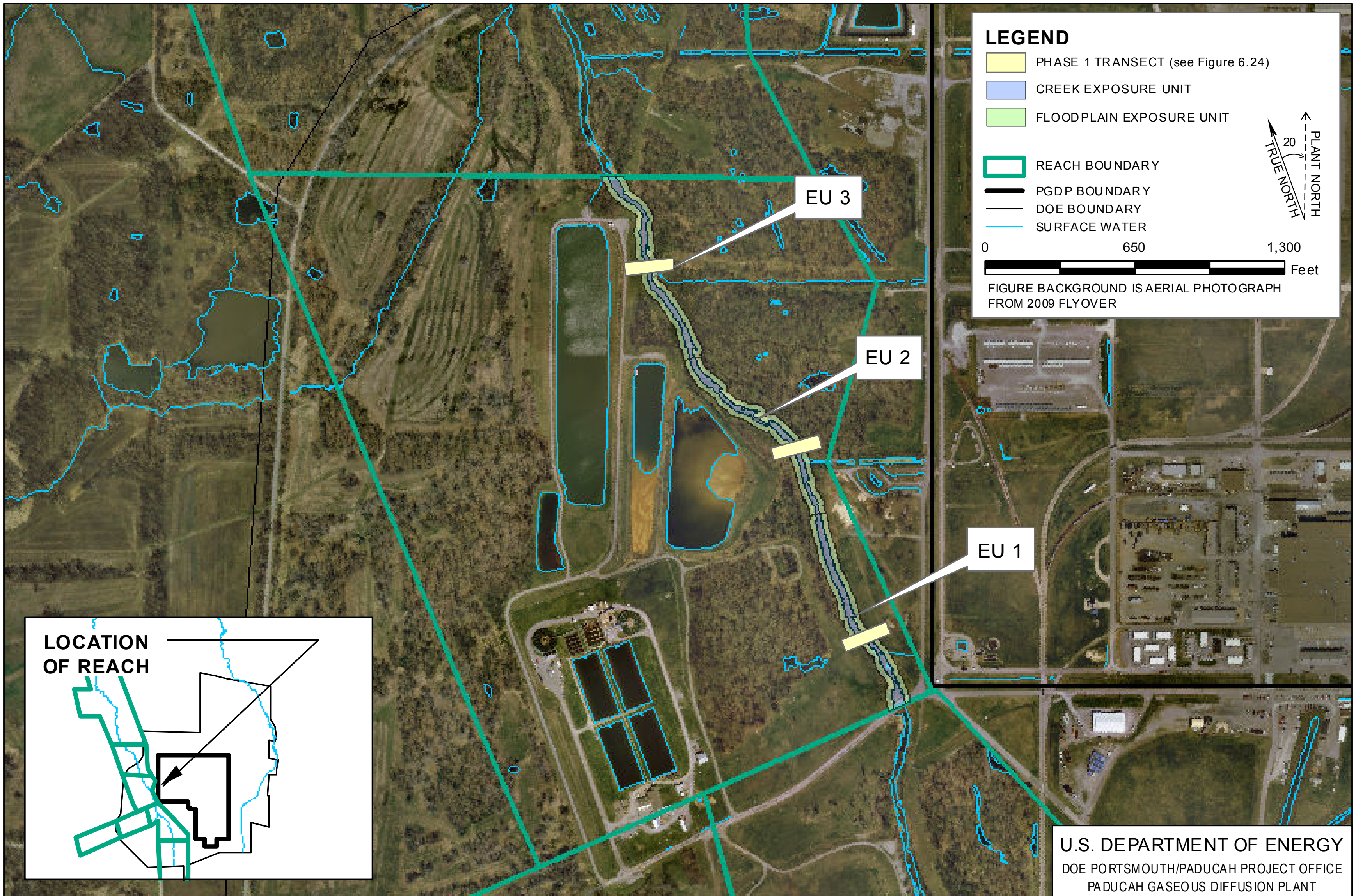

Figure 6.23. Planned Sampling at Bayou Creek Reach 3

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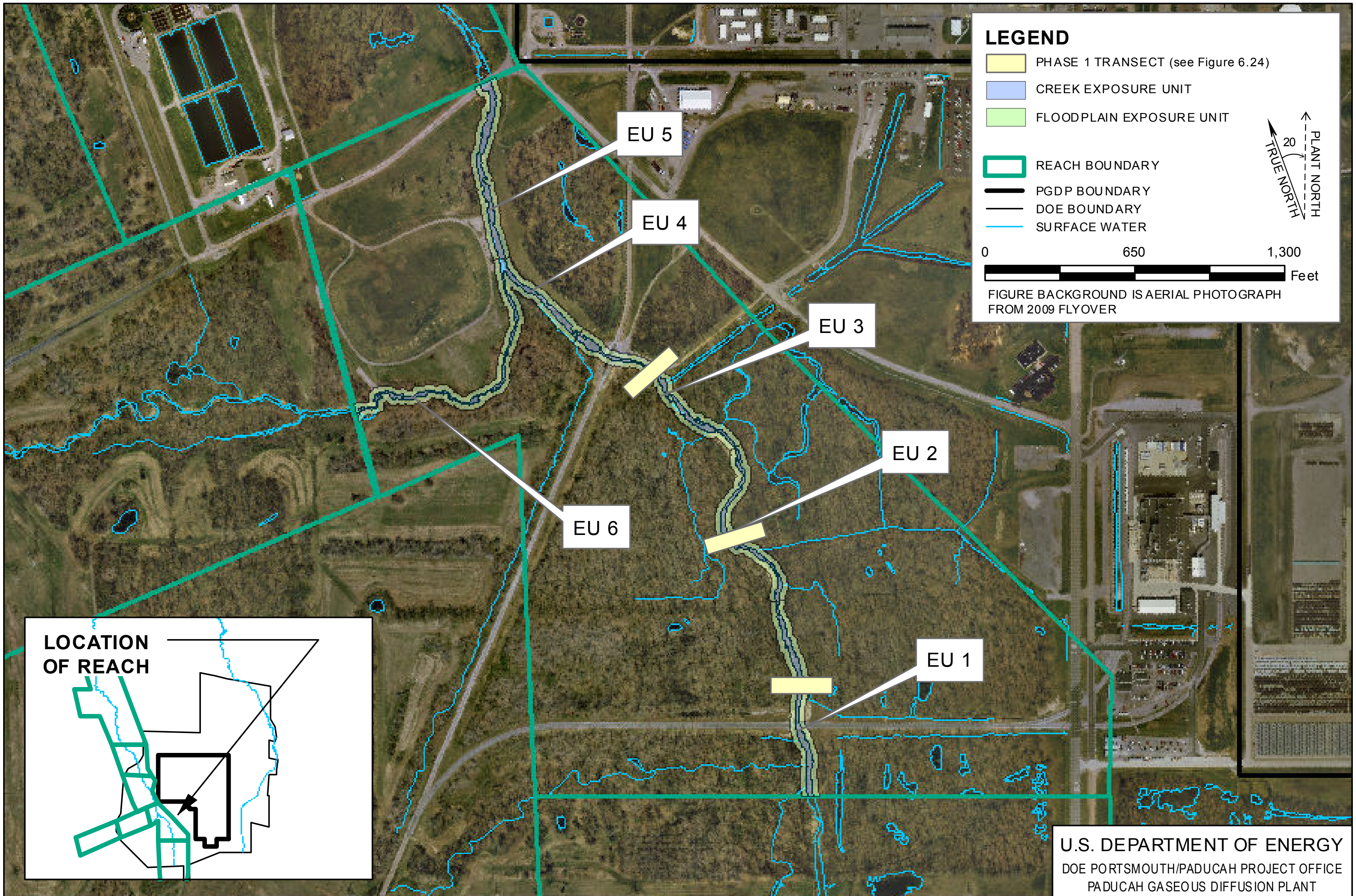

Figure 6.24. Planned Sampling at Bayou Creek Reach 4

LATA Environmental Services of Kentucky, LLC

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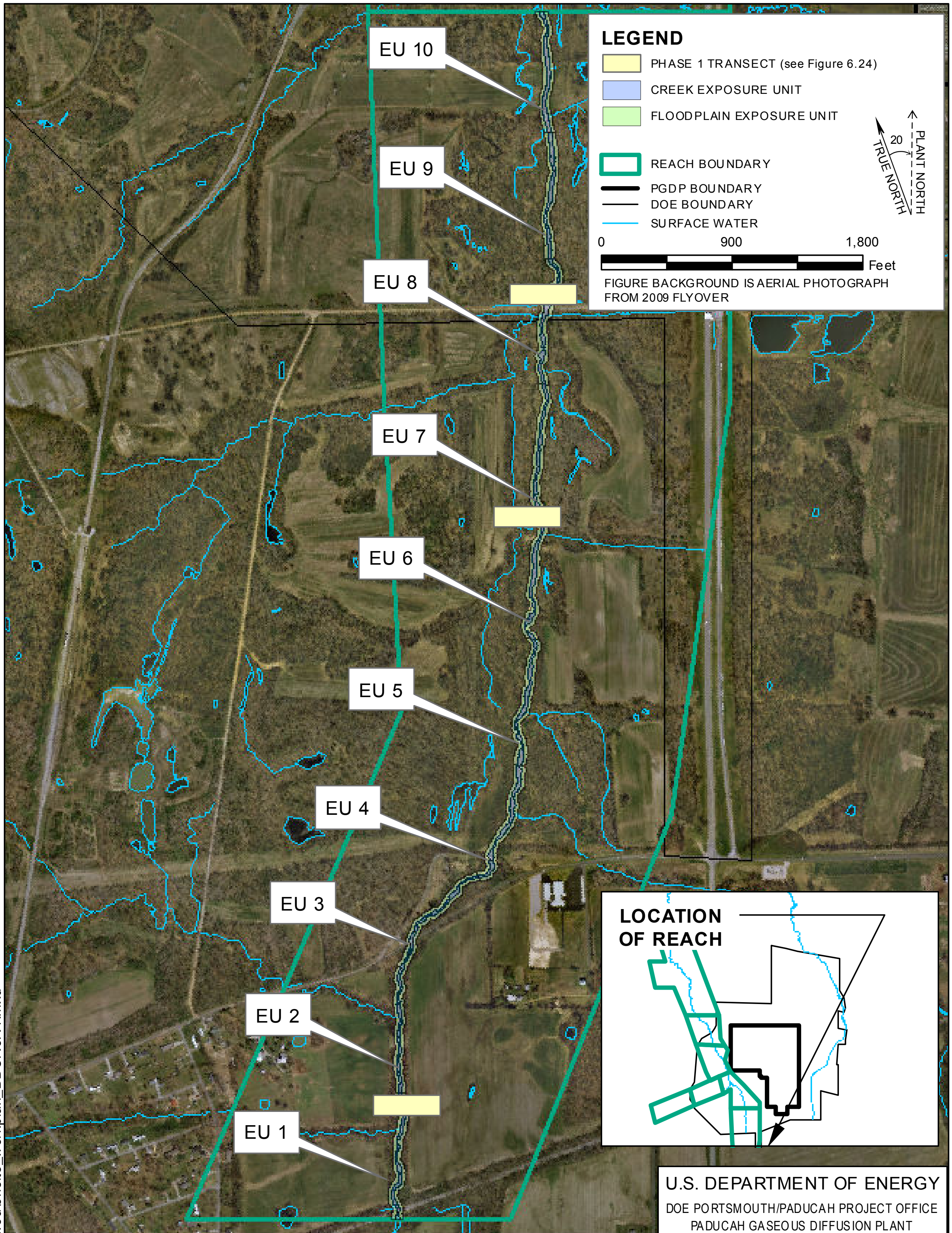

Figure 6.25. Planned Sampling at Bayou Creek Reach 5

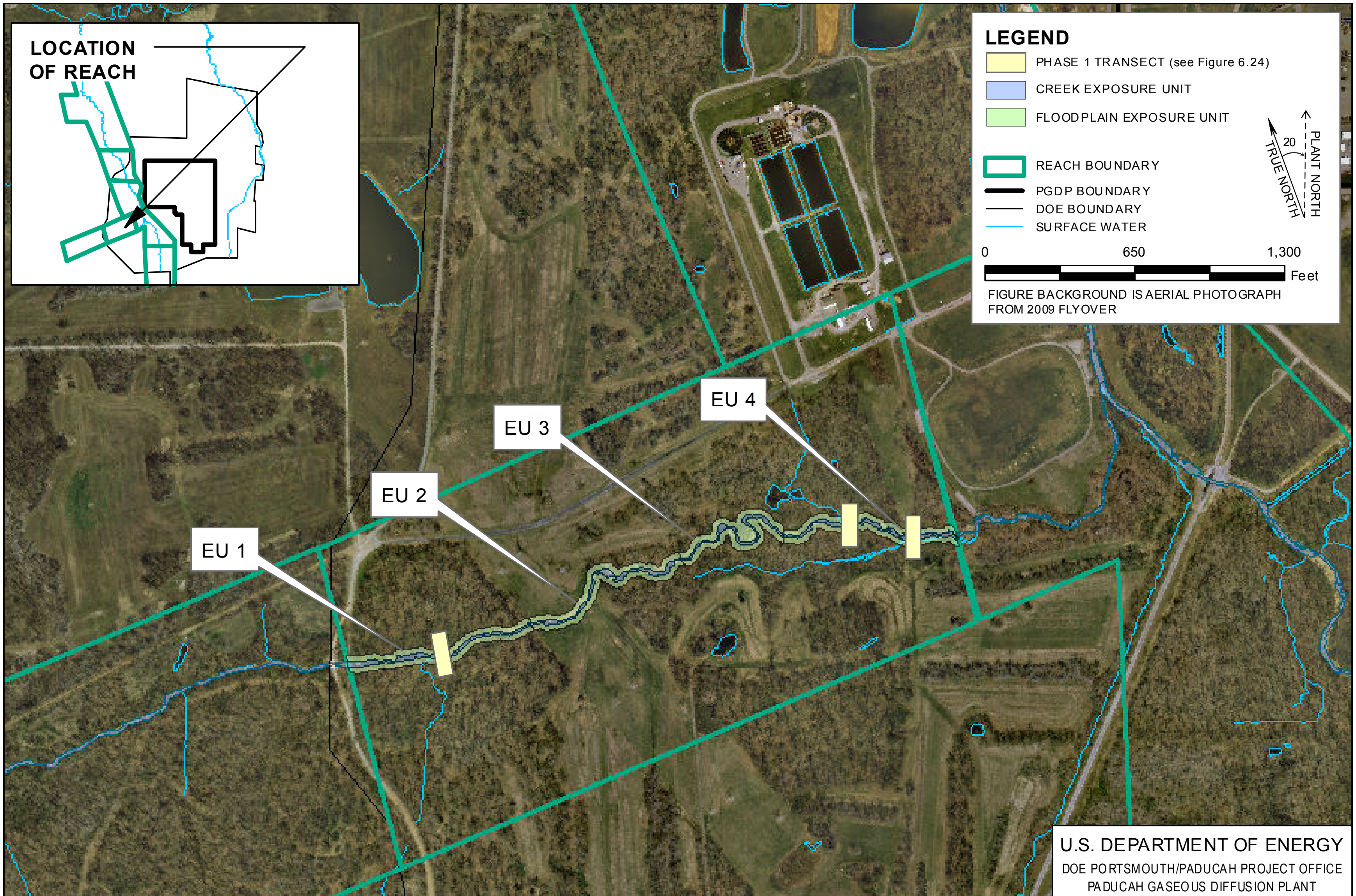

Figure 6.26. Planned Sampling at Bayou Creek Reach 6

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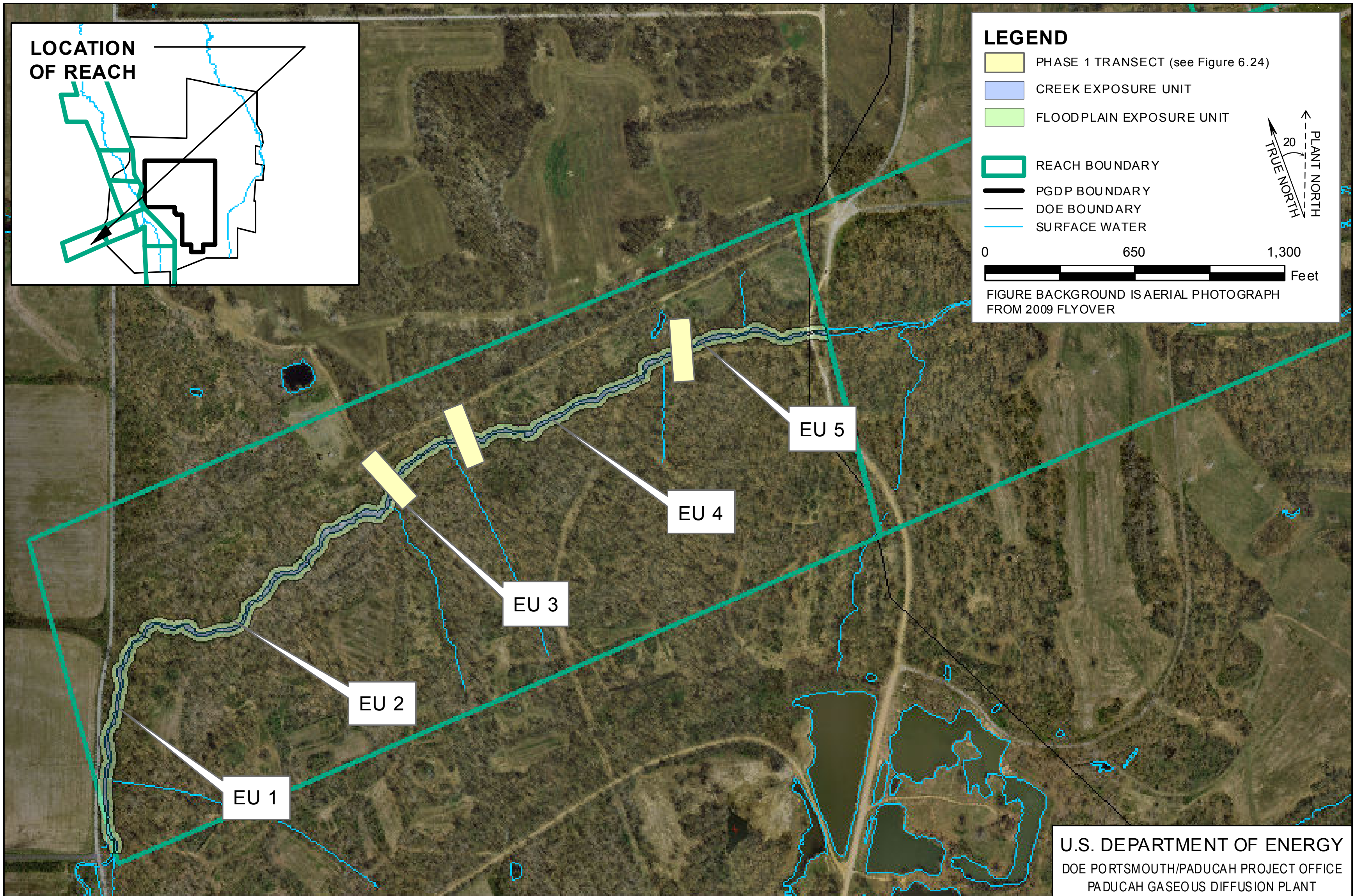

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Figure 6.27. Planned Sampling at Bayou Creek Reach 7

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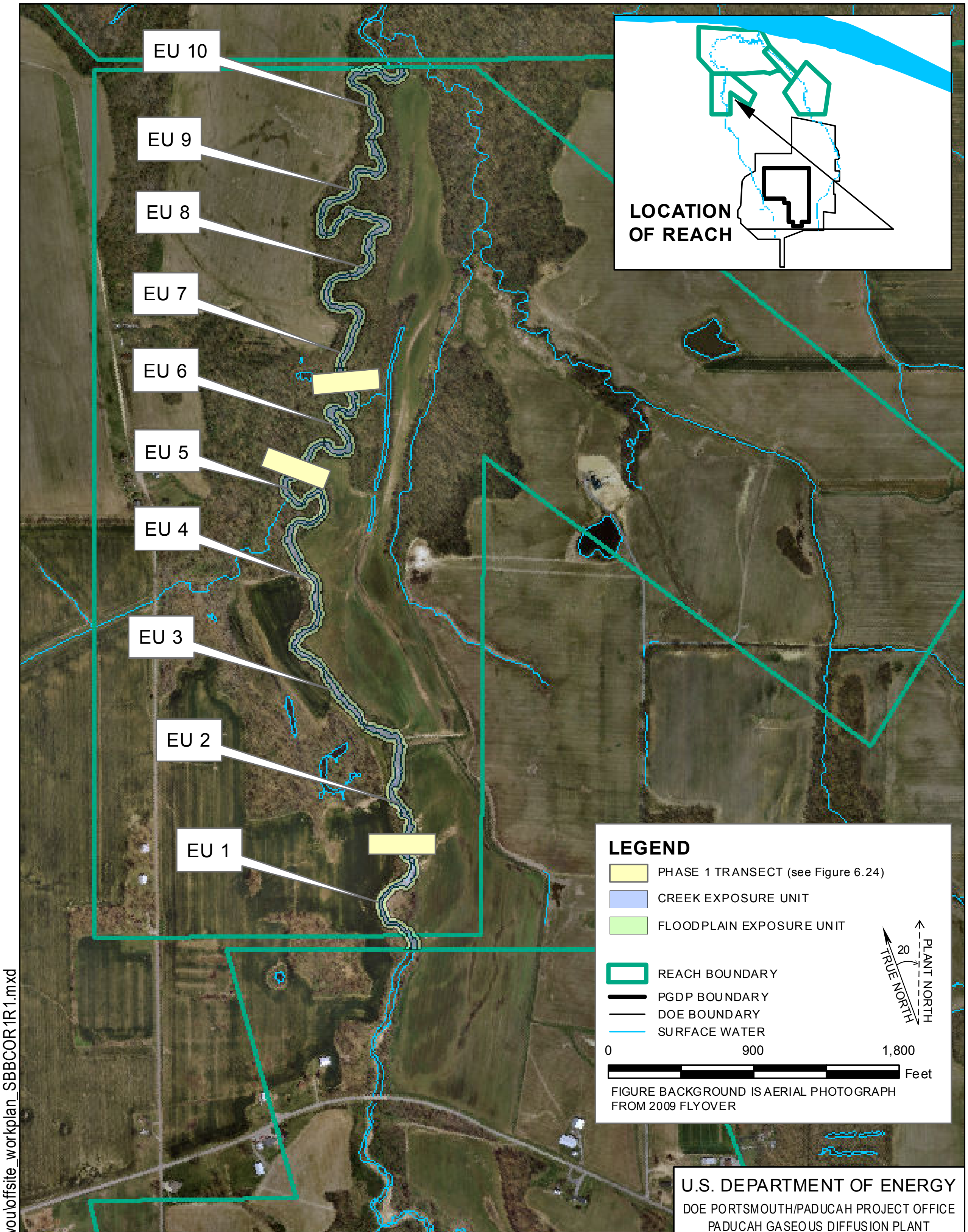

Figure 6.28. Planned Sampling at Bayou Creek Ohio River Floodplain Reach 1

6.8 OHIO RIVER FLOODPLAIN

The Ohio River floodplain (ORFP) is not a part of any SWMU; however, this area was an area of interest during the scoping of this RI/FS investigation for an ecological risk assessment. Given the overwhelming influence of the Ohio River on this area, and the expectation that there are insignificant levels of contamination within the ORFP, the ecological investigation will be conducted subsequent only to the identification of PGDP-related contaminants located in the ORFP and posing a potential threat to human health or the environment identified in the RI report and ecological risk assessment associated with the upstream creek reaches.

Contamination is not expected to be found above thresholds of concern in the ORFP for the following reasons:

- Prior to establishing the outfall permitting network, standard operational releases over the years likely resulted in the flushing of any contaminated sediment into the Ohio River.

- Soil piles created from spoils from historic dredging of the creeks that are assumed to have contaminant concentrations indicative of past contaminant concentrations in creek sediments contain low levels of contamination at or below background concentrations or were not contaminated.

- Aerial photographs indicate surface water conduits are relatively well-channelized, and the water course has not changed significantly over the years. This could indicate that any PGDP-related contaminants would not have been widely distributed through the floodplain. Any contamination, if present, likely would be locked in sediment deposits, given the profound Ohio River influence and sediment deposition on this area during high water events.

Significant flooding events, most recently in 1997, 2005, and 2011, crested at Paducah at 51.97 ft, 47.9 ft, and 55.03 ft, respectively, above flood stage, which is 39 ft at Paducah. Other recent, seasonal flooding events that also set more modest records were in 1998 at 43.20 ft, 1999 at 44.23 ft, 2002 at 44.36 ft, 2003 at 44.95 ft, 2008 at 45.37 ft, and in 2010 44.34 ft all approximately 15 ft above flood stage. It is expected that any contamination found in the ORFP area will not have a definitive link to PGDP due to potential contaminant influences from upstream of the Ohio River basin. Given the wide spread influence of upstream Ohio River industries not associated with PGDP, sampling would not be able to demonstrate significant contamination unrelated to that generally found in the river due to dilution effects, rendering any sampling effort ineffectual.

A preliminary nature and extent investigation of the ORFP will be conducted for the identification of uranium associated with PGDP operations. Results that indicate a layer of sediment contaminated with uranium will require further investigation and that the FFA parties return to scoping for a separate investigation of the ORFP.

6.8.1 Nature and Extent

Historical sampling near the ORFP is illustrated in Figure 6.29.

6.8.2 Previous Risk Assessment Discussion/Summary

No previous risk assessments have been conducted.

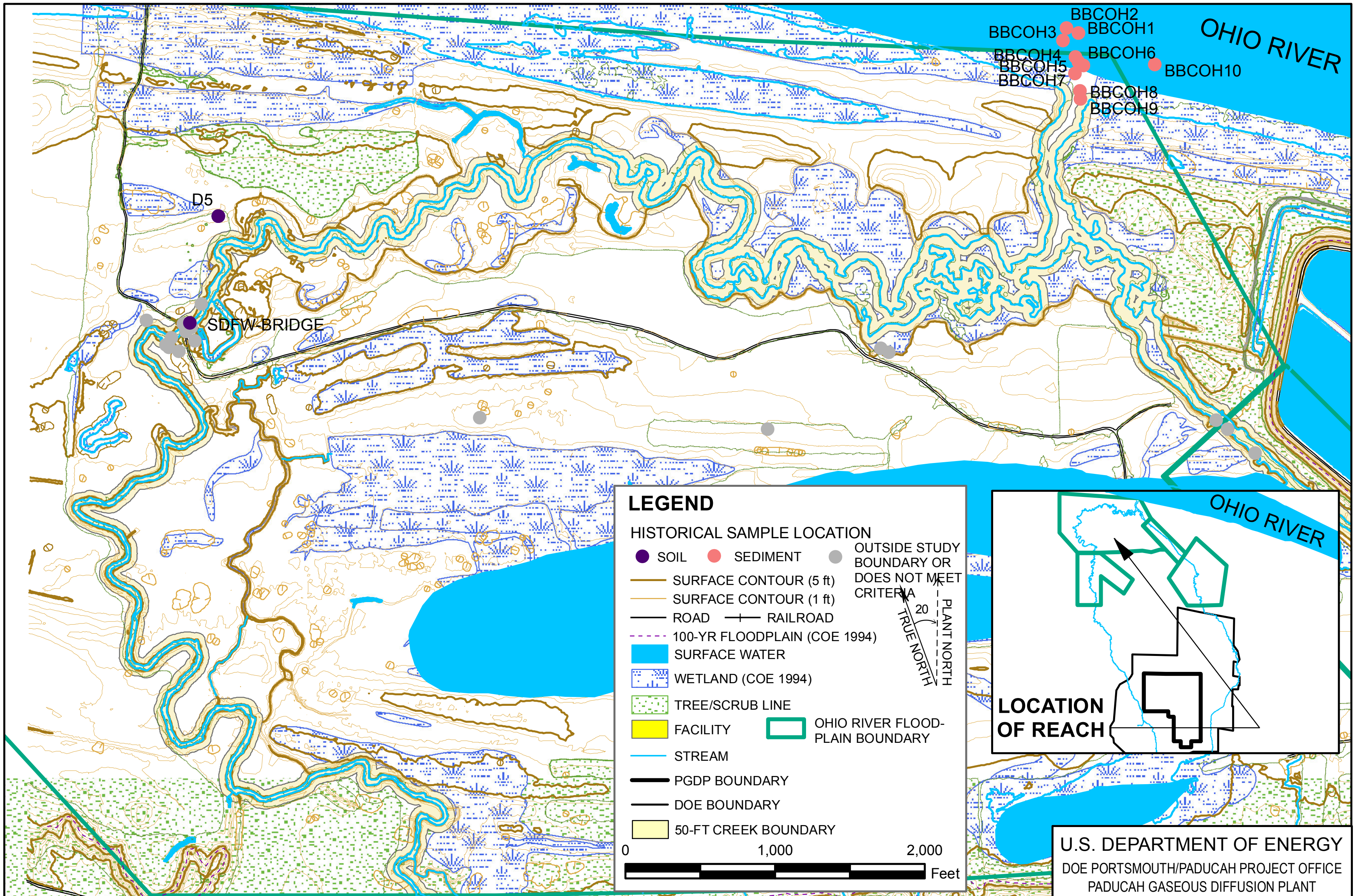

Figure 6.29. Historical Sampling near the Ohio River Floodplain

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6.8.3 Previous Actions Taken

No previous actions have been taken.

6.8.4 Risk Exposure CSM

The risk exposure CSM illustrated in Figure 5.2 does not apply to the uranium stratification sampling that will occur in the ORFP.

6.8.5 Remaining Problems

Remaining problems for the ORFP are discussed further within this section.

6.8.5.1 Characterization and inventory of wastes

There currently is no waste for this unit.

6.8.5.2 Information status of key assessment factors

Table 6.3 identifies the status of key assessment factors.

Table 6.3. Status of Key Assessment Factors for Ohio River Floodplain

SWMU	Description	Waste Handling Practices	Contamination		Migration of Contamination	
			Presence	Extent	Surface Runoff	Infiltration
65	Bayou Creek	A	A	A	W	A
64	Little Bayou Creek	A	A	A	W	A

A—Factor is adequately defined. Current information is adequate to design a targeted sampling plan, but data gaps and uncertainties are such that the goals and objectives of the RI/FS cannot be met.
W—Factor is well defined. Current information is adequate to meet the goals and objectives of the RI/FS.
Information provided in this table is taken from DOE 1999.

6.8.5.3 Release potential from contaminant sources

Bayou Creek has been assessed using available data to define its potential as a pathway for contaminated material. Water and sediments within the creek may be contaminated. Subsurface soils within the 500-year floodplain of Bayou Creek also may be contaminated.

Little Bayou Creek has been assessed using available data to define its potential as a pathway for contaminated materials. Little Bayou Creek flows primarily through agricultural and forested lands on its way to the Ohio River. Water and sediments within the creek may be contaminated. Subsurface soils within the 500-year floodplain of Little Bayou Creek also may be contaminated.

Both creeks flow into the ORFP.

6.8.6 Remedial Alternatives Development Summary

No potential response actions are anticipated.

6.8.7 Data Needs

Sediment samples are necessary to perform an investigation of the ORFP to confirm the assumption that there is no PGDP-related uranium contamination. Contamination is not expected to be found above thresholds of concern in the ORFP.

6.8.8 Field Sampling Plan

The sampling strategy is to perform an investigation to determine nature and extent.

6.8.8.1 Sampling strategy

The sampling strategy consists of a single event for Sections 1 and 2 of the Bayou Creek, Section 1 of the Little Bayou Creek, and the sediment trap of the ORFP. Samples will be used to confirm the presence or absence of a uranium contaminated layer of sediment in the ORFP.

The ORFP Reach consists of the most downstream areas of the Bayou Creek and the Little Bayou Creek prior to their convergence and the remaining portion of Bayou Creek prior to its convergence with the Ohio River.. For the purpose of this investigation, the creeks will be divided into sections. Bayou Creek will be divided into three discreet sections: north-south trending area of Bayou Creek that feeds into the moist soils unit (MSU) (Bayou Creek Section 1), the east-west trending section that does not appear to be directly connected to the MSU and connects with Little Bayou Creek (Bayou Creek Section 2), and the northeast-southwest portion that begins to fan out prior to flowing into the Ohio River (Sediment Trap). Little Bayou Creek will consist of only one section that represents that area extending from the Little Bayou Creek Ohio River floodplain Reach 2 to the confluence with Bayou Creek (Little Bayou Creek Section 1).

Bayou Creek Sections 1 and 2. Each section will contain two sample locations in depositional areas within the creek channel, and these will be chosen based on professional judgment, considering sediment bed characteristics. Each sample location will consist of four samples per sediment bed.

Little Bayou Creek Section 1 This section will contain one sample location in a depositional area within the creek channel, and these will be chosen based on professional judgment, considering sediment bed characteristics. Each sample location will consist of four samples per sediment bed.

Sediment Trap This section will contain one sample location in a depositional area within the creek channel, and these will be chosen based on professional judgment, considering sediment bed characteristics. Each sample location will consist of four samples per sediment bed.

6.8.8.1.1 Sampling media and methods

One type of sampling and data collection activity will be performed—intrusive media sampling (sediment). Investigation activities will use DOE Prime Contractor-approved procedures that are consistent with EPA procedures and protocols.

Intrusive Sampling

Media samples will be collected to characterize areas that have been evaluated as having data gaps. The samples will be collected using DOE Prime Contractor-approved procedures and will be analyzed using field test methods, and selected samples will be submitted to a DOECAP-accredited analytical laboratory for analysis.

Sediment Sampling. Sediment shall be collected from deep sediment with the use of a stainless-steel sampler, hand auger, spoon, trowel, spade, or scoop.

6.8.8.1.2 Sample analysis

Sediment samples obtained will be consistent for all sediment beds for the Bayou Creek, Little Bayou Creek, and the sediment trap sections of the ORFP and will be analyzed for uranium by XRF.

Fixed-based laboratory confirmation samples will be collected for 25% of all sediment samples with the highest uranium XRF results..

6.8.8.1.3 Sampling procedures

Sampling procedures are described in the QAPP for this work plan (Section 17).

6.8.8.1.4 Documentation

Requirements for documentation are located in the QAPP for this work plan (Section 17).

6.8.8.2 Sample location survey

GPS coordinates in 1602 Kentucky State Plane South Zone with submeter accuracy will be obtained for all sampling locations. Additionally, depths for each sample obtained also will be recorded. Where possible, flags or wooden or metal stakes will be used to mark sampling locations. Each sampling location will be described with field maps and photographs. This will enable reestablishment of the sampling locations if the markers are disturbed or cannot be placed.

6.8.8.3 Maps/locations

Figure 6.30 shows the proposed sampling locations for the ORFP.

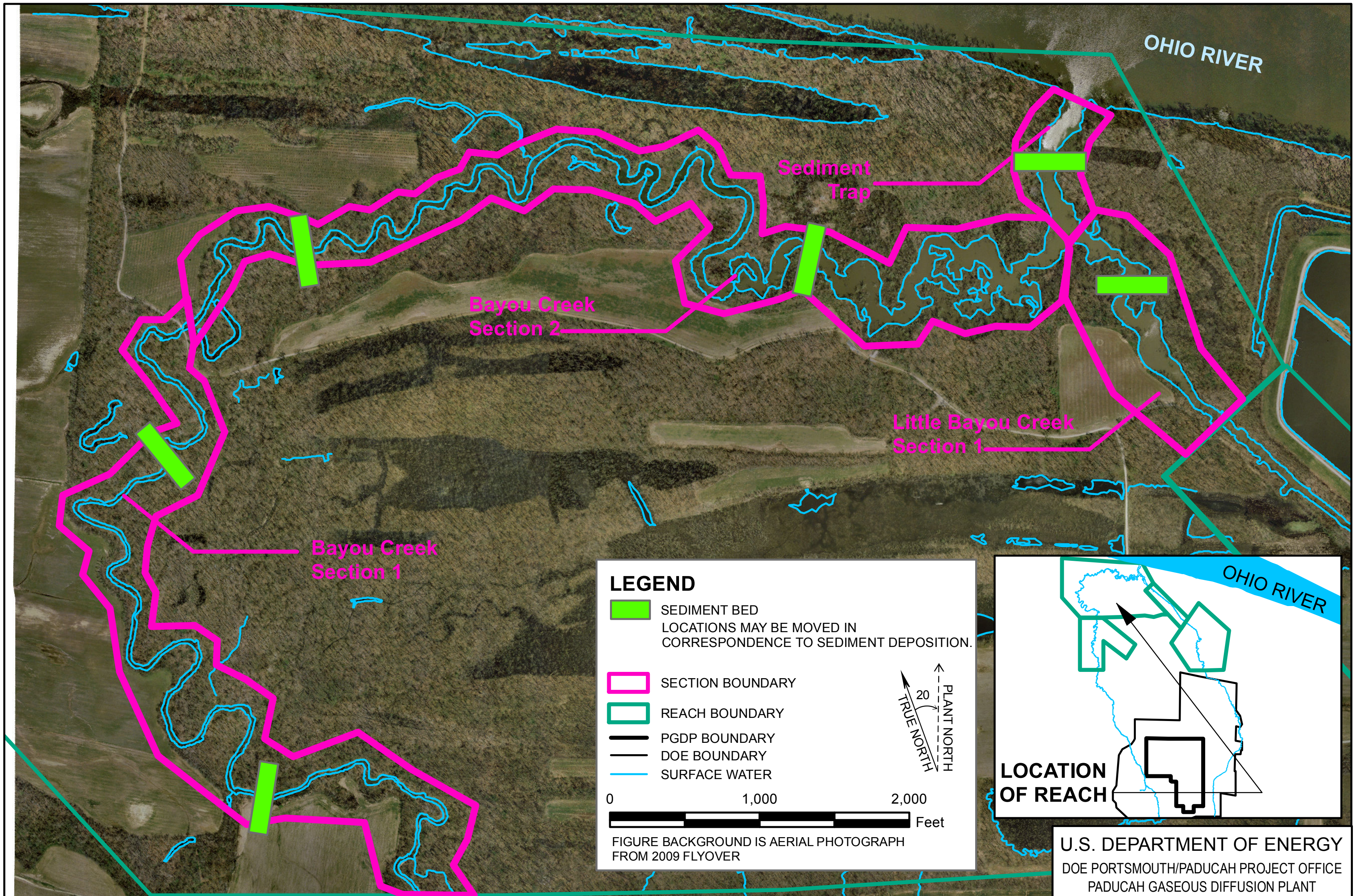

Figure 6.30. Planned Sampling at the Ohio River Floodplain

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7. LITTLE BAYOU CREEK

Little Bayou Creek is a stream located east of PGDP that flows north, converges with Bayou Creek north of the site and eventually discharges into the Ohio River. The portion of Little Bayou Creek within the DOE boundary also has been designated as SWMU 64.

For the purposes of this Work Plan, Little Bayou Creek is broken down into six distinct areas that move progressively from the Limited Area to the Ohio River. Those areas are industrial area EUs, outfall ditches downstream of the weirs, creek reaches, floodplain soils, seeps area, and Ohio River floodplain.

7.1 LOCATION

Little Bayou Creek begins approximately 0.4 miles south of PGDP and flows along the east side of PGDP and the DOE property boundary to the Ohio River (COE 1994) (Figure 6.1). Reaches 1 through 4 encompass the length of the creek from the south DOE property boundary crossing to the 100-year floodplain of the Ohio River, a flow distance of approximately 4.0 miles along the main creek channel. PGDP's NSDD (Reaches 5 and 6) is a primary tributary that originates in the north-central area of PGDP. Little Bayou Creek Reaches 5 and 6 (which do not include the ditch length inside the fenced security area and the ditch length outside the security area south of Outfall 003) have a combined flow distance of approximately 1.1 miles. Figure 6.11 shows the location of the Little Bayou Creek reaches. Little flow originates in the headwaters of Little Bayou Creek south of PGDP. Nearly 100% of the flow in the creek is derived from PGDP effluent streams.

7.2 OPERATION HISTORY

Little Bayou Creek is used to discharge wastewater and stormwater from the plant site to the Ohio River. Discharges to Little Bayou Creek occur through KPDES outfalls 002, 003, 010, 011, 012, 013, 018, and 019, as shown in Figure 6.1. Little Bayou Creek has received the effluent of PGDP's east side processes since operation of the plant began. The east side of the plant contains most of the heavily industrialized area of the plant, including the main uranium processing buildings. Contaminants in the process effluents of PGDP are believed to be a source of the contamination in Little Bayou Creek.

7.3 OPERATIONAL CONCEPTUAL SITE MODEL

The operational CSM is illustrated in Figure 5.1. Little Bayou Creek has inputs from many areas and eventually flows into the Ohio River.

7.4 INDUSTRIAL AREA EXPOSURE UNITS

The ecological strategy will be the same as for Bayou Creek (Section 6.4).

7.5 OUTFALL DITCHES BELOW THE WEIRS

The scope for outfall ditches under the SWOU is the area between the outfall weirs and drainage into Little Bayou Creek for outfall ditches 002, 010, 011, 012, 013, 018, and 019. Outfall 003 has been closed as a result of the NSDD Section 1 and 2 Project and will not be considered during this investigation. Outfall 018 was closed as a part of the C-746-S&T Landfills closure and will not be considered during this investigation.

7.5.1 Nature and Extent

As documented in the SWOU SI (DOE 2008a), sampling of the outfalls listed above and their associated internal ditches and Sections 3, 4, and 5 of the NSDD was conducted to determine the source of potential contamination to the creeks surrounding the industrialized portion of PGDP. Outfalls 001, 002, 008, 010, 011, 012, and 015 were investigated as part of the SWOU On-Site Removal Action. These data were used to develop source terms to support transport modeling and to develop EPCs for each EU. These areas were characterized using the following strategy:

(1) Identify areas of elevated contaminant concentrations (i.e., identify "hot spots") in surface soil and sediment along Outfalls 001, 002, 008, 010, 011, and 015 and associated internal ditches and areas and with Sections 3, 4, and 5 of the NSDD and identify the extent of contamination in these areas.

(2) Further delineate hot spots in soils and sediment found in Outfalls 001, 002, 008, 010, 011, and 015 and associated internal ditches and areas and Sections 3, 4, and 5 of the NSDD.

(3) Determine the potential for migration of contamination through Outfalls 001, 002, 008, 010, 011, and 015 from their associated internal ditches and areas and from the storm water sewers associated with C-333-A, C-337-A, and C-340.

As documented in the Action Memorandum for Contaminated Sediment Associated with the SWOU (On-Site) (DOE 2009a), a non-time-critical removal action for the SWOU (On-Site) was warranted. Completion of this removal action reduced the risk to current and future workers, excavation workers, and recreators from direct contact by removing known sources of contamination. Under this action, hot spots were removed, and excavated areas were backfilled with clean soil and restored. Cleanup was verified by post-excavation sampling and it was determined that the cleanup levels for all COCs had been achieved. In achieving these cleanup goals, this ensures that direct contact risk at the on-site ditches for the current industrial worker falls within the EPA risk range and that direct contact risk at the NSDD for both the current industrial worker and recreational user falls within the EPA risk range (DOE 2008b).

Maps of historical sampling for Outfalls 010 and 011 below their weirs are shown in Figures 7.1 and 7.2. No historical sampling data is available for Outfalls 002 and 012 downstream of the weirs within the criteria set for the SWOU (see Section 15).

7.5.2 Previous Risk Assessment Discussion/Summary

It should be noted that previous risk assessments utilized different decision rules than those that will be used for this RI/FS. If risk estimates were recalculated using current methods, exposure parameters, and toxicity information (DOE 2011b), the results could differ markedly; however, the assessments did indicate the contaminants and media that needed to be considered during the scoping of this work plan.

No previous risk assessments have been performed specifically for the outfall ditches below the weirs; however, data collected during the PGDP SI, Phase II, subsequently were evaluated and presented in Results of the Site Investigation, Phase II (CH2M HILL 1992). The risk assessment included an evaluation of exposure scenarios for both Bayou and Little Bayou Creeks and was completed using sampling results likely not consistent with current conditions. Results presented in the PGDP SI, Phase II show the maximum risk from measured external off-site radiation dose rates was found in the KPDES

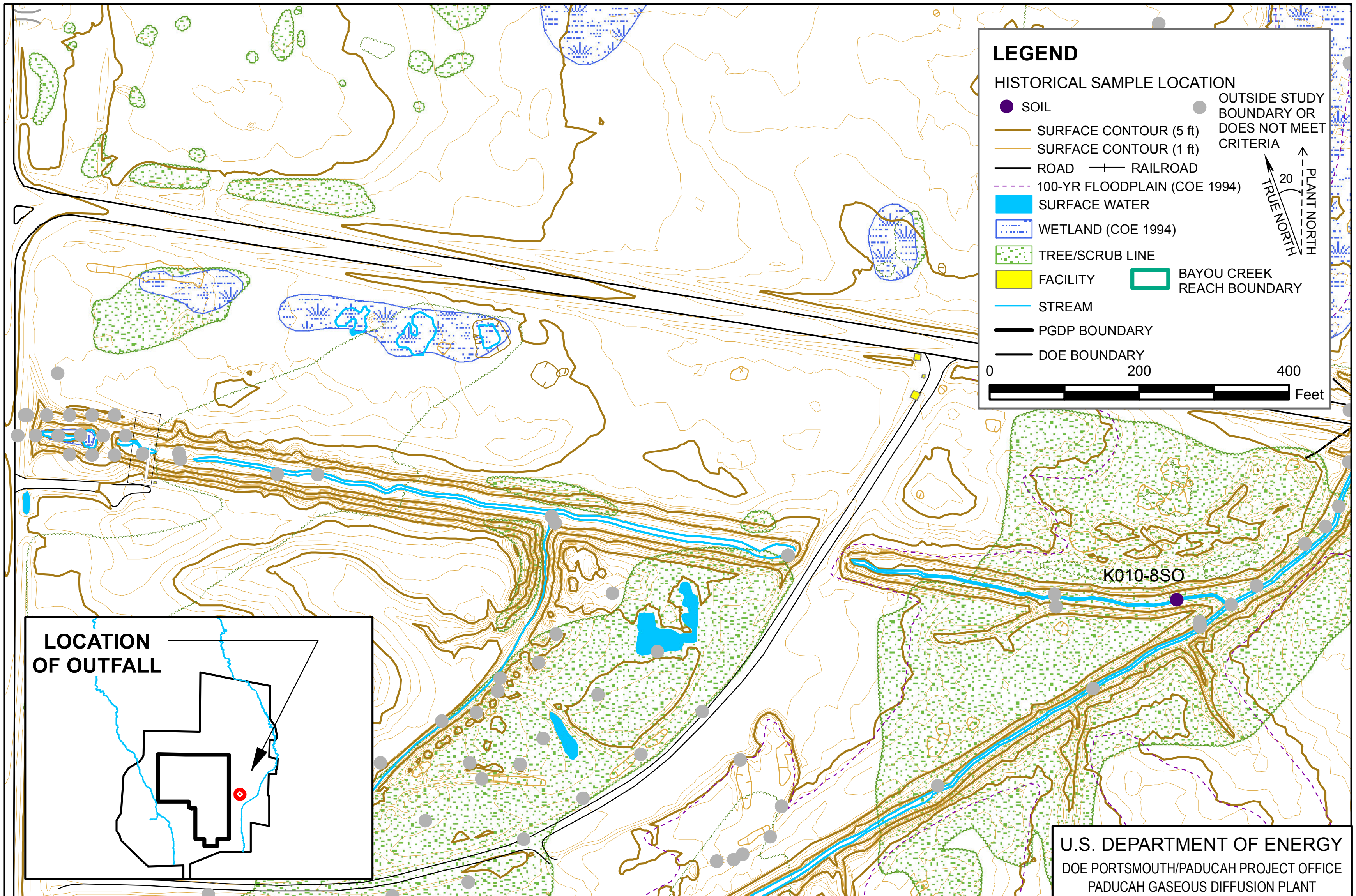

Figure 7.1. Historical Sampling near Outfall 010

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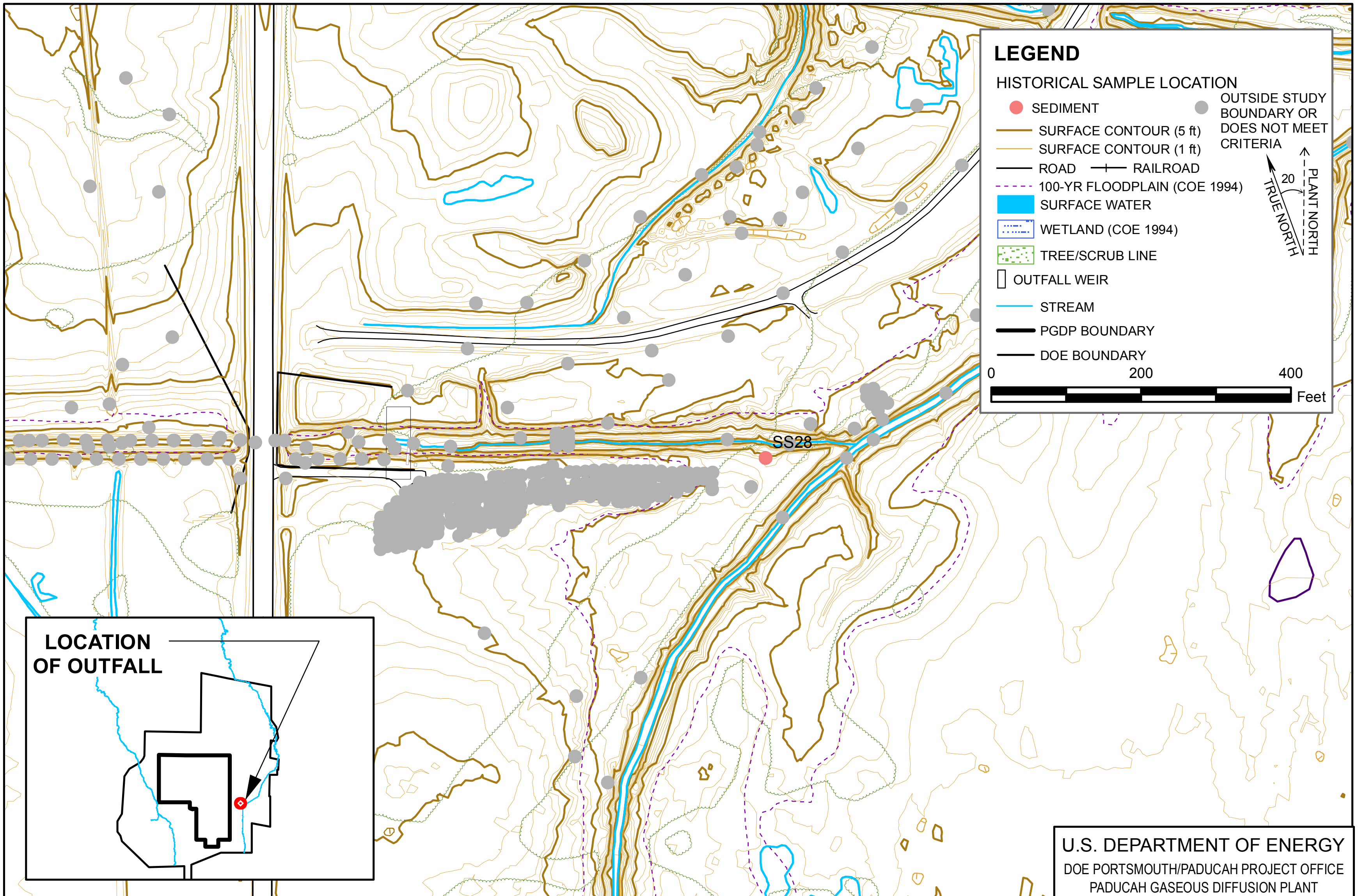

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Figure 7.2. Historical Sampling near Outfall 011

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Outfall 011 ditch. The maximum external radiation risk value for Little Bayou Creek, not including the KPDES Outfall 011 ditch, is 4 x 10^{-5}. Refer to Section 7.6.2 for a summary of the previous risk results for Little Bayou Creek.

7.5.3 Previous Actions Taken

As stated in the preceding section, no previous risk assessments have been performed specifically for the outfall ditches below the weirs; consequently, no actions previously have been taken for this investigation area.

7.5.4 Risk Exposure CSM

The risk exposure CSM is illustrated in Figure 5.2. Outfall ditches below the weirs have a direct contact and incidental ingestion ELCR for water, sediment, and soil to the current/future industrial worker, future resident, current/future recreational users, and terrestrial and aquatic biota.

7.5.5 Remaining Problems

Remaining problems for the outfall ditches below the weirs are discussed further within this section.

7.5.5.1 Characterization and inventory of wastes

There currently is no waste for this unit.

7.5.5.2 Information status of key assessment factors

Table 7.1 identifies the status of key assessment factors.

Table 7.1. Status of Key Assessment Factors for Outfall Ditches below the Weirs Leading to Little Bayou Creek

SWMU	Description	Waste Handling Practices	Contamination		Migration of Contamination	
			Presence	Extent	Surface Runoff	Infiltration
60	Outfall 002	W	A	A	A	A
61	Outfall 013	W	A	A	A	A
66	Outfall 010	W	W	W	A	A
67	Outfall 011	W	W	W	A	A
168	Outfall 012	W	A	A	A	A
N/A	Outfall 019	W	A	A	A	A

A—Factor is adequately defined. Current information is adequate to design a targeted sampling plan, but data gaps and uncertainties are such that the goals and objectives of the RI/FS cannot be met.
W—Factor is well defined. Current information is adequate to meet the goals and objectives of the RI/FS.
Information provided in this table is taken from DOE 1999.
N/A—Not applicable

7.5.5.3 Release potential from contaminant sources

On the basis of available data, Little Bayou Creek (SWMU 64) has been characterized according to its potential for release of contaminated materials to the environment. Little Bayou Creek flows primarily through agricultural and forested lands on its way to the Ohio River. Multiple pathways of exposure are present, both to the recreational user and to the environment. Water and sediments within the creek and surface soils adjacent to the creek are expected to be contaminated. Subsurface soils within the 500-year floodplain of Little Bayou Creek also may be contaminated.

7.5.6 Remedial Alternatives Development Summary

Potential response actions can be found in Appendix C.

7.5.7 Data Needs

Outfall ditches 002, 010, 011, and 012, upstream of the outfall weirs, have been the subject of extensive sampling and a removal action as discussed previously; however, no sampling of the ditches has taken place below the weirs. As a result, data will be collected below the weir for outfall ditches 002, 010, 011, 012, and 013. The primary data need for Little Bayou Creek (SWMU 64) is to determine if contaminants are present, and, if so, determine extent of contamination and whether they have an adverse effect on human health or ecological receptors. To this end, sediment samples will be collected from within the outfall ditches.

7.5.8 Field Sampling Plan

The sampling strategy discussed in the following subsections is modeled after the on-site ditch approach (DOE 2005).

7.5.8.1 Sampling strategy

The sampling strategy will be the same as for Bayou Creek (Section 6.5.8.1) for the outfall ditches.

7.5.8.1.1 Sampling media and methods

The sampling media and methods will be the same as for Bayou Creek (Section 6.5.8.1.1) for the outfall ditches.

7.5.8.1.2 Sample analysis

Sample analysis will be the same as for Bayou Creek (Section 6.5.8.1.2) for the outfall ditches.

7.5.8.1.3 Sampling procedures

Sampling procedures are described in the QAPP for this work plan (Section 17).

7.5.8.1.4 Documentation

Requirements for documentation are located in the QAPP for this work plan (Section 17).

7.5.8.2 Sample location survey

GPS coordinates in 1602 Kentucky State Plane South Zone with submeter accuracy will be obtained for all sampling locations. Additionally, depths for each sample obtained also will be recorded. Where possible, flags or wooden or metal stakes will be used to mark sampling locations. Each sampling location will be described with field maps and photographs. This will enable reestablishment of the sampling locations if the markers are disturbed or cannot be placed.

7.5.8.3 Maps/locations

Figures 7.3 through 7.7 illustrate proposed sampling for the outfall ditches below the weirs.

7.6 CREEK REACHES

For the purpose of this investigation, Little Bayou Creek has been subdivided into six reaches to facilitate data analysis and interpretation. The reaches are illustrated on Figure 6.11.

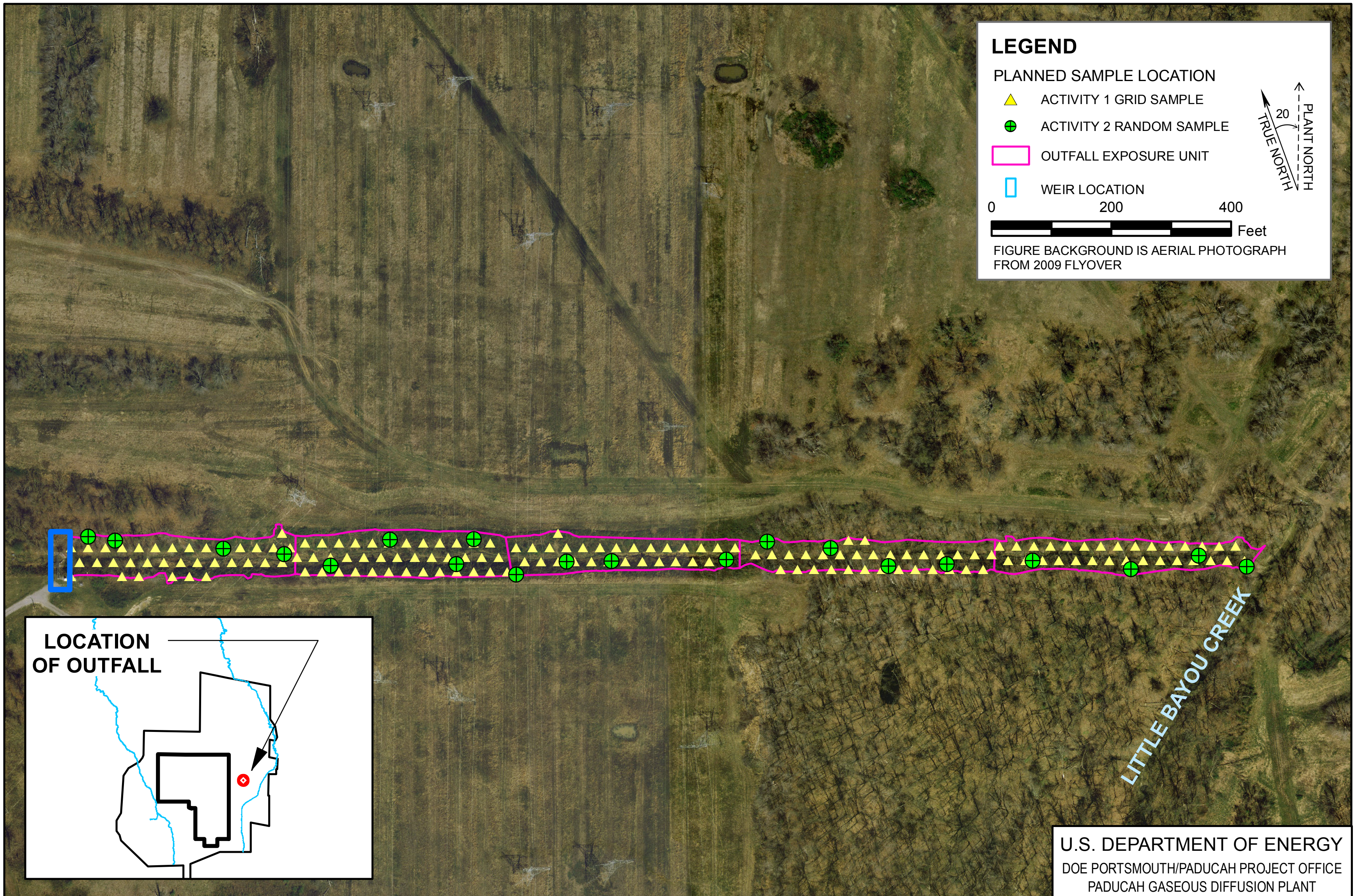

Figure 7.3. Planned Sampling at Outfall 002

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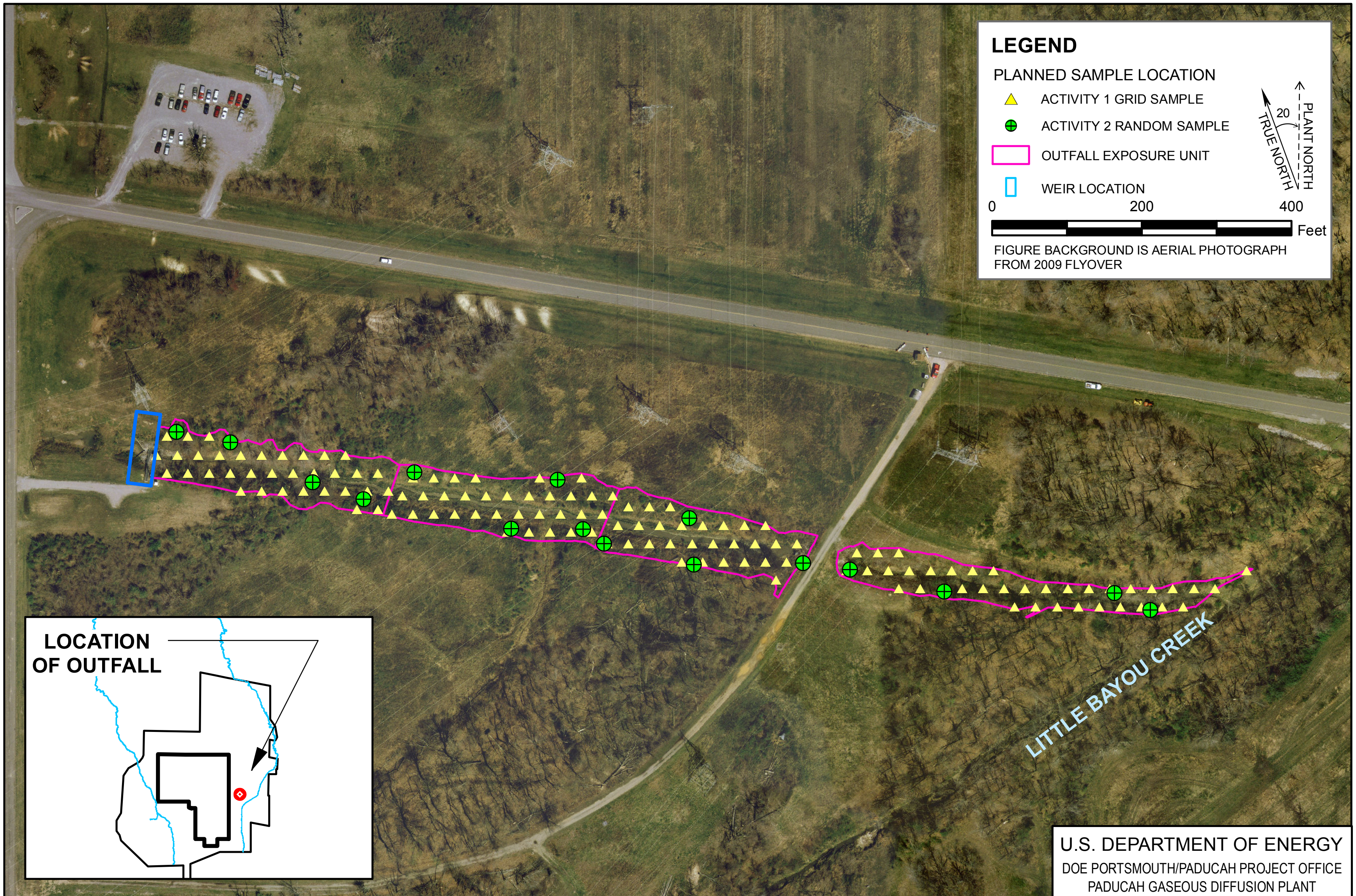

Figure 7.4. Planned Sampling at Outfall 010

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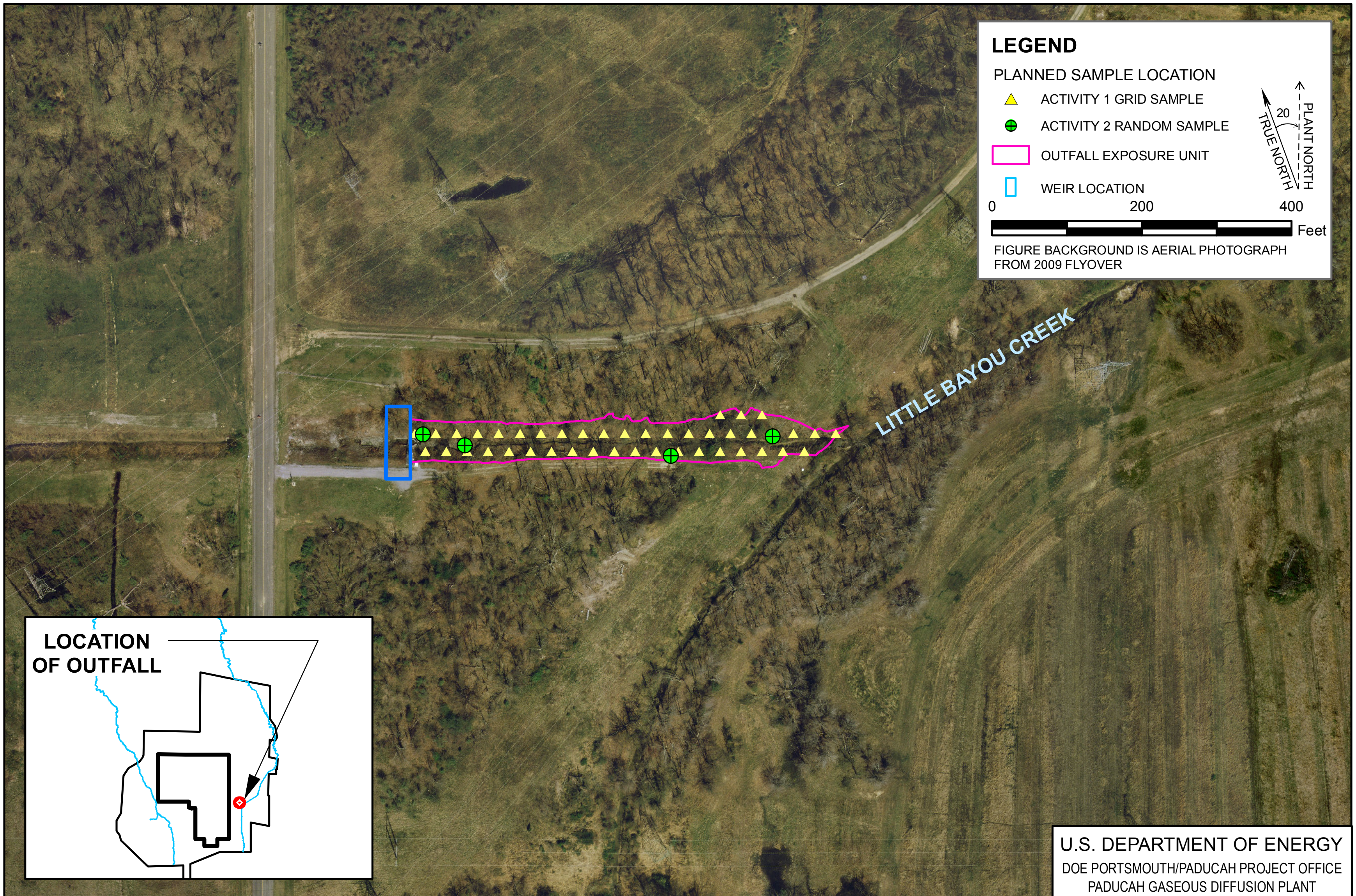

Figure 7.5. Planned Sampling at Outfall 011

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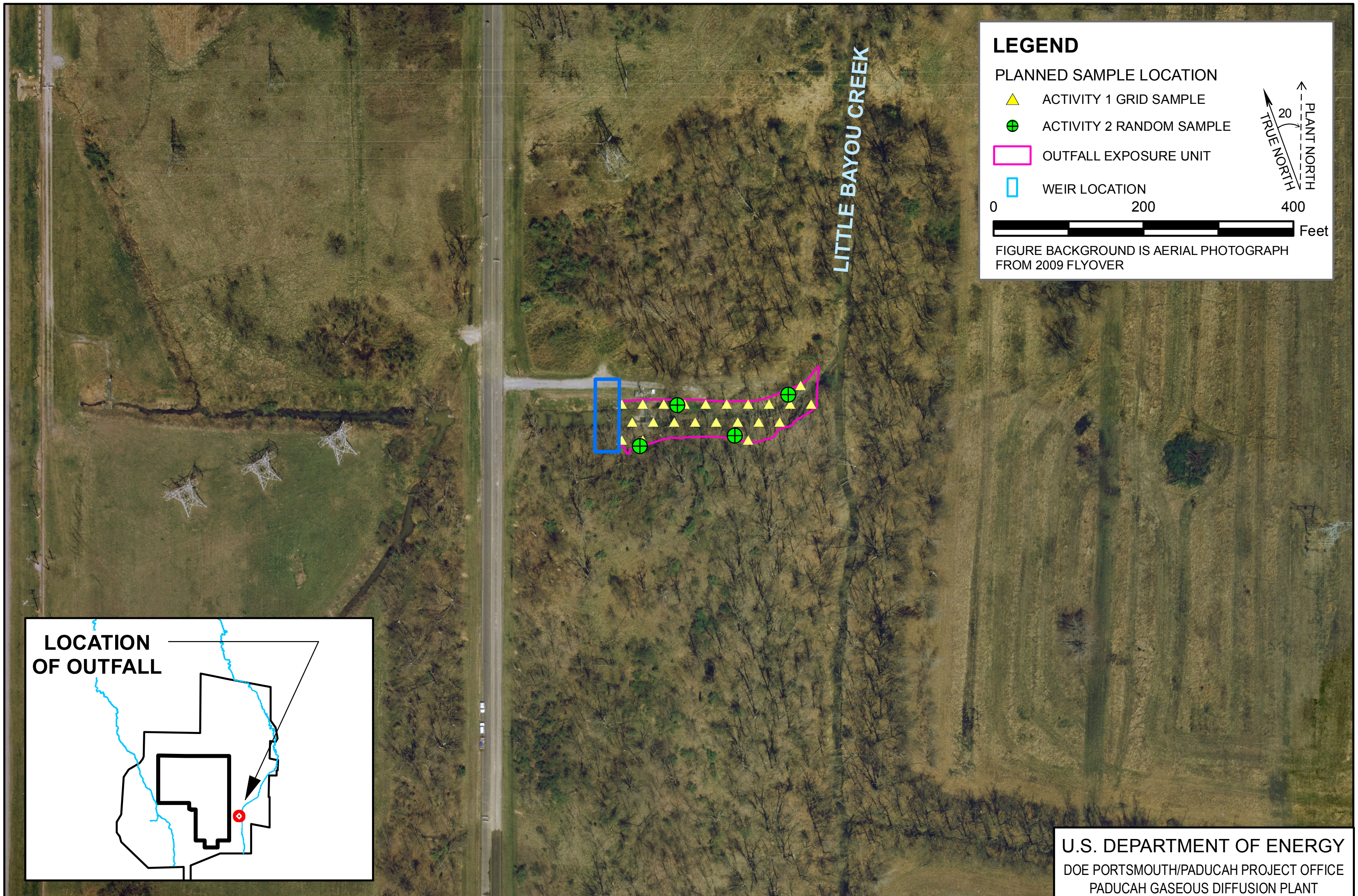

Figure 7.6. Planned Sampling at Outfall 012

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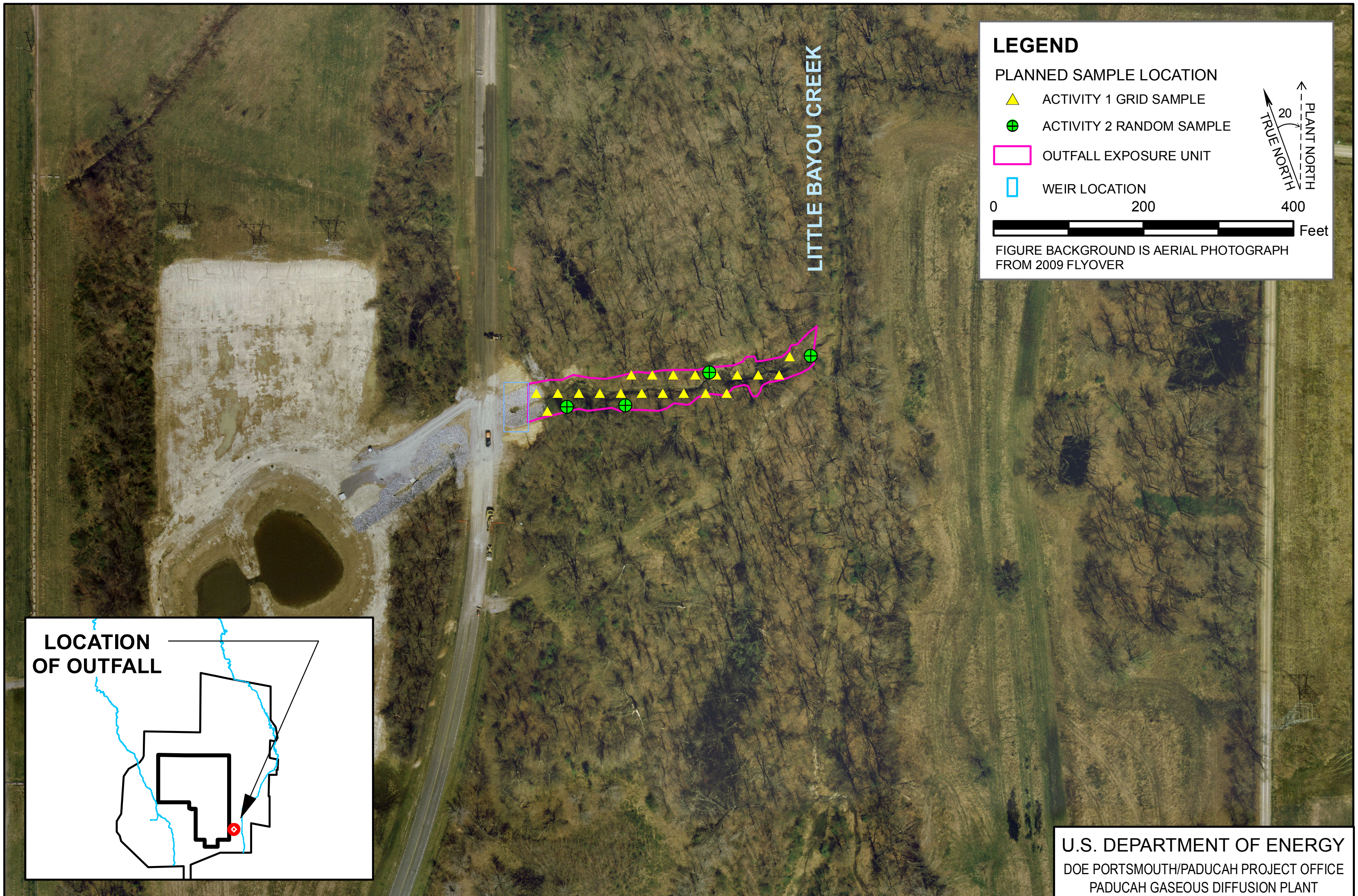

Figure 7.7. Planned Sampling at Outfall 013

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7.6.1 Nature and Extent

Historical sampling where available is shown for the Little Bayou Creek reaches in Figures 7.8 through 7.10; and the map of available historical sampling for the Little Bayou Creek floodplain Reach 1 is shown in Figure 7.11. Historical sampling data are not available for Little Bayou Creek Reach 4 and Little Bayou Creek Ohio River floodplain Reach 2 within the criteria set for the SWOU (see Section 15).

7.6.2 Previous Risk Assessment Discussion/Summary

It should be noted that previous risk assessments utilized different decision rules than those that will be used for this RI/FS. If risk estimates were recalculated using current methods, exposure parameters, and toxicity information (DOE 2011b), the results could differ markedly; however, the assessments did indicate the contaminants and media that needed to be considered during the scoping of this work plan.

Data for the Little Bayou Creek have been assessed and risk documented as part of the following reports:

- Results of the Site Investigation, Phase I (CH2M HILL 1991a),
- Results of the Public Health and Ecological Assessment, Phase II (CH2M HILL 1991b),
- Baseline Risk Assessment and Technical Investigation Report for the Northwest Dissolved-Phase Plume, Appendix E (DOE 1994b), and
- PGDP PCB Sediment Survey, Big Bayou Creek, and Little Bayou Creek (COE 1996b).

PGDP SI, Phase I

The PGDP SI, Phase I, risk assessment (CH2M HILL 1991a) included an evaluation of exposure scenarios for both Little Bayou and Bayou Creeks. COPCs included organics, inorganics, and radionuclides. The following exposure routes were evaluated for adults and 2-6 year-old children:

- Ingestion of surface water and incidental ingestion of sediment during swimming (organics and inorganics);
- Ingestion of surface water while swimming (radionuclides);
- Ingestion of sediment while swimming, wading, fishing, etc. (radionuclides); and
- Ingestion of fish (organics, inorganics, and radionuclides).

Chemical-specific toxicity values were selected and an estimate of ELCR, and noncarcinogenic HQs were calculated for each of the organic and inorganic COPCs. Risk of cancer incidence and risk of cancer death were calculated for the radionuclide data. Results of the PGDP SI, Phase I, contain ELCRs and HQs for both an average exposure and a reasonable maximum exposure (CH2M HILL 1991a).

The ELCR for ingestion of surface water for an average exposure was 2×10^{-10} with an HI <1 and for a maximum exposure was 8×10^{-10} with an HI <1. The ELCRs for average and maximum exposure for ingestion of sediment were 0 with HIs <1.

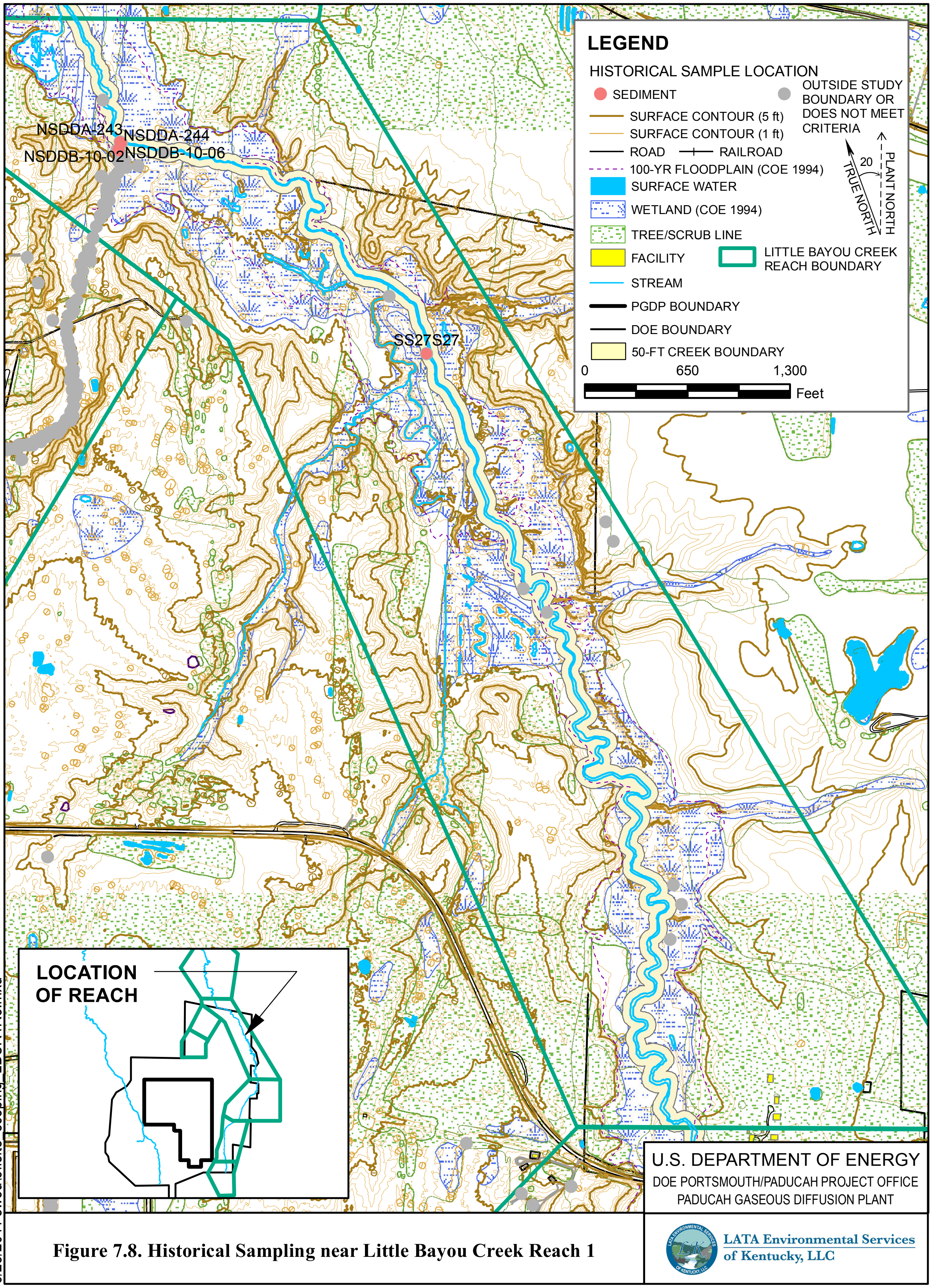

Figure 7.8. Historical Sampling near Little Bayou Creek Reach 1

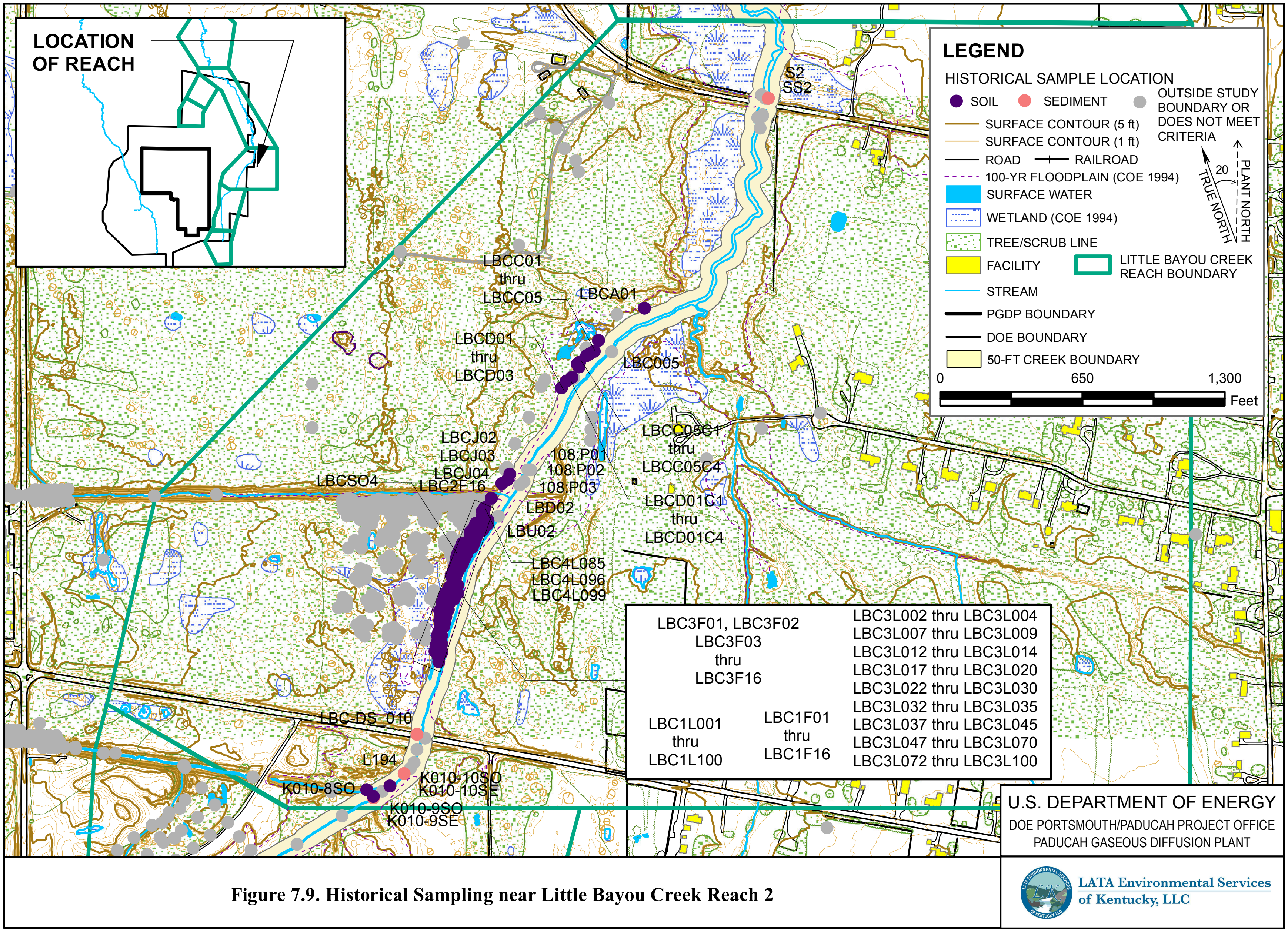

Figure 7.9. Historical Sampling near Little Bayou Creek Reach 2

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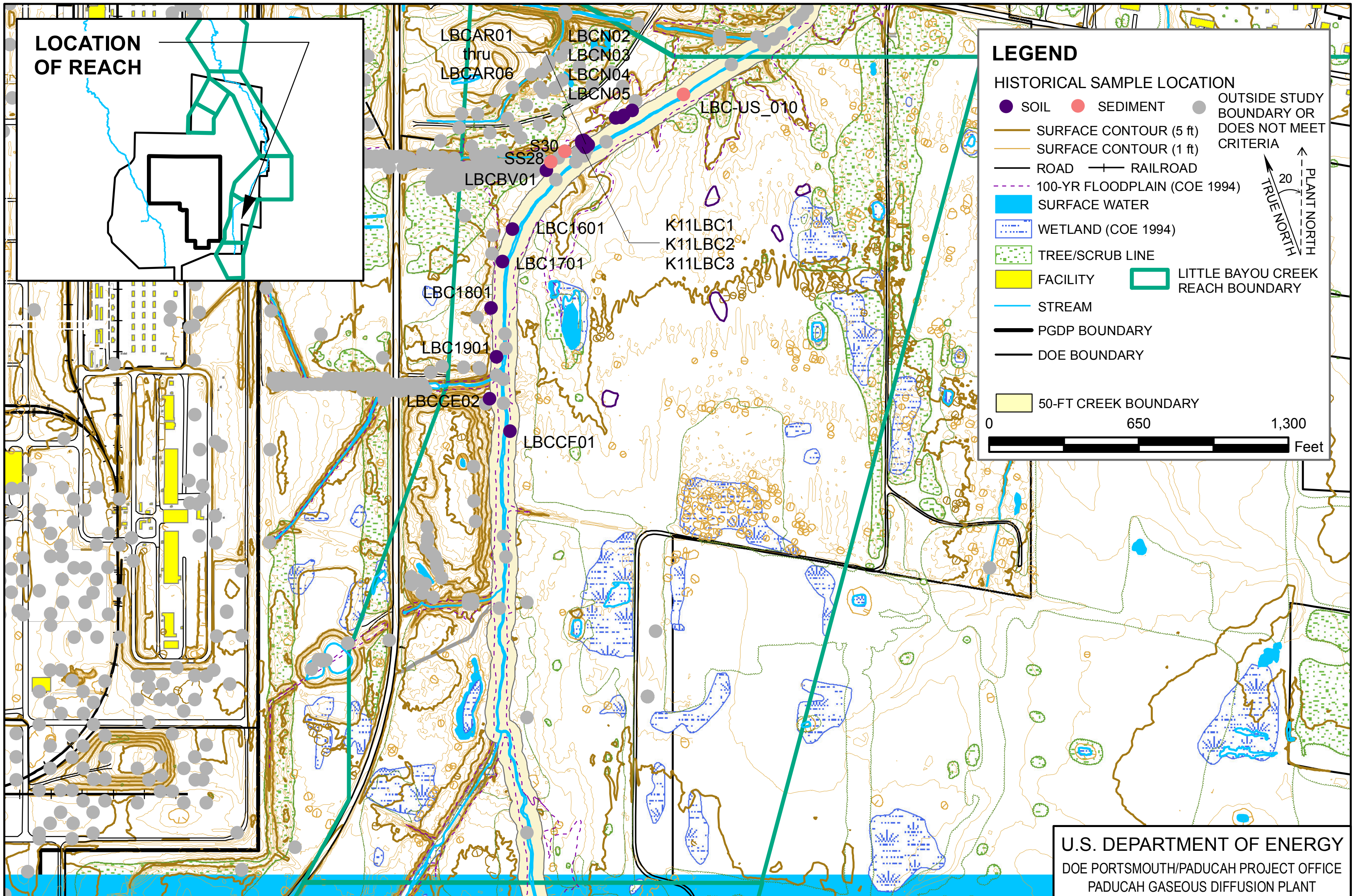

Figure 7.10. Historical Sampling near Little Bayou Creek Reach 3

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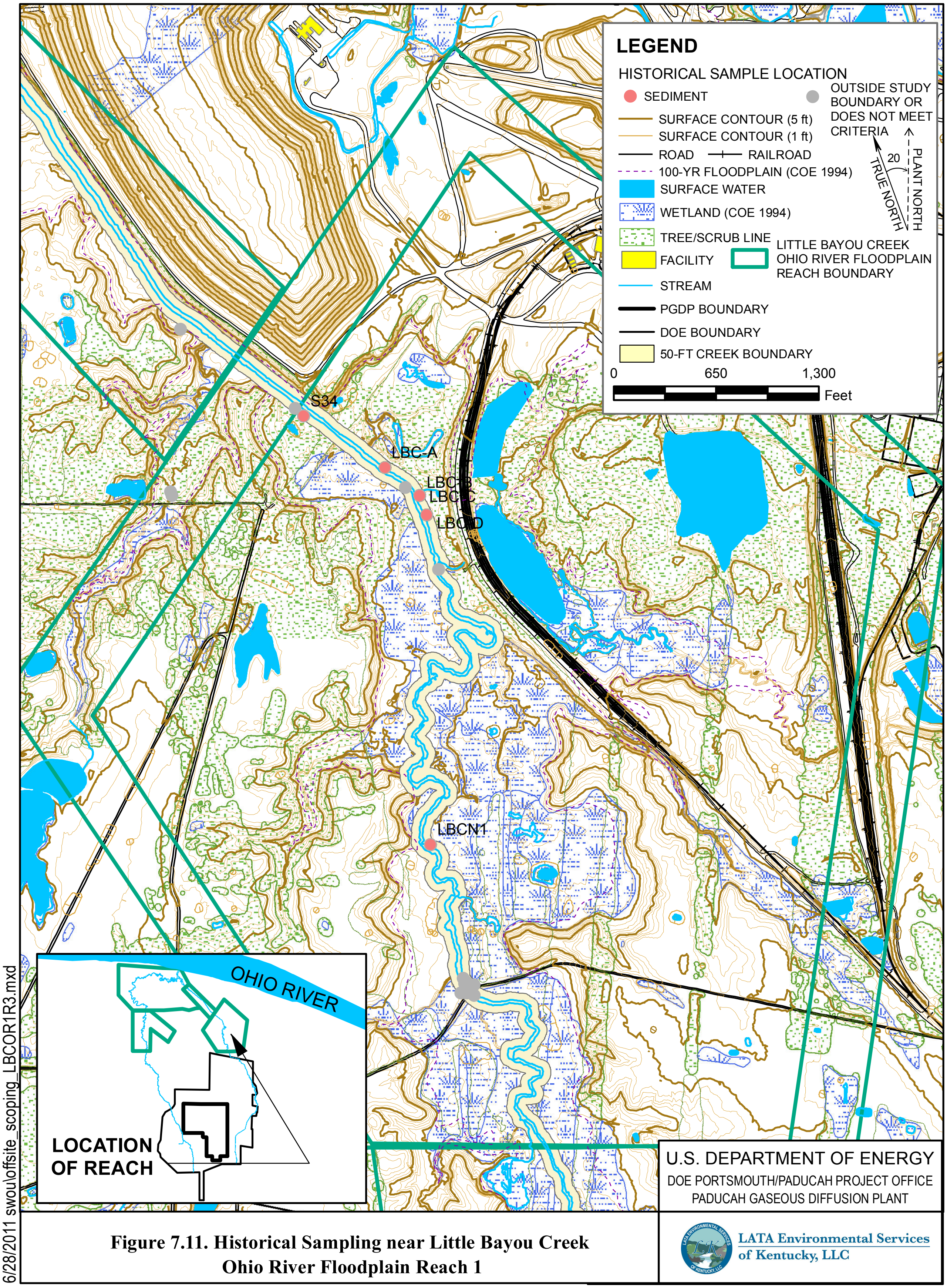

Figure 7.11. Historical Sampling near Little Bayou Creek Ohio River Floodplain Reach 1

Fish were collected during sampling activities from locations within both Little Bayou and Bayou Creeks. The resulting data were compiled into separate datasets for each creek for the purposes of the nonradiological risk assessment; however, the data were compiled in a single dataset for the evaluation of the ingestion of fish contaminated with radionuclides. Unlike Bayou Creek, arsenic was not detected in fish from Little Bayou Creek. No organic contaminants were detected in the fish tissues; however, the inorganic contaminants chromium, selenium, barium, and manganese were identified as COCs and contributed to a total HI of 0.9 for this pathway. The fish collected in Little Bayou Creek were evaluated for human ingestion during the risk assessment conducted for the PGDP SI, Phase I (CH2M HILL 1991a). The ELCR for average exposure was 0 with an HI of 0.3 and for a maximum exposure was 0 with an HI of 0.9.

The only radionuclide detected and evaluated during the risk assessment was Tc-99 at a maximum activity concentration of 5.95 pCi/g. The risk of cancer incidence from ingestion of fish tissue indicates that this radionuclide also is a COC.

PGDP SI, Phase II

Data collected during the PGDP SI, Phase II, subsequently were evaluated and presented in The Public Health and Ecological Assessment, Phase II (CH2M HILL 1991b). The following exposure routes for off-site residents, on-site worker, and worker/intruder were evaluated:

- Direct contact with surface soil,
- Ingestion of surface water,
- Ingestion of sediment,
- Ingestion of biota, and
- Ingestion of crops.

The PGDP SI, Phase II, risk assessment evaluated exposure to an individual swimming in the Little Bayou Creek (CH2M HILL 1991b). The exposure pathways included ingestion of surface water and incidental ingestion of soil/sediment. No COCs were identified for this exposure scenario. Contamination in Little Bayou Creek included metals and PCBs in sediments. PCBs appeared to be the major COC. Near Outfall 011, creek sediment PCB concentrations were high. Eighty-four percent of fish tested for PCBs had tissue levels greater than the EPA action level. While sediment PAHs at Outfall 011 exceeded effects range-low (ER-Ls), PAH concentrations in Little Bayou Creek sediment and surface waters were below them. Chromium and zinc were found at potentially toxic levels in sediment, but not in surface water. Chemical carcinogenic ELCR from exposure to contaminated sediments were highest in Little Bayou Creek, but did not exceed 2×10^{-5}.

Radionuclides were detected in surface water above reference values in the samples below the confluence of the outfalls with Little Bayou Creek, with the exception of neptunium-237, which was not detected in the samples. uranium-234 and uranium-238 contributed to a total ELCR of 5×10^{-7} for incidental ingestion. With the exception of Tc-99, there was a general decrease in the level of detected radionuclide contamination, proceeding from the sampling location farthest upstream (below the confluence of the outfall farthest upstream) to the sampling location farthest downstream. Most of the radiological risk from ingestion of sediments is due to uranium-234, uranium-238, and neptunium-237 which contribute to a total ELCR of 3×10^{-6}.

Risks from exposure to direct external radiation were calculated from direct dose rate measurements made with thermoluminescent dosimeters (TLDs) placed along Little Bayou Creek, the NSDD, and KPDES Outfall 011 ditch. These ELCRs range from 1×10^{-5} to 6×10^{-5}. Annual dose from these sites ranged from 1 to 6 mrad/year. Annual average background for radiation exposure across the United States is approximately 94 mrad/year. A detailed summary of the external radiation risks at each TLD location is provided in the PGDP SI, Phase II (CH2M HILL 1991b).

It is important to remember that because of the current guidance [e.g., Paducah Risk Methods Document Volumes 1 (DOE 2011b) and 2 (DOE 2010a) and Methods for Assessing Biological Integrity of Surface Waters in Kentucky (KDEP 2008)], the scenarios, exposure parameters, and methods used by DOE in 1997 are not those currently used at PGDP. In addition, it is important to realize that the toxicity values used in the assessments may have changed since the completion of the previous assessments. If risk estimates were recalculated using current methods, exposure parameters, and toxicity information, the results could differ markedly; however, this assessment does indicate the contaminants and media that need to be considered when developing the sampling plan for the SWOU.

The PGDP SI, Phase II identified unacceptable risks to human health (recreational user) for fish ingestion from Little Bayou Creek (CH2M HILL 1991b). For this exposure, PCBs and beryllium both were determined to be COCs. Systemic toxicity hazard for the same exposure was unacceptable for chromium.

Biological Monitoring Program/Watershed Monitoring

Surface Water. Lead was the only analyte detected at levels greater than both reference levels and ambient water quality criteria (AWQC) in Little Bayou Creek surface water. Lead concentrations were elevated at stations in biological monitoring program (BMP) Reaches 1 and 2 downstream of the KPDES outfalls; however, negative results for PCBs may have been a result of high detection limits. Copper, lead, and zinc exceeded background levels and AWQC at stations upgradient of BMP Reaches 5 and 6. Lead in BMP Reach 5 (Station NS4) was more than 13 times its chronic AWQC value.

Sediment. Chromium and zinc concentration in sediment exceeded ER-L values at stations downstream of the KPDES outfalls, but stations in BMP Reach 3 adjacent to the outfalls did not show elevated levels of metals. Chromium and zinc exceeded their ER-Ls at Outfall 011, but not at other outfalls. No sediment PCBs were detected in Little Bayou Creek by the SI, but again, detection limits were suspect. PCB-contaminated sediments were found at Outfall 011. No other organics were detected above reference levels. PCB concentrations were high in sediment upgradient from BMP Reach 6, gradually declining with distance downstream. Concentrations 220 times higher than the PCB ER-L were reported for Station LB21, inside the PGDP fence, 22 times higher at LB24, just outside the fence, and 1.4 times the ER-L downstream in BMP Reach 5 at Station LB26.

Tissue Analyses. Significant PCB contamination was found in fish tissue from several areas of Little Bayou Creek, particularly in the area of the Outfalls (BMP Reaches 2 and 3). Action-level PCB residues were found in 84 percent of the fish tested from BMP Station LB2, next to the outfalls (Birge et al. 1990).

Toxicity Testing. No toxicity data were collected from the NSDD, but tests of water from Outfall 003 at the head of BMP Reach 6 indicated no significant toxicity to aquatic biota.

Radionuclides. Daily dose rates were estimated for fish across the entire Little Bayou Creek system using reasonable maximum exposure for sediments and surface waters. Dose rates were below recommended dose rate limits for aquatic organisms (1 rad/day).

Northwest Dissolved-Phase Plume BRA and TI Report

Data for Little Bayou Creek seeps area was collected as part of the *Baseline Risk Assessment and Technical Investigation Report for the Northwest Dissolved Phase Plume, Paducah Gaseous Diffusion Plant, Appendix E* (DOE 1994b). Various time periods were evaluated; however, for this assessment, only fish ingestion for year zero was considered. For year zero, the time period assumes that unrestricted use of groundwater begins immediately. Concentrations of COPCs used for this time period are those calculated using analytical results and are kept constant for the duration of the period assessed. Within one group of data, systemic toxicity for the consumption of fish pathway for the residential/recreational user was identified. The COCs were determined to be manganese, 1,1,2-trichloroethane, carbon tetrachloride, and dieldrin. For the same well group, within the ingestion of fish pathway, COCs were determined to be 1,1,2-trichloroethane, dieldrin, and TCE for ELCRs.

Ecological Risk Assessment. An ecological risk assessment was conducted to evaluate potential adverse effects associated with the dissolved-phase of the Northwest Plume. The assessment included potential impacts to both terrestrial and aquatic biota: fish, benthic macroinvertebrates, terrestrial mammals, and avian piscivores. The assessment focused on potential future risks to aquatic biota in the Ohio River and to terrestrial wildlife feeding in areas irrigated with contaminated groundwater. While the analysis does not equate directly with reaches defined for the SWOU, the results for the watershed, as a whole, are discussed below. There were no apparent risks from contaminants in the dissolved-phase of the Northwest Plume to aquatic organisms exposed to Ohio River surface water or sediments. No analytes exceeded aquatic benchmarks for surface water or sediment, and radionuclide levels were unlikely to result in unacceptable doses. Herbivorous mammals inhabiting land irrigated with contaminated groundwater may be exposed to toxic levels of aluminum, arsenic, TCE, and vinyl chloride, assuming fate and transport models accurately portray future conditions. No other analytes or radionuclides were predicted to reach unacceptable levels. Avian piscivores frequenting fish ponds irrigated with groundwater from the dissolved-phase of the Northwest Plume may be exposed to toxic levels of aluminum, lead, bis(2-ethylhexyl)phthalate, and dieldrin. Estimated concentrations of these contaminants may reach levels detrimental to individual piscivores. No other analytes or radionuclides were predicted to reach levels of potential concern.

COE PCB Sediment Study

PCB contamination was detected in outfalls 002, 011, 012, and 018 during the investigation. Little Bayou Creek receives effluents from these outfalls. The detection of PCBs in Little Bayou Creek at the sampling point downstream of the confluence of Outfall 011 confirms past studies in which PCBs had been reported in this area, resulting in the posting of this creek to warn of PCB contamination. This supports the theory that Little Bayou Creek once was a pathway for the transport of PCBs originating within the PGDP facility. The pathway of this contamination into Little Bayou Creek includes KPDES outfalls and surface runoff from the plant area.

7.6.3 Previous Actions Taken

The DOE completed an interim corrective measure to restrict casual public access to creeks, outfalls, and lagoons in August 1993 (DOE 1993). This corrective measure included the installation of fencing and the posting of warning signs at various off-site locations at PGDP, one of which is located within the defined reaches for Bayou Creek. At KPDES Outfall 001 and New Water Line Road, warning signs were installed stating that the ditch is contaminated and should not be used for drinking, recreational, or fishing purposes. Additional activities at locations on Bayou Creek were included in the 1992 Interim Corrective Measure Work Plan (DOE 1992); however, Kentucky and United States Environmental Protection Agency deferred action at these Bayou Creek locations on November 24, 1992 and January 14, 1992, respectively, until additional characterization could be performed to determine if any actions are required. No other response actions have been taken to address contamination present in Bayou Creek, although response actions have been taken in outfall ditches and on-site to remove/prevent contamination from entering the creek system.

7.6.4 Risk Exposure CSM

The risk exposure CSM is illustrated in Figure 5.2. Little Bayou Creek reaches have a direct contact and incidental ingestion ELCR for water, sediment, and soil to the current/future industrial worker, future resident, current/future recreational users, and terrestrial and aquatic biota.

7.6.5 Remaining Problems

Remaining problems for the creek reaches are discussed further within this section.

7.6.5.1 Characterization and inventory of wastes

There currently is no waste for this unit.

7.6.5.2 Information status of key assessment factors

Table 7.2 identifies the status of key assessment factors.

Table 7.2. Status of Key Assessment Factors for Little Bayou Creek

SWMU	Description	Waste Handling Practices	Contamination		Migration of Contamination	
			Presence	Extent	Surface Runoff	Infiltration
64	Little Bayou Creek	A	A	A	W	A

A—Factor is adequately defined. Current information is adequate to design a targeted sampling plan, but data gaps and uncertainties are such that the goals and objectives of the RI/FS cannot be met.
W—Factor is well defined. Current information is adequate to meet the goals and objectives of the RI/FS.
Information provided in this table is taken from DOE 1999.

7.6.5.3 Release potential from contaminant sources

Little Bayou Creek has been assessed using available data to define its potential as a pathway for contaminated materials. Little Bayou Creek flows primarily through agricultural and forested lands on its way to the Ohio River. Water and sediments within the creek may be contaminated. Subsurface soils within the 500-year floodplain of Little Bayou Creek also may be contaminated.

7.6.6 Remedial Alternatives Development Summary

Potential response actions can be found in Appendix C.

7.6.7 Data Needs

Sediment, soil, surface water, and ecological samples are necessary to perform human health and ecological risk assessments for the Little Bayou Creek reaches to determine if remedial actions are necessary.

7.6.8 Field Sampling Plan

The sampling strategy is to perform the investigation in three pieces; early sampling, Phase 1, and Phase 2. Each set of samples will be used to confirm the strategy and refine the sampling plan for the subsequent phases to establish sampling and analytical needs; therefore, this sampling plan should be considered dynamic with respect to the actual sample locations and analyses described. Decision points are discussed within the sampling strategy herein.

7.6.8.1 Sampling strategy

The sampling strategy will be the same as for Bayou Creek (Section 6.6.8.1) for the creek reaches.

7.6.8.2 Sampling media and methods

The sampling media and methods will be the same as for Bayou Creek (Section 6.6.8.2) for the creek reaches.

7.6.8.3 Sample analysis

Sample analysis will be the same as for Bayou Creek (Section 6.6.8.3) for the creek reaches.

7.6.8.4 Sampling procedures

Sampling procedures are described in the QAPP for this work plan (Section 17).

7.6.8.5 Documentation

Requirements for documentation are located in the QAPP for this work plan (Section 17).

7.6.8.6 Breakout by reach

Little Bayou Creek has been divided into six reaches for the purposes of this investigation (Figure 6.11). Two of the reaches lie within the 100-year floodplain of the Ohio River; the remaining four reaches are upstream.

7.6.8.7 Sample location survey

GPS coordinates in 1602 Kentucky State Plane South Zone with submeter accuracy will be obtained for all sampling locations. Additionally, depths for each sample obtained also will be recorded. Where possible, flags or wooden or metal stakes will be used to mark sampling locations. Each sampling location will be described with field maps and photographs. This will enable reestablishment of the sampling locations if the markers are disturbed or cannot be placed.

7.6.8.8 Maps/locations

Figures 7.12 through 7.17 illustrate proposed sampling for the six reaches of Little Bayou Creek.

7.7 FLOODPLAIN SOILS

Discussion of floodplain soil is included in creek reaches discussion.

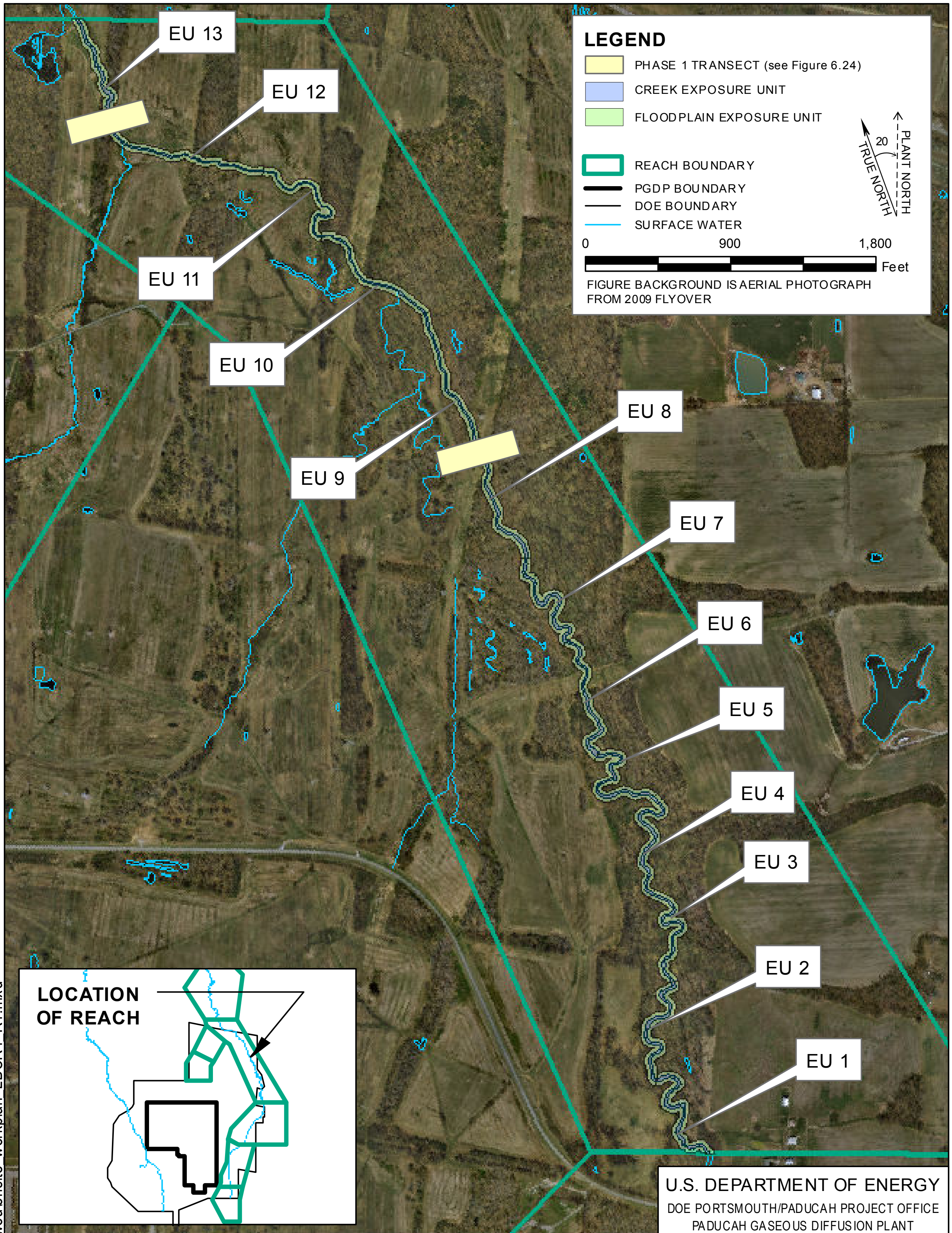

Figure 7.12. Planned Sampling at Little Bayou Creek Reach 1

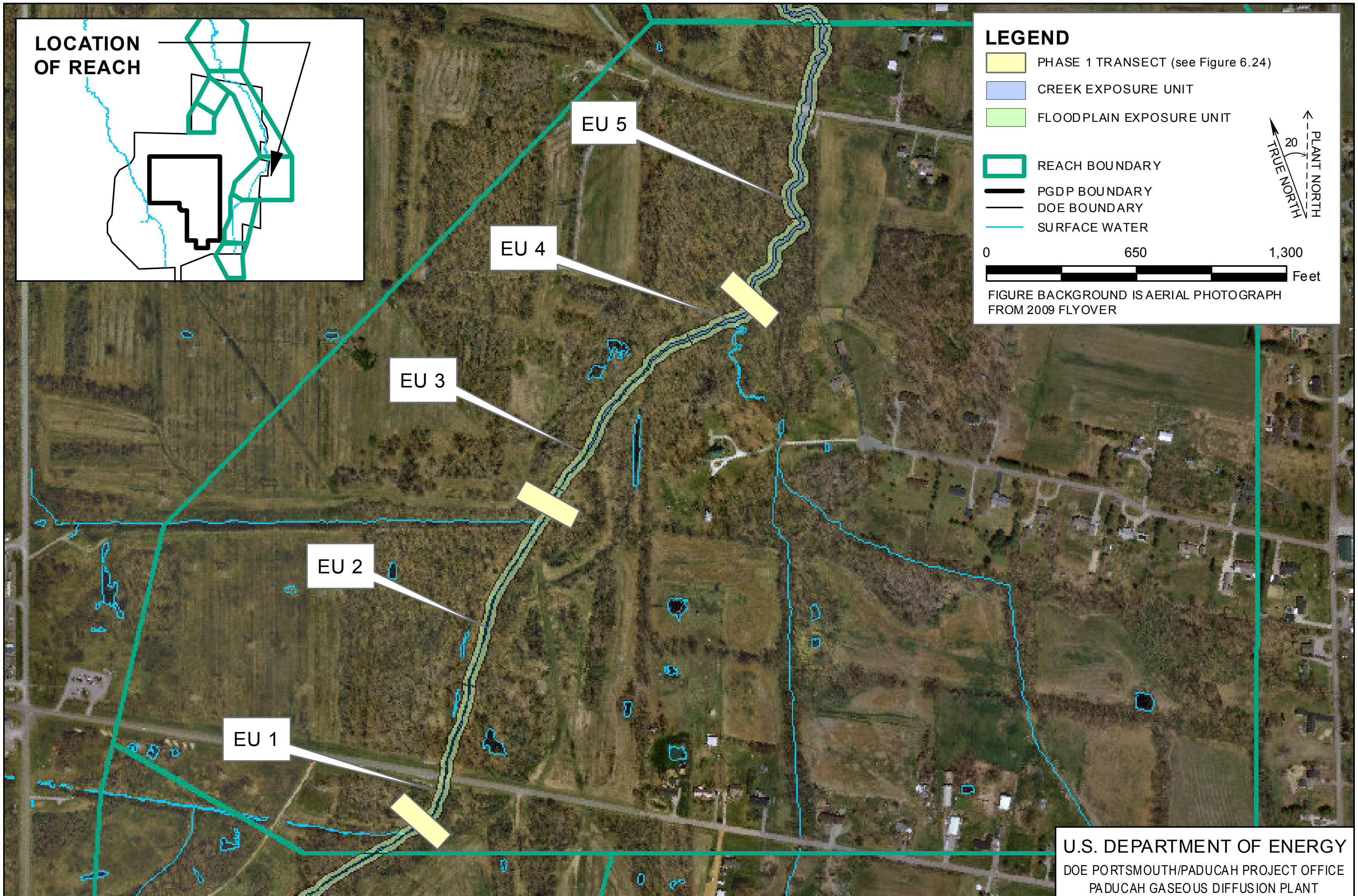

Figure 7.13. Planned Sampling at Little Bayou Creek Reach 2

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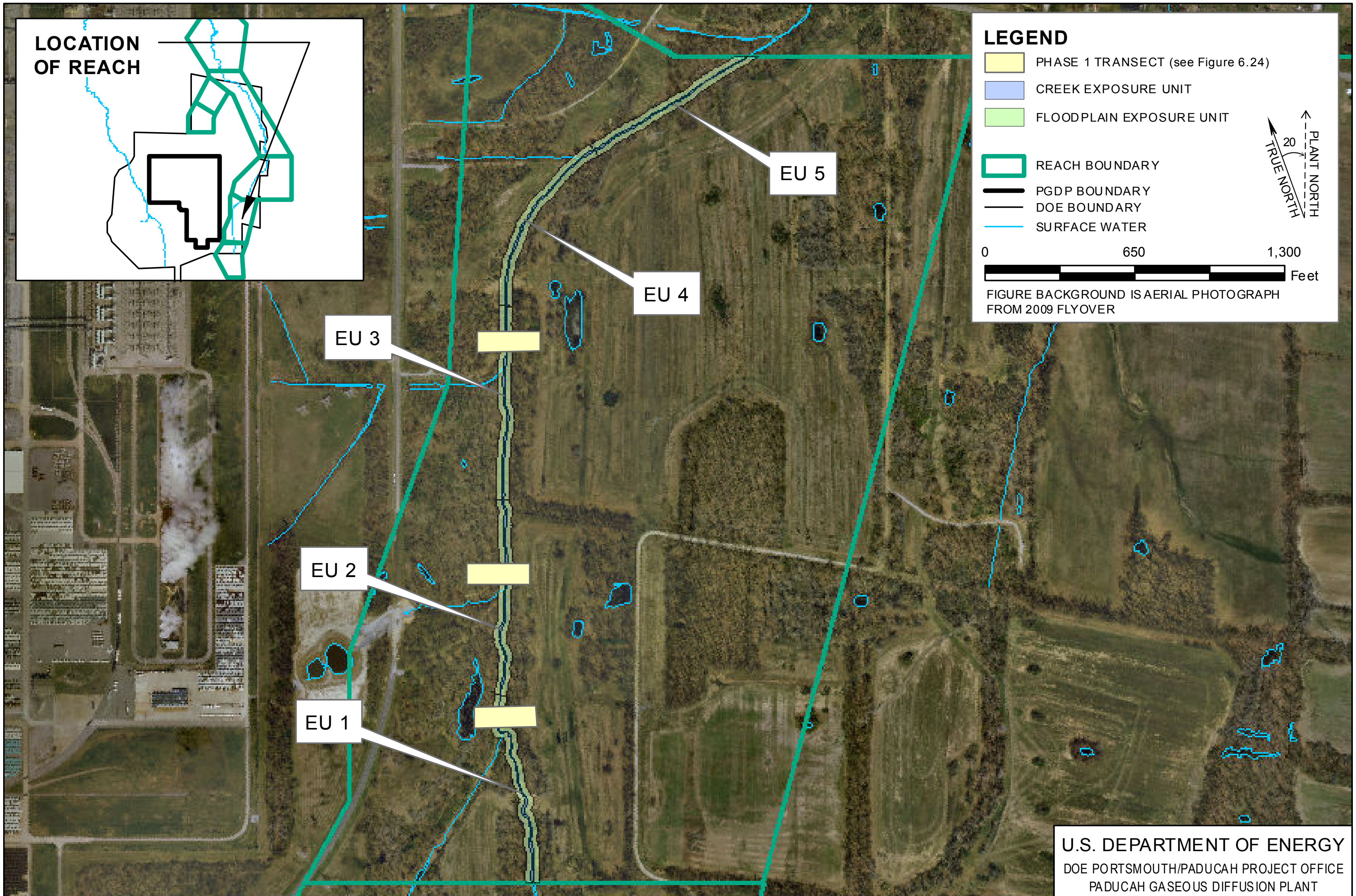

Figure 7.14. Planned Sampling at Little Bayou Creek Reach 3

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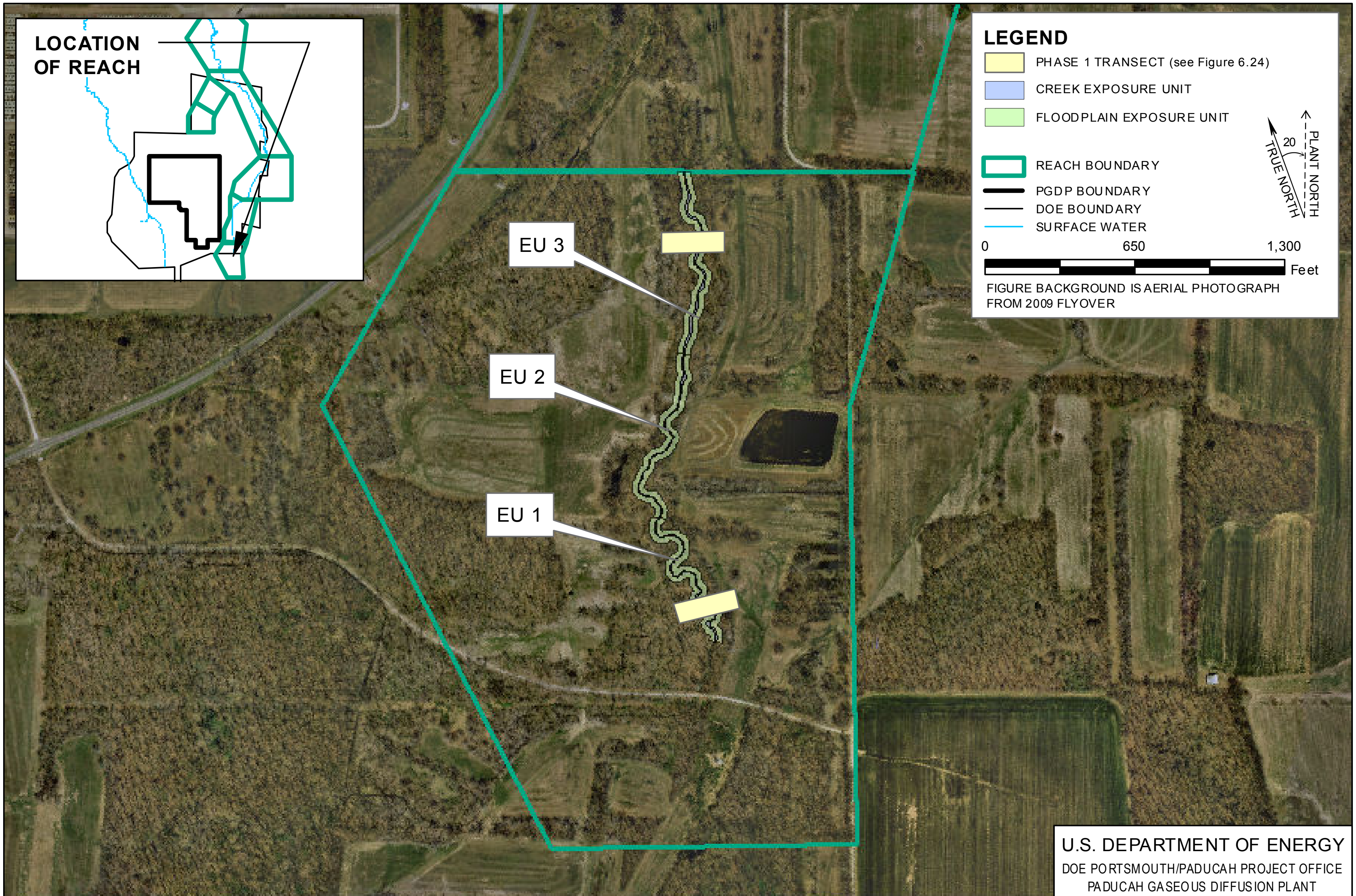

Figure 7.15. Planned Sampling at Little Bayou Creek Reach 4

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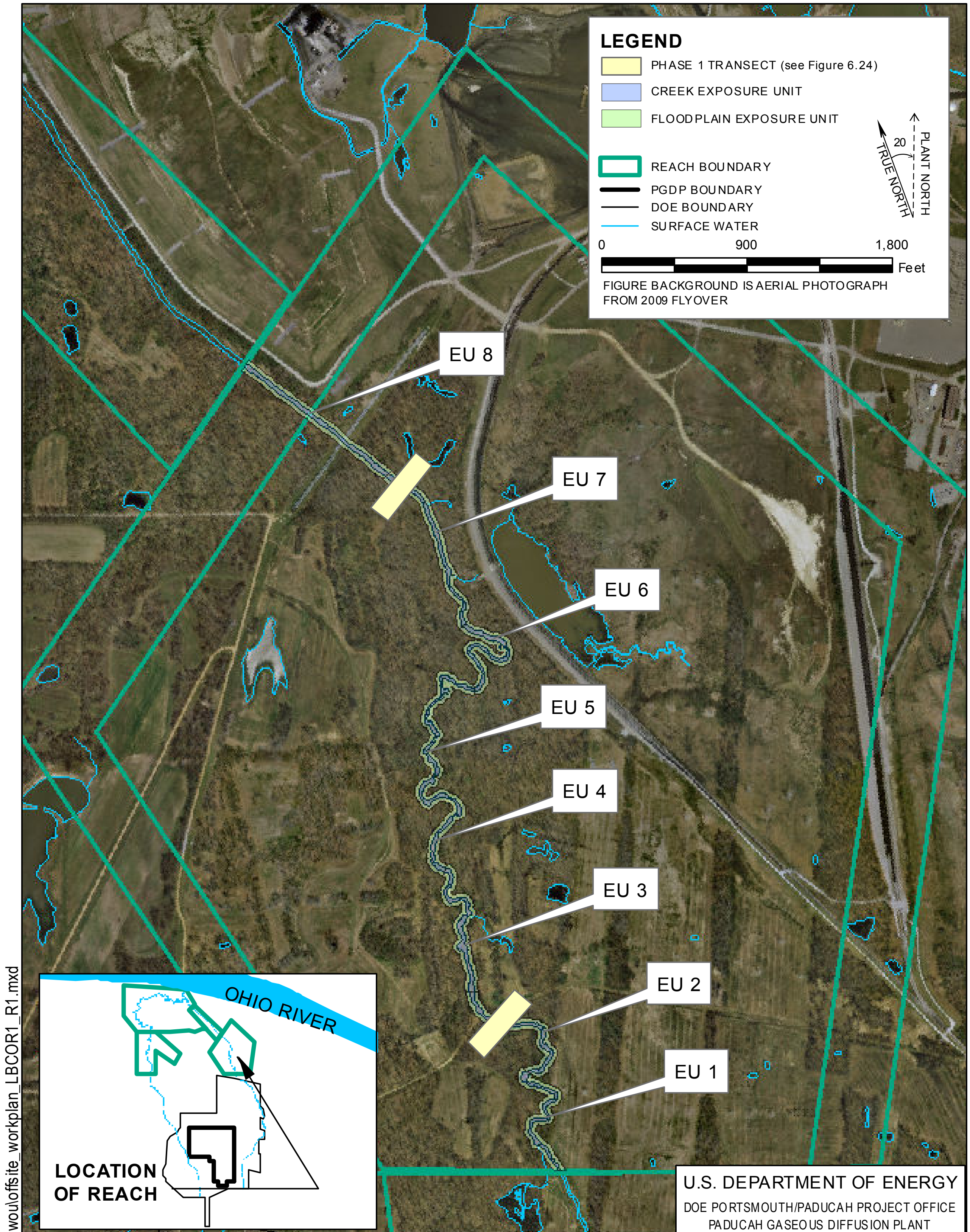

Figure 7.16. Planned Sampling at Little Bayou Creek Ohio River Floodplain Reach 1

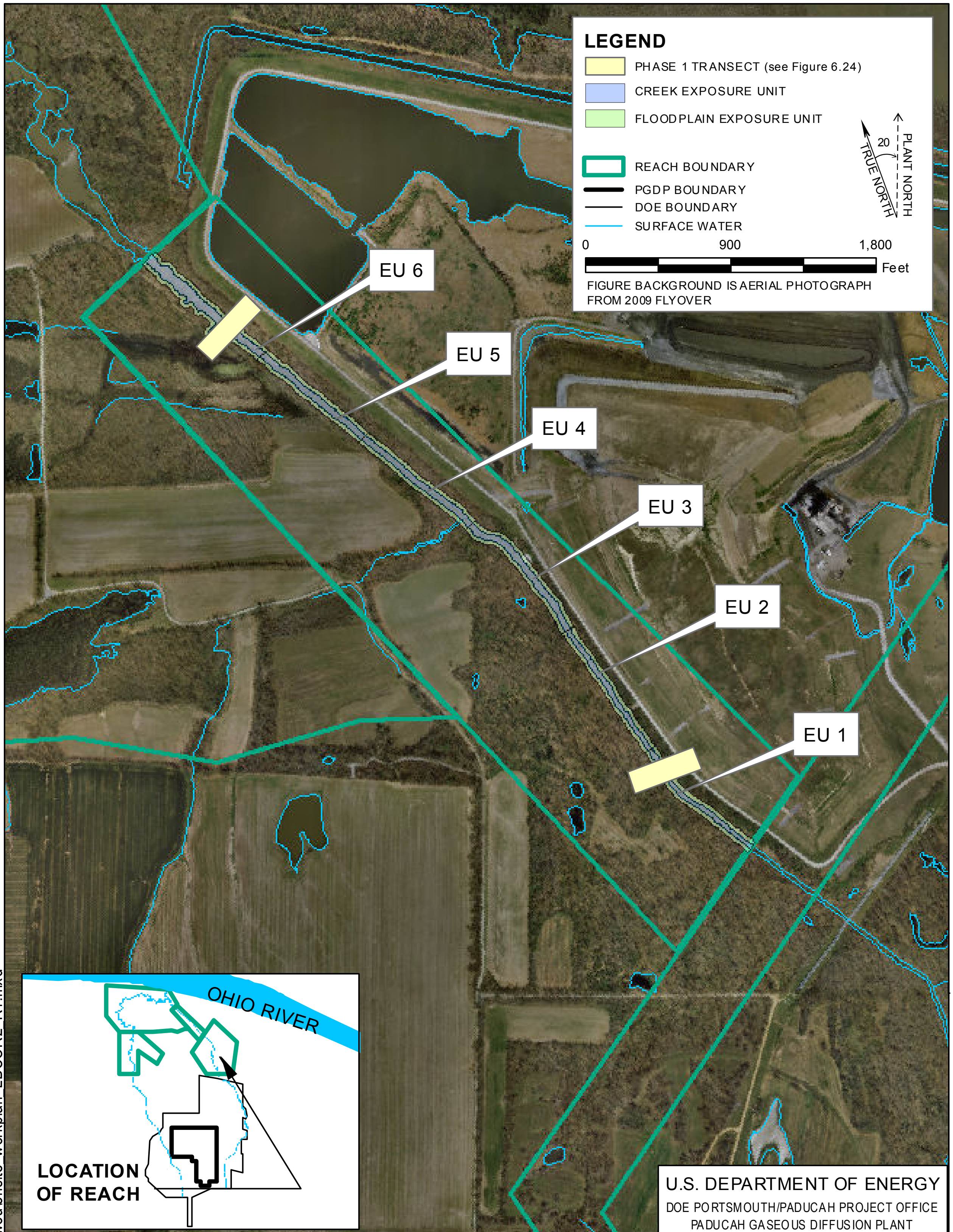

Figure 7.17. Planned Sampling at Little Bayou Creek Ohio River Floodplain Reach 2

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7.8 SEEPS AREA

The seeps area is part of the Little Bayou Creek (Figure 6.11), due to the fact that this area receives water from the groundwater, additional ecological sampling has been included; therefore, only the Field Sampling Plan section has been included for this area. Data derived from the additional sampling covered in this subsection of the work plan also will support the BERA. The routine sampling for this area is covered in Section 7.6, Creek Reaches.

7.8.1 Field Sampling Plan

The purposes of the seeps area sampling are to understand better the potential for risk to identify ecological receptors of concern exposed to VOCs from the Northwest Plume surfacing to Little Bayou Creek in the Seeps Area EU and to answer the following question: Are dissolved-phase plume-related constituents (VOCs only) present in the surface water and/or sediment of the Seeps Area at levels that exceed risk thresholds for the ecological receptors of concern considering all lines of evidence? Tc-99 also is a PGDP-related contaminant in the Northwest Plume, but has been detected at concentrations well below levels of ecological concern. A review of recent data indicated that the maximum concentration of Tc-99 detected in the Northwest Plume in recent years is 313 pCi/L, which is well below the ecological NFA value of 2.47 E+05 pCi/L listed in the Risk Methods Document (DOE 2010b).

7.8.1.1 Sampling Strategy

Phase 1—Ecological. Samples will be collected from up to 10 sample locations at identified seep locations. At each sample location, a sediment (0–6 inches bgs) sample and surface water sample from the "throat" of the seep will be collected. Sampling will be performed during the time of year when concentrations are expected to peak, if seasonal fluctuations in groundwater influence to the creeks are present. Also, low-flow conditions are preferable to ensure that sampling occurs at a time when concentrations are greatest (i.e., not diluted by creek water during high flow events). Samples will be collected from the seep itself, not from water in the mixing zone downgradient of the seep. Additionally, reference sediment samples will be collected upgradient of the seep locations within the seep area.

VOCs (TCE and breakdown products) will be the only COC in the seeps area. Tc-99 also is a PGDP-related contaminant in the Northwest Plume, but it has been detected at concentrations well below levels of ecological concern. A review of recent data indicated that the maximum activity concentration of Tc-99 detected in the Northwest Plume in recent years is 313 pCi/L, which is well below the ecological No Further Action value listed in the Ecological Risk Methods Document (DOE 2011b; DOE 2010b).

Passive diffusion samplers (e.g., polyethylene bags, peepers) may be considered for the surface water samples to establish representative VOC concentrations at the surface water/groundwater interface zone. This method reduces the potential for "missing" pulses of contamination that may occur sporadically (e.g., if the groundwater plume only intersects with the creek after rainfall events, which causes the water table to rise to the point that it intersects with Little Bayou Creek) and allows for spatial delineation of seeps of highest contamination. A brief description of sampling methodology follows.

Diffusion samplers may be used for determining relative concentrations across a given area rather than absolute concentrations.

Deploy samplers at 10 groundwater/surface water interaction zones.

Retrieve samplers after equilibrium has been reached (suggested deployment time is dependent on chemical properties, temperature, and hydraulic conditions; typical "wait time" for VOCs is 2 weeks).

Submit samples to laboratory for analysis.

Decision Rules—Ecological:

If concentrations of analytes exceed aquatic benchmarks, or result in an FCM HQ > 1, the ecological risk assessment will proceed to Phase 2.

Phase 2—Ecological. It is assumed that FCM results from Phase 1 will not result in adverse effects because VOCs are not bioaccumulative. Therefore, the focus of Phase 2 is expected to be on potential impacts to local populations of aquatic receptors in direct contact with the seep contaminants. Steps for Phase 2 sampling are as follows:

Collect up to 7 benthic invertebrate community samples (5 Seep locations + 2 reference areas) co-located with sediment sample locations. Samples will be collected in areas as close as possible to the seeps (downgradient) that can be colonized by benthic invertebrates.

Perform up to 7 fathead minnow toxicity tests (5 Seep locations + 2 reference areas) co-located with sediment sample locations. Fish toxicity tests are selected over water flea tests due to the fact that fish appear to be more sensitive to the chemical(s) of concern (VOCs). The Canadian Water Quality Guidelines for the Protection of Aquatic Life evaluated both fish (trout) and daphnia toxicity data during the development of their WQC and based their benchmark value for TCE on the fish data due to greater sensitivity. Surface water samples for toxicity tests would be collected from the "throat" of the seep. Samples will not be collected from the mixing zone.

Five in stream surface water samples from immediately downstream of the seeps also will be collected during Phase 2 to determine the extent of mixing.

Up to 7 benthic invertebrate toxicity tests (5 Seep locations + 2 reference areas) will be performed. Sediment samples for toxicity tests to be collected immediately downgradient of seeps.

Decision Rules—Ecological:

For fish and benthic invertebrate toxicity tests, if the RPD of growth or survival is 20% or more from reference and control samples, it is assumed that biologically significant impacts are occurring due to exposure to VOCs.

For the benthic invertebrate community studies, if the target reach is determined to be in a lower (i.e., worse) water quality category than the reference reach according to the Commonwealth of Kentucky's MBI, then it is assumed that biologically significant impacts are occurring due to exposure to VOCs (or another contaminant).

7.8.1.2 Sampling Media and Methods

One type of sampling and data collection activity will be performed—intrusive media sampling (water and sediment). Investigation activities will use DOE Prime Contractor-approved procedures that are consistent with EPA procedures and protocols.

Intrusive Sampling

Various media samples will be collected to characterize areas that have been evaluated as having data gaps. The samples will be collected using DOE Prime Contractor-approved procedures and will be analyzed using field test methods, and selected samples will be submitted to a DOECAP-accredited analytical laboratory for analysis.

Sediment sampling. Sediment shall be collected at a depth of 0–6 inches bgs with the use of a stainless-steel sampler, hand auger, spoon, trowel, spade, or scoop.

Surface water sampling. Surface water samples will be collected at the "throat" of the seeps and immediately downstream of the seeps as unfiltered samples.

Ecological sampling. Benthic Invertebrate samples will be collected in accordance with acceptable EPA procedures.

7.8.1.3 Sample Analysis

Phase 1 sediment and surface water samples will be analyzed for VOCs (TCE and breakdown products only), geotechnical parameters (10% of surface samples), and TOC (sediment only).

Phase 2 sediment samples will be analyzed for 10-day *H. azteca* survival and growth toxicity test and benthic invertebrate community test.

Surface water samples will be analyzed for VOCs (TCE only) and fathead minnow (*P. promelas*) larval survival and growth toxicity test.

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8. OIL INVERSION RUBBLE DAMS (SWMUs 105, 106, 107, AND 129)

Four soil-covered rubble dams are to be evaluated. Each of these SWMUs consists of a concrete rubble dam within a particular outfall ditch constructed for the purpose of preventing oil from reaching the Bayou and Little Bayou Creeks that may be or may have been released from PGDP. The dams consist of inverted culvert piping that channels surface water from the base of the pond on the upstream side of the dam to a higher level on the downstream side. A description of each of the rubble dams follows:

- SWMU 105 (Rubble Dam Pile 3) is approximately 20 ft long and 10 ft wide. Materials at the site include concrete slabs, bed gravel, and dirt from PGDP road construction spoils. The concrete is partially buried, but approximately 50 yd^3 of concrete pieces is visible.

- SWMU 106 (Rubble Dam Pile 4) is approximately 25 ft long and 15 ft wide. Material at the site consists of concrete slabs from PGDP road construction spoils. The concrete is partially buried, but approximately 5 yd^3 of concrete pieces is visible.

- SWMU 107 (Rubble Dam Pile 5) is approximately 30 ft long and 20 ft wide. Material consists of concrete slabs from PGDP road construction spoils. The concrete is partially buried, but consists of a total of approximately 225 yd^3 of concrete pieces, with approximately 17 yd^3 of the concrete pieces visible.

- SWMU 129 (Rubble Dam Pile 27) is approximately 20 ft long and 8 ft wide. Materials consist of concrete slabs and rubble from PGDP. The concrete is partially buried, but approximately 3 yd^3 of concrete pieces is visible.

The dams at SWMU 106 and SWMU 129 were removed and replaced in 2010. Soil underneath each dam was sampled prior to constructing the new dam with clean materials. The waste generated from the dam removals was characterized and disposed of at the C-746-U Landfill.

8.1 LOCATION

Figure 8.1 shows the locations of the rubble dam SWMUs.

SWMU 105 is located on DOE-owned property east of PGDP and Dyke Road. It is within the outfall ditch for and upgradient of KPDES Outfall 011 where it discharges into Little Bayou Creek.

SWMU 106 is located on DOE-owned property east of PGDP and Dyke Road and south of McCaw Road. It is within the outfall ditch for and upgradient of KPDES Outfall 010 where it discharges into Little Bayou Creek.

SWMU 107 is located on DOE-owned property east of PGDP and Dyke Road. It is within the outfall ditch for and upgradient of KPDES Outfall 002 where it discharges into Little Bayou Creek. SWMU 107 is immediately downgradient of SWMU 175 Concrete Rubble Pile.

SWMU 129 is located on DOE-owned property west of the PGDP. It is within the outfall ditch for and upgradient of KPDES Outfall 008 where it discharges into Bayou Creek.

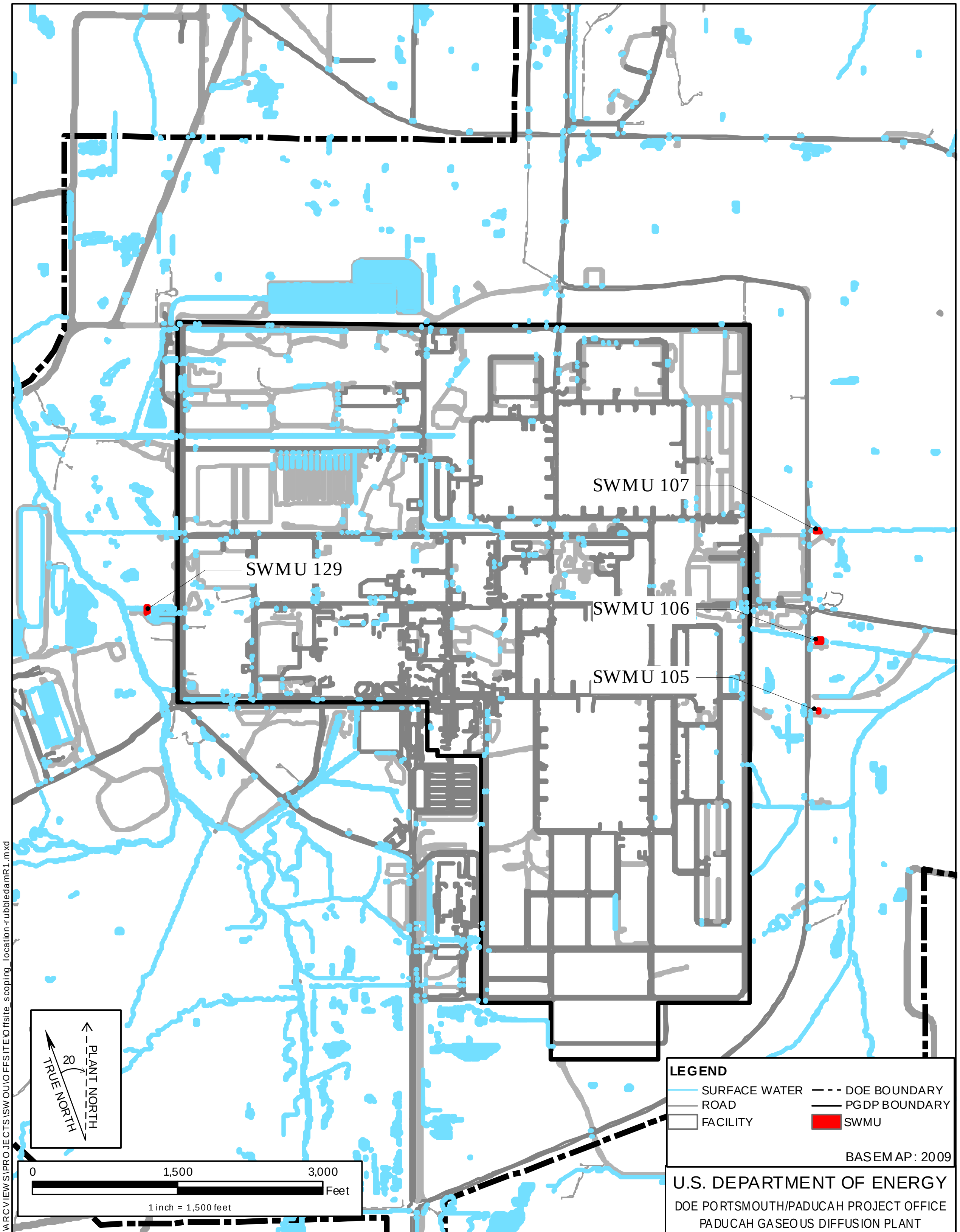

Figure 8.1. Location of SWMUs 105, 106, 107, and 129

8.2 OPERATION HISTORY

These four rubble dams have been in operation since the early 1980s, and each one is constructed to allow water flow from the bottom of the upstream pond. This construction allows capture of any oil that may be floating on the water surface upstream of the dam from entering either Bayou Creek or Little Bayou Creek. That purpose is intended to continue throughout plant operations at PGDP.

8.3 OPERATIONAL CSM

The operational CSM is illustrated in Figure 5.1. The rubble dams consist primarily of concrete slabs. Surface water runoff from the rubble dams is directed into Little Bayou Creek and Bayou Creek.

8.4 NATURE AND EXTENT

SWMU 105 (Rubble Dam Pile 3)

In the early 1990s, concrete and soil at SWMU 105 were surveyed for radiation. The concrete was surveyed for beta and gamma radiation and the soil was surveyed for gamma radiation. Those surveys found no radiation above background levels (DOE 1997). The Waste Area Group (WAG) 17 RCRA Facility Investigation (RFI)/RI (DOE 1997) included a visual inspection of the site and a review of the screening results. At Outfall 011, the only detection of note was 52 pCi/L Tc-99 in surface water. No elevated radiation as been found in the sediments at the outfall.

The area surrounding SWMU 105 was sampled during the SWOU SI. Maximum concentrations detected in this area were Total PCBs at 16,300 µg/kg downstream of the dam, uranium-238 activity at 83.4 pCi/g downstream of the dam, and cesium-137 activity at 0.34 pCi/g downstream of the dam.

Figure 8.2 shows locations of historical sampling conducted near SWMU 105.

SWMU 106 (Rubble Dam Pile 4)

In the early 1990s, the concrete and surrounding soil at SWMU 106 were screened for beta and gamma radiation. Those surveys found contamination in the concrete with maximum readings approximately 1,600 counts per minute (cpm) greater than background levels. The concrete slabs with elevated readings were marked with red paint. Gamma surveys of soil found no radiation above background levels. The WAG 17 RFI/RI (DOE 1997) included a visual inspection of the site, a review of the screening results, an Ultrasonic Ranging and Data System (USRADS) survey of the site, and sampling of the concrete. The USRADS survey identified three locations with pancake probe gamma readings greater than the SWMU reference value (73 cpm), while no location at the site had sodium iodide probe readings greater than the SWMU gamma reference value. Biased surveys at the three locations had mean readings of 705 cpm, 1,551 cpm, and 620 cpm, all of which exceed both the SWMU reference value and the PGDP background value (160 cpm). The WAG 17 RFI/RI report concluded that, other than the three locations with elevated radioactivity, widespread radiation is not present at the site (DOE 1997).

The area surrounding SWMU 106 was sampled for the exposure unit at Outfall 010 during the SWOU SI. Maximum concentrations detected in this area were uranium-238 activity at 12.27 pCi/g upstream of the dam and cesium-137 activity at 0.81 pCi/g upstream of the dam. Total PCBs were not detected in the area surrounding SWMU 106.

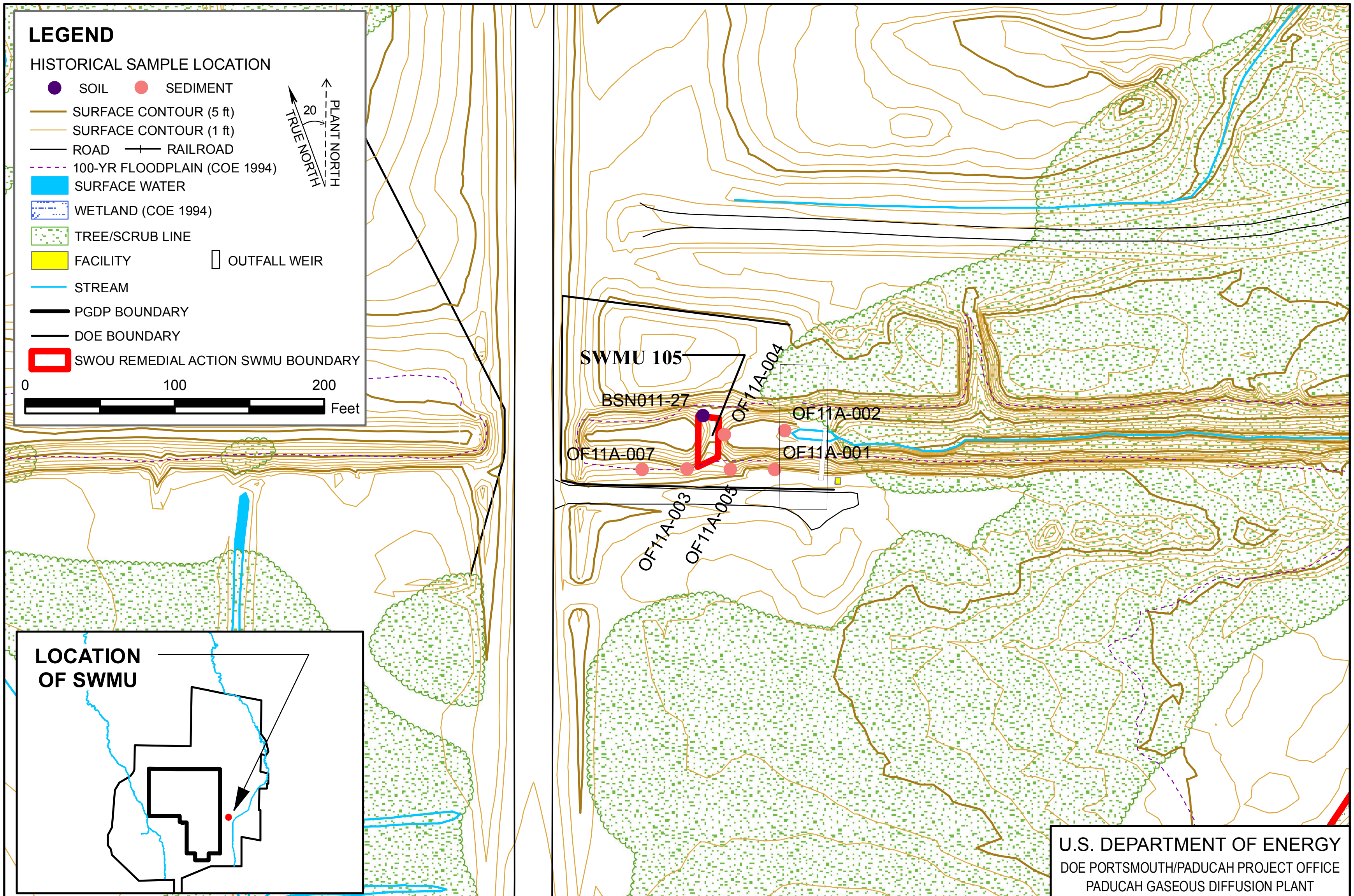

Figure 8.2. Historical Sampling near SWMU 105

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After replacement of the rubble dam in 2010, sampling results indicate uranium-238 was detected just above background (1.2 pCi/g in surface and subsurface) at 1.33 pCi/g. PCBs were detected at 11 ppb.

Figure 8.3 shows locations of historical sampling conducted near SWMU 106.

SWMU 107 (Rubble Dam Pile 5)

In the early 1990s, concrete and soil at SWMU 107 were surveyed for radiation; during this time beta and gamma radiation was found on five slabs with maximum readings of approximately 400 cpm greater than background. The contaminated concrete slabs were marked with red paint. The gamma surveys of soil found no radiation above background levels. The WAG 17 RFI/RI included a visual inspection of the site, a review of the screening results, and a USRADS survey (DOE 1997). The USRADS survey identified areas with radiation on the north side of the dam and one location with radiological contamination when measured with a sodium iodide probe reading. A biased survey was completed at this location and resulted in a maximum reading of 2,322 cpm, which was less than the PGDP background value of 3,274 cpm. No samples were collected at the site. At Outfall 002, Tc-99 has been identified in the surface water at activities as high as 60 pCi/L, but not in the corresponding sediments. No other elevated radionuclides have been identified at Outfall 002. Detections of Tc-99 also have been identified upgradient of the concrete rubble in the ditch.

The area surrounding SWMU 107 was sampled for the exposure unit at Outfall 002 during the SWOU SI. Maximum concentrations detected in this area were Total PCBs at 2,350 µg/kg upstream of the dam, Uranium-238 activity at 20.8 pCi/g upstream of the dam, and cesium-137 activity at 0.96 pCi/g upstream of the dam.

Figure 8.4 shows locations of historical sampling conducted near SWMU 107.

SWMU 129 (Rubble Dam Pile 27)

In the early 1990s, concrete at SWMU 129 was screened for beta, and gamma radiation and soil at the site was screened for gamma radiation. Neither survey detected radiation above background levels. The WAG 17 RFI/RI included a visual inspection of the site and a review of the screening results (DOE 1997). At Outfall 008, Tc-99 has been identified historically in the surface water with activities up to 37 pCi/L, U-234 up to 6.8 pCi/L, and U-238 up to 7.1 pCi/L. However, none of these contaminants have been found in the corresponding sediments near Outfall 008. Detections of Tc-99, U-234, and U-238 have been identified upgradient of the concrete rubble in the ditch, indicating that the rubble is not likely the source of these constituents.

The area surrounding SWMU 129 was sampled for the EU at Outfall 008 during the SWOU SI. Maximum concentrations detected in this area were total PCBs at 320 µg/kg downstream of the dam, uranium-238 activity at 15.55 pCi/g in an adjacent ditch to the dam, and cesium-137 activity at 0.91 pCi/g upstream of the dam. Beryllium, chromium, and vanadium also were detected above background values. After replacement of the rubble dam in 2010, sampling results indicate uranium-238 was detected just above background (1.2 pCi/g in surface and subsurface) at 2.56 pCi/g. PCBs were detected at 42 ppb.

Figure 8.5 shows locations of historical sampling conducted near SWMU 129.

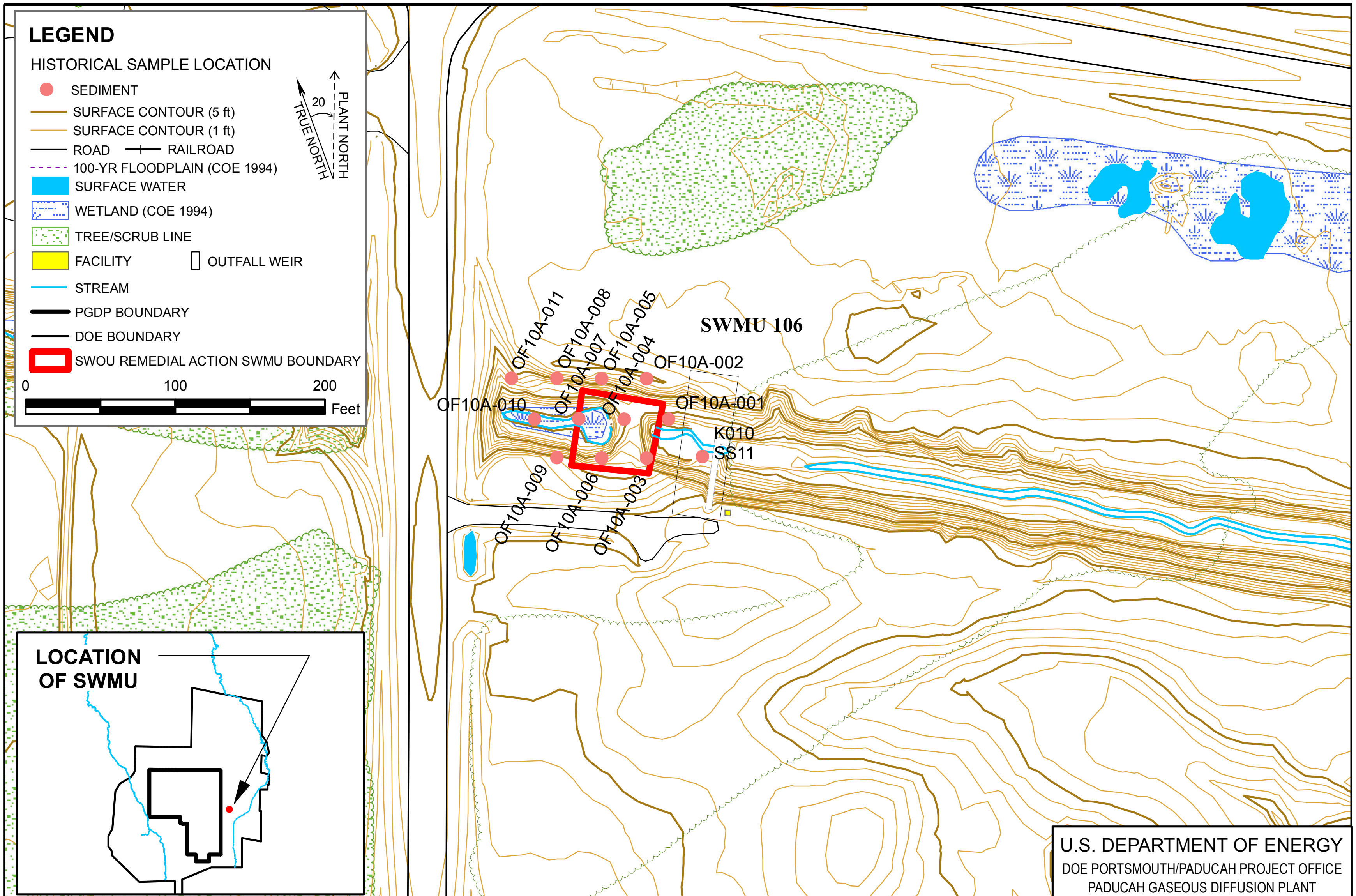

Figure 8.3. Historical Sampling near SWMU 106

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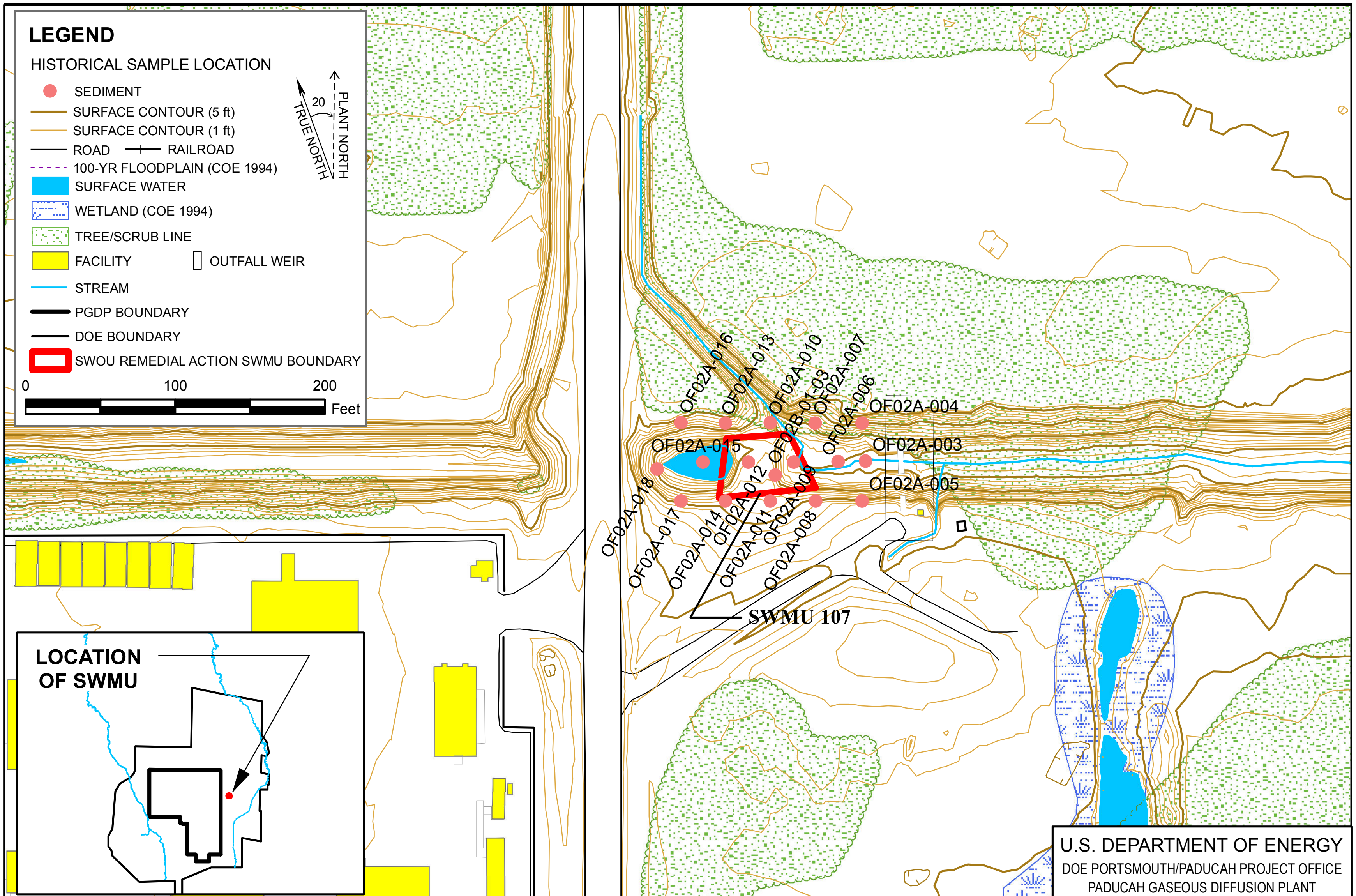

Figure 8.4. Historical Sampling near SWMU 107

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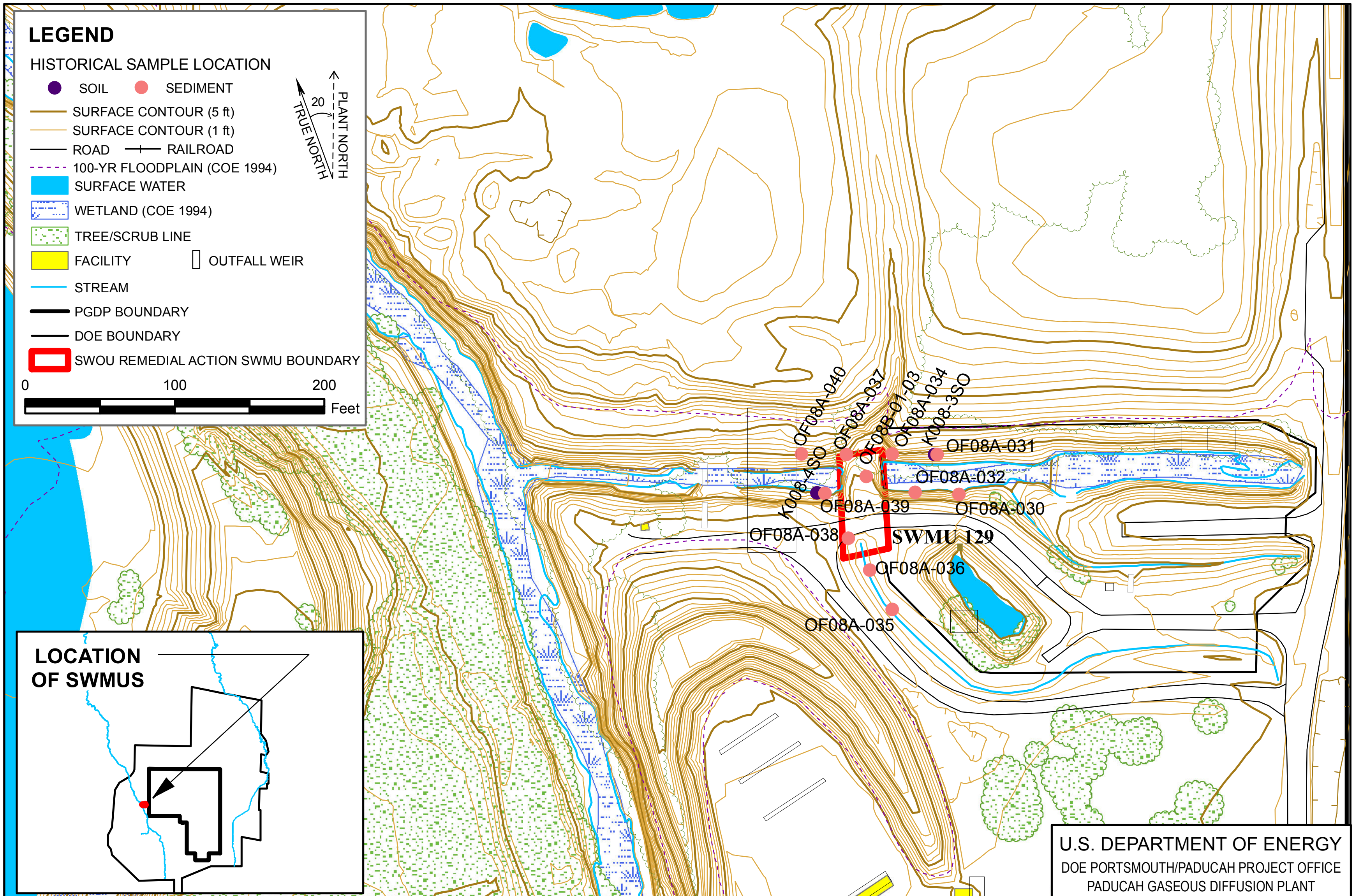

Figure 8.5. Historical Sampling near SWMU 129

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8.5 PREVIOUS RISK ASSESSMENT DISCUSSION/SUMMARY

It should be noted that previous risk assessments utilized different decision rules than those that will be used for this RI/FS. If risk estimates were recalculated using current methods, exposure parameters, and toxicity information, the results could differ markedly; however, the assessments did indicate the contaminants and media that needed to be considered during the scoping of this work plan.

SWMU 105 (Rubble Dam Pile 3)

No previous risk assessment information is available for SWMU 105.

SWMU 106 (Rubble Dam Pile 4)

A BHHRA for SWMU 106 was performed during the WAG 17 RFI/RI work, and the results of this assessment were presented in the WAG 17 RFI/RI report (DOE 1997). This BHHRA is no longer representative of the current state as the dam was removed and replaced with clean material in 2010.

The SERA conducted as part of the WAG 17 RFI/RI included SWMU 106. No complete ecological exposure pathways were identified for concrete; therefore, no COPECs were retained for this site.

SWMU 107 (Rubble Dam Pile 5)

SWMU 107 was evaluated as part of the WAG 17 RFI/RI, and it contained no human health COPCs (DOE 1997). The SERA conducted as part of the WAG 17 RFI/RI included SWMU 107. No complete ecological exposure pathways were identified for concrete; therefore, no COPECs were retained for this site.

SWMU 129 (Rubble Dam Pile 27)

SWMU 129 was evaluated as part of the WAG 17 RFI/RI, and it contained no human health COPCs (DOE 1997). This evaluation, however, is not representative of the current conditions as the dam was removed and replaced with clean material in 2010. The SERA conducted as part of the WAG 17 RI included SWMU 129. There was no evidence of concrete or soil radiological contamination; therefore, no COPECs were retained for this site.

All Oil Dams

Further, all of these SWMUs, 105, 106, 107, and 129, were sampled during the SWOU SI (DOE 2008a) and excavation was not required during the removal action as defined by the EE/CA Action Memo (DOE 2009a).

8.6 PREVIOUS ACTIONS TAKEN

SWMUs 105, 106, 107, and 129 were constructed in the early 1980s to contain discharges of oil released to the outfalls. The outfalls and their SWMU numbers upstream of each of the Oil Inversion Rubble Dams are provided below:

- SWMU 105—KPDES Outfall 011 SWMU 67
- SWMU 106—KPDES Outfall 010, SWMU 66
- SWMU 107—KPDES Outfall 002, SWMU 60

- SWMU 129—KPDES Outfall 008, SWMU 63

Due to concerns about the presence of PCBs and radiological contamination in outfalls at the plant, ICMs were instituted in 1992 to restrict public access to creeks, outfalls, and lagoons surrounding PGDP. Access restriction was accomplished through the installation of fencing and the posting of warning signs at various off-site locations. Subsequently, in 2000, additional warning signs were posted that identified the creeks, outfalls, and lagoons as contaminated areas. In 2008, warning signs were posted along the creeks that identified some areas as potentially contaminated.

<u>SWMU 105 (Rubble Dam Pile 3)</u>

In 1983, Outfall 011 was the object of an extensive PCB "hot spot" excavation conducted by DOE (Ashburn 1983) where the upper 1.5 ft of sediment in the Outfall 011 ditch from the PGDP security fence to Dyke Road was excavated to remove PCB contamination, and the ditch was restored with clean material (Ashburn 1983). There have been no CERCLA actions for the internal plant ditches to Outfall 011; however, DOE has implemented several remedial measures and treatability studies in areas of Outfall 011 located outside of the plant security fence.

<u>SWMUs 105 (Rubble Dam Pile 3) and 106 (Rubble Dam Pile 4)</u>

In 1994, discharge water from the C-617 Treatment Lagoon was diverted from Outfall 011 to Outfall 010 to mitigate resuspension of PCB-contaminated sediment. In 1995, the DOE coated the Outfall 011 ditch with a bentonite concentrate to prevent erosion and potential contaminant migration. In 1996, the DOE performed a Nature's Way bioremediation technology field demonstration in an effort to minimize/eliminate further PCB releases at the PGDP (LMES 1997). Test data from the field demonstration indicated that PCB concentrations in the samples were lower than the pre-application samples.

<u>SWMUs 106 (Rubble Dam Pile 4) and 129 (Rubble Dam Pile 27)</u>

On January 19, 2007, the DOE submitted a non-time-critical Removal Notification for SWOU (On-Site) indicating that a removal action was warranted based upon the results of the SI/BRA (DOE 2008a). Subsequent to receiving Removal Notification approval, the DOE prepared an EE/CA that described the environmental conditions that supported the need for a removal action, developed and evaluated various alternatives, and recommended the preferred alternative. The recommended response action cited within the EE/CA (DOE 2008b) is consistent with the final actions for the PGDP and will contribute to the efficient performance of long-term remediation of PGDP. An Action Memorandum (DOE 2009a) was followed by preparation and issuance of a Removal Action Work Plan (DOE 2009b), and execution of a removal action that was completed in 2010 to remove sediment and soil that meet certain risk-based concentrations developed to meet the objectives of the SWOU (On-Site) SI. Results of this removal action are documented in the *Removal Action Report for Contaminated Sediment Associated with The Surface Water Operable Unit (On-Site) at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-0357&D1 (DOE 2010a). Removal actions were recommended and carried out at Outfall 008 (SWMU 63) upgradient of SWMU 129 and Outfall 010 (SWMU 66) upgradient of SWMU 106.

During the 2010 removal of the rubble dams at SWMU 106 and SWMU 129, samples were taken after removing the old dams and piping, but prior to replacing them with clean materials. Two samples were taken from the bottom and one sample on each sidewall of each excavation. Samples were analyzed for constituents consistent with the *Work Plan for the Soils Operable Unit RI/FS at the Paducah Gaseous Diffusion Plant Paducah, Kentucky*, DOE/LX/07-0120&D2/R2 (DOE 2010c). Resulting data from this removal show that uranium-238 (1.33—2.56 pCi/g) was detected just above background (1.2 pCi/g for both surface and subsurface soils) and significantly lower than the 3.64 pCi/g recreator "no-action" level. The same sampling effort had analytical results for PCBs that were detected from 11–42 mg/kg.

8.7 RISK EXPOSURE CSM

The risk exposure CSM is illustrated in Figure 5.2. The potential sources at the rubble dams consist primarily of concrete slabs. Potential contamination from the rubble dams may have migrated to on-site ditches and outfalls via runoff or the rubble itself may provide media for exposure. The rubble dams have a direct contact and incidental ingestion ELCR for rubble to the current/future industrial worker, future resident, current/future recreational users, and terrestrial biota.

8.8 REMAINING PROBLEMS

Remaining problems for SWMUs 105, 106, 107, and 129 are discussed further within this section.

8.8.1 Characterization and Inventory of Potential Exposure Media

The volume and type of potential exposure media for each of the oil inversion rubble dams are shown in Table 8.1.

Table 8.1. Volume and Type of Potential Exposure Media for Oil Inversion Rubble Dams

SWMU	Volume and Type of Potential Exposure Media
105	50 yd^3 of concrete slabs, bed gravel, and dirt from PGDP road construction spoils
106	5 yd^3 of new materials (2010)
107	approximately 225 yd^3 of concrete slabs from PGDP road construction spoils
129	3 yd^3 new materials (2010)

8.8.2 Information Status of Key Assessment Factors

Table 8.2 identifies the status of key assessment factors.

Table 8.2. Status of Key Assessment Factors for SWMUs 105, 106, 107, and 129

SWMU	Waste Handling Practices	Contamination		Migration of Contamination	
		Presence	Extent	Surface Runoff	Infiltration
105	A	A	A	A	A
106	NA	NA	NA	NA	NA
107	A	A	A	A	A
129	NA	NA	NA	NA	NA

A—Factor is adequately defined. Current information is adequate to design a targeted sampling plan, but data gaps and uncertainties are such that the goals and objectives of the RI/FS cannot be met.
NA—Not applicable; replaced with new materials in 2010.
Information provided in this table is taken from DOE 1999.

8.8.3 Release Potential from Contaminant Sources

The surfaces of the concrete rubble in SWMU 105 and SWMU 107 may have been in contact with radioactive materials, PCB-bearing oils, and/or associated metals while inside the PGDP plant area. Since placement of the concrete rubble at each of the oil dam areas, weathering processes may have caused leaching of these potential contaminants to surface water and sediment in the outfall ditch. Some of the concrete and associated bed gravel and dirt is in direct contact with surface water and sediment at the sampling station. Given the low mobility of the potential contaminants, significant migration into subsurface soil or shallow groundwater is not considered to be a problem.

The concrete rubble is not likely to be a continuing source of contaminants. Concrete rubble on the DOE Reservation was placed at the various sites up to 20 years ago (DOE 1996) and all the contaminants leachable under natural conditions probably have been removed. Contaminants remaining on the concrete have adsorbed or bonded to the concrete, and additional leaching to soil would require extremely low pH conditions not likely in the natural environment at PGDP. Any contaminants remaining on the concrete, however, could pose a minimal exposure risk to human health or the environment through direct contact. Runoff from concrete surfaces is a potential, but not a likely, migration pathway.

Surface water in the ditch is in contact with some of the concrete rubble, providing another potential contaminant pathway, both by sediment and aqueous transport. Although it is likely that any contaminants leached from the concrete to sediment and surface water have been transported from the site already, no data are available to confirm or deny their presence.

This is no longer the case at the concrete rubble dams within SWMU 106 and SWMU 129 because they were removed and replaced with clean material in 2010 and were described in greater detail in Section 8.6

8.9 REMEDIAL ALTERNATIVES DEVELOPMENT SUMMARY

Potential response actions can be found in Appendix C.

8.10 DATA NEEDS

<u>SWMU 105 (Rubble Dam Pile 3)</u>

Existing information on SWMU 105 is limited to results of a radiation survey that indicated no elevated readings above background. No samples have been collected at the site to confirm the presence or absence of contaminants. The proposed data needs from the site include a radiometric survey and surface soil samples to determine the presence or absence of contamination and to calculate the true average of contamination of the surface soil across the dam.

<u>SWMU 106 (Rubble Dam Pile 4)</u>

There are no data needs for SWMU 106 because a removal action occurred in 2010, as previously discussed in Section 8.7. The 2010 data are included in Appendix D.

<u>SWMU 107 (Rubble Dam Pile 5)</u>

Existing information on SWMU 107 includes results of a radiation screening survey and a USRADS survey. The USRADS data suggests that radiation is present in surface soil at the site. No samples have been collected at the site for analysis to confirm the presence or absence of contaminants. The proposed data needs from the site include a radiometric survey and surface soil samples to determine the presence or absence of contamination and to calculate the true average of contamination of the surface soil across the dam.

SWMU 129 (Rubble Dam Pile 27)

There are no data needs for SWMU 129 because a removal action occurred in 2010, as previously discussed in this section. The 2010 data are included in Appendix D.

8.11 FIELD SAMPLING PLAN

The purpose for sampling at SWMUs 105 (Rubble Dam Pile 3) and 107 (Rubble Dam Pile 5) is to calculate the true average of contamination across the surface of each of the dams. It is assumed that the final end state for the rubble dams after the RI is that they will remain in place, because they will continue to serve an important environmental function that prevents the potential spread of contamination in the event of a release from the PGDP into the surface water systems and, as such, will continue to be maintained as industrial facilities. To aid in that purpose, access controls will be maintained; therefore, direct exposure to surface materials is the only human health concern under the current condition.

8.11.1 Sampling Strategy

Sampling for human health is consistent with the surface soil sampling plan from Soils OU RI/FS Work Plan (DOE 2010c). A schematic diagram is shown in Figure 8.6. Sampling will include a radiological walkover and the collection of soil samples conducted as follows:

The radiological walkover survey will include 100% survey of exposed surfaces including intake and discharge pipes. If the radiological survey indicates elevated levels in soil areas, one biased grab soil sample (0–6 inches) will be collected at the location with the elevated level. Surface soil grab samples will be collected from the exposed surface of each dam using a grid appropriate to the size of the dam. If a sample cannot be obtained in accordance with the grid, a replacement/contingency sample will be collected and will be documented in the deviations section of the RI report. For objects with the potential for surface contamination (i.e., concrete, plastic, metal), a radiological survey will be performed to assess total and removable contamination.

No specifically ecologically-focused sampling is planned for the following reasons:

The rubble dams are not expected to serve as habitat. Muskrats or other burrowing animals may compromise the function of dams and these would be removed. Smaller organisms may use the rubble dams, but populations would not be adversely affected by dam-related contamination due to the extremely small size of the dams in relation to available area of habitat adjacent to the dams.

Evaluation for ecological risks can be done using data collected to support human health and nature extent efforts.

Surface soil samples will be collected from the surface of the dam structure at the oil inversion rubble dams. Sediment samples will be taken upgradient and downgradient of the dams within the respective outfall ditches during the field effort for Phase I field sampling for Bayou Creek and Little Bayou Creeks, as discussed in Sections 6 and 7 of this work plan. In addition, sediment samples will be collected within the respective outfall ditches of the rubble dams from the weirs to the confluence of the outfall ditch to either Bayou or Little Bayou Creek during the field sampling for the creeks, as discussed in Sections 6 and 7 of this work plan.

Decision Rules:

The following decision rules will be applied to this sampling effort:

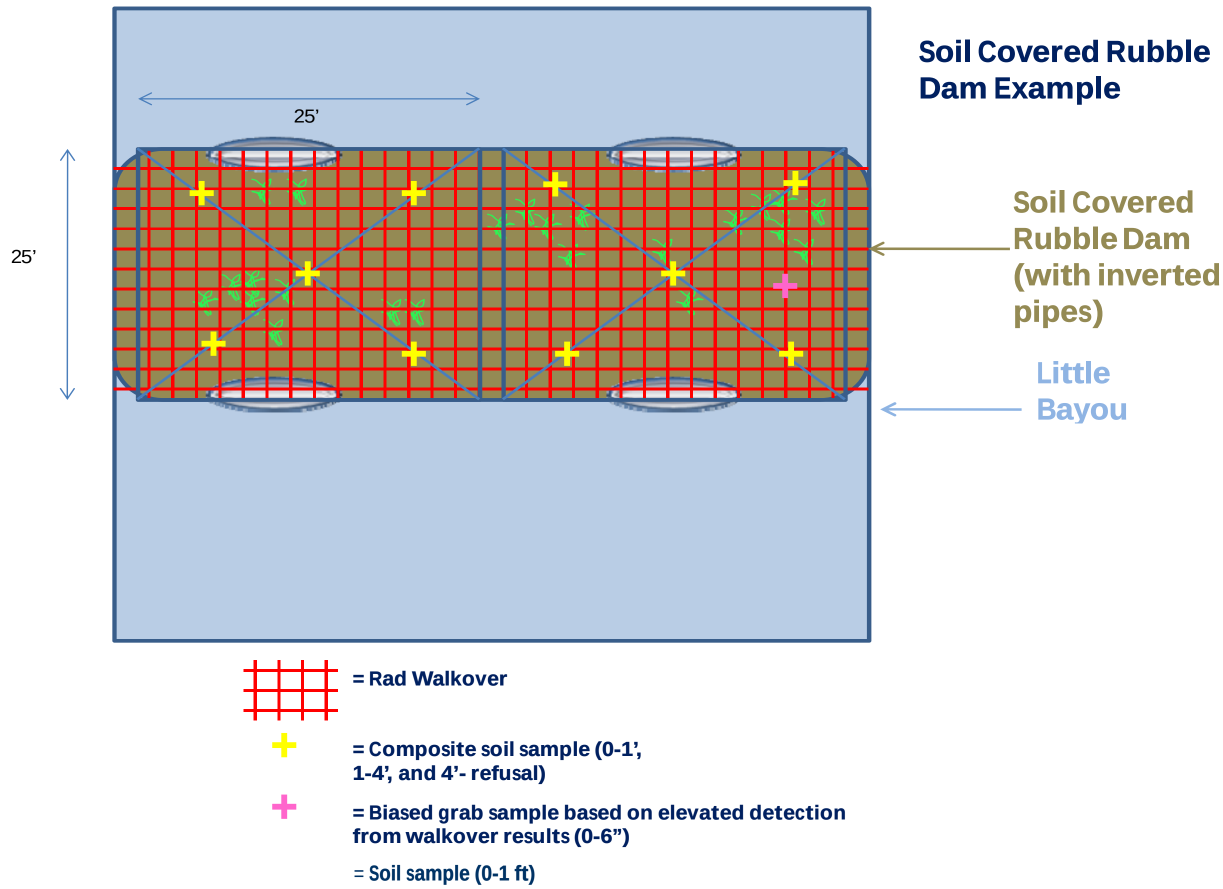

Figure 8.6. Example Schematic Diagram of Sampling Rubble Dam

If surface soil sample results for the dam exceed a cumulative human health ELCR of 1 x 10^{-6} or an HI of 1 for the appropriate worker scenario, (EPC equals the 95% UCL on the mean) then the dam moves to the FS for decision making. If any surface soil sample from the rubble dam exceeds any action level corresponding to the appropriate worker scenario, the sample location will be identified as a hot spot. The extent of the hot spot may be determined either by adjacent sample results that are below the action level or by contingency sampling, but will not extend past the SWMU boundary.

A SERA (Steps 1 and 2 of the 8-step process) will be performed, but no further evaluation is considered necessary because ecological risk is not expected to be significant at the rubble dams due to limited habitat size and quality, and based on the assumption that any significant harmful ecological effects will be captured by human health decisions. Additional ecological evaluation may be performed based on professional judgment.

8.11.1.1 Sampling media and methods

Two types of sampling and data collection activities will be performed—nonintrusive data collection (radiation walkover surveys) and intrusive media sampling (soil). Investigation activities will use DOE Prime Contractor-approved procedures that are consistent with EPA procedures and protocols.

Nonintrusive Data Collection

A radiological walkover survey of each SWMU will be performed using a FIDLER or similar instrument coupled with a GPS device. The intent of the radiological walkover of the SWMUs is for investigative purposes to indicate areas of elevated gamma radiation, which may be attributed to increased radioactivity in the soil.

Intrusive Sampling

Various media samples will be collected to characterize areas that have data gaps. The samples will be collected using DOE Prime Contractor-approved procedures and will be submitted to a DOECAP-accredited laboratory for analysis.

Soil Sampling. Soil shall be collected at a depth of 0–1 ft bgs with the use of a stainless-steel sampler, hand auger, spoon, trowel, spade, or scoop.

8.11.1.2 Sample analysis

The analytical suite, which may be revised based on the Phase 1 Creek sample results, will include metals, radionuclides, PAHs, and PCBs.

8.11.1.3 Sampling procedures

Sampling procedures are described in the QAPP for this work plan (Section 17).

8.11.1.4 Documentation

Requirements for documentation are located in the QAPP for this work plan (Section 17).

8.11.1.5 Sample location survey

GPS coordinates in 1602 Kentucky State Plane South Zone with submeter accuracy will be obtained for all sampling locations, including the locations from the radiological walkover survey. Additionally, depths for each sample obtained also will be recorded. Where possible, flags or wooden or metal stakes will be used to mark sampling locations. Each sampling location will be described with field maps and photographs. This will enable reestablishment of the sampling locations if the markers are disturbed or cannot be placed.

8.11.1.6 Maps/locations

Figures 8.7 and 8.8 illustrate sampling planned for SWMUs 105 (Rubble Dam Pile 3) and 107 (Rubble Dam Pile 5).

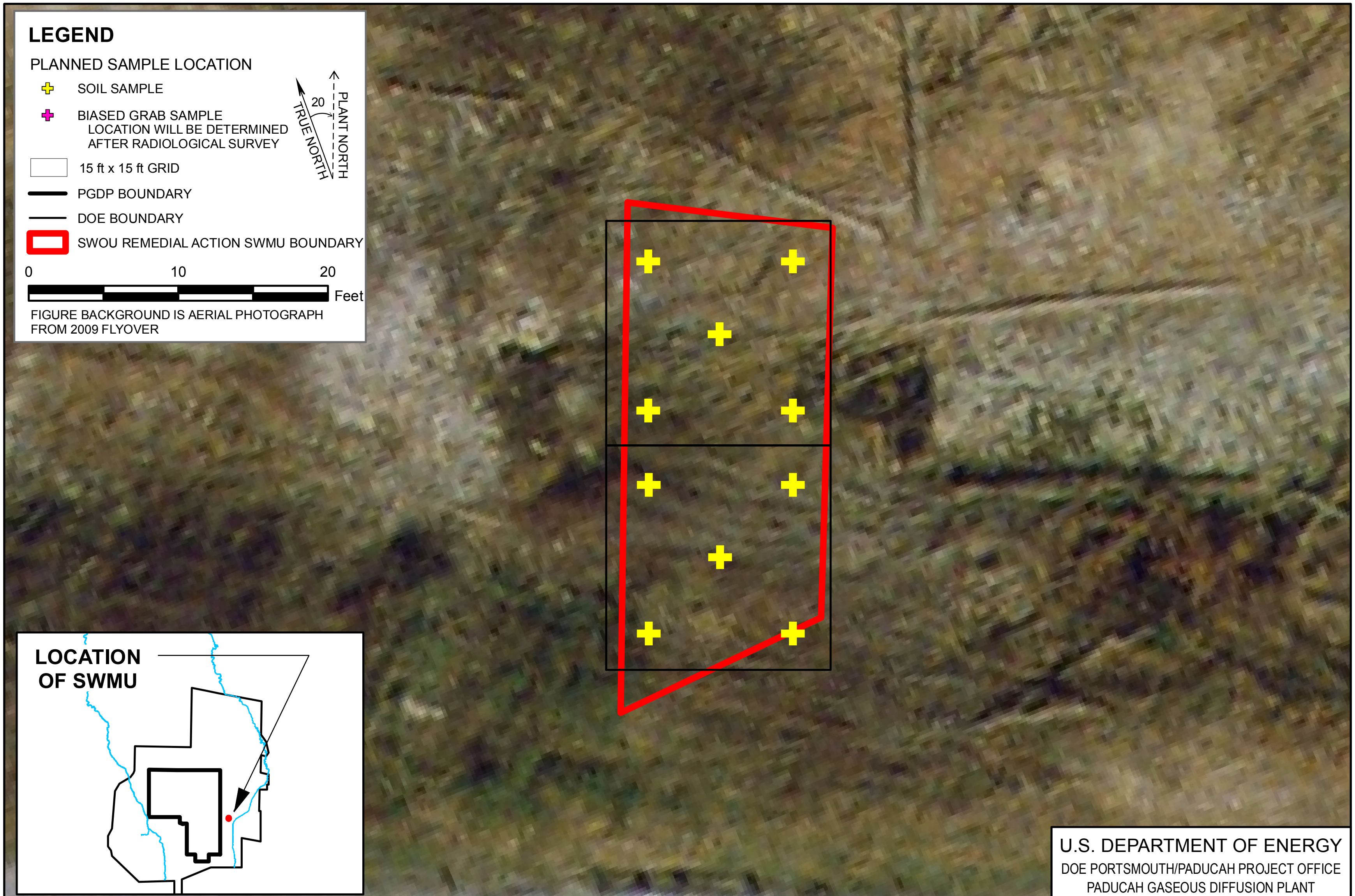

Figure 8.7. Planned Sampling at SWMU 105

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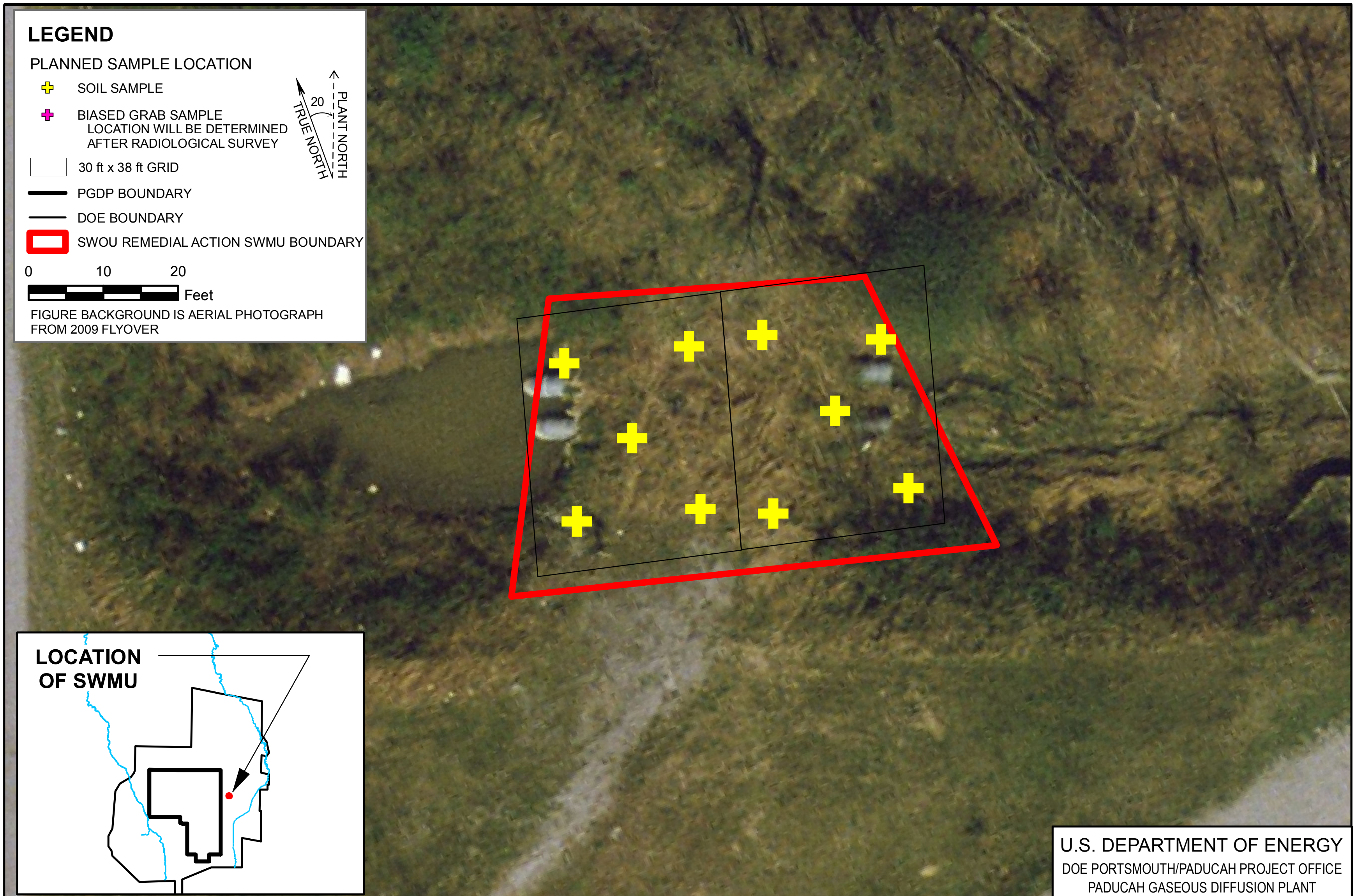

Figure 8.8. Planned Sampling at SWMU 107

LATA Environmental Services of Kentucky, LLC

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9. HORSE CROSSING (SWMU 108)

Material at the site consists of concrete slabs that may have come from PGDP roadway construction spoils. The concrete slabs were placed within the culvert to provide a crossing over Little Bayou Creek for hunters and equestrians. The approximate volume of concrete is 100 yd^3.

9.1 LOCATION

SWMU 108 is located at the horse trail culvert near the confluence of Little Bayou Creek and the ditch leading from KPDES Outfall 002 (Figure 9.1). The site is east of the PGDP, east of Dyke Road and within the DOE Reservation. It is downstream of SWMUs 60, Outfall 002; SWMU 107 Oil Inversion dam (see previous chapter); and 175 Concrete Rubble pile.

9.2 OPERATION HISTORY

Exact dates are unknown, but the concrete slabs likely were placed at this location in the late 1980s.

9.3 OPERATIONAL CSM

The operational CSM is illustrated in Figure 5.1. SWMU 108 is in the Little Bayou Creek watershed.

9.4 NATURE AND EXTENT

In the early 1990s, concrete and soil at the site was screened for radiation. Beta and gamma screening of the concrete indicated no radiation above background levels. Gamma screening of the soil upstream and downstream of the culverts indicated areas approximately 3 ft above the water level with gamma radiation up to 60,000 cpm over background. The WAG 17 RFI/RI included a visual inspection of the site, a review of the screening results, and PCB screening of the soil (DOE 1997). Three soil samples were collected for PCB field screening. Two of the samples were < 0.5 mg/kg, while the third sample had a reading of 16.0 to 25.0 mg/kg. The positive reading for PCBs at this one location resulted in the collection of a fourth sample that was submitted for laboratory analysis. Results of analysis indicated the presence of PCBs: Aroclor 1248 was detected at a concentration of 30 µg/kg, and Aroclor 1260 was detected at a concentration of 43 µg/kg. The sample also had a gross alpha activity of 6.80 $\pm$ 4.50 pCi/g and a gross beta activity of 2.90 $\pm$ 1.20 pCi/g. In accordance with agreements on historical data use (see Section 15), these data are not included in Appendix D.

9.5 PREVIOUS RISK ASSESSMENT DISCUSSION/SUMMARY

It should be noted that previous risk assessments utilized different decision rules than those that will be used for this RI/FS. If risk estimates were recalculated using current methods, exposure parameters, and toxicity information, the results could differ markedly; however, the assessments did indicate the contaminants and media that needed to be considered during the scoping of this work plan.

A BHHRA was performed using data collected at SWMU 108 (Horse Crossing) as part of the WAG 17 RFI/RI (DOE 1997). For the recreational user, the total ELCR across all pathways at SWMU 108 equaled

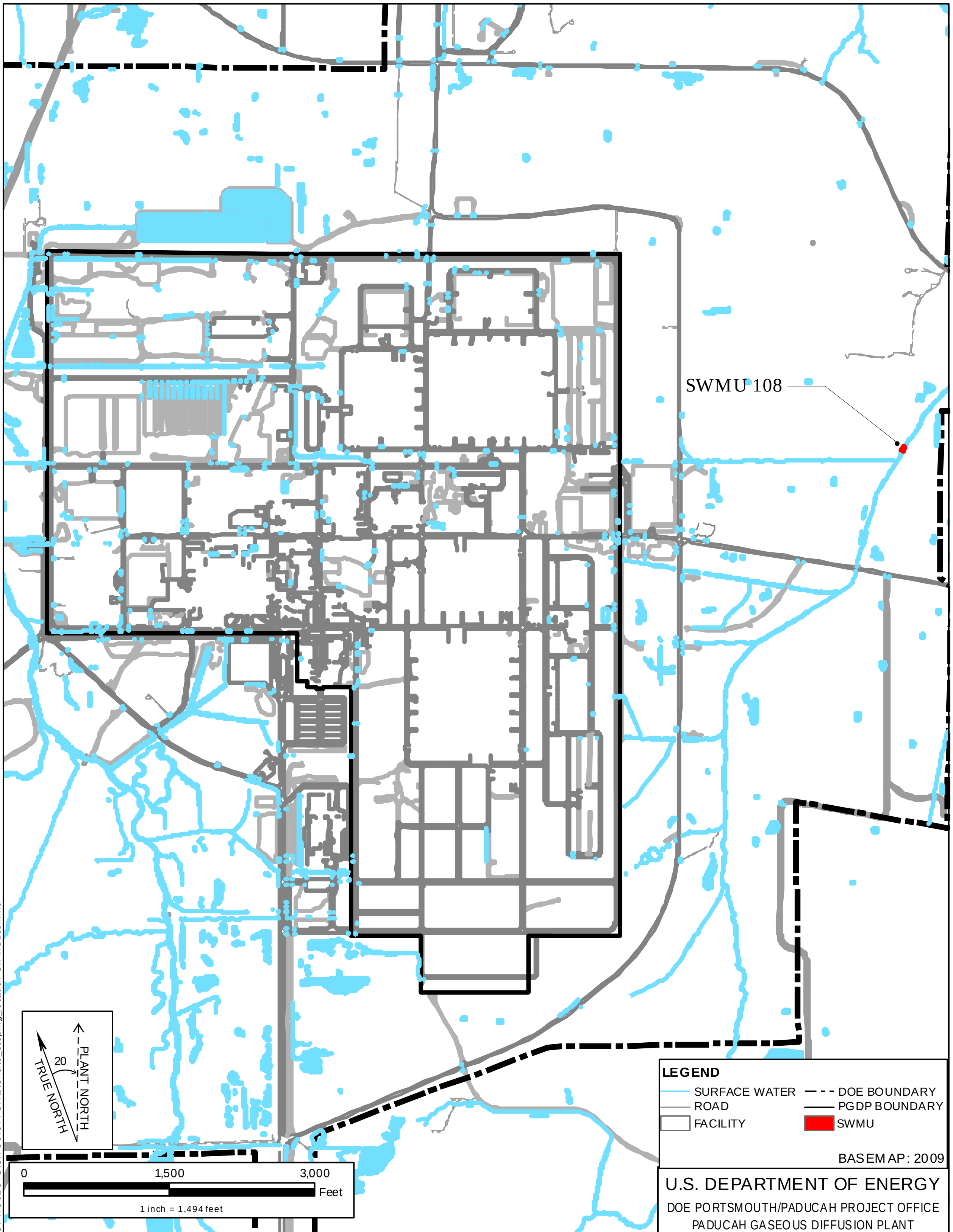

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Figure 9.1. Location of SWMU 108

3×10^{-7}. For sediment, the pathways include incidental ingestion, dermal contact, inhalation, and external exposure to ionizing radiation. External exposure to ionizing radiation was also a pathway for concrete. For surface water, the exposure routes include incidental ingestion, dermal contact, and external exposure to ionizing radiation. No contaminants that drive risk were determined for this surface water exposure scenario. Also, there were no COPCs with toxicity information to evaluate total ELCR for the industrial worker scenario.

The screening ecological risk assessment conducted as part of the WAG 17 RI included SWMU 108 (Horse Crossing) (DOE 1997). Surface soil and sediment were evaluated for potential risks to benthic macroinvertebrates, soil microflora, soil invertebrates, terrestrial plants, and terrestrial wildlife. While no analytes were found to exceed toxicological benchmarks for any ecological endpoints, Aroclors 1248 and 1260 were retained as COPECs because no benchmarks were available for soil microflora or soil invertebrates for these compounds.

9.6 PREVIOUS ACTIONS TAKEN

No response actions have been implemented at SWMU 108 (Horse Crossing).

9.7 RISK EXPOSURE CSM

The risk exposure CSM is illustrated in Figure 5.2. The potential source at SWMU 108 (Horse Crossing) consists of concrete slabs. Contamination from SWMU 108, if it exists, may have migrated to Little Bayou Creek via runoff or the rubble itself may provide direct exposure to the current/future industrial worker, future resident, current/future recreational users, or terrestrial biota.

9.8 REMAINING PROBLEMS

Remaining problems for SWMU 108 (Horse Crossing) are discussed further within this section.

9.8.1 Characterization and Inventory of Potential Exposure Media

The culvert is 20 ft x 20 ft x 10 ft deep and there are two 8-ft diameter pipes, 22 ft long, laid in the Little Bayou Creek bed covered with concrete slabs and packed with bank gravel. The total volume of rubble pack around the horse crossing is 150 yd^3, about 100 yd^3 of which is in the culvert. Radiological scanning in 1992 indicated beta radiation at 210,000 dpm in the last ft of the culvert. The WAG 17 RFI/RI stated that PCBs were detected in surface soil: Aroclor 1248 (0.03 mg/kg) and Aroclor 1260 (0.043 mg/kg) (DOE 1997).

9.8.2 Information Status of Key Assessment Factors

Table 9.1 identifies the status of key assessment factors.

Table 9.1. Status of Key Assessment Factors for SWMU 108

SWMU	Description	Waste Handling Practices	Contamination		Migration of Contamination	
			Presence	Extent	Surface Runoff	Infiltration
108	Concrete rubble	A	A	A	A	A

A—Factor is adequately defined. Current information is adequate to design a targeted sampling plan, but data gaps and uncertainties are such that the goals and objectives of the RI/FS cannot be met.
Information provided in this table is taken from DOE 1999.

9.8.3 Release Potential from Contaminant Sources

The surfaces of the concrete rubble may have been contaminated while inside the PGDP plant area from contact with radionuclides, PCB-bearing oils, and associated metals. Data from the WAG 17 investigation confirms the presence of PCBs and radionuclides in surface soil at SWMU 108. Since placement of the concrete rubble at SWMU 108 (Horse Crossing), weathering processes may have caused leaching of potential contaminants to sediment and surface water in the ditch. Given the low mobility of the potential contaminants, significant migration into subsurface soil or shallow groundwater is not considered a problem.

The concrete rubble likely is not a continuing source of contaminants. Concrete rubble on the DOE Reservation was placed at the various sites up to 20 years ago (DOE 1996), and all the contaminants leachable under natural conditions probably have been removed. Contaminants remaining on the concrete have adsorbed or bonded to the concrete, and additional leaching to soil would require extremely low pH conditions not likely in the natural environment at PGDP. Any contaminants remaining on the concrete, however, could pose a threat to human health or the environment through contact with exposed surfaces. Runoff from concrete surfaces is a potential, but not a likely, migration pathway.

Surface water in the ditch is in contact with some of the concrete rubble, providing another potential contaminant pathway, both by sediment and aqueous transport. Although it is likely that any contaminants leached from the concrete to sediment and surface water already have been transported from the site, no data are currently available to confirm their presence or absence.

9.9 REMEDIAL ALTERNATIVES DEVELOPMENT SUMMARY

A potential remedy for this site is removal and replacement of this crossing due to fixed contamination, followed by sampling to verify that all contaminants have been addressed. The action may be scheduled to occur during other remedial actions on Little Bayou Creek (SWMU 64). If no action is taken for Little Bayou Creek or if there is another convenient time, then action for SWMU 108 (Horse Crossing) will be coordinated with any similar activities.

9.10 DATA NEEDS

The primary data needs for SWMU 108 are to define the nature, extent, and release of contamination to the environment. That is, to determine if contaminants from SWMU 108 (Horse Crossing) are being added to Little Bayou Creek and, if so, are they adversely affecting it. In order to determine this, sediment samples from Little Bayou Creek will be collected upgradient and downgradient of SWMU 108 (Horse Crossing).

9.11 FIELD SAMPLING PLAN

9.11.1 Sampling Strategy

The purpose of collecting samples is to understand better the nature and extent of contamination. To that end, samples will be collected from SWMU 108 (Horse Crossing) as shown on Figure 9.2. These samples will be collected during the Phase 1 Little Bayou Creek sampling, as described in Section 7, and will be used to develop Phase 2 sampling for Little Bayou Creek.

9.11.1.1 Sampling media and methods

One type of sampling and data collection activity will be performed—intrusive media sampling (sediment and soil). Investigation activities will use DOE Prime Contractor-approved procedures that are consistent with EPA procedures and protocols.

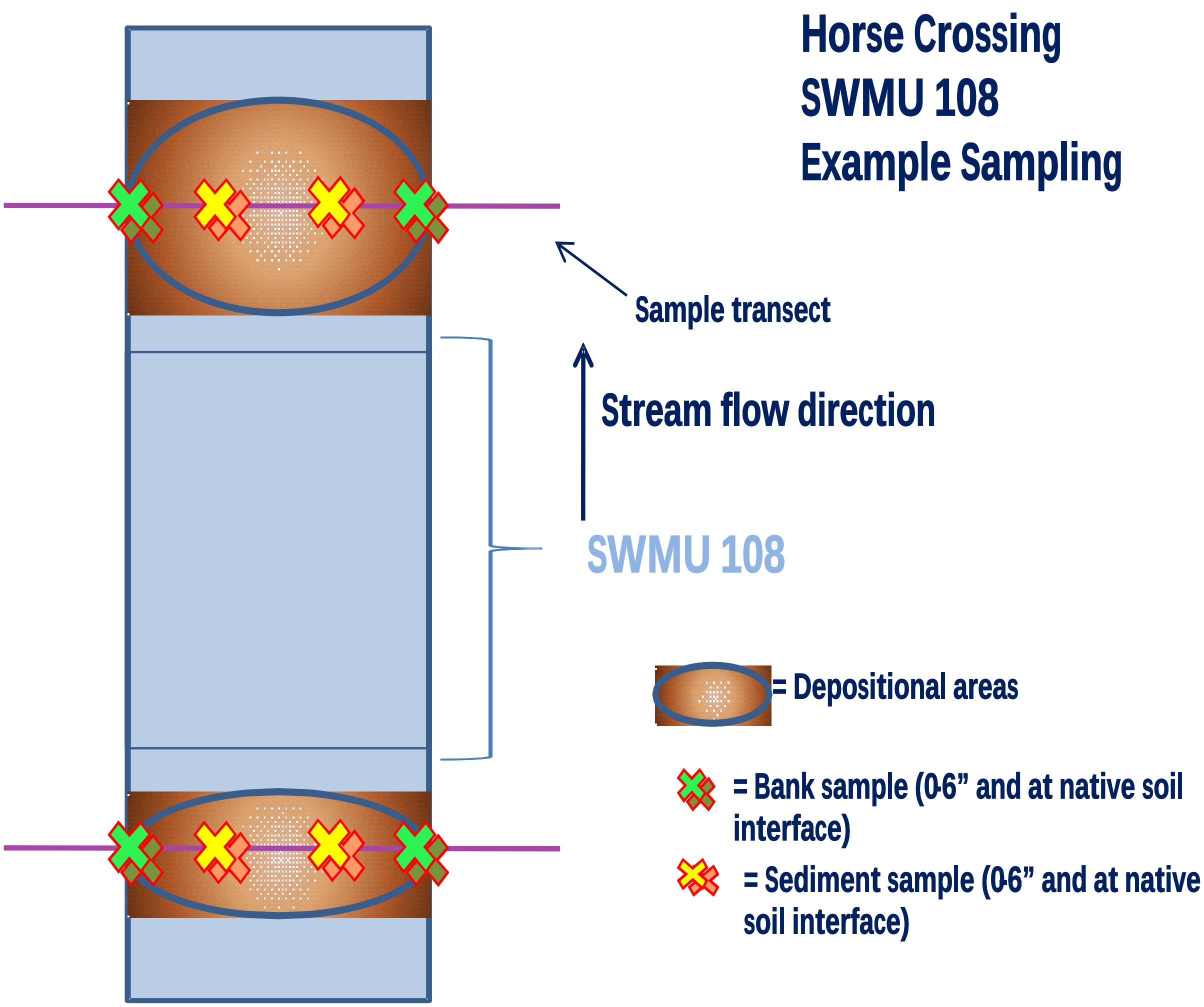

Figure 9.2. Schematic of SWMU 108 Sampling

Intrusive Sampling

Various media samples will be collected to characterize areas that have data gaps. The samples will be collected using DOE prime contractor-approved procedures and will be submitted to a DOECAP-accredited laboratory for analysis.

Sediment/Soil Sampling. Sediment/soil shall be collected at a depth of 0–6 inches bgs and at the sediment/native soil interface with the use of a stainless-steel sampler, hand auger, spoon, trowel, spade, or scoop.

9.11.1.2 Sample analysis

Analytical requirements are based on Phase 1 Little Bayou Creek sampling (Section 7). Since high quality data is desired for decision making and to establish the analytes for Phase 2 of the creek sampling, fixed-based laboratory analyses will be performed. Samples will be analyzed for metals, radionuclides, PAHs, and PCBs. If PCBs are detected in any of the samples, one congener evaluation will be performed per transect. The decision on which sample to be run for the congener analysis will be made with consideration of and in conjunction with other creek samples; however, the evaluation will be run only on a sample that has a positive detection for PCBs. In order to perform the congener evaluation on the same sample that has a detection of PCB, the fixed-base laboratory will need to hold the extract from the PCB analysis until the RI PM or designee has determined the samples on which to perform a congener evaluation.

9.11.1.3 Sampling procedures

Sampling procedures are described in the QAPP for this work plan (Section 17).

9.11.1.4 Documentation

Requirements for documentation are located in the QAPP for this work plan (Section 17).

9.11.1.5 Sample location survey

GPS coordinates in 1602 Kentucky State Plane South Zone with submeter accuracy will be obtained for all sampling locations. Additionally, depths for each sample obtained also will be recorded. Where possible, flags or wooden or metal stakes will be used to mark sampling locations. Each sampling location will be described with field maps and photographs. This will enable reestablishment of the sampling locations if the markers are disturbed or cannot be placed.

9.11.1.6 Maps/locations

Figure 9.3 illustrates sampling planned for SWMU 108.

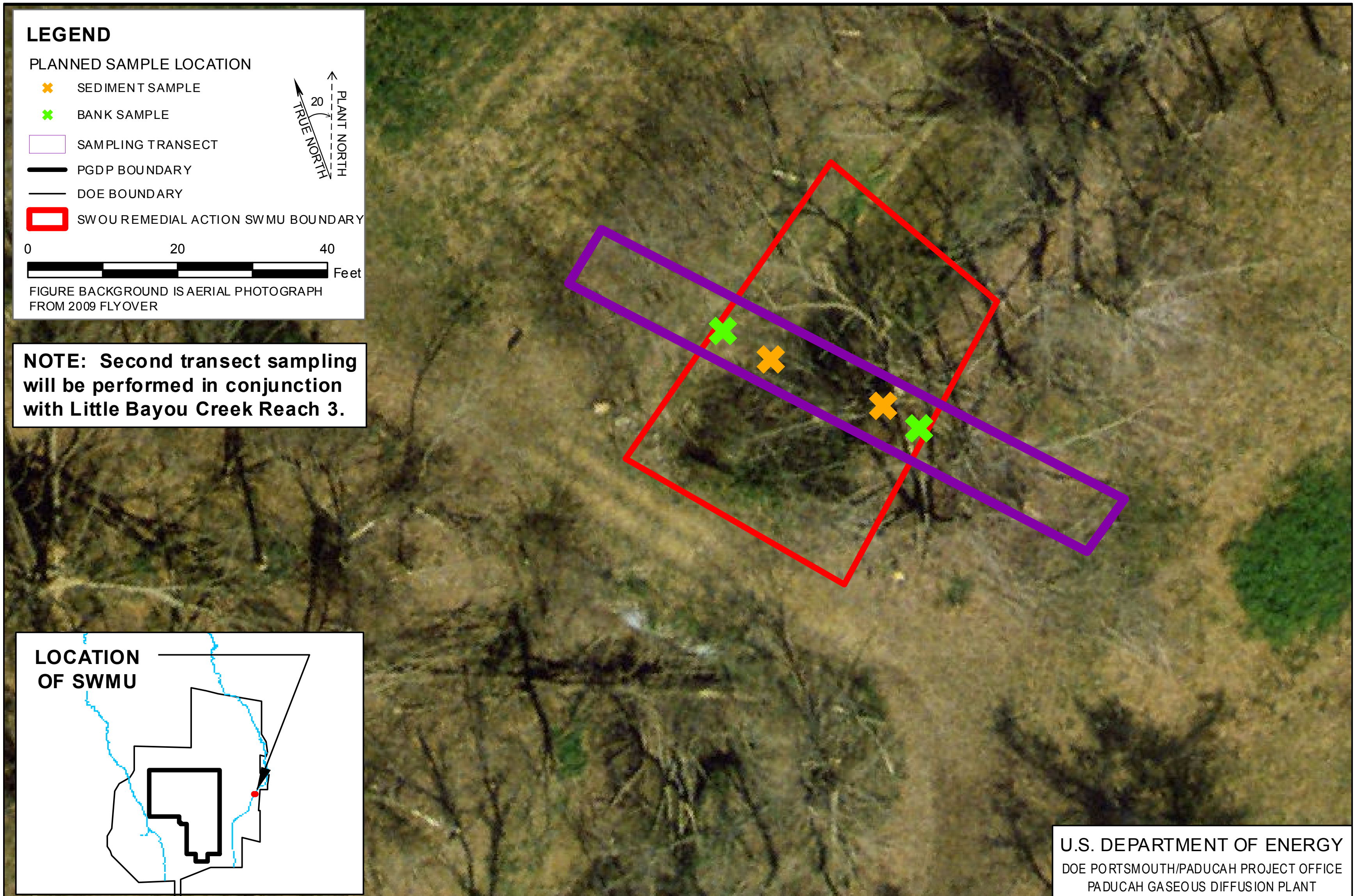

Figure 9.3. Planned Sampling at SWMU 108

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10. BANK EROSION CONTROL RIPRAP (SWMUs 93, 109, AND 175)

This group of SWMUs consists of three areas where concrete has been placed within a creek or ditch for the purpose of erosion control. A description of each follows.

SWMU 93 (Erosion Control Concrete Disposal Area)

The WAG 17 RFI/RI categorized SWMU 93 as an "isolated waste pile," the contents of which have no specific or obvious purpose (DOE 1997). The concrete rubble actually was clustered in two piles separated by 40 to 50 ft. One pile consisted of five large pieces just south of the KPDES Outfall 013 ditch. The other pile consisted of four to five large pieces and several smaller pieces in the KPDES Outfall 013 ditch. The volume of concrete was not determined.

SWMU 109 (Erosion Control Rubble Pile 7)

The material at SWMU 109 is composed of concrete slabs and rubble from PGDP street maintenance programs. The approximate volume of concrete is 20 yd^3. The pieces of concrete sit in the bed of Little Bayou Creek to control erosion near the water sampling station weir.

SWMU 175 (Erosion Control Rubble Pile 28)

The material at SWMU 175 consists of concrete rubble from PGDP. The concrete has been placed on the ditch bank to provide erosion control over an area approximately 400 ft long and 20 ft wide; however, the volume of concrete has not been determined.

10.1 LOCATION

Figure 10.1 shows the locations of the three SWMUs in this group.

SWMU 93 is located within KPDES Outfall 013 (SWMU 61) east of and adjacent to Dyke Road in the southeastern portion of the DOE Reservation, east of the fenced perimeter of PGDP.

SWMU 109 is located near the water sampling station on Little Bayou Creek (SWMU 64) at Ogden Landing Road (Kentucky Highway 358) in the vicinity of the eastern boundary of the DOE Reservation.

SWMU 175 is located in the KPDES Outfall 002 (SWMU 60) immediately upgradient of SWMU 107 Oil Inversion Dam (see Section 6).

10.2 OPERATION HISTORY

The exact dates of placement of the concrete rubble at these three SWMUs are unknown. SWMUs 93 and 109 were designated as SWMUs in the 1980s, and SWMU 175 was designated as such in 1992; therefore, their existence predates their respective SWMU designations.

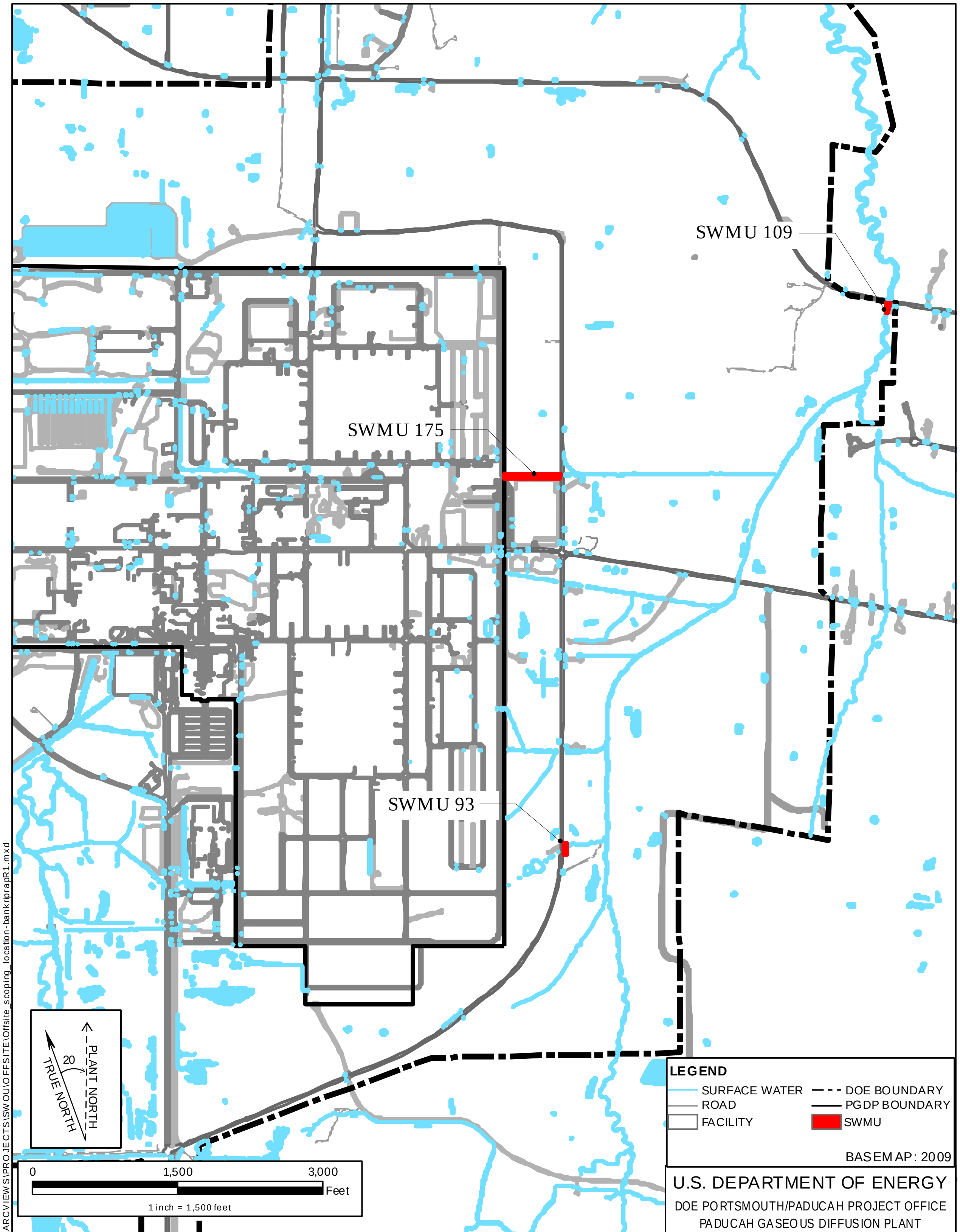

Figure 10.1. Location of SWMUs 93, 109, and 175

10.3 OPERATIONAL CSM

The operational CSM is illustrated in Figure 5.1. SWMUs 93, 109, and 175 are identified as rubble piles and are in the Little Bayou Creek watershed.

10.4 NATURE AND EXTENT

SWMU 93 (Erosion Control Concrete Disposal Area)

In the early 1990s, SWMU 93 was screened for alpha, beta, and gamma radiation. Results of these screenings indicated no radiation above background levels (DOE 1997). The WAG 17 RFI/RI included a visual inspection of the site and a review of the screening results (DOE 1997). No elevated contamination was found. Sampling was consistent with *Sampling and Analysis Plan for Rubble Areas at the Paducah Gaseous Diffusion Plant Paducah, Kentucky* (DOE 2008c). Figure 10.2 shows locations of historical sampling conducted near SWMU 93.

SWMU 109 (Erosion Control Rubble Pile 7)

In the early 1990s, the concrete and soil at SWMU 109 were screened for radiation. Beta and gamma radiation screening of the concrete identified five locations with readings ranging from 150 to 1,000 cpm over background levels. Screening of the soil identified areas 3 ft above the creek water level with gamma radiation readings of 30,000 to 50,000 cpm. The WAG 17 RFI/RI included a visual inspection of the site, a review of the screening results, and PCB screening of soil (DOE 1997). Three soil samples were collected for PCB field screening (Y1090A, Y1090B, and Y1090D); two of the samples (Y1090B and Y1090D) were < 0.5 mg/kg, and the third had a reading of 0.5 to 1.0 mg/kg. The positive reading for PCBs at one location resulted in the collection of a fourth sample (Y1090C), which was submitted for laboratory analysis. Results of analysis indicated the presence of the PCBs Aroclor 1248 and Aroclor 1260 at concentrations of 570 mg/kg and 2001 mg/kg, respectively. The sample had a gross alpha activity of 48.10 $\pm$ 11.80 pCi/g and a gross beta activity of 59.90 $\pm$ 8.10 pCi/g. Figure 10.3 shows locations of historical sampling conducted near SWMU 109 that were collected within the criteria set for this work plan (i.e., post-2000).

SWMU 175 (Erosion Control Rubble Pile 28)

In the early 1990s, SWMU 175 was screened for radiation, and alpha, beta, and gamma radiation were all below background levels. The WAG 17 RFI/RI included a visual inspection of the site and a review of screening results (DOE 1997). Sampling was conducted within Outfall 002 during the SWOU SI in 2008. Among the analytes exceeding background were chromium, Tc-99, and U-238. Conclusions drawn in the EE/CA Action Memorandum were that no "hot spots," as defined by the SI, existed within Outfall 002 (DOE 2009a). Figure 10.4 shows locations of historical sampling conducted near SWMU 175.

10.5 PREVIOUS RISK ASSESSMENT DISCUSSION/SUMMARY

It should be noted that previous risk assessments utilized different decision rules than those that will be used for this RI/FS. If risk estimates were recalculated using current methods, exposure parameters, and toxicity information, the results could differ markedly; however, the assessments did indicate the contaminants and media that needed to be considered during the scoping of this work plan.

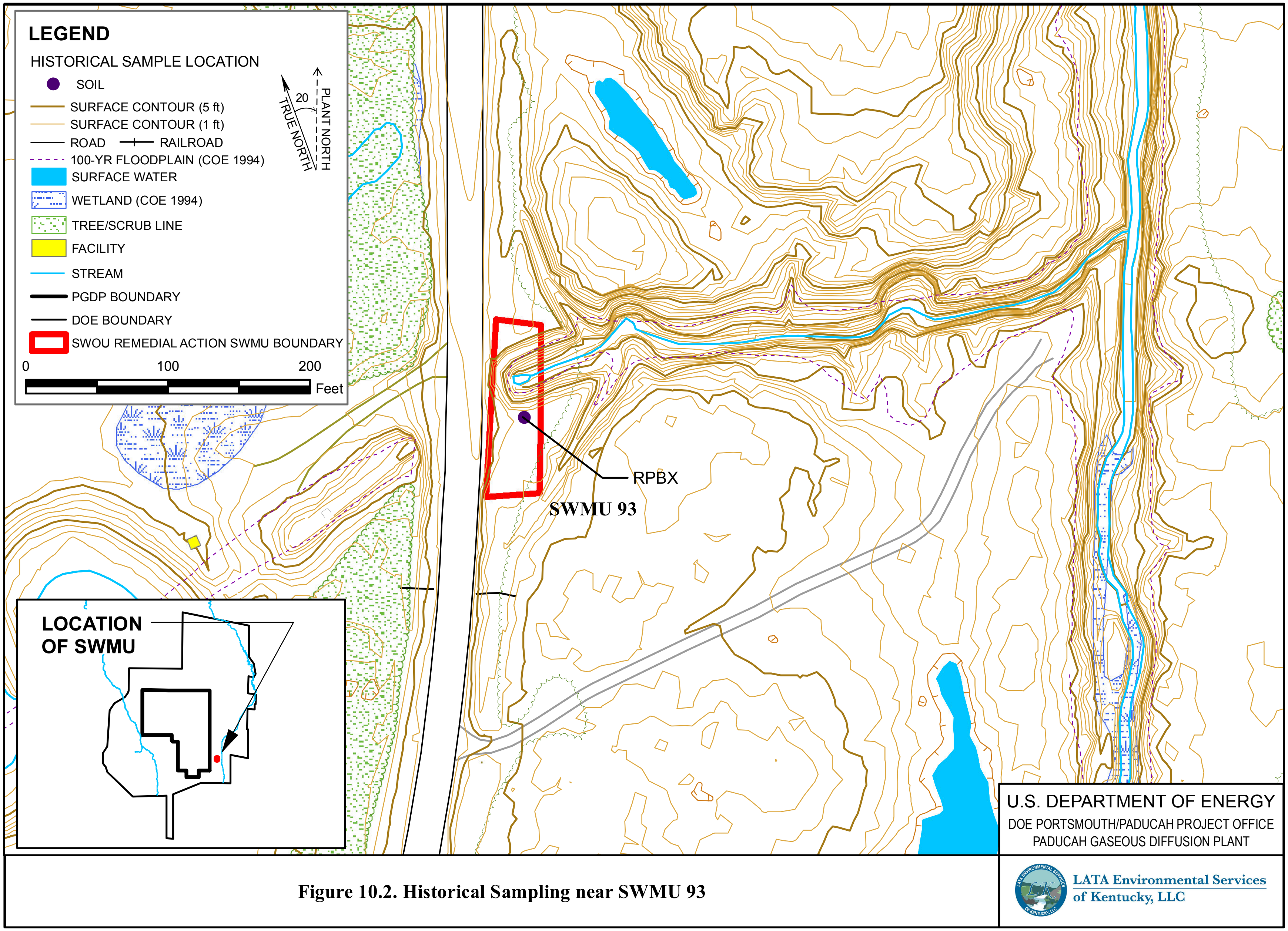

Figure 10.2. Historical Sampling near SWMU 93

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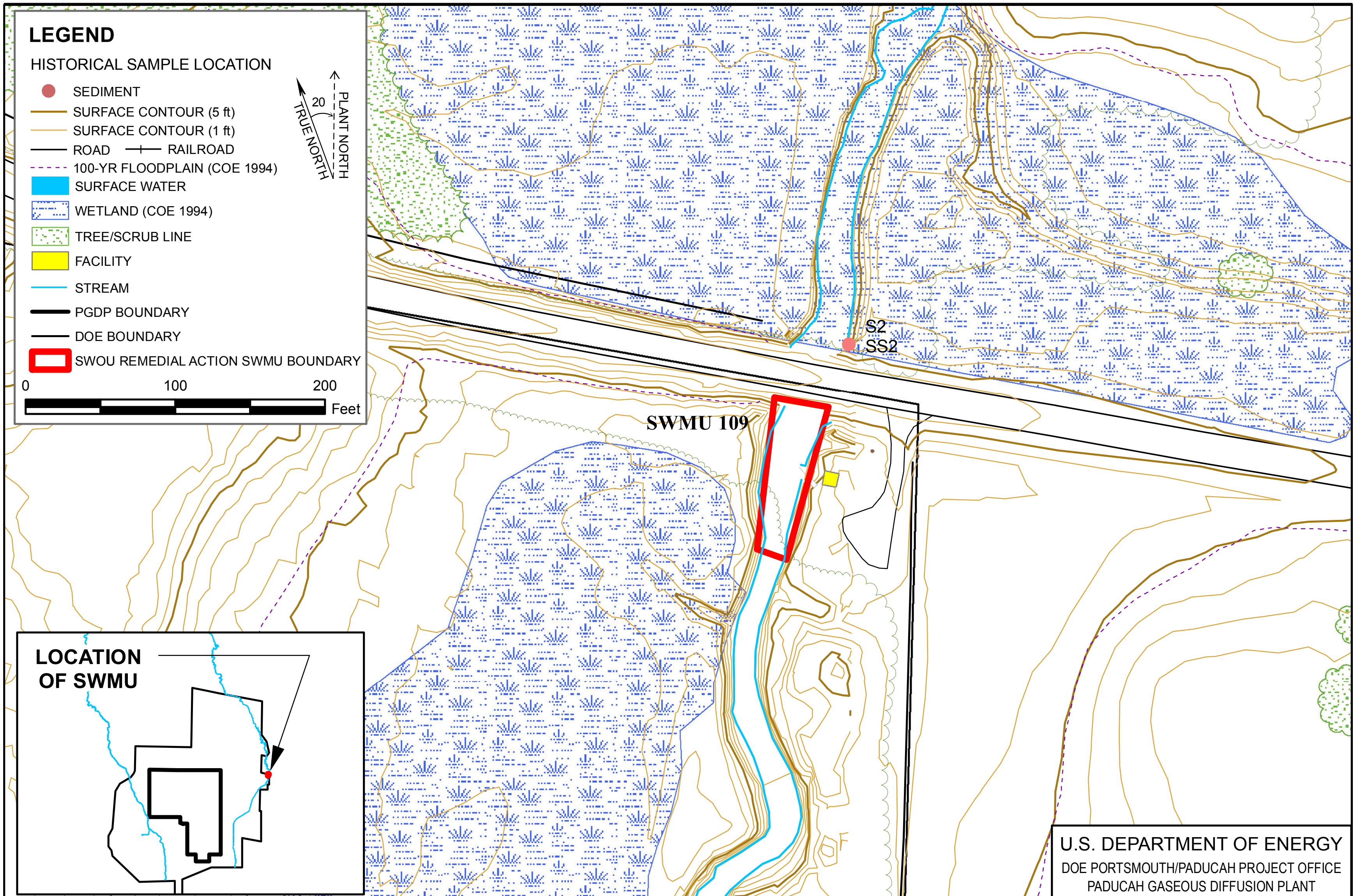

Figure 10.3. Historical Sampling near SWMU 109

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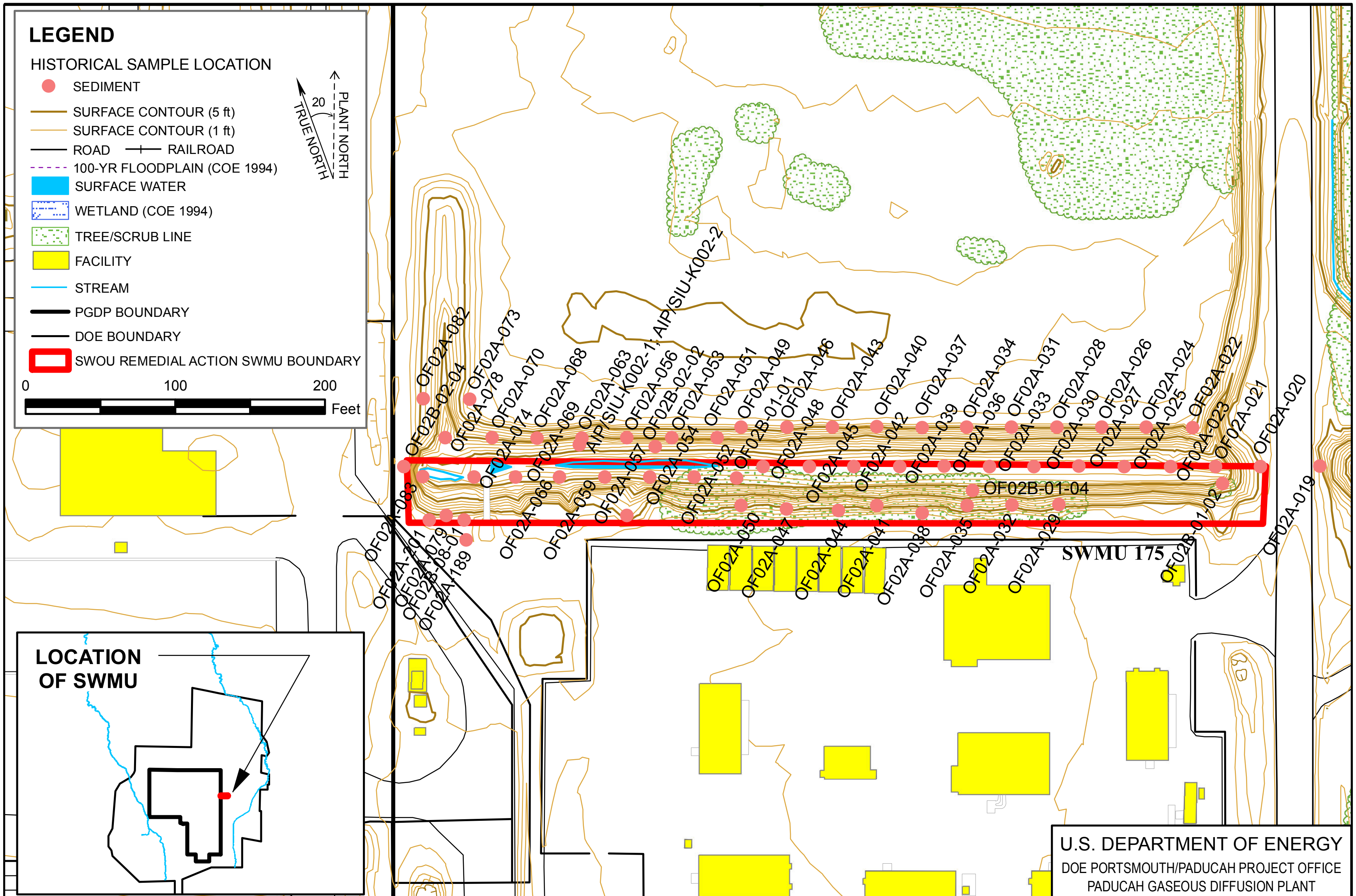

Figure 10.4. Historical Sampling near SWMU 175

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SWMU 93 (Erosion Control Concrete Disposal Area)

The WAG 17 RFI/RI risk assessment did not include SWMU 93 because existing data from the site did not identify any COPCs.

SWMU 109 (Erosion Control Rubble Pile 7)

A BHHRA was conducted for and included in the WAG 17 RFI/RI (DOE 1997). The previous BHHRA identified unacceptable risk to the adult recreational user for ingestion of rabbit (systemic toxicity hazard greater than 1.0 and ELCR greater than 1 $x10^{-4}$). The COC is Aroclor 1260 and the medium of concern is soil. A screening ecological risk assessment for SWMU 109 was conducted as part of the WAG 17 RI (DOE 1997). Surface soil and sediment were evaluated for potential risks to benthic macroinvertebrates, soil microflora, soil invertebrates, terrestrial plants, and terrestrial wildlife. No COPECs were identified for sediment. Aroclor 1248 in surface soil marginally exceeded the NOAEL HQ of 1.4 for short-tailed shrew based on the one soil sample available for the site. While no analytes were found to exceed toxicological benchmarks for any other ecological endpoints, Aroclors 1248 and 1260 were retained as COPECs because no benchmarks were available for soil microflora or soil invertebrates for these compounds.

SWMU 175 (Erosion Control Rubble Pile 28)

SWMU 175 was evaluated as part of the WAG 17 RI, and it contained no human health COPCs (DOE 1997). The SERA included SWMU 175; however, no COPECs were retained for the site.

10.6 PREVIOUS ACTIONS TAKEN

SWMU 93 (near Outfall 013) was removed as a maintenance action in 2009 as part of lowering the culvert at Outfall 013. The rubble was replaced with riprap for erosion control. Soil sampling and radiological scans were conducted after removal of the concrete, but before replacement of riprap. These samples and scans indicated no contamination present above background levels. Data are included in Appendix D. The 2009 data will be included in the RI/FS report. SWMU 93 will not be discussed further in this section.

No response actions have been implemented at SWMU 109 (Erosion Control Rubble Pile 7) or SWMU 175 (Erosion Control Rubble Pile 28).

10.7 RISK EXPOSURE CSM

The risk exposure CSM is illustrated in Figure 5.2. The potential sources of contamination at the areas of bank erosion-control riprap consist primarily of concrete slabs. Potential contamination from these areas may have migrated to Little Bayou Creek via runoff or the concrete rubble itself may provide media for exposure through direct contact to the current/future industrial worker, future resident, current/future recreational users, and terrestrial biota.

10.8 REMAINING PROBLEMS

Remaining problems for SWMUs 109 (Erosion Control Rubble Pile 7) and 175 (Erosion Control Rubble Pile 28) are discussed further within this section.

10.8.1 Characterization and Inventory of Potential Exposure Media

SWMU 109 consists of concrete slabs from PGDP street maintenance programs placed in Little Bayou Creek adjacent to the creek bank to control bank erosion at a water sampling station weir. Approximately 500 ft^2 of paving is present, with about 20 yd^3 of concrete. The total volume of concrete and rubble is unknown. In the early 1990s, a beta/gamma survey found five locations with readings ranging from 150 to 1,000 counts per minute (cpm) above background. Screening of the soil identified areas of soil with 20,000 to 50,000 cpm gamma readings that were approximately 3 ft above surface water level. The WAG 17 RFI/RI Report stated that PCBs were detected in soil (Aroclor 1248 at 0.57 ppm; Aroclor 1260 at 0.20 ppm) (DOE 1997).

SWMU 175 consists of concrete rubble that provides erosion control on the ditch bank. The area covered is approximately 400 ft x 20 ft, but the actual rubble volume is unknown. In the early 1990s, radiological screening found no radiation above background in concrete or soil.

10.8.2 Information Status of Key Assessment Factors

Table 10.1 identifies the status of key assessment factors.

Table 10.1. Status of Key Assessment Factors for SWMUs 109 and 175

SWMU	Waste Handling Practices	Contamination		Migration of Contamination	
		Presence	Extent	Surface Runoff	Infiltration
109	A	A	A	A	A
175	A	A	A	A	A

A—Factor is adequately defined. Current information is adequate to design a targeted sampling plan, but data gaps and uncertainties are such that the goals and objectives of the RI/FS cannot be met.
Information provided in this table is taken from DOE 1999.

10.8.3 Release Potential from Contaminant Sources

The surfaces of the concrete rubble in SWMUs 109 (Erosion Control Rubble Pile 7) and 175 (Erosion Control Rubble Pile 28) may have been contaminated while inside the PGDP plant area from contact with radionuclides, PCB-bearing oils, and associated metals. Since placement of the concrete rubble in the creek bed, weathering processes may have caused leaching of these potential contaminants to surface water and sediment in the Little Bayou Creek. No concrete currently is on the creek bank, but previous placement of concrete on the bank may have leached contamination to surface soil. Data from the WAG 17 investigation confirmed the presence of PCBs in surface soil. In general, the potential contaminants are not particularly mobile and have a tendency to bind to soil particles rather than migrate through the vadose zone. Given the low mobility of the potential contaminants, significant migration from these SWMUs into subsurface soil or shallow groundwater is not considered a problem.

The concrete rubble is not likely to be a continuing source of contaminants. Concrete rubble on the DOE Reservation was placed at the various sites up to 20 years ago, and all the contaminants leachable under natural conditions probably have been removed (DOE 1996). Contaminants remaining on the concrete have adsorbed or bonded to the concrete, and additional leaching to soil would require extremely low pH conditions not likely to be encountered in the natural environment at PGDP. Any contaminants remaining on the concrete, however, could pose a threat to human health or the environment through contact with exposed surfaces. Runoff from concrete surfaces is a potential, but not a likely, migration pathway.

Surface water and sediment in Little Bayou Creek are in contact with the concrete rubble, providing another potential contaminant pathway, both by sediment and aqueous transport. Although it is likely that any contaminants leached from the concrete to sediment and surface water already have been transported from the site, no data are currently available to confirm their presence or absence.

10.9 REMEDIAL ALTERNATIVES DEVELOPMENT SUMMARY

A potential remedy for SWMU 109 (Erosion Control Rubble Pile 7) is removal and replacement of the riprap due to fixed contamination followed by sampling to verify that all contaminants have been addressed. The action may be scheduled to occur during any remedial action on Little Bayou Creek (SWMU 64). If no action is taken for Little Bayou Creek or if there is another convenient time, action for SWMU 109 will be coordinated with any similar activities at a convenient time.

10.10 DATA NEEDS

Existing information on SWMU 109 (Erosion Control Rubble Pile 7) identified radionuclide contamination on concrete and soil and PCB contamination of soil; however, it is unclear if the PCB contamination is from this SWMU or was transported from elsewhere within the surface water system. The primary data needs for this SWMU are to determine the nature, extent, and release of contamination into the environment. That is, to determine if contaminants from SWMU 109 are being added to the creek system and, if so, to determine if they are affecting the creek adversely. Sediment samples will be collected upgradient and downgradient of the structure.

SWMU 175 (Erosion Control Rubble Pile 28) has been sampled extensively as part of the SWOU SI (DOE 2005); therefore, it has no data needs.

10.11 FIELD SAMPLING PLAN

No sampling plans have been developed for 175 (Erosion Control Rubble Pile 28).

The purpose of collecting samples at SWMU 109 (Erosion Control Rubble Pile 7) is to understand better the nature and extent of contamination there and, if it exists, to determine if contaminants from SWMU 109 have an adverse impact on Little Bayou Creek. SWMU 109 sampling will take place during the Phase 1 creek sampling event (see Section 7). Information from the SWMU 109 sampling effort will be used to support Phase 2 sampling efforts for Little Bayou Creek.

10.11.1 Sampling Strategy

Sampling will take place at SWMU 109 (Erosion Control Rubble Pile 7) only. A total of two in-stream transects (two creek bed locations, two bank locations) will be placed, one upgradient and one downgradient of the SWMU. Sediment/soil samples will be collected. Each sample location will have one surface (0–6 inch bgs) sample and one sample at the sediment/native soil interface. Four sample locations in each transect are planned. These transects are in addition to the Little Bayou Creek transects planned for Phase 1.

10.11.1.1 Sampling media and methods

One type of sampling and data collection activity will be performed—intrusive media sampling (sediment and soil). Investigation activities will use DOE Prime Contractor-approved procedures that are consistent with EPA procedures and protocols.

Intrusive Sampling

Various media samples will be collected to characterize areas that have been evaluated as having data gaps. The samples will be collected using DOE Prime Contractor-approved procedures and will be submitted to a DOECAP-accredited analytical laboratory for analysis.

Sediment/Soil Sampling. Sediment/soil shall be collected at depths of 0–6 inches bgs and at the sediment/native soil interface with a stainless-steel sampler, hand auger, spoon, trowel, spade, or scoop.

10.11.1.2 Sample analysis

Because high quality data are desired for decision making and to establish the analytes for Phase 2 of the creek sampling, fixed-based laboratory analyses will be performed. Analytical requirements are based on Phase 1 creek sampling (Section 7). Samples will be analyzed for metals, radionuclides, PAHs, and PCBs. If PCBs are detected in any of the samples, one congener evaluation will be performed per transect. The decision on which sample to be run for the congener analysis will be made with consideration of and in conjunction with other creek samples; however, the evaluation will be run only on a sample that has a positive detection for PCBs. In order to perform the congener evaluation on the same sample that has a detection of PCB, the fixed-base laboratory will need to hold the extract from the PCB analysis until the RI PM or designee has determined the samples on which to perform a congener evaluation.

10.11.1.3 Sampling procedures

Sampling procedures are described in the QAPP for this work plan (Section 17).

10.11.1.4 Documentation

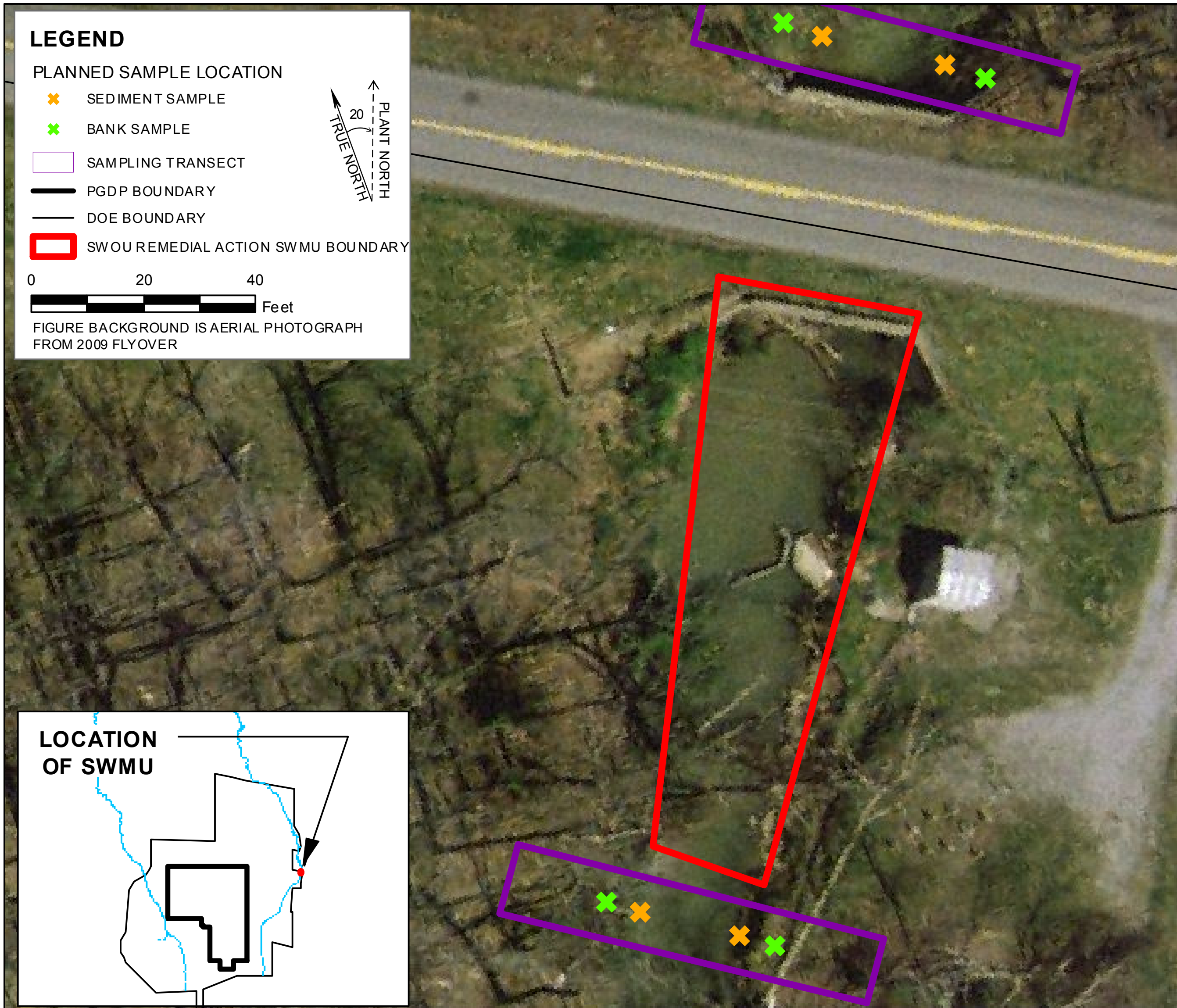
Requirements for documentation are located in the QAPP for this work plan (Section 17).

10.11.1.5 Sample location survey

GPS coordinates in 1602 Kentucky State Plane South Zone with submeter accuracy will be obtained for all sampling locations. Additionally, depths for each sample obtained also will be recorded. Where possible, flags or wooden or metal stakes will be used to mark sampling locations. Each sampling location will be described with field maps and photographs. This will enable reestablishment of the sampling locations if the markers are disturbed or cannot be placed.

10.11.1.6 Maps/locations

Figure 10.5 illustrates sampling planned for SWMU 109.



U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

LATA Environmental Services of Kentucky, LLC

Figure 10.5. Planned Sampling at SWMU 109

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11. NSDD, SECTIONS 3, 4, AND 5 (SWMU 58)

The NSDD is a man-made surface channel that is part of the original design of the PGDP used to transfer effluents from PGDP to Little Bayou Creek via Outfalls 003, 018 and 019. Sections 3, 4, and 5 of this SWMU include 8,180 ft of channel north of the fenced perimeter.

11.1 LOCATION

Sections 3, 4, and 5 of the NSDD are located outside the security fenced area (PGDP boundary) on property owned by DOE (Figure 11.1). The NSDD originates within the north-central portion of PGDP and discharges into Little Bayou Creek to the north of the plant.

11.2 OPERATION HISTORY

Sections 3, 4, and 5 of the NSDD have received surface water runoff and wastewater from various sources within the PGDP. This area has been investigated previously and the contamination associated with these areas has been determined to have originated from plant activities.

11.3 OPERATIONAL CSM

The operational CSM is illustrated in Figure 5.1. NSDD Sections 3, 4, and 5 receive runoff from Soils OU SWMUs and have a direct transport route for potential contaminants to migrate to Little Bayou Creek.

11.4 NATURE AND EXTENT

NSDD Sections 3, 4, and 5 and their associated internal ditches and areas (including SWMUs 92 and 97) have been characterized in several previous investigations. These included the PGDP Phase I and Phase II SIs (CH2M HILL 1991a; CH2M HILL 1991b; CH2M HILL 1992); various WAG and SWMU remedial investigations, site evaluations, and removal actions; and a 1996 PCB Study by the U.S. Army Corps of Engineers (COE 1996b). In 2005, the SI for the SWOU (On-Site) (DOE 2008a) investigated the potential for or threat of release into the environment of hazardous substances, as defined by CERCLA § 101 (14), pollutants, or contaminants, as defined by CERCLA § 101 (33), including cesium-137, neptunium-237, uranium-238, thorium-228, thorium-230, antimony, arsenic, iron, lead, manganese, Total PCBs, total PAHs, and TCE. A complete list of detected analytes is provided in the SWOU (On-Site) SI/BRA Report (Appendix D, Table D.1.) (DOE 2008a).

Sampling of Sections 3, 4, and 5 of the NSDD was conducted to determine nature and extent of contamination within these sections. These areas were characterized using the following strategy:

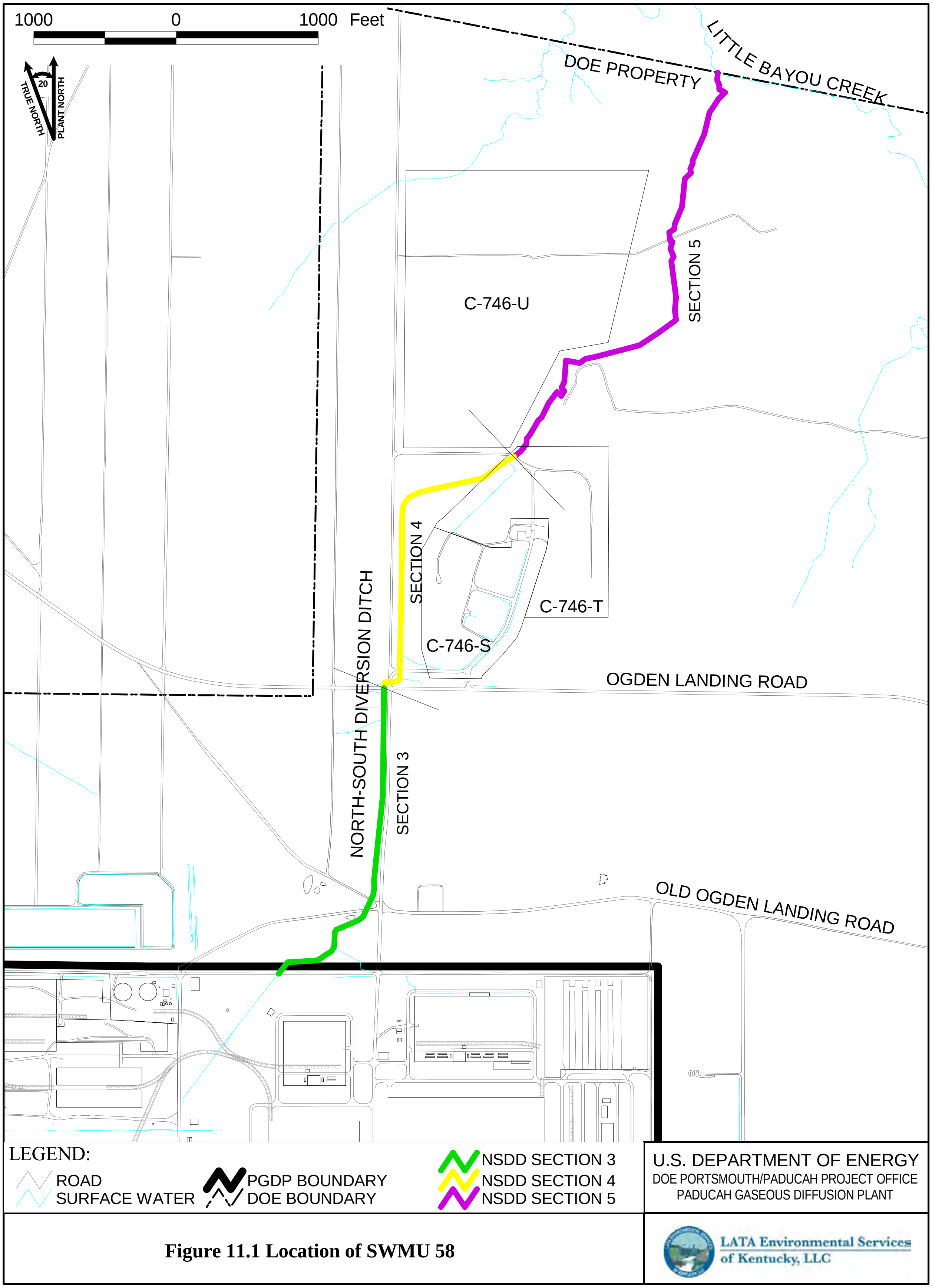

Figure 11.1 Location of SWMU 58

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(1) Identify areas of elevated contaminant concentrations (i.e., identify "hot spots") in surface soil and sediment in Sections 3, 4, and 5 of the NSDD and identify the extent of contamination in these areas.

(2) Further delineate hot spots in soils and sediment found in Sections 3, 4, and 5 of the NSDD.

(3) Determine the potential for migration of contamination through the storm water sewers associated with C-333-A, C-337-A, and C-340.

Based on the results of 258 Activity 1 samples and 16 duplicates, the NSDD Activity 1 sampling revealed that hot spots were greater than indicator levels in samples collected in all three EUs within Sections 3 and all four EUs within Section 5. There were no exceedances of indicator levels in Activity 1 samples collected in Section 4.

Of 75 Activity 2 samples and 6 duplicates, 22 contained at least one analyte that exceeded its characterization level. Radionuclides that exceeded indicator levels included cesium-137, thorium-228, thorium-230, and neptunium-237. Inorganic analytes exceeding indicator levels included arsenic and manganese. Organic analytes exceeding indicator levels included only Total PCBs. These samples were located in all three EUs within Section 3, only one of the three EUs within Section 4, and all four EUs within Section 5.

11.5 PREVIOUS RISK ASSESSMENT DISCUSSION/SUMMARY

It should be noted that previous risk assessments utilized different decision rules than those that will be used for this RI/FS. If risk estimates were recalculated using current methods, exposure parameters, and toxicity information, the results could differ markedly; however, the assessments did indicate the contaminants and media that needed to be considered during the scoping of this work plan.

During the PGDP SI, Phase II site investigation, surface water, sediment, and stream bank samples were collected from the NSDD (CH2M Hill 1991b). PCB and metal concentrations were reported at levels thought to be toxic to aquatic organisms. The highest levels of contaminants were found within PGDP boundaries, upgradient from Little Bayou Creek Reaches 5 and 6, which minimizes the potential for significant exposure of aquatic or terrestrial wildlife. No significant risks were identified for exposure of aquatic organisms to radionuclides.

The SERA conducted for the NSDD as a part of the PGDP SI, Phase II identified COPECs that exceeded no action levels and were retained (CH2M Hill 1991b). Additionally, the PCB food Web modeling revealed significant risks to several soil- and sediment-based receptors. Per EPA guidance and guidance in the PGDP Risk Methods Document, these results indicate that further evaluation of potential for ecological risk is required.

With the completion of the removal action for the NSDD, Sections 3, 4, and 5, earlier human health risk assessments no longer are representative of current conditions. The material presented here is from the Removal Action Report, which included a human health risk analysis completed using post-removal action sampling results DOE 2010a).

The risk evaluation calculated the cumulative residual risk and hazard for exposure units with excavated hot spots within the NSDD for the industrial worker and for the recreational user. Results of the risk evaluation indicate that the cumulative ELCR and HI for COCs from EUs with excavated hot spots within Sections 3 and 5 of the NSDD achieved the removal action objectives of a cumulative ELCR of 1×10^{-5} and a cumulative HI of 1.0 (DOE 2010a).

11.6 PREVIOUS ACTIONS TAKEN

Previous actions for the NSDD began in 1977 with the installation of the C-616-C Lift Station, which diverted all normal flow from upstream locations in the NSDD to the C-616-F Full Flow Lagoon. In 1982, a portion of the NSDD (Section 4) located north of Ogden Landing Road was relocated to its present configuration to facilitate construction of the C-746-S and C-746-T Landfills. As a result of this relocation, the old channel was not remediated but simply buried and is not a part of a BGOU SWMU investigation nor the SWOU. In the 1990s, additional actions for the NSDD were conducted, including the installation of another lift station (C-616-H Lift Station) in 1991. An interim action to mitigate discharge of contaminants into the NSDD (1995), and erection of institutional control measures along Sections 3 and 4 of the NSDD to comply with 10 *CFR* Part 835 were implemented in 1999. Institutional control measures consisted of radiological barriers (i.e., yellow and magenta chains), "Fixed Contamination Area" signs, and "10 *CFR* § 835" explanation signs. In 2002, an interim remedial action for Sections 1 and 2 of the NSDD was implemented in accordance with the *Record of Decision for Interim Remedial Action for Sections 1 and 2 at the North-South Diversion Ditch at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1948&D2/R1 (DOE 2002). The interim action included excavation of all source material and blocking of culverts to accomplish the primary objectives, which were to mitigate the introduction of contaminants into the NSDD, decrease the migration of contaminants already present in the NSDD, and decrease the potential for direct human contact with the contaminated material.

On January 19, 2007, DOE submitted a non-time-critical Removal Notification (DOE 2007) for SWOU (On-Site) indicating that a removal action was warranted based upon the results of the SI/BRA (DOE 2008a). Subsequent to receiving Removal Notification approval, DOE prepared an EE/CA that described the environmental conditions that supported the need for a removal action, developed and evaluated various alternatives, and recommended the preferred alternative. The recommended response action cited within the EE/CA, excavation of "hot spots" is consistent with the final actions for the PGDP and contributed to the efficient performance of long-term remediation of PGDP. The removal action was completed in 2010 and reached cleanup goals specified in the EE/CA. A residual direct contact risk evaluation showed the EUs with the excavated areas had cumulative residual risk and hazard values for the SWOU COPCs at 1×10^{-5} and < 0.1, respectively, for the teen recreational user and 7×10^{-6} and 0.4 for the industrial worker (DOE 2010a). These excavated areas were backfilled with clean material as noted in the Removal Action Report (DOE 2010a).

Figure 11.2 illustrates the locations within the NSDD (SWMU 58) that were removed in support of the SWOU removal action.

11.7 RISK EXPOSURE CSM

The risk exposure CSM is illustrated in Figure 5.2. The potential sources at SWMU 58 consist of the following:

- SWMU 145-related landfills,
- Discharges/run-off from the C-746-U Landfill,
- Contributions from the old Section 4 channel, and
- A highway that crosses the NSDD, Section 3.

Potential contamination from these areas may have been transported to Little Bayou Creek or may have

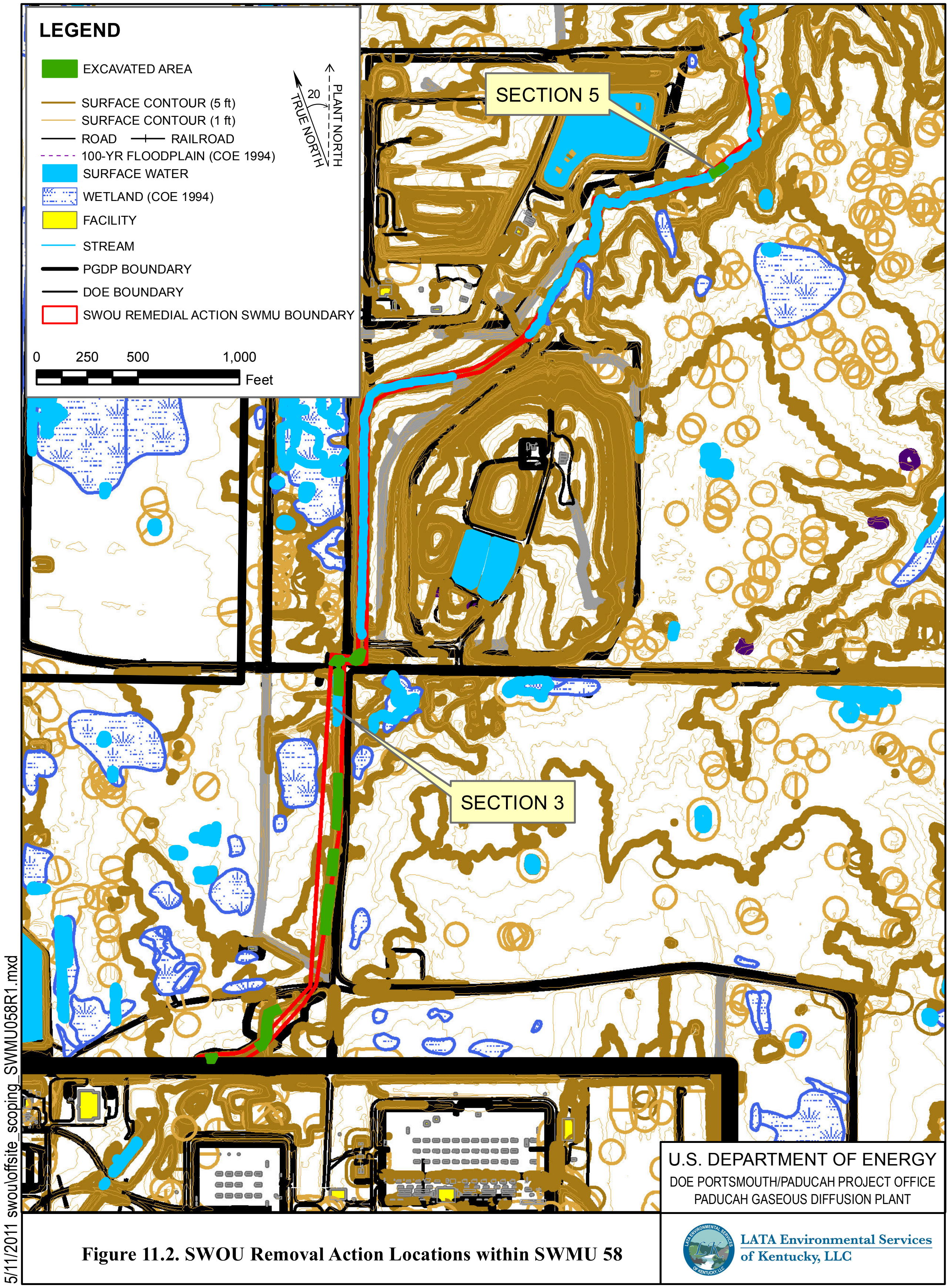

Figure 11.2. SWOU Removal Action Locations within SWMU 58

been absorbed by plants or consumed by animals. Through these exposure media, risk exposure may occur through incidental ingestion.

11.8 REMAINING PROBLEMS

The NSDD was addressed for human health as part of the on-site ditch removal action (DOE 2010a). No additional sample collection is anticipated for human health risk analysis, nature and extent, or fate and transport; however, sampling will be conducted in order to support a baseline ecological risk evaluation.

11.8.1 Characterization and Inventory of Wastes

There is currently no waste for this unit.

11.8.2 Information Status of Key Assessment Factors

Table 11.1 identifies the status of key assessment factors.

Table 11.1. Status of Key Assessment Factors for SWMU 58

SWMU	Description	Waste	Contamination		Migration of Contamination	
		Handling Practices	Presence	Extent	Surface Runoff	Infiltration
58	NSDD Sections 3, 4, and 5	A	W	W	W	A

A—Factor is adequately defined. Current information is adequate to design a targeted sampling plan, but data gaps and uncertainties are such that the goals and objectives of the RI/FS cannot be met.
W—Factor is well defined. Current information is adequate to meet the goals and objectives of the RI/FS.
Information provided in this table was taken from DOE 1999 and updated based on information from DOE 2008a.

11.8.3 Release Potential from Contaminant Sources

On the basis of available data, the NSDD has been characterized according to its potential for release of contaminated materials to the environment. As a result of the on-site ditch removal action (DOE 2010b), human health concerns were addressed and the potential for further contaminant releases remains low.

11.9 REMEDIAL ALTERNATIVES DEVELOPMENT SUMMARY

If additional response actions are necessary at this site, a potential remedy is removal and replacement of fixed contamination in the ditch followed by sampling to verify that all contamination has been addressed.

11.10 DATA NEEDS

There are no data needs pertaining to human health assessments.

Any remaining data needs are related to an ecological risk assessment. The existing, applicable data set for the NSDD will be used to perform a risk assessment according to the Ecological Risk Methods

Document (DOE 2011b; DOE 2010b). Adjustments for areas that have been remediated will be made by removing data points from data sets that were collected from remediated areas and replacing with confirmation samples, if available. The ecological risk assessment will take into account previous ecological risk assessment conclusions. This sampling will follow the same procedures and decision rules used for the outfall ditches (Sections 6 and 7).

11.11 FIELD SAMPLING PLAN

The purpose of sampling Sections 3, 4, and 5 of the NSDD are to supplement the existing data in order to support a baseline ecological risk assessment.

11.11.1 Sampling Strategy

Ecological data collection will include collection of surface sediment samples, site-specific toxicity, and uptake values. Sample locations will be based on professional judgment, considering such factors as sediment bed characteristics.

Decision Rules—Ecological:

AUFs less than 1 may be considered for the ditches, but should be used judiciously. For example, the Commonwealth of Kentucky prefers that chemicals not be eliminated as COPECs solely because a small AUF resulted in HQs < 1.

Complete Steps 1 through 3a (Activities 1–4 only of Step 3a) of the ecological risk assessment process (DOE 2011b; DOE 2010b) on available data. The ditch will be carried forward to an ecological sampling, if the following conditions are met for chemicals determined to be COPECs (i.e., maximum detected concentrations exceed screening values, and the detected concentration range is determined to exceed background and/or reference concentrations):

- Endpoint receptors (benthic invertebrates) will be carried forward for further evaluation under ecological sampling if a comparison of detected concentrations to available toxicity benchmarks for the given medium (sediment or surface water) is exceeded and a weight-of-evidence discussion concludes that adverse effects to these communities is a realistic possibility.

- Measurement endpoints (e.g., the green heron) will be carried forward for further evaluation under ecological if their FCM HQ, based on upper-bound exposure input values (e.g., use of 95% UCLs for the exposure point concentrations) and LOAEL TRV, exceeds a value of 1, with the exception of the little brown bat, which represents a T&E species. The bat receptor will be carried forward if its FCM HQ, based on upper-bound inputs and NOAEL TRVs, exceeds a value of 1. Site-specific uptake factors developed during the early sediment-stability sampling will be considered.

- The COPEC will be carried forward to ecological sampling if the weight-of-evidence evaluation suggests that it is a site-related chemical that has a reasonable possibility for causing adverse impacts to populations for one or more measurement endpoint. The following weight of evidence considerations should be considered:

- The chemical is considered to be potentially site-related based on known historical processes occurring at PGDP and fate-and-transport pathways that exist at the site.

- An evaluation of chemical-specific properties (e.g., chemical form/bioavailability of chemical used in toxicity studies, vs. expected form/bioavailability of the COPEC), including the possible consideration of alternative TRVs, uptake factors, etc., confirms that the exceedance of HQ threshold values in the risk characterization is realistic.

- A review of available historical data/results, particularly field studies, confirms the potential for adverse effects.

- Results from any toxicity studies performed during the early sediment stability confirm the predicted risk results of the SERA.

11.11.2 Sampling Media and Methods

One type of sampling and data collection activity will be performed—intrusive media sampling, (sediment). Investigation activities will use DOE Prime Contractor-approved procedures that are consistent with EPA procedures and protocols.

Intrusive Sampling

Various media samples will be collected to characterize areas that have been evaluated as having data gaps. The samples will be collected using DOE Prime Contractor-approved procedures and will be analyzed using field test methods, and selected samples will be submitted to a DOECAP-accredited analytical laboratory for analysis.

Sediment Sampling. Sediment shall be collected at a depth of 0-6 inches bgs with the use of a stainless-steel sampler, hand auger, spoon, trowel, spade, or scoop.

11.11.3 Sample Analysis

Sediment samples will be analyzed for 10-day *H. azteca* survival and growth toxicity test, and 28-day *L. variegatus* bioaccumulation test.

All bioaccumulation tests will be analyzed for metals, radionuclides, PAHs, geotechnical parameters (10% of surface samples), and PCBs.

11.11.4 Sampling Procedures

Sampling procedures are described in the QAPP for this work plan (Section 17).

11.11.5 Documentation

Requirements for documentation are located in the QAPP for this work plan (Section 17).

11.11.6 Sample Location Survey

GPS coordinates in 1602 Kentucky State Plane South Zone with submeter accuracy will be obtained for all sampling locations. Additionally, depths for each sample obtained also will be recorded. Where possible, flags or wooden or metal stakes will be used to mark sampling locations. Each sampling location will be described with field maps and photographs. This will enable reestablishment of the sampling locations if the markers are disturbed or cannot be placed.

11.11.7 Maps/Locations

Figure 11.3 illustrates proposed sampling for the NSDD.

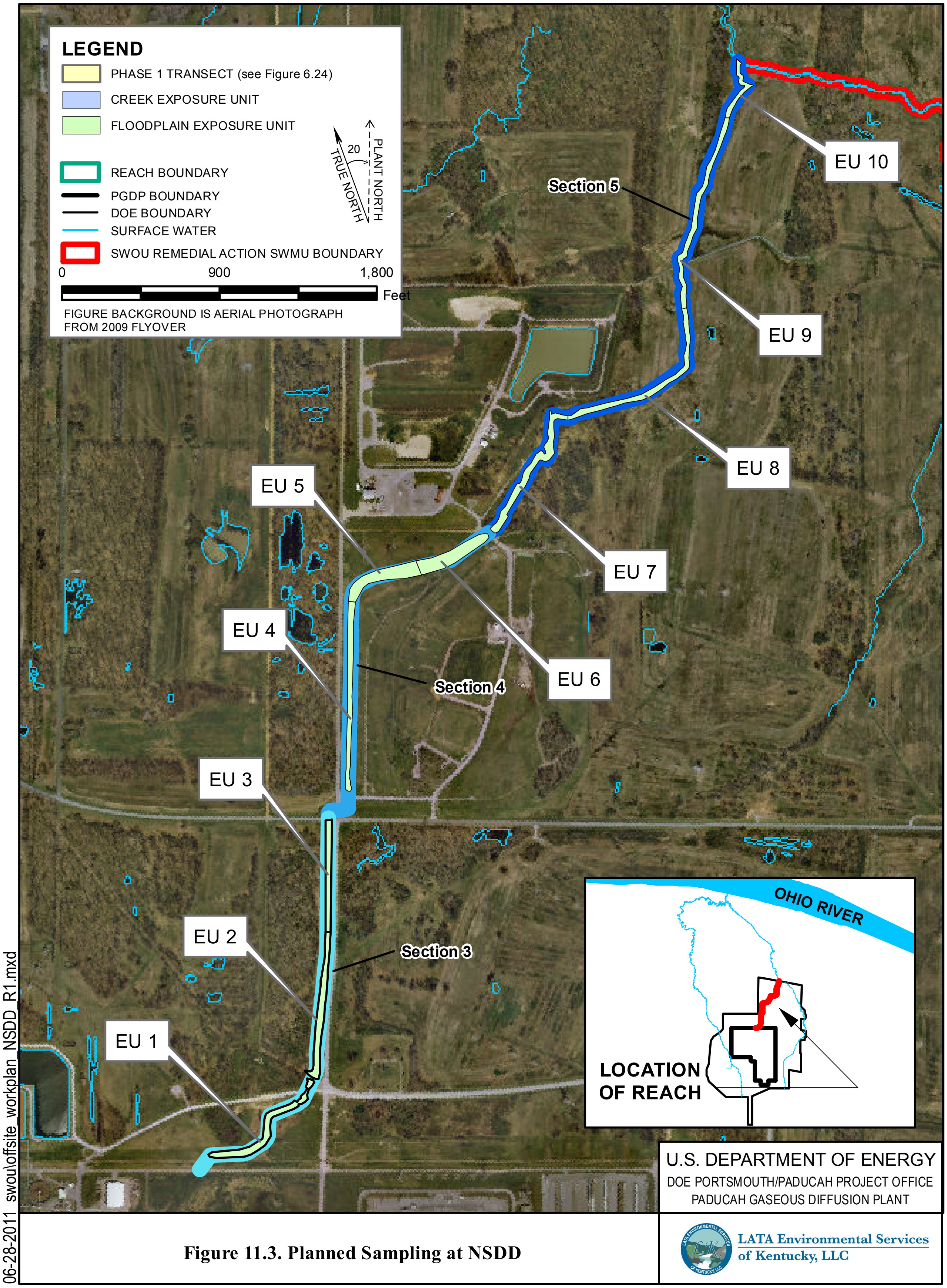

Figure 11.3. Planned Sampling at NSDD

12. HORSESHOE LAGOON (SWMU 185)

SWMU 185, the C-611-4 Horseshoe Lagoon, consists of a U-shaped lagoon. The impoundment is 80 ft x 71 ft x 8-ft deep, was excavated into native soil and is unlined.

12.1 LOCATION

SWMU 185 is located west of Bayou Creek. It is approximately 800 ft west of the PGDP and 800 ft north of Water Works Road (Figure 12.1).

12.2 OPERATION HISTORY

Horseshoe Lagoon (SWMU 185) was constructed in 1985. It is part of the series of lagoons that were associated with the C-611 Water Treatment Plant. Materials in these lagoons consist entirely of Ohio River water and chemicals resulting from potable water treatment and water softening processes. The lagoons are unlined and were excavated into the upper continental clays. Operation of the C-611 Water Treatment Facility began in the early 1940s as part of the KOW; however, water softening was not part of the process until the PGDP began operations in the 1960s. Several of the lagoons date back to that time. Water from the Ohio River is pumped into the C-611 facility and treated by one of three hardness reducing methods:

- Lime softening [applying $Ca(OH)_2$ to precipitate $CaCO_3$ and $Mg(OH)_2$]
- Soda ash softening (adding $NaCO_3$ to precipitate $CaCO_3$)
- Ferric sulfate coagulation (adding $FeSO_4$ coagulation to precipitate $CaSO_4$)

Flocculated material is discharged to the C-611-V Lagoon for primary settling, then to the C-611-Y Lagoon for additional sludge settling, then to Bayou Creek through KPDES Outfall 006. During sludge removal activities at the C-611-V Lagoon, effluent goes to the C-611-W Lagoon for primary settling. When C-611-V was taken out of service for dredging, the C-611-4 Horseshoe Lagoon was used on a limited basis for settling of flocculated material. Dates of use for the C-611-4 Horseshoe Lagoon are unknown; however, historical documentation indicate that the lagoon has not been in use for at least 20 years.

12.3 OPERATIONAL CSM

The operational CSM is illustrated in Figure 5.1. Horseshoe Lagoon (SWMU 185) has the potential for transport to Bayou Creek through Outfall 014.

12.4 NATURE AND EXTENT

C-611-4, the Horseshoe Lagoon, was included in the WAG 13 work plan (DOE 1994a) with the other C-611 Lagoons [C-611-W (SWMU 21), C-611-Y (SWMU 22), and C-611-V (SWMU 23)] and the C-100 Southside Berms (SWMU 138).

In February 1992, 13 grab samples of sludge were collected and analyzed for radionuclides and for total metals (DOE 1994a). In addition, samples were analyzed using Toxicity Characteristic Leaching

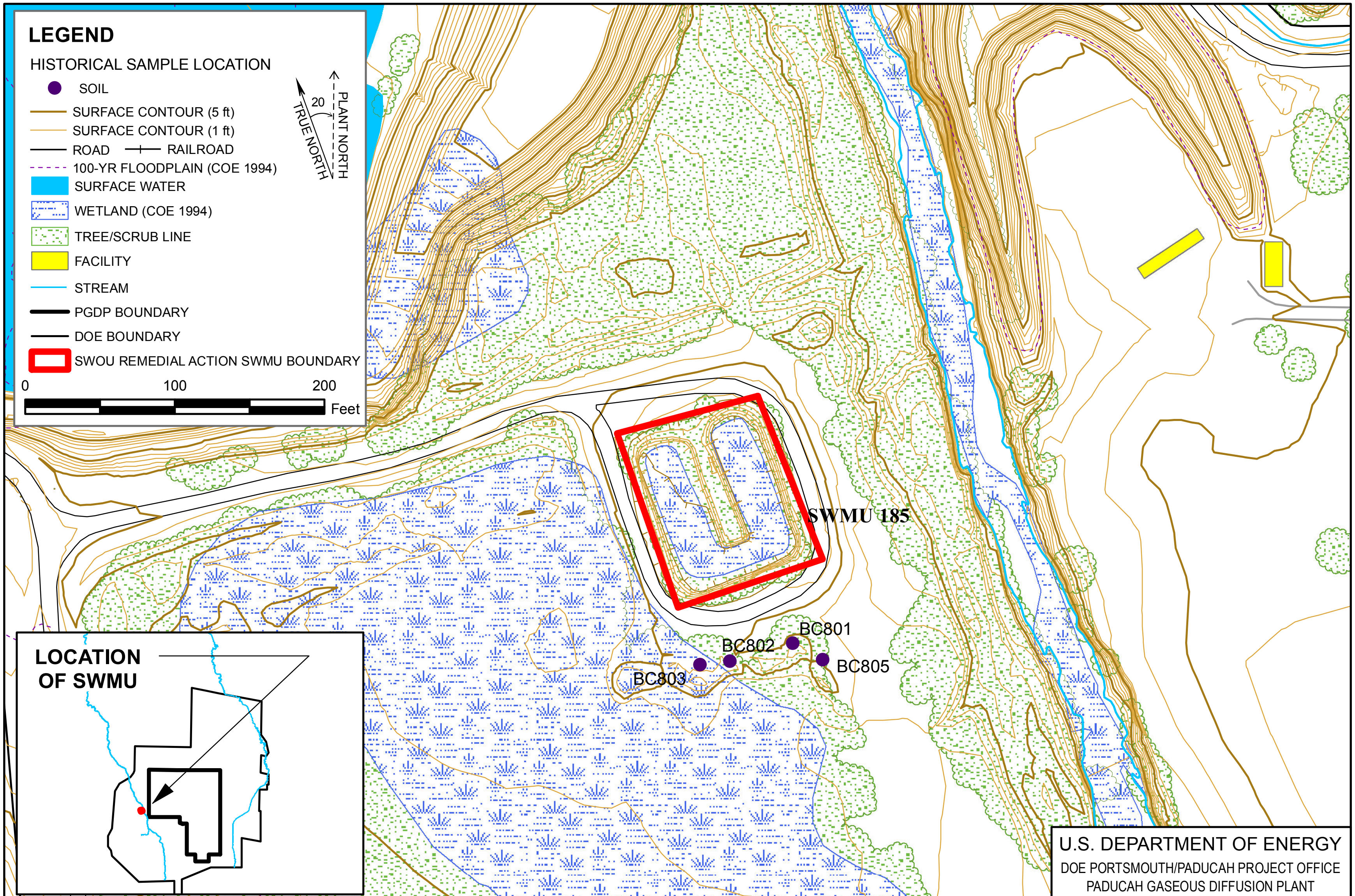

Figure 12.1. SWMU 185 Location and Historical Sampling

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Procedure (TCLP) methodology for volatile and semivolatile compounds and for metals. Analytical results of total metal analyses indicated that the following were detected in the sludge: barium, cadmium, chromium, nickel, lead, thallium, arsenic, mercury, and selenium. These sample results were compared to reference locations [reference samples were derived from 11 locations unaffected by PGDP operations (three from upstream in Bayou Creek, three from upstream in Little Bayou Creek and 5 floodplain samples from 100-year floodplain soils taken near the plant)]. The following metals were detected in sludge samples from the Horseshoe Lagoon in excess of the reference locations: cadmium, chromium, lead, thallium, arsenic, and mercury. TCLP analyses and the corresponding total metal analyses had no detectable concentrations, indicating that metals in the sludge are not leachable.

Further investigation was postponed after the DOE completed an evaluation of sludge samples from the lagoons and concluded that a KDEP classification of special waste (water treatment plant sediment) per 401 *KAR* 45:100 was appropriate. The DOE requested reprioritization of WAG 13 in 1994 (DOE 1994c), and SWMU 185 was placed into the SWOU.

The previous investigation results are not expected to be representative of current conditions due to the inactive status of Horseshoe Lagoon during the last 20 years or more.

12.5 PREVIOUS RISK ASSESSMENT DISCUSSION/SUMMARY

No human health or ecological risk assessments have been performed.

12.6 PREVIOUS ACTIONS TAKEN

No previous response actions have taken place at the Horseshoe Lagoon (SWMU 185).

12.7 RISK EXPOSURE CSM

The risk exposure CSM is illustrated in Figure 5.2. The contamination at Horseshoe Lagoon (SWMU 185) may expose the current/future industrial worker, future resident, current/future recreational users, aquatic and terrestrial biota by direct contact and incidental ingestion to surface water and sediments.

12.8 REMAINING PROBLEMS

Remaining problems for Horseshoe Lagoon (SWMU 185) are discussed further within this section.

12.8.1 Characterization and Inventory of Wastes

There currently is no waste for this unit.

12.8.2 Information Status of Key Assessment Factors

Table 12.1 identifies the status of key assessment factors.

Table 12.1. Status of Key Assessment Factors for SWMU 185

SWMU	Description	Waste Handling Practices	Contamination		Migration of Contamination	
			Presence	Extent	Surface Runoff	Infiltration
185	Horseshoe Lagoon	W	W	W	W	P

P—Factor is poorly defined. Current information is inadequate to design a targeted sampling plan, and data gaps and uncertainties are such that the goals and objectives of the RI/FS cannot be met.
W— Factor is well defined. Current information is adequate to meet the goals and objectives of the RI/FS.
Information provided in this table is taken from DOE 1999.

12.8.3 Release Potential from Contaminant Sources

The primary migration pathway is considered to be sediment and surface water contaminant migration from the lagoon discharge point near Outfall 014 (see Figure 6.1).

12.9 REMEDIAL ALTERNATIVES DEVELOPMENT SUMMARY

No immediate response action is expected at Horseshoe Lagoon (SWMU 185). Potential response actions that may be implemented are remedial (see Appendix C) or removal.

12.10 DATA NEEDS

The primary data needs for Horseshoe Lagoon (SWMU 185) are to determine if contaminants are present, and, if so, determine extent of contamination and whether they have an adverse effect on human health or ecological receptors.

12.11 FIELD SAMPLING PLAN

The purposes of sampling the Horseshoe Lagoon are to better understand the nature and extent of contamination, including allowing for an early action evaluation based upon biased sampling, and to answer the following questions:

- Are contaminants present in the sediment of the lagoon at levels exceeding surface soil background and/or appropriate reference concentrations, or above radiological activity thresholds?

- Are site-related constituents present in the sediment of the lagoon at average levels that exceed background and a risk-based value for the most reasonable anticipated receptor (i.e., teen recreational user or outdoor worker) derived using 1×10^{-6} ELCR or a HI of 1?

- Are site-related constituents present in the lagoon at levels that exceed risk thresholds for the ecological receptors of concern?

The sampling strategy is modeled after the on-site ditch approach (DOE 2005).

12.11.1 Sampling Strategy

Figure 12.2 provides a schematic of the sampling approach. In developing this approach, it was assumed that the Horseshoe Lagoon is contaminated and that hot spots exist. The Horseshoe Lagoon is small, approximately 0.3 acre in size; therefore, it contains only one EU.

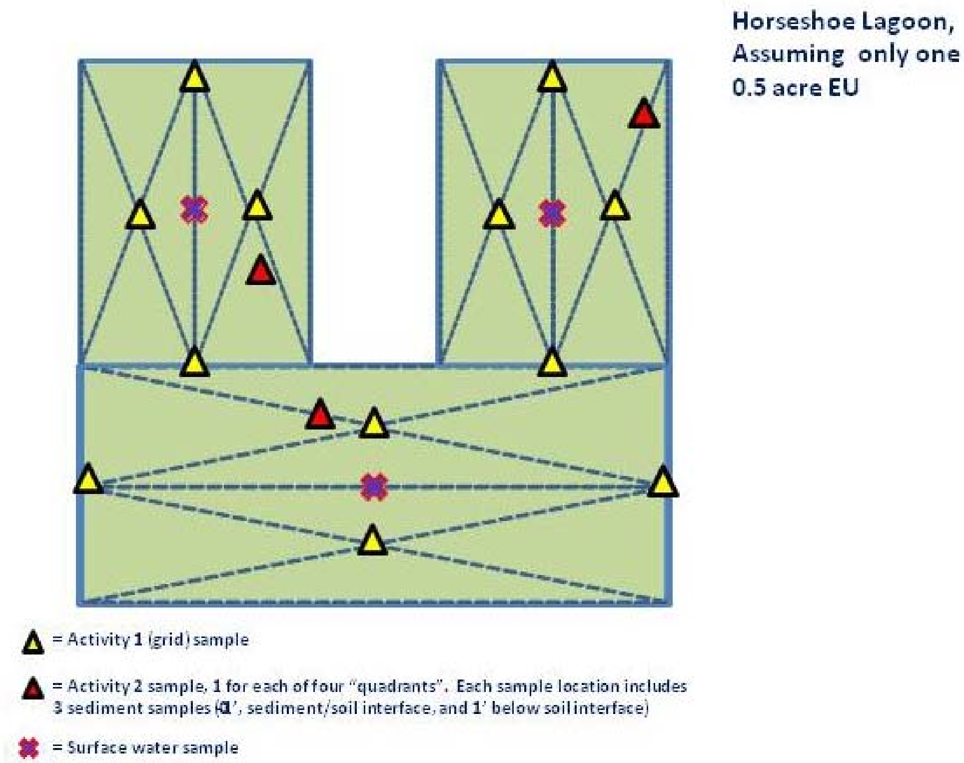

Figure 12.2. Example Schematic Diagram of Sampling Horseshoe Lagoon

Sampling will be conducted as follows:

Activity 1: Grid Sampling

Eight sediment samples will be collected based on a 30-ft hot spot grid, with 90% certainty, or 707 ft^2 triangular hot spot area grid with random starting location, extending from bank to bank. Lagoon is 0.1266 acres.

Three filtered and three unfiltered surface water samples will be collected, one each from all three sections of the lagoon.

Activity 2: Definitive Sampling

Horseshoe Lagoon will be divided into three sections. One sample will be collected from a random location within each of the three sections. Each sample location includes 3 samples (0–6 inches bgs, sediment/soil interface, and 1 ft below soil interface).

If sediment beds are found greater than 3 ft bgs, then a sediment sample will be collected near the midpoint between the interface sample and the surface sediment sample. Additional sample set will be obtained at the discharge point of Outfall 014 (0–6 inches bgs and sediment/soil interface).

Decision Rules:

If any sample within the lagoon exceeds the creek reach sampling Phase 1 action level, the sample location will be identified as a hot spot. If hot spots are identified as part of Activity 1 sampling, then the area immediately adjacent to the location containing the hot spot also will be sampled using Activity 2 methods. When performing this contingency sampling, the size of the adjacent location sampled will be limited to a 35 by 35 ft area (1,225 ft^2). Within this area, two Activity 1 contingency samples will be collected. Extent of hot spot will be determined by adjacent sample results below the action level. If results averaged within the lagoon (EPC equals the 95% UCL on the mean) exceed a cumulative ELCR of 1 x 10-6 or an HI of 1 for the Industrial Worker (or Recreational User), then the lagoon moves to the feasibility study for decision making.

Decision Rules—Ecological:

Endpoint receptors (benthic invertebrates) will be recommended for further evaluation if a comparison of detected concentrations to available toxicity benchmarks for the given medium (sediment, or surface water) are exceeded.

Measurement endpoints (e.g., the kingfisher) will be retained for further evaluation if their FCM HQ, based on upper-bound exposure input values (e.g., use of 95% UCLs for the EPCs) exposure input values and LOAEL TRVs exceed a value of 1, with the exception of the little brown bat, which represents a T&E species. The bat receptor will be carried forward if its FCM HQ, based on upper-bound inputs and NOAEL TRVs, exceeds a value of 1. Site-specific uptake factors developed during investigations of other PGDP ecological EUs will be considered.

The following weight of evidence considerations should be considered:

A spatial evaluation of elevated COPEC concentrations indicates that a realistic potential exists for adverse impacts to local receptor populations (if sampling placement/density adequately bounds contamination).

The chemical is considered to be potentially site-related based on known historical processes occurring at PGDP and fate-and-transport pathways that exist at the site.

An evaluation of chemical specific properties (e.g., chemical form/bioavailability of chemical used in toxicity studies, vs. expected form/bioavailability of the COPEC), including the possible consideration of alternative TRVs, uptake factors, etc., confirms that the exceedance of HQ threshold values in the risk characterization is realistic.

Results from any toxicity studies performed during investigations of other PGDP ecological EU confirm the results of the SERA.

12.11.1.1 Sampling media and methods

One type of sampling and data collection activity will be performed—intrusive media sampling (water, sediment, and soil). Investigation activities will use DOE Prime Contractor-approved procedures that are consistent with EPA procedures and protocols.

Intrusive Sampling

Media samples will be collected to characterize areas that have been evaluated and found to have data gaps. The samples will be collected using DOE Prime Contractor-approved procedures and will be analyzed using field test methods, and selected samples will be submitted to a DOECAP-accredited analytical laboratory for analysis.

Sediment/Soil Sampling. Sediment/soil shall be collected at depths of 0–6 inches, at the sediment/native soil interface, and 1 ft below the sediment/native soil interface with the use of a stainless-steel sampler, hand auger, spoon, trowel, spade, or scoop.

Surface Water Sampling. Surface water samples will be collected as unfiltered samples.

12.11.1.2 Sample analysis

Activity 1 sediment and soil samples will be analyzed for PCBs, uranium, lead, and cesium-137 by *ex situ* field analytical methods. Ten percent (10%) of the total samples collected will be selected randomly and submitted for fixed-base laboratory analysis.

Surface water samples will be analyzed for VOCs (TCE only), metals, radionuclides, and physical parameters [e.g., pH, hardness, dissolved oxygen (DO), and conductivity].

Activity 2 sediment and soil samples will be analyzed for metals, radionuclides, PAHs, VOCs (TCE only), and PCBs. If PCBs are detected in any of the samples, one congener evaluation will be performed. The congener evaluation will be run only on a sample that has a positive detection for PCBs. In order to perform the congener evaluation on the same sample that has a detection of PCB, the fixed-base laboratory will need to hold the extract from the PCB analysis until the RI PM or designee has determined the samples on which to perform a congener evaluation.

Analytical requirements may be broadened based on analysis of Phase 1 creek sampling.

12.11.1.3 Sampling procedures

Sampling procedures are described in the QAPP for this work plan (Section 17).

12.11.1.4 Documentation

Requirements for documentation are located in the QAPP for this work plan (Section 17).

12.11.2 Sample Location Survey

GPS coordinates in 1602 Kentucky State Plane South Zone with submeter accuracy will be obtained for all sampling locations. Additionally, depths for each sample obtained also will be recorded. Where possible, flags or wooden or metal stakes will be used to mark sampling locations. Each sampling location will be described with field maps and photographs. This will enable reestablishment of the sampling locations if the markers are disturbed or cannot be placed.

12.11.3 Maps/Locations

Figure 12.3 illustrates the planned sample locations for SWMU 185.

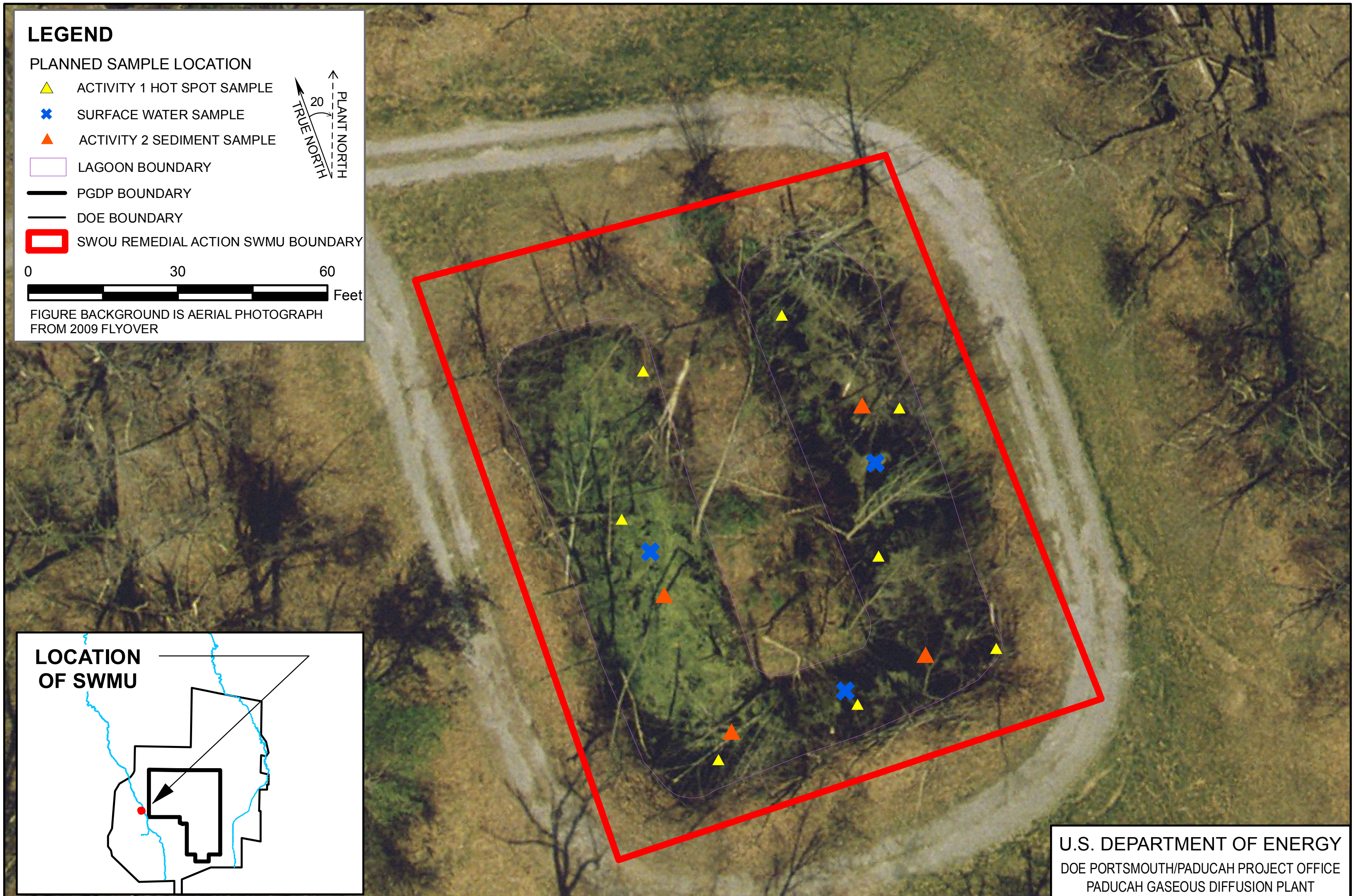

Figure 12.3. Planned Sampling at SWMU 185

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13. YELLOW WATER LINE (SWMU 205)

The Yellow Water Line (YWL) is a subsurface vitrified clay pipe that was used from December 1942 until August 1945 to convey yellow water trade wastes from the KOW TNT manufacturing area to a discharge point on Bayou Creek (TCT-St. Louis 1991). Yellow water is typically acidic and is a by-product of the TNT manufacturing process. Specifically the contaminated wastewater is a byproduct of the washing process used in the production of TNT. The portion of the YWL included within SWMU 205 consists of approximately 3,200 ft of 12-inch diameter, segmented, vitrified-clay pipe and six associated 36-inch diameter manholes (denoted as MH 28-R through MH 33-R on Figure 13.1). It also includes the northern headwall of the line (denoted as HW on Figure 13.1), which was constructed of acid-proof brick. As part of the WAGs 1 and 7 RI work, a survey was conducted in early April 1996 in an attempt to determine the location of the YWL with respect to the C-746-K Landfill (DOE 1996). Using the 1942 Rust Engineering blueprints as a guide, the survey indicated that the line ran in an east-west direction beneath the northern portion of the landfill site. Other than remnants of the headwall on Bayou Creek, no visible evidence of the line has been found in the area encompassed by SWMU 205, and it appears that the manholes have been removed or covered over most likely in 1951 when the C-746-K Landfill was built. Based on the 1996 survey, the depth of the eastern portion of the YWL with respect to current ground surface varies from approximately 18 ft bgs to as little as 2 ft bgs. The topography of SWMU 205 is relatively flat over most of its area, with the exception of the C-746-K Landfill area. In general, the ground surface gently slopes (typically < 6%) eastward toward Bayou Creek in the area north of the landfill and east of the C-611 Water Treatment Plant, with elevations ranging between approximately 360 to 374 ft msl. At the C-746-K Landfill, surface elevations range from 370 to 390 ft msl.

The SWMU 205 area has field scrub-shrub type vegetation, typically consisting of sun-tolerant woody species mixed with field grasses or planted wildlife grasses (CH2M HILL 1991a; CH2M HILL 1991b). Surface-water runoff from the SWMU 205 area flows east into Bayou Creek.

13.1 LOCATION

SWMU 205, the eastern portion of the YWL, is located on DOE-owned property west of the PGDP and east of the C-611 Water Treatment Plant extending from the C-746-K Landfill to Bayou Creek (Figure 13.1). It encompasses that portion of the YWL and its associated manholes that lie between station 31+50 (the westernmost drainage swale of the C-746-K Landfill) and station 63+54 (the northern headwall on Bayou Creek). The best available data concerning the location and depth of the YWL are blueprints produced by Rust Engineering in 1942, prior to construction of the KOW (Rust 1942).

13.2 OPERATION HISTORY

The YWL (SWMU 205) was used from December 1942 until August 1945. Contaminants may have been released from the YWL to the environment through leaks or cracks in the pipe as well as through past discharges of yellow water though the headwall. Yellow water is highly acidic, yellow to orange-red in color, relatively stable, and resistant to biological oxidation. Based on the nature of the yellow water trade wastes, the potential contaminants present at the YWL area include nitroaromatic compounds [particularly TNT, trinitrobenzene (TNB), and 2,4-dinitroluene (2,4-DNT)], metals (particularly aluminum, arsenic, and manganese), acids (nitric and sulfuric), nitrates, and sulfates. For the five-month period between September 1945 and January 1946, Atlas Powder conducted decontamination procedures at the KOW, during which all underground wastewater lines, including the YWL, were flushed with water to remove residuals (TCT-St. Louis 1991). In addition, sodium bicarbonate was used extensively to

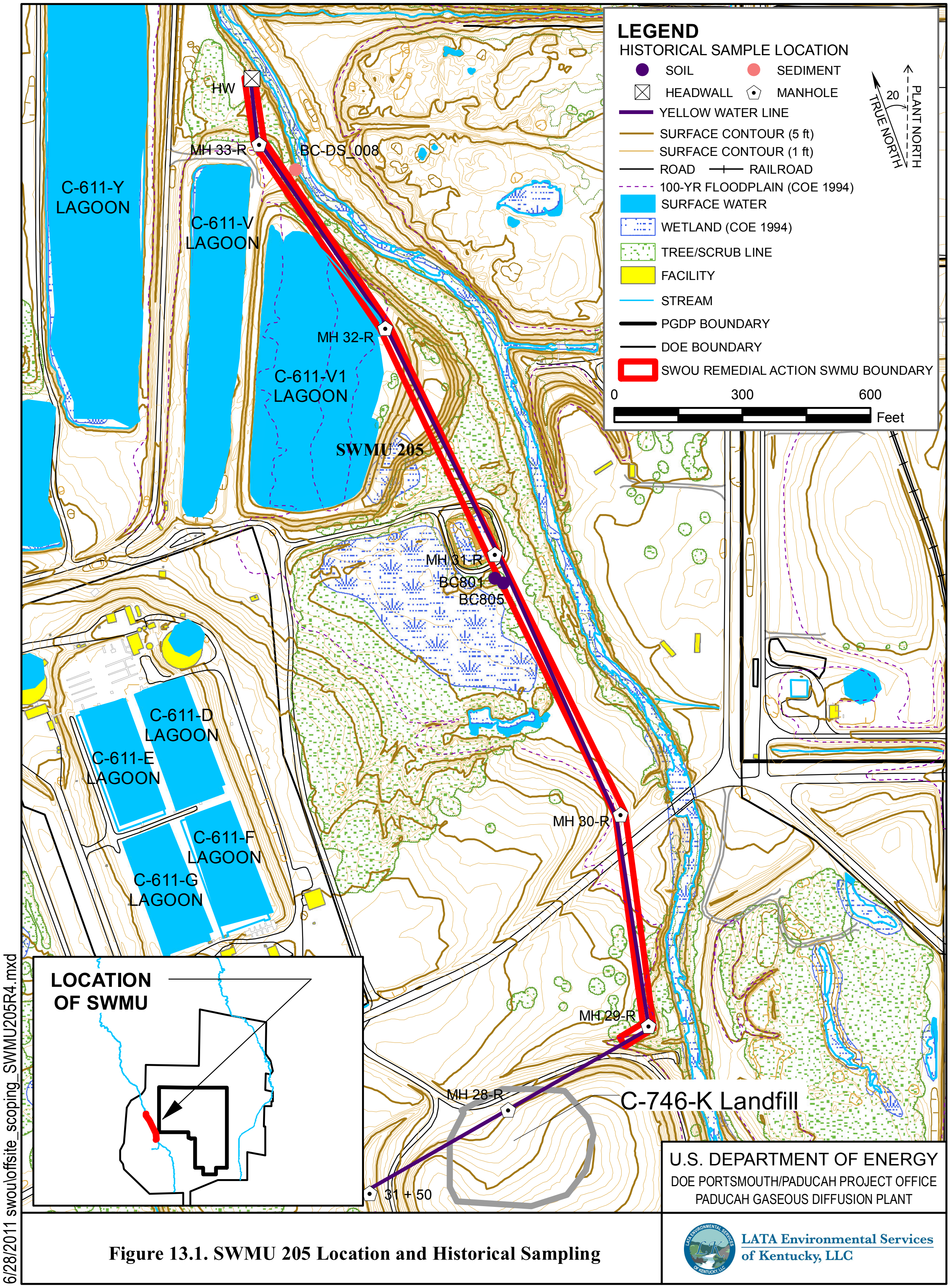

Figure 13.1. SWMU 205 Location and Historical Sampling

wash out the sewer lines (Maxim 1997); however, no records exist as to whether any excavation or demolition of the YWL (SWMU 205) occurred during decontamination activities at the KOW or during the construction of the PGDP. The external structures of the line (i.e., manhole covers and the standpipes) no longer are visible at SWMU 205, indicating that the portions of the line may have been demolished or removed most likely during expansion of the C-611 Water Treatment Plant and construction of the C-746-K Landfill in 1951.

13.3 OPERATIONAL CSM

The operational CSM is illustrated in Figure 5.1. The YWL (SWMU 205) has the potential for direct transport to Bayou Creek.

13.4 NATURE AND EXTENT

Portions of the YWL (SWMU 205) previously have been investigated as part of a three-phased RI of the former KOW conducted for the COE between 1991 and 1997 (TCT-St. Louis 1991; TCT-St. Louis 1995; Maxim 1997). These investigations addressed only those portions of the line located to the west of the C-746-K Landfill, outside the boundaries of SWMU 205. Results from these previous investigations suggest the creek sediments are not heavily contaminated with nitroaromatic compounds, although some highly localized nitroaromatic contamination is found very near damaged sewer lines or headwalls (Maxim 1997). During the previous investigations, a piece of TNT was found in the sewer line, indicating there is a potential for TNT to be present within the clay pipe.

Some surface water and sediment sampling has been conducted in the vicinity of the eastern portion of the YWL on Bayou Creek. Five sediment sample locations on Bayou Creek provide data concerning PCB concentrations, and gross alpha and beta activity for samples collected during the 1994 COE PCB study (COE 1996a; COE 1996b). The results were all below detection limits. In accordance with agreements on historical data use (see Section 15) these data are not included in Appendix D.

Soil and groundwater sampling have been conducted in the vicinity of the southern portion of SWMU 205 (station 31+50 to manhole MH 29-R on Figure 13.1) during numerous past investigations at the C-746-K Landfill (SWMU 8). The results of these investigations are presented in the WAGs 1 and 7 RI Report (DOE 1996). Several boring locations were situated directly along or within 25 ft of the likely path of the YWL; however, none of these borings encountered any evidence of the line.

The YWL is not known to be releasing contaminants to groundwater, although the potential for such releases exists. The absence of nitroaromatic compounds in groundwater monitoring wells at the landfill and at wells located downgradient of the SWMU 205 at PGDP provides evidence that SWMU 205 is not contributing to widespread groundwater contamination in that area. Previous investigations addressing western portions of the YWL suggest that evidence of a release to groundwater most likely would be found immediately adjacent to breaks in the line or near the discharge point at the headwall. With the exception of the sampling at the C-746-K Landfill, no groundwater samples have been collected close to the reported location of the YWL in the SWMU 205 area.

13.5 PREVIOUS RISK ASSESSMENT DISCUSSION/SUMMARY

No previous risk assessments have been performed for SWMU 205.

13.6 PREVIOUS ACTIONS TAKEN

No previous response actions have been taken at SWMU 205.

13.7 RISK EXPOSURE CSM

The risk exposure CSM is illustrated in Figure 5.2. The potential sources at the YWL (SWMU 205) may have been transported to Bayou Creek, potentially exposing current/future industrial workers, future residents, current/future recreational users, and terrestrial and aquatic biota to direct contact and incidental ingestion risks for surface water and sediment/sludge.

13.8 REMAINING PROBLEMS

Remaining problems for the YWL (SWMU 205) are discussed further within this section.

13.9 CHARACTERIZATION AND INVENTORY OF WASTES

The volume of sludge is unknown. This portion of the yellow water line is thought to run beneath the C-746-K Landfill (SWMU 8) and may run beneath SWMU 185. Waste produced at TNT Wash House was highly acidic. Potential contaminants present at the SWMU 205 area include nitroaromatic compounds (particularly TNT, TNB, and 2,4-DNT); metals (particularly aluminum, arsenic, and manganese) acids (nitric and sulfuric); nitrates, and sulfates.

13.10 INFORMATION STATUS OF KEY ASSESSMENT FACTORS

Table 13.1 identifies the status of key assessment factors.

Table 13.1. Status of Key Assessment Factors for SWMU 205

SWMU	Description	Waste Handling Practices	Contamination		Migration of Contamination	
			Presence	Extent	Surface Runoff	Infiltration
205	Eastern Portion of the Yellow Water Line	A	P	P	A	A

A—Factor is adequately defined. Current information is adequate to design a targeted sampling plan, but data gaps and uncertainties are such that the goals and objectives of the RI/FS cannot be met.
P—Factor is poorly defined. Current information is inadequate to design a targeted sampling plan, and data gaps and uncertainties are such that the goals and objectives of the RI/FS cannot be met.
Information provided in this table is taken from DOE 1999.

13.11 RELEASE POTENTIAL FROM CONTAMINANT SOURCES

On the basis of process knowledge, the YWL (SWMU 205) has been assessed for its potential for release of contaminants into surface water, sediments, subsurface soils, and groundwater. Although it has been out-of-service for more than 50 years, a potential exists that the yellow water pipeline currently is releasing contaminants into the environment. Contaminants present in the pipeline or in surrounding soils may leach into underlying soils or may discharge into Bayou Creek. In addition, pieces of TNT could be lodged within sections of the pipe, providing a continuing source of contamination to surrounding media through leaks in joints or breaks in the pipe. Particularly during periods of heavy rainfall, surface runoff could be channeled into the YWL through manholes or cracks in shallow portions of the line, flushing contaminants into surrounding soils and into the adjacent creek.

13.12 REMEDIAL ALTERNATIVES DEVELOPMENT SUMMARY

Information regarding potential response actions is provided in Appendix C.

13.13 DATA NEEDS

The location of the YWL in the field is known only from the original drawings; therefore, the location of the YWL will need to be verified. In addition, a sample of the discharge water from the YWL or surface water samples from the creek upgradient and downgradient of the discharge location is needed to determine if residual contamination exists in the YWL and if it is being transported to Bayou Creek. The sample also will be used to determine if contaminants are migrating to Bayou Creek from the YWL acting as a conduit from the C-746-K Landfill. Sediment samples from Bayou Creek, both upgradient and downgradient of the YWL discharge point, are needed to determine if SWMU 205 is contributing contaminants to Bayou Creek. In addition, soil samples from beneath the YWL are needed to determine if contaminants have been or are leaching into deep soil.

13.14 FIELD SAMPLING PLAN

The purpose of sampling is to determine if the YWL serves as a preferential pathway for water/contaminants from the C-746-K Landfill to Bayou Creek due to releases from the landfill and to determine if residual contamination exists in the YWL and is being transported to Bayou Creek.

When developing this plan, it was assumed that the YWL is made of clay with possibly a gravel base and the manways have been removed so that the manholes cannot be accessed from the surface. Engineering drawings indicate that the YWL is 8–15 ft bgs sloping to the north and discharging into Bayou Creek. YWL is ~3,200 ft long. The section of the YWL that runs east-west under the C-746-K Landfill may have been removed when the C-746-K Landfill was built; note that borings located between MH 28-R and MH 29-R in (Wehran 1981) did not encounter any evidence of the line. The remaining section of the line running south to north from MH 29-R to Bayou Creek is approximately 2,750 ft long. The discharge location on Bayou Creek is just upgradient of KPDES Outfall 015.

13.14.1 Sampling Strategy

Using the map in the 1999 work plan or, if they can be located, blueprints from Rust (Plan and Profile Drawings: 505 Trade Waste Sewer Outside Lines, Drawing Numbers KyOW505-015, KyOW505-016, KyOW505-012, and KyOW505-026, Rust Engineering Company) survey/mark the suspected YWL location on the ground (Rust 1942).

Locate the headwall where YWL discharges into Bayou Creek.

If headwall and YWL discharge can be located and if water is present in the YWL, sample discharge water (1 surface water sample).

If headwall cannot be found in the field, determine its "suspected" approximate location from map and survey data. Sample surface water in creek upgradient and downgradient of confirmed or suspected discharge place near the west bank of the creek (2 surface water samples).

Sediment samples will be collected as follows:

A total of two in-stream transects (two creek bed locations, two bank locations) will be placed, one upgradient and one downgradient of the YWL discharge location. These transects are in addition to the Bayou Creek transects planned for Phase 1 (see Section 6).

Each sediment sample location will have one surface (0–6 inches bgs) sample and one sample at the sediment/native soil interface.

Conduct geophysical survey above and below the C-746-K Landfill and direct push borings to determine location of the YWL.

If the YWL cannot be located at the C-746-K Landfill, then using the marked location of the YWL, place direct push boring transects for up to 40 ft perpendicular to the YWL for the purpose of finding the YWL as follows:

- One transect immediately downgradient of the C-746-K Landfill, and
- One transect immediately upgradient of the headwall (confluence of the YWL and Bayou Creek).

At eight locations approximately evenly spaced between the two locations described above (the length of the line along this trajectory is approx. 2,750 ft; therefore, this represents a line of DPT borings approximately every 500 ft).

Depth of DPT borings is to be the 3 ft below the depth of YWL in the vicinity of the trench (approximately 12–16 ft bgs).

- Identify YWL.
- Collect soil sample from location that represents the base of the YWL to 1 ft below the base of the YWL and from 2–3ft below the base of the YWL.

13.14.1.1 Sampling media and methods

One type of sampling and data collection activity will be performed—intrusive media sampling (water, sediment, and soil). Investigation activities will use DOE Prime Contractor-approved procedures that are consistent with EPA procedures and protocols.

Intrusive Sampling

Various media samples will be collected to characterize areas that have been evaluated as having data gaps. The samples will be collected using DOE Prime Contractor-approved procedures and will be submitted a DOECAP-accredited analytical laboratory for analysis.

Sediment/Soil Sampling. Soil/sediment shall be collected at of depths 0–6 inches bgs and at the sediment/native soil interface with the use of a stainless-steel sampler, hand auger, spoon, trowel, spade, or scoop.

Soil Sampling. Soil shall be collected at depths from the base of the YWL to 1 ft below the base and from 2-3 ft below the base of the YWL with the use of a stainless-steel sampler, hand auger, spoon, trowel, spade, or scoop.

Surface Water Sampling. Surface water samples will be collected as unfiltered samples.

Deep Soil by DPT Rig. Soil samples will be collected under the bottom of the YWL using a DPT rig, if the line can be located.

13.14.1.2 Sample analysis

All samples will be analyzed at a fixed-base laboratory because a comprehensive analytical suite is needed to look for residual YWL contaminants as well as contaminants that may have come from the C-746-K Landfill.

Analysis of sediment samples is based on the Phase 1 creek sampling and will include metals, radionuclides, PAHs, geotechnical parameters (10% of surface samples), and PCBs. If PCBs are detected in any of the transect samples, one congener evaluation will be performed. The congener evaluation will be run only on a sample that has a positive detection for PCBs. In order to perform the congener evaluation on the same sample that has a detection of PCB, the fixed-base laboratory will need to hold the extract from the PCB analysis until the RI PM or designee has determined the samples on which to perform a congener evaluation.

Analysis of soil samples will include VOCs, PCBs, PAHs, metals, explosives, (TNT and its breakdown products) and radionuclides (including radium-226 due to coal ash). This exhaustive list of analytes is needed because unknown contaminants might have entered the YWL from the C-746-K Landfill.

Analysis of unfiltered surface water samples will be for VOCs, metals, explosives (TNT and its breakdown products), radionuclides (including radium-226 due to coal ash), and physical parameters (e.g., pH, hardness, DO, conductivity).

13.14.1.3 Sampling procedures

Sampling procedures are described in the QAPP for this work plan (Section 17).

13.14.1.4 Documentation

Requirements for documentation are located in the QAPP for this work plan (Section 17).

13.14.2 Sample Location Survey

GPS coordinates in 1602 Kentucky State Plane South Zone with submeter accuracy will be obtained for all sampling locations. Additionally, depths for each sample obtained also will be recorded. Where possible, flags or wooden or metal stakes will be used to mark sampling locations. Each sampling location will be described with field maps and photographs. This will enable reestablishment of the sampling locations if the markers are disturbed or cannot be placed.

13.14.3 Maps/Locations

Planned sampling locations are shown in Figure 13.2.

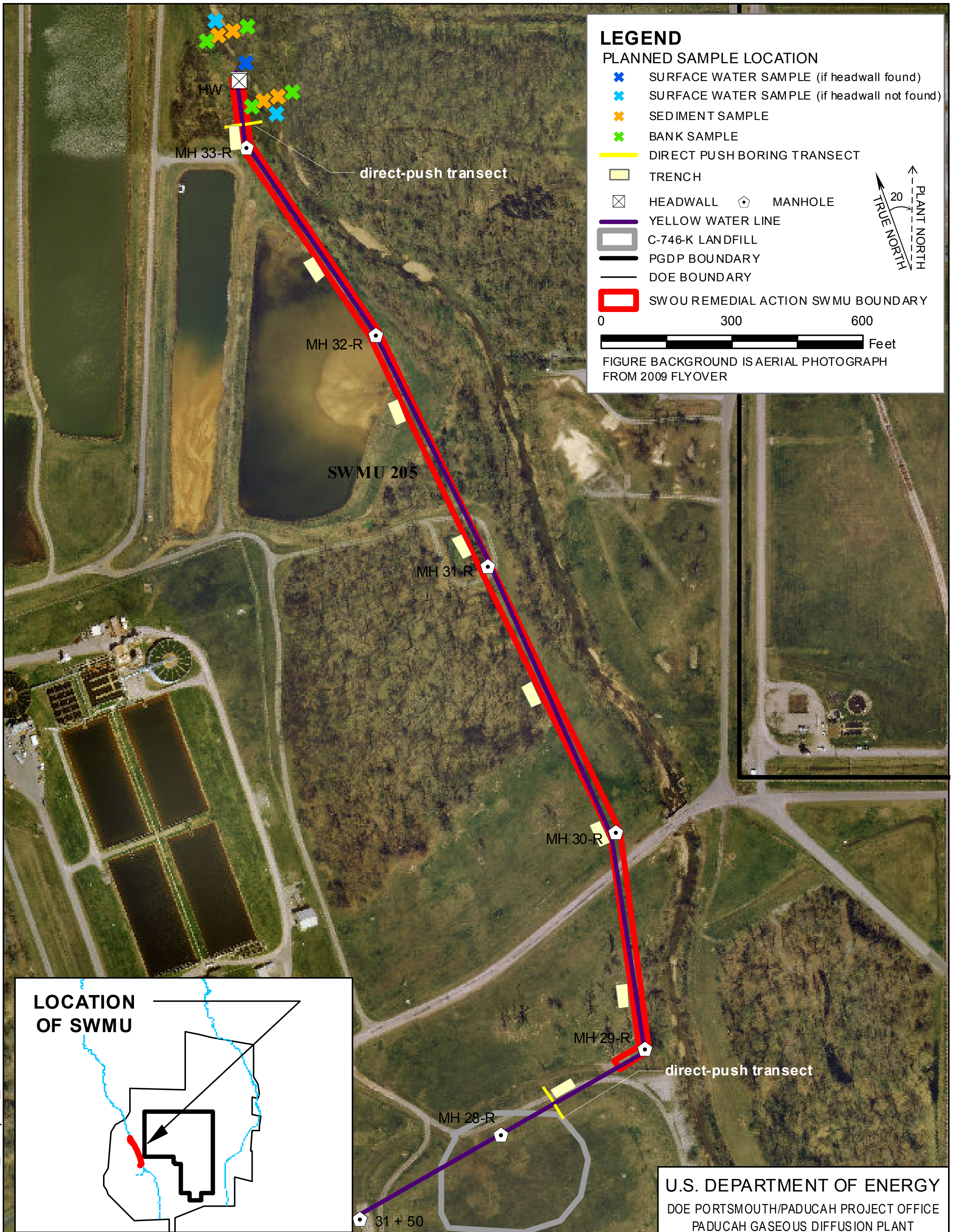

Figure 13.2. Planned Sampling at SWMU 205

14. ISOLATED STRUCTURES (SWMUs 113, 199, 549, AND 550)

Four isolated structures are to be evaluated. These are as follows:

(1) SWMU 113 consists of concrete and rubble placed to provide bridge support. The approximate volume of concrete at the site is 10 yd^3.

(2) SWMU 199 is a former Bayou Creek Monitoring Station on Bayou Creek. Currently it consists of an 8 ft x 8 ft concrete pad.

(3) SWMU 549 is a concrete and rubble waste pile consisting of an L-shaped pile of concrete with rubble waste approximately 30 ft x 30 ft in area.

(4) SWMU 550 consists of five sections of concrete culvert strewn over an area of 20 ft x 20 ft. The volume of waste is small consisting of the 5 concrete culvert sections only.

14.1 LOCATION

Figure 14.1 shows the locations of the four SWMUs included in this group.

SWMU 113 is located to the north of the PGDP on TVA property at the bridge where Anderson Road crosses the Little Bayou Creek (SWMU 64).

SWMU 199 a former monitoring station is located northwest of PGDP at the intersection of West Boone Road and Bayou Creek in the WKWMA.

SWMU 549 is located on the south bank of KPDES Outfall 008, downgradient of SWMUs 63 and 129 west of the PGDP on DOE-owned property.

SWMU 550 is located on the west bank of the ditch upgradient of KPDES Outfall 001 west of the PGDP on DOE-owned property.

14.2 OPERATION HISTORY

SWMU 113 (Isolated Structure Rubble Pile 11)
At SWMU 113, concrete slabs and rubble from a PGDP-source were placed along the bank of Little Bayou Creek at some time in the 1980s to support a steel grate bridge that crosses Little Bayou Creek.

SWMU 199 (Isolated Structure Bayou Creek Monitoring Station)
The dimensions of the station house at the former monitoring station were approximately 2.4 m wide by 2.4 m long by 2.4 m tall (8 ft x 8 ft x 8 ft). Between 1976 and 1987, the station was a monitoring location for surface water discharge from the PGDP under the National Pollutant Discharge Elimination System program. The station house was used subsequently to store monitoring equipment after 1987. During an act of vandalism in 1991, a mercury manometer was broken, spilling approximately 100 ml of mercury. After cleanup of the spill, Industrial Hygiene personnel measured the level of mercury in the air at 0.025 mg/m^3, well below the National Institute for Occupational Safety and Health 10-hour time-weighted average exposure limit of 0.05 mg/m^3. When cleanup operations were completed in 1991, the door of the monitoring station was welded shut to prevent access. The site received SWMU designation in 1994

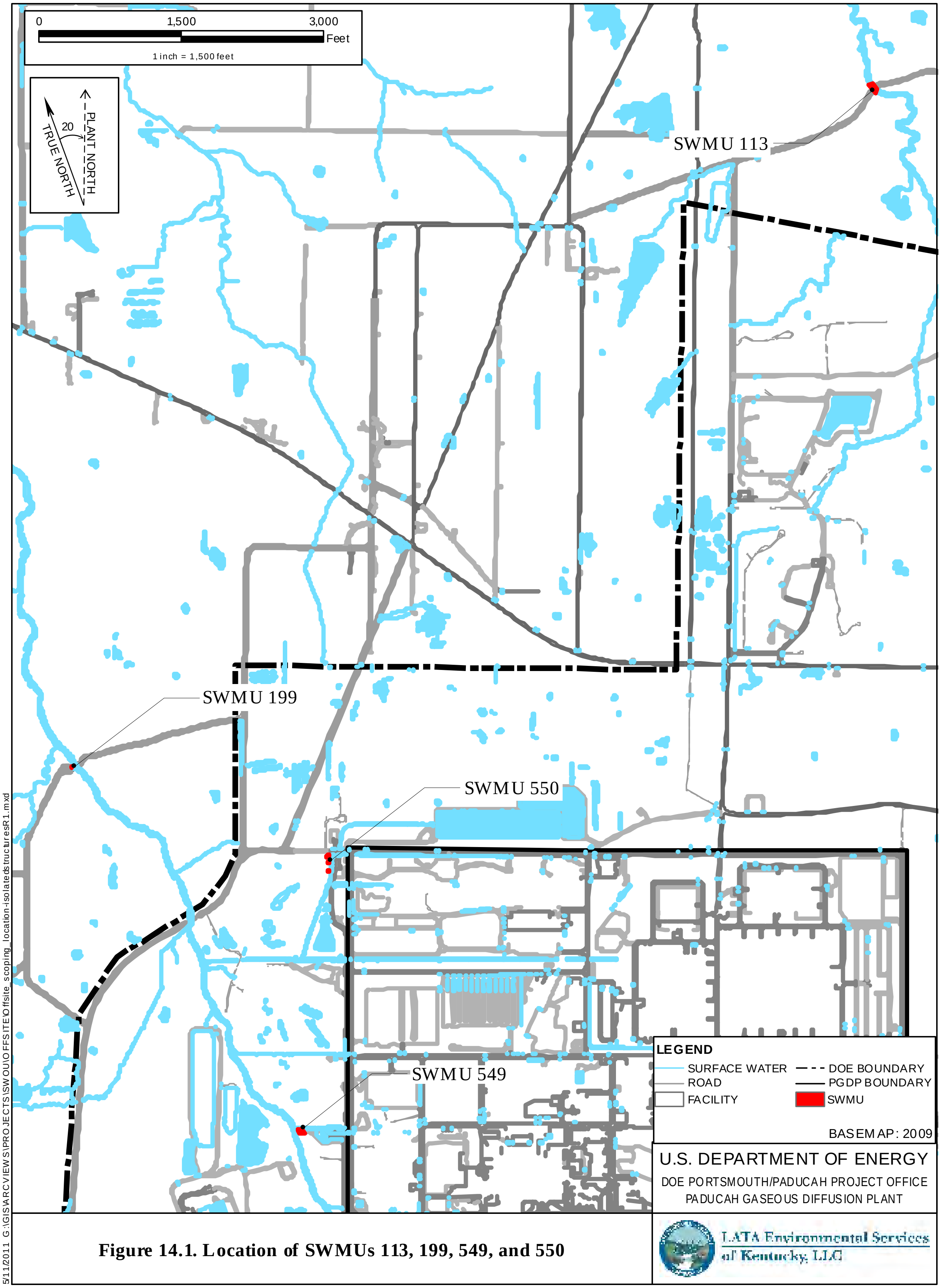

Figure 14.1. Location of SWMUs 113, 199, 549, and 550

after a facility inspection identified the potential for mercury to have entered the environment through seams in the concrete floor and along instrumentation lines. The walls and roof of the monitoring station were removed in 1995 and the floor was painted with waterproof paint. The station is inactive and currently all that remains is the cement flooring.

<u>SWMU 549 (Isolated Structure Rubble Pile at Outfall 008)</u>
SWMU 549 is believed to have been created during the installation of the refrigerated auto-sampler project in the early 1990s.

<u>SWMU 550 (Isolated Structure Concrete Culvert at Outfall 001)</u>
The date of placement of the rubble making up SWMU 550 is unknown; however, two pieces of culvert pipes were found on March 24, 2003, and three more were found on March 27, 2003; therefore, the date of placement is prior to 2003.

14.3 OPERATIONAL CSM

The operational CSM is illustrated in Figure 5.1. SWMUs 113, 199, 549, and 550 are depicted under the category of Rubble Piles and have the potential of runoff to Bayou and Little Bayou Creeks.

14.4 NATURE AND EXTENT

<u>SWMU 113 (Isolated Structure Rubble Pile 11)</u>
In the early 1990s, SWMU 113 was screened for radiation. Beta and gamma screening of the concrete showed no radiation above background levels. Gamma screening of soil adjacent to the concrete showed radiation levels at three times greater than background. The WAG 17 RFI/RI included a visual inspection of the site, a review of screening results, and PCB field screening of surface soil (DOE 1997). The two samples collected for PCB screening both were < 0.5 mg/kg. No samples were collected for laboratory analysis. SWMU 113 is shown in Figure 14.1.

<u>SWMU 199 (Isolated Structure Bayou Creek Monitoring Station)</u>
A facility inspection of SWMU 199 in 1994 identified the potential for mercury to have entered the environment through seams in the concrete floor and along instrumentation lines due to a mercury release at the site in 1991; however, no previous environmental investigations have been performed for SWMU 199. Historical sampling near SWMU 199 is shown in Figure 14.2.

<u>SWMU 549 (Isolated Structure Rubble Pile at Outfall 008)</u>
A radiological survey of SWMU 549 on 5 of 10 rocks on January 23, 2003, indicated activity in the range of 755 to 17,945 dpm; however, no environmental investigations have been performed. Historical sampling near SWMU 549 is shown in Figure 14.3.

<u>SWMU 550 (Isolated Structure Concrete Culvert at Outfall 001)</u>
A radiological survey of SWMU 550 on the 2 culvert pieces found on March 24, 2003, indicated activity up to 23,000 dpm and a radiological survey on the additional 3 culvert pieces found on March 27, 2003, indicated activity up to 11,000 dpm; however, no environmental investigations have been performed. Historical sampling near SWMU 550 is shown in Figure 14.4.

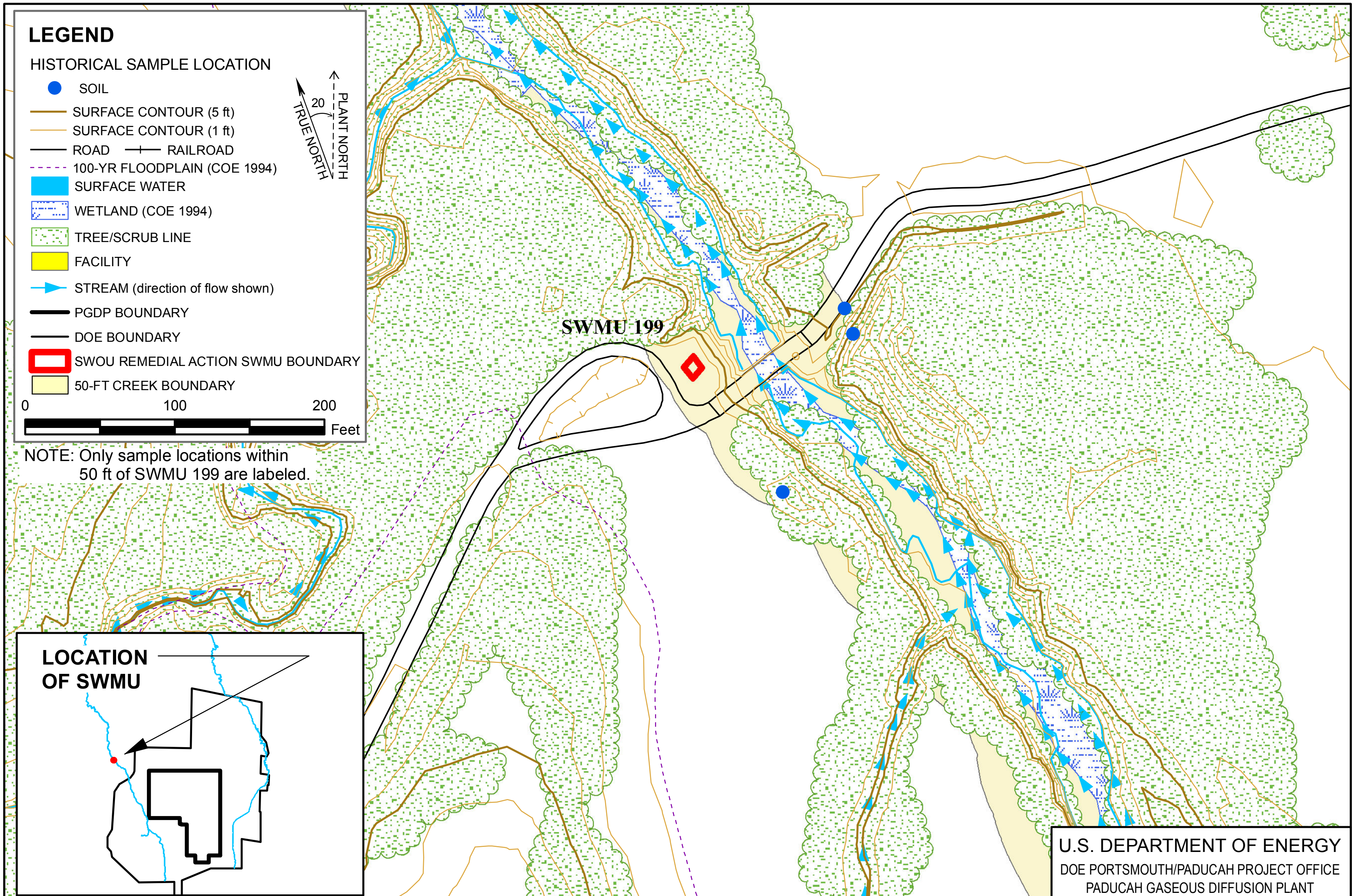

Figure 14.2. Historical Sampling near SWMU 199

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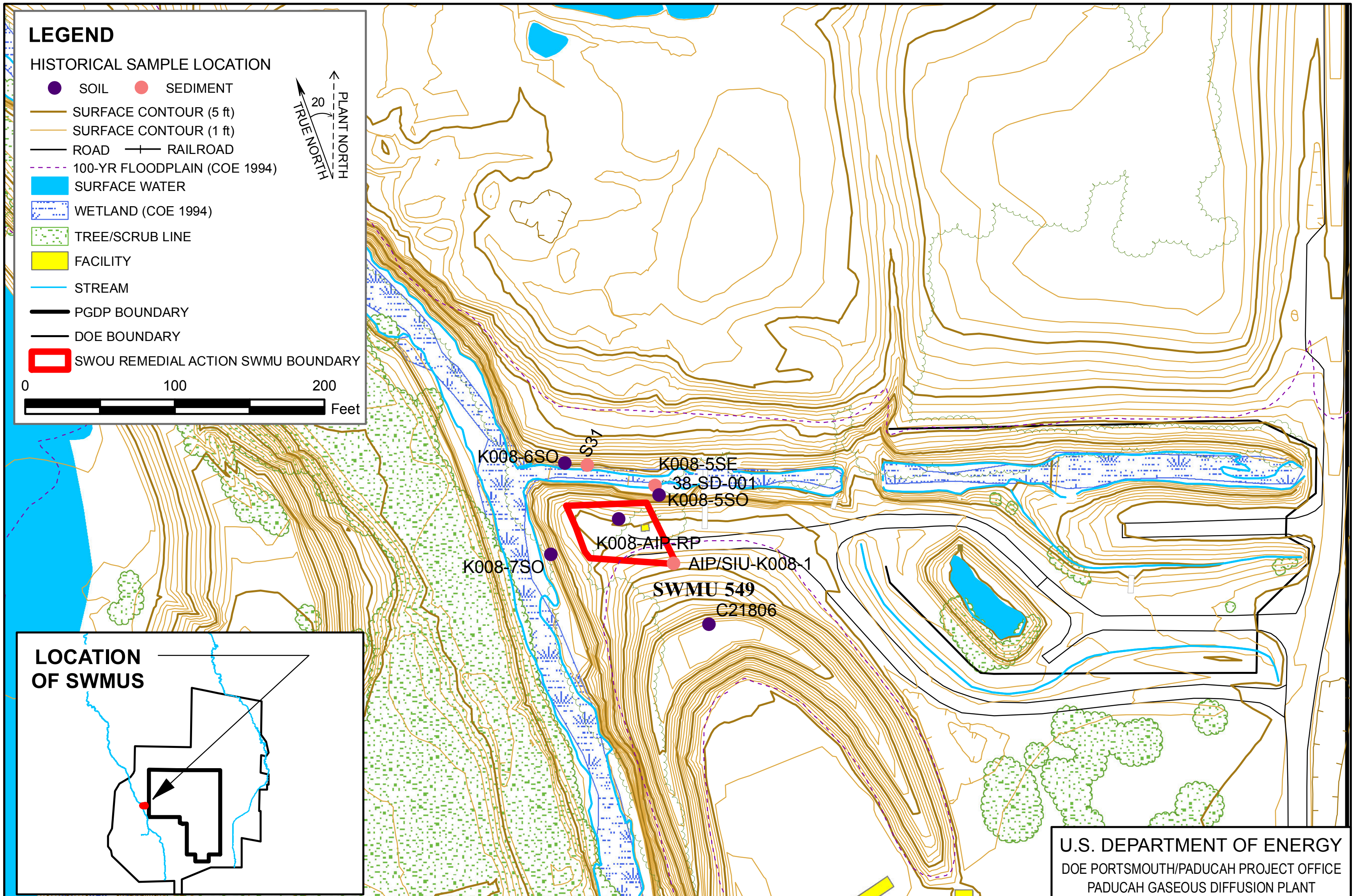

Figure 14.3. Historical Sampling near SWMU 549

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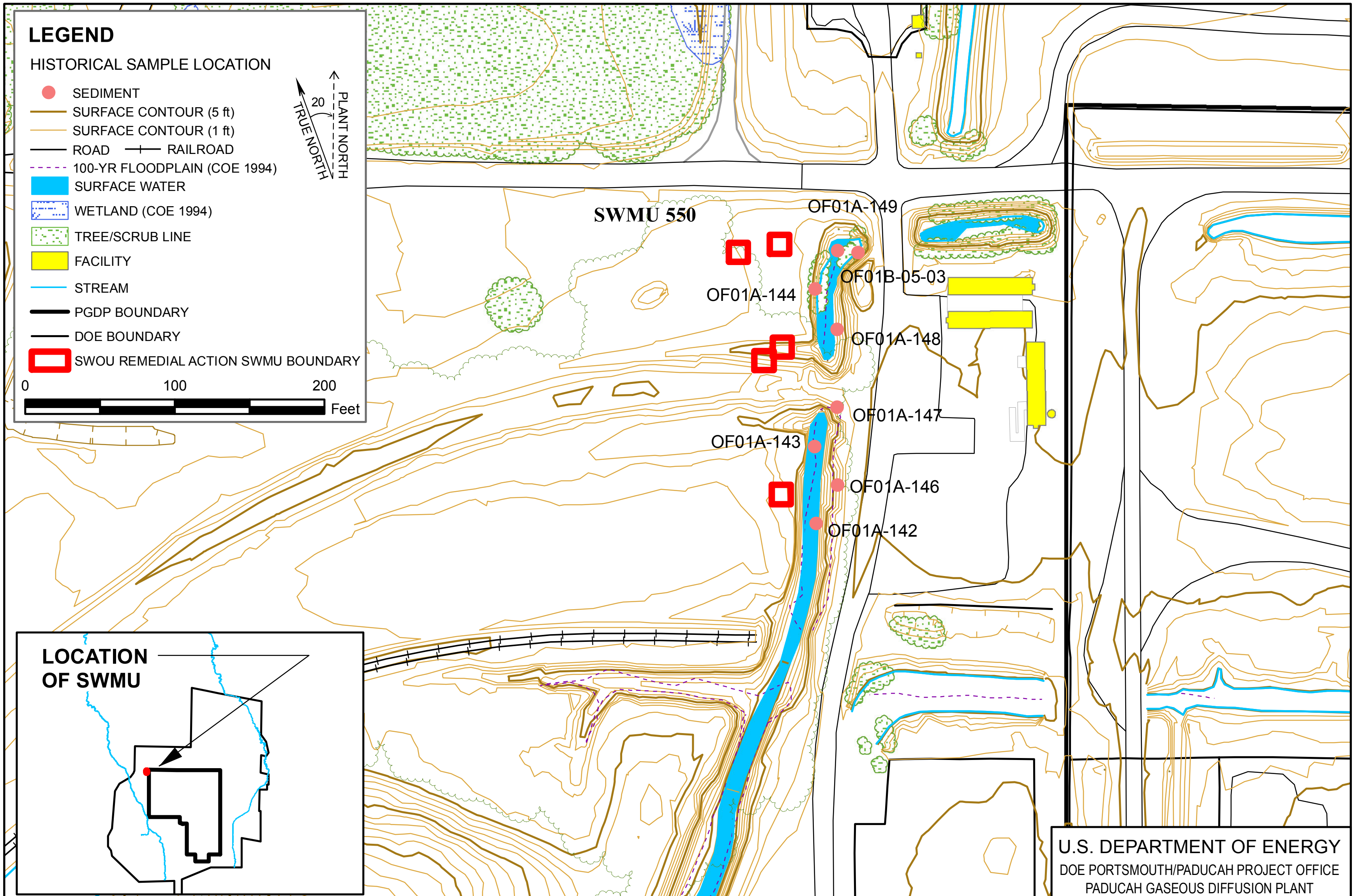

Figure 14.4. Historical Sampling near SWMU 550

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14.5 PREVIOUS RISK ASSESSMENT DISCUSSION/SUMMARY

It should be noted that previous risk assessments utilized different decision rules than those that will be used for this RI/FS. If risk estimates were recalculated using current methods, exposure parameters, and toxicity information, the results could differ markedly; however, the assessments did indicate the contaminants and media that needed to be considered during the scoping of this work plan.

SWMU 113 (Isolated Structure Rubble Pile 11) was evaluated as part of the WAG 17 RI and it contained no human health COPCs (DOE 1997). The screening ecological risk assessment included SWMU 113. Because there was no evidence of previous concrete or soil radiological contamination and PCBs were not detected in surface soil, no COPECs were retained.

No previous risk assessments have been performed for SWMU 199 (Isolated Structure Bayou Creek Monitoring Station), SWMU 549 (Isolated Structure Rubble Pile at Outfall 008), or SWMU 550 (Isolated Structure Concrete Culvert at Outfall 001).

14.6 PREVIOUS ACTIONS TAKEN

Response actions at SWMU 113 (Isolated Structure Rubble Pile 11) include fencing and posting.

At SWMU 199 (Isolated Structure Bayou Creek Monitoring Station), the mercury spill was cleaned up in 1991, and the door of the monitoring station was welded shut to prevent access. In 1995, the roof and walls were removed and the floor was painted with waterproof paint as a maintenance action. Currently all that remains is the cement flooring.

Response actions include fencing and posting at SWMU 549 (Isolated Structure Rubble Pile at Outfall 008) and SWMU 550 (Isolated Structure Concrete Culvert at Outfall 001).

14.7 RISK EXPOSURE CSM

The risk exposure CSM is illustrated in Figure 5.2. The potential sources at SWMU 113 ((Isolated Structure Rubble Pile 11), SWMU 549 (Isolated Structure Rubble Pile at Outfall 008), and SWMU 550 (Isolated Structure Concrete Culvert at Outfall 001)—may have been transported to Bayou Creek, potentially exposing current/future industrial workers, future residents, current/future recreational users, and terrestrial biota to direct contact risks. The potential sources at SWMU 199 (Isolated Structure Bayou Creek Monitoring Station) may have been transported to Bayou Creek, potentially exposing future residents, current/future recreational users, and terrestrial and aquatic biota to direct contact and incidental ingestion risks for contaminated rubble and soil/sediment.

14.8 REMAINING PROBLEMS

Remaining problems for SWMUs 113, 199, 549, and 550 are discussed further within this section.

14.8.1 Characterization and Inventory of Potential Exposure Media

SWMU 113 (Isolated Structure Rubble Pile 11) has approximately 10 yd^3 of concrete, but the total volume of waste is unknown. In the early 1990s, a beta/gamma survey that was performed did not identify contamination in rubble, but did identify gamma radiation at 3x background in soil. The WAG 17 RFI/RI Report stated that PCBs were detected in soil at less than 0.5 mg/kg (DOE 1997). The Human

Health Risk Assessment indicated no COC. A screening-level Ecological Risk Assessment was completed with no COPEC retained.

SWMU 199 (Isolated Structure Bayou Creek Monitoring Station) has a remaining concrete floor that is 8 ft x 8 ft with expected contamination of mercury resulting from the historic spill.

SWMU 549 (Isolated Structure Rubble Pile at Outfall 008) consists of concrete with rubble (L-shaped) approximately 30 ft x 30 ft in area. The actual volume of material is unknown. A radiological survey on 5 of 10 rocks on January 23, 2003, indicated activity in the range of 755 to 17,945 dpm.

SWMU 550 (Isolated Structure Concrete Culvert at Outfall 001) includes five sections of concrete covering an area of 20 ft x 20 ft. The actual volume of waste is unknown. Two culvert pipes were found on March 24, 2003, and three more found on March 27, 2003. A radiological survey on the two culverts on March 25, 2003, indicated activity up to 23,000 dpm. A radiological survey on the additional three culverts on March 27, 2003, found activity up to 11,000 dpm.

14.8.2 Information Status of Key Assessment Factors

Table 14.1 identifies the status of key assessment factors.

Table 14.1. Status of Key Assessment Factors for SWMUs 113, 199, 549, and 550

SWMU	Description	Waste Handling Practices	Contamination		Migration of Contamination	
			Presence	Extent	Surface Runoff	Infiltration
113	Concrete Rubble Pile	A	A	A	A	A
199	Bayou Creek Monitoring Station	W	W	A	W	W
549	Concrete and Rubble Waste	A	A	A	A	A
550	Concrete and Rubble Piles	A	A	A	A	A

A—Factor is adequately defined. Current information is adequate to design a targeted sampling plan, but data gaps and uncertainties are such that the goals and objectives of the RI/FS cannot be met.
W—Factor is well defined. Current information is adequate to meet the goals and objectives of the RI/FS.
Information provided in this table is taken from DOE 1999.

14.8.3 Release Potential from Contaminant Sources

The surfaces of the concrete rubble at SWMU 113, SWMU 549, and SWMU 550 may have been contaminated while inside the PGDP plant area from contact with radioactive materials, PCB-bearing oils, and associated metals. Since placement of the concrete rubble at the site, weathering processes may have caused leaching of these potential contaminants to surface water, soil and sediment in the outfall ditch. Some of the concrete and associated bed gravel and dirt at SWMU 113 is in direct contact with surface water and sediment. Given the low mobility of the potential contaminants, significant migration into subsurface soil or shallow groundwater is not considered to be a problem.

The concrete rubble is not likely to be a continuing source of contaminants. Concrete rubble on the DOE Reservation was placed at the various sites up to 20 years ago (DOE 1996) and all the contaminants leachable under natural conditions probably have been removed. Contaminants remaining on the concrete have adsorbed or bonded to the concrete, and additional leaching to soil would require extremely low pH conditions not likely to be encountered in the natural environment at the PGDP. Any contaminants remaining on the concrete, however, could pose a threat to human health or the environment through contact with exposed surfaces. Runoff from concrete surfaces is a potential, but not a likely, migration pathway.

At SWMU 199, although cleanup operations successfully removed the spilled mercury, loss of some mercury through seams in the concrete floor or instrumentation lines is possible. The quantity of mercury released was approximately 100 ml (0.06 gal). If the mercury release went through the concrete floor, the mercury migrated into the subsurface soil or fill underlying the floor. Migration of mercury to the adjacent creek is not likely. Given the small size of the spill and the relatively low mobility of mercury, deep migration into subsurface soil and shallow groundwater is not considered a problem.

14.9 REMEDIAL ALTERNATIVES DEVELOPMENT SUMMARY

<u>SWMU 113 (Isolated Structure Rubble Pile 11)</u>

A potential remedy for SWMU 113 is removal of the concrete/soil due to fixed contamination followed by sampling to verify that all contaminants have been addressed. The action is anticipated to occur during the Little Bayou Creek remedial action; however, if no action is taken for Little Bayou Creek, or if there is another convenient time, then the removal could occur then.

<u>SWMU 199 (Isolated Structure Bayou Creek Monitoring Station)</u>

A potential remedy for SWMU 199 is removal of the concrete due to mercury contamination followed by sampling to verify that all mercury contamination has been addressed. The action is anticipated to occur during the Bayou Creek remedial action; however, if no action is taken for Bayou Creek, or if there is another convenient time, then the removal could occur then. In addition, this SWMU is being evaluated as a possible maintenance action.

<u>SWMU 549 (Isolated Structure Rubble Pile at Outfall 008)</u>

A potential remedy for SWMU 549 is removal of the concrete due to fixed contamination followed by sampling and surveying to verify that all PCBs, metals, and radionuclides have been addressed [consistent with *Sampling and Analysis Plan for Rubble Areas at the Paducah Gaseous Diffusion Plant Paducah, Kentucky* (DOE 2008c)]. The action is anticipated to occur during the Bayou Creek remedial action; however, if no action is taken for Bayou Creek, or if there is another convenient time, then the removal could occur then. In addition, this SWMU is being evaluated as a possible maintenance action.

<u>SWMU 550 (Isolated Structure Concrete Culvert at Outfall 001)</u>

A potential remedy for SWMU 550 is removal of the concrete culvert sections due to fixed contamination followed by sampling and surveying to verify that all PCBs, metals, and radionuclides have been addressed [consistent with *Sampling and Analysis Plan for Rubble Areas at the Paducah Gaseous Diffusion Plant Paducah, Kentucky* (DOE 2008c)]. The action is anticipated to occur during the Bayou Creek remedial action; however, if no action is taken for Bayou Creek, or if there is another convenient time, then the removal could occur then. In addition, this SWMU is being evaluated as a possible maintenance action.

14.10 DATA NEEDS

Existing information on SWMU 113 (Isolated Structure Rubble Pile 11) has identified radionuclide and PCB contamination in soil; however, it is unclear if the contamination is from this SWMU or was transported from elsewhere within the surface water system. The primary data need for this SWMU is to define the contribution of SWMU 113 to Little Bayou Creek to determine if contaminants are being added to the Little Bayou Creek and, if so, it Little Bayou Creek being adversely affected. Sediment samples will be collected upgradient and downgradient of the structure to determine if there is a contribution of contaminants to Little Bayou Creek from this structure.

There are no data needs for SWMU 199 (Isolated Structure Bayou Creek Monitoring Station), SWMU 549 (Isolated Structure Rubble Pile at Outfall 008), and SWMU 550 (Isolated Structure Concrete Culvert at Outfall 001) because the remedial alternative for these locations is removal of the concrete rubble. These three locations will not be discussed further.

14.11 FIELD SAMPLING PLAN

The purpose of the field sampling at SWMU 113 (Isolated Structure Rubble Pile 11) is to determine the extent of contamination and the potential for adverse impacts to human health and the environment that might require remedial action.

14.11.1 Sampling Strategy

A total of two cross-stream transects (two creek bed locations, two bank locations) will be placed, one upgradient and one downgradient of the concrete structure at SWMU 113 (Isolated Structure Rubble Pile 11). These transects are in addition to the Little Bayou Creek transects planned for Phase 1. Sediment samples only will be collected. Each sediment sample location will have one surface (0–6-inches bgs) sample and one sample at the sediment/native soil interface. Four sample locations in each transect are planned.

14.11.1.1 Sampling media and methods

One type of sampling and data collection activity will be performed—intrusive media sampling (sediment and soil). Investigation activities will use DOE Prime Contractor-approved procedures that are consistent with EPA procedures and protocols.

Intrusive Sampling

Various media samples will be collected to characterize areas that have data gaps. The samples will be collected using DOE Prime Contractor-approved procedures and will be submitted to a DOECAP-accredited analytical laboratory for analysis.

Sediment/Soil Sampling. Sediment/soil shall be collected at depths of 0–6 inches bgs and at the sediment/native soil interface with the use of a stainless-steel sampler, hand auger, spoon, trowel, spade, or scoop.

14.11.1.2 Sample analysis

Analytical requirements are based on Phase 1 creek sampling (see Section 6). Since high quality data is desired for this effort for the purpose of decision making and to aid in the focusing of analytes for Phase 2 of the creek sampling, fixed-based laboratory analyses only will be performed. Samples will be analyzed for metals, radionuclides, PAHs, and PCBs. If PCBs are detected in any of the samples, one congener evaluation will be performed per transect. The decision on which sample to be run for the congener analysis will be made with consideration of and in conjunction with other creek samples; however, the evaluation will be run only on a sample that has a positive detection for PCBs. In order to perform the congener evaluation on the same sample that has a detection of PCB, the fixed-base laboratory will need to hold the extract from the PCB analysis until the RI PM or designee has determined the samples on which to perform a congener evaluation.

14.11.1.3 Sampling procedures

Sampling procedures are described in the QAPP for this work plan (Section 17).

14.11.1.4 Documentation

Requirements for documentation are located in the QAPP for this work plan (Section 17).

14.11.2 Sample Location Survey

GPS coordinates in 1602 Kentucky State Plane South Zone with submeter accuracy will be obtained for all sampling locations. Additionally, depths for each sample obtained also will be recorded. Where possible, flags or wooden or metal stakes will be used to mark sampling locations. Each sampling location will be described with field maps and photographs. This will enable reestablishment of the sampling locations if the markers are disturbed or cannot be placed.

14.11.3 Maps/Locations

Planned sample locations for SWMU 113 are shown in Figure 14.5.

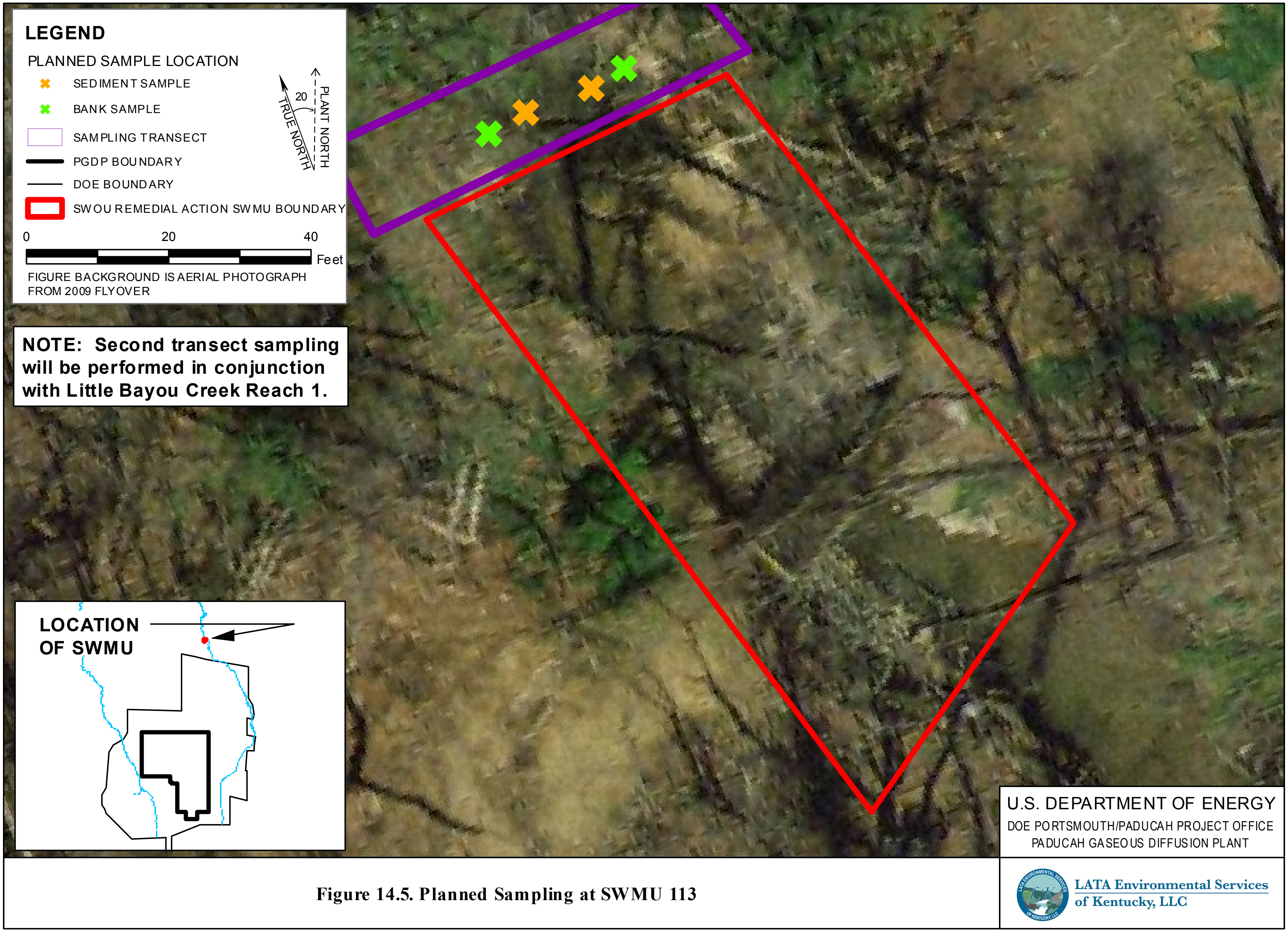


Figure 14.5. Planned Sampling at SWMU 113

5/11/2011 swou\offsite_workplan_SWMU113_R1.mxd

15. DATA QUALITY ANALYSIS

The field sampling strategy for this RI includes elements of stratified sampling, systematic (or grid) sampling, adaptive cluster sampling, composite sampling, and random sampling (EPA 2002). Analysis of these samples will be a combination of field laboratory data and fixed-base laboratory data. The RI will include a data quality analysis to (1) examine differences and comparability of fixed-base laboratory data and field laboratory data generated by this RI and (2) evaluate the use of historical data for the SWMU/AOC. Some of the decision rules that will be used in the data quality analysis when determining the usability of historical data are the following:

- Historical data that is dated 1999 or prior years will be excluded from use. Data that is 2000 or more recent will be utilized after evaluation for quality and representativeness of current conditions.

- Historical data that has been qualified as rejected by data validation or by data assessment will not be included in the historical dataset. A list of data assessment qualifiers considered as rejected, applicable to the SWOU Off-site RI/FS are the following:

  - R: Result unusable.

  - R-NORAD: Result unusable; uranium-235 portion of calculation is below reliable detection limits.

- Historical data that contain units inconsistent with the sampled media or with the analysis will not be included in the historical dataset (e.g., a soil sample with analytical units reported in mg/L or a radiological result with units reported in mg/kg).

- Historical data for radionuclide results with no minimum detectable concentration or minimum detectable activity recorded will not be included in the historical dataset.

- Historical data for nonradionuclide results with no reported result and no detection limit recorded will not be included in the historical dataset.

- Historical data for radionuclide results with a null or zero recorded as a counting error will not be included in the historical dataset.

- Data assessment qualifiers previously placed on the data will be noted and applied as appropriate. For example, the data assessment qualifiers listed here (only two are shown) should be used for information only and should not be used for risk evaluation/assessment purposes or as replacements for planned data.

  - IN-LABQC: Result should be considered information only. Quality control requirements of the laboratory method were not met.

  - KYRHTAB-ER: Kentucky Radiation Health and Toxic Agents Branch has performed an independent data evaluation (not to be confused with data verification and validation) and the data presents error problems (i.e., no counting uncertainty or zero counting uncertainty).

- A nonradionuclide result will be considered a nondetect if it is qualified by the reporting laboratory with a “U” qualifier or a “<” qualifier.

- A nonradionuclide result will be considered a nondetect if it has a “U” validation code or a “U” data assessment code.

- A radiological result will not be screened as a detection if the reported result is less than the total propagated uncertainty or the minimum detectable concentration or minimum detectable activity.

Any exceptions to these rules will be documented in the data quality analysis as part of the RI.

Existing data and information for each SWMU/AOC formed the basis for determining the amount of additional characterization data necessary to reach an action/NFA determination. In addition to analytical data, process knowledge, personnel interviews, and records/document searches all are useful in that determination. The site conceptual model for contaminant transport determines the applicability of each type of preliminary information/data, which in turn is used in support of a risk assessment.

All existing information about the SWMU/AOC and relevant surrounding area were collected including, but not limited to, the following:

- Compiling facility records, personnel interview records, and process description information for each SWMU/AOC;

- Defining processes and materials used, where chemicals and materials were used/disposed of, and where and how potential contaminants may have been introduced to the SWMU/AOC and subsequently released to the environment;

- Compiling all analytical data for the SWMU/AOC and surrounding area, including radiological surveys, geophysical surveys, sample results, geotechnical information, historical photographs, maps, and drawings; and

- Collecting and evaluating any existing computational assessments (risk assessment) or conceptual evaluations and the results and conclusions of any previous investigations.

The CSM is the working basis for planning the SWMU/AOC sampling requirements. The CSM presented in Figure 5.2 identifies the probable and potential contaminant migration and exposure pathways at the SWOU SWMUs/AOCs. From the source, probable exposure media are identified with solid lines. These probable exposure media will be the focus of the investigation activities.

The CSM for this investigation identified the following as the primary sources of contamination: past spills and releases from operations. Although specific information is not available regarding all past spills or releases. Contaminants are available for direct contact on-site through incidental ingestion, inhalation, dermal exposure, or external exposure (for gamma-emitting radionuclides). Receptors potentially exposed to soil are workers, recreational users, and ecological receptors.

All receptors also may be exposed to contaminants through ingestion of biota that has taken up contamination from soil. The SWOU will complete a sitewide ecological risk assessment in accordance with the 2010 Ecological Risk Methods Document (DOE 2011b; DOE 2010b) based on data collected. Exposure of ecological receptors through other media is evaluated in the appropriate OUs.

For certain SWMUs, early action may be appropriate per the Paducah SMP.

15.1 SAMPLING STRATEGY

This section describes the approach for using various characterization tools, survey methods, and sampling processes to classify and characterize residual contamination to support an action/NFA decision. Characterization approaches are included in the following discussion.

15.1.1 Identifying Data Gaps and Defining Program Requirements

Evaluation of the adequacy and representativeness of existing information is determined by the following criteria:

- Will existing data support the SWMU/AOC decision making; and
- Will data support a risk assessment. Specifically, there must be analytical data of sufficient and appropriate quality for the full set of COCs and COPCs/COPECs to determine if there is a threat to human health or the environment?

If data are not adequate and representative, the data gaps are identified and additional sampling is planned to ensure adequate, sufficient, and representative data to support the decision for action/NFA for each SWMU/AOC. QA data considerations made to ensure that data quality requirements are met include sample point density, number of samples, analyses required, locations, depth of samples, and compositing methodology. QC considerations include adherence to field and laboratory procedures/protocols and data validation/management procedures as described in the appropriate chapters.

15.1.2 Preliminary Remediation Goals

Chemical-specific preliminary remediation goals (PRGs) are concentration goals for individual chemicals in specific medium and land use combinations, which are used by risk managers as long-term targets during the analysis and selection of remedial alternatives. Chemical-specific PRGs are from two general sources. These are (1) concentrations based on applicable or relevant and appropriate requirements (ARARs) and (2) concentrations based on risk assessment. The chemical-specific PRGs discussed in this document are concentrations based on human health risk assessment; however, concentrations based on ARARs and ecological risk assessment are discussed and presented within the Paducah Risk Methods Document (DOE 2011b; DOE 2010b).

Chemical-specific PRGs also can be used as screening tools. Screening against chemical-specific PRGs and other limiting criteria is discussed in the RI Report as a preliminary step in the RI/FS process. Comparisons can be used to focus concern on a specific medium or COPC and support "no further action" recommendations. PRGs for this project will be the lesser of the no action cancer- and no action hazard-based PRGs and the greater of PGDP background values and no action cancer- and no action hazard-based PRGs for the appropriate future use taken from Appendix A of the most recent, approved version of the Paducah Risk Methods Document (DOE 2011b; DOE 2010b). Prior to screening, the BRA will determine the most up-to-date sources of criteria.

15.2 NATURE AND EXTENT EVALUATION

Nature and extent of contamination will be determined using the full range of background available to PGDP and samples from reference locations.

15.3 BASELINE RISK ASSESSMENT

This project includes an RI/FS, BRA, remedy selection, and implementation of any necessary response actions for on-site and off-site areas, including Bayou Creek, Little Bayou Creek, and Outfalls 001, 002, 008, 009, 010, 011, 012, 013, and 015. Though remediation of Outfalls 005, 006, 017, and 019 and their associated ditches is not planned until after GDP shutdown, data associated with them (e.g., creek data upstream and downstream of the point of discharge, KPDES monitoring data, and information on ecological receptors) will be included in the RI/FS during the pre-shutdown phase. The BRA will use all historical data of sufficient quality and representative of current site conditions screened in accordance with the 2011 Paducah Risk Methods Document (DOE 2011b; DOE 2010b), as well as the data collected during the field investigation described in this work plan. The BRA will be compiled in accordance with the 2011 Human Health and 2010 Ecological Paducah Risk Methods Documents (DOE 2011b; DOE 2010b).

As ecological data are collected and screened for each given unit, management decision points are used to support decisions about whether to continue evaluating ecological risk, if additional data may be required for the risk evaluation, or if the data collected will support the risk evaluation. Prior to risk evaluation of a site, a scoping meeting will be conducted with risk assessors from the regulatory agencies.

Documentation for the SWOU RI/FS also will include a BRA. The BRA will include, at a minimum, a complete BHHRA that is consistent with methods presented in Chapter 3 of Volume 1 of the Paducah Risk Methods Document and a BERA consistent with methods presented in Volume 2 of the Paducah Risk Methods Document (DOE 2011b; DOE 2010b) or most recent approved versions. The objectives of the BRA will include the following:

- Evaluate the potential threat to human health in the absence of any action.
- Evaluate the potential threat to ecological resources in the absence of any action.
- Provide a basis for determining if a response action is necessary or justified.
- Provide the information needed to determine what concentrations of chemicals and radionuclides are considered protective of human health and the environment.
- Provide a baseline for comparing the level of protection from various response alternatives relative to potential human health and ecological effects.

To meet these objectives, the risk assessment will identify and characterize the following items:

- Levels of hazardous substances present in relevant media, including a review of relevant biological and chemical information, and the potential changes in concentration and activities of hazardous substances in relevant media over time.
- Potential exposure pathways and routes and the extent of actual or predicted exposure.
- Potential human receptors by defining the size, characteristics, and location of human populations that may be exposed to contaminants at or migrating from the study areas.
- Extent of potential impact by quantifying potential carcinogenic risk and noncarcinogenic/systemic hazards.

- Potential ecological harm within the study area from exposure to contaminants at or migrating from the study areas.

- Levels of uncertainty associated with the assessment, including a summary of the strengths and weaknesses of site characterization, toxicity assessment, exposure assessment, and health risk characterization. The summary will include a discussion of the effect of the major assumptions made during risk characterization upon the resulting risk values. Uncertainty analysis may include sensitivity or other quantitative analyses if these are deemed necessary for forthcoming response action decisions.

The BRA will include completion of fate and transport modeling consistent with the Paducah Risk Methods Document (DOE 2011b; DOE 2010b) or most recent approved version, modeling matrix, and generation of information that can be incorporated in the Paducah sitewide risk assessment model (DOE 2003).

15.3.1 Human Health

Using the presentations and interpretations of the results, the decision rules developed during the DQO process will be addressed, and the various statistical assumptions forming the basis of the sampling plan will be verified. Appendix B presents the general report outlines for the RI and FS.

To support the risk evaluation, and consistent with the Paducah Risk Methods Document (DOE 2011b; DOE 2010b) or the most recent, approved version, probabilistic fate and transport modeling may be employed. The use of this modeling helps account for uncertainties in the size of the source zones and transport parameters and allows an evaluation of error bounds. These modeling tools may include the Statistical Analysis and Decision Assistance (SADA); Seasonal Soil Compartment Model (SESOIL); and Analytical Transient 1-,2-,3-Dimensional (AT123D). SADA is used to refine source zones. SESOIL is a leaching model used to estimate the time-variant contaminants loading from each source area to the RGA. AT123D is used to complete saturated flow and contaminants transport modeling.

15.3.1.1 Data evaluation

When fieldwork is completed and data have been verified, validated, assessed, and evaluated (as described in Section 18), data will be screened as described in the Paducah Risk Methods Document (DOE 2011b; DOE 2010b) or most recent, approved version to determine COPCs for each unit. These COPCs and subsequent possible COCs will be documented in a RI report followed by a FS report. The primary purpose of the RI and FS reports will be to present the results from the field investigation and evaluate alternatives to the extent necessary to select a remedy.

15.3.1.2 Exposure assessment

This section of the BHHRA will delineate the pathways through which the receptors may be exposed under both current and future conditions. The exposure assessment will be conducted in accordance with the Risk Methods Document (DOE 2011b; DOE 2010b) or most recent, approved version. This section will present CSMs and supporting text. Also, each pathway will be described in terms of source, route of exposure, exposure point, and receptor. This format will be followed, because all four must be present for a complete pathway to exist.

Exposure assessments in BHHRAs completed in the past indicate that at least 24 exposure pathways should be considered as potential pathways in all assessments (DOE 2011b; DOE 2010b). Further, exposure assessments will be performed on a range of worker exposure times if the selected exposure time deviates significantly from the assumptions in the Paducah Risk Methods Document (DOE 2011b; DOE 2010b).

15.3.1.3 Toxicity assessment

The primary purpose of this section of the BHHRA will be to report the toxic effects of the COPCs on exposed populations. The toxicity assessment will be conducted in accordance with Paducah Risk Methods Document (DOE 2011b; DOE 2010b) or most recent, approved version. In addition, this section will briefly describe the methods used by EPA, and in the toxicity assessment, to develop toxicity parameters, delineate the sources used to acquire the toxicity parameters, and present tables summarizing the toxicity information used in the risk assessment.

15.3.1.4 Risk characterization

The primary purpose of this section of the BHHRA will be to integrate the information developed in the exposure assessment with the effects information presented in the toxicity assessment to characterize the risks and hazards posed by environmental contamination at PGDP. The risk characterization will be conducted in accordance with Paducah Risk Methods Document (DOE 2011b; DOE 2010b) or most recent, approved version. In this section, the following items will be presented: the methods used to integrate the information to characterize risks and hazards and the tables and a narrative summarizing the risk characterization for each exposure unit under each current and potential future use scenario. This section will conclude with a listing of use scenarios of concern for each location and a listing of COCs, pathways of concern, and mediums of concern for each use scenario of concern.

15.3.1.5 Evaluation of uncertainties

Uncertainties are associated with each of the steps of the BHHRA. Following a general discussion of uncertainties in risk assessment, this section presents the uncertainties that will be addressed in BHHRAs prepared for PGDP and provides a format for summarizing this information (when a qualitative uncertainty analysis or sensitivity analysis is performed). The uncertainty evaluation will be conducted in accordance with the most recent, approved version of the Paducah Risk Methods Document (DOE 2011b; DOE 2010b).

The potential effect of the uncertainties on the final risk characterization must be considered when interpreting the results of the risk characterization, because the uncertainties directly affect the final risk estimates. The types of uncertainties that must be considered can be divided into four broad categories. These are uncertainties associated with data and data evaluation (i.e., identification of COPCs), exposure assessment, toxicity assessment, and risk characterization. Specific uncertainties under each of these broad categories that will be addressed in the BHHRAs completed for PGDP are listed in the following material.

At minimum, all BHHRAs will contain a qualitative uncertainty analysis that will include a quantitative sensitivity analysis of salient uncertainties. In the qualitative uncertainty analysis, the magnitude of the uncertainty on the risk characterization will be categorized as small, moderate, or large. Uncertainties categorized as small will be those that should not cause the risk estimates to vary by more than one order of magnitude; uncertainties categorized as moderate will be those that may cause the risk estimates to vary by between one and two orders of magnitude; and, uncertainties categorized as large will be those that may cause the risk estimates to vary by more than two orders of magnitude.

In the qualitative uncertainty analysis, it will be noted that the uncertainties listed and evaluated are neither independent nor mutually exclusive; therefore, it will be concluded that the total effect of all uncertainties upon the risk estimates is not the sum of the estimated effects of each uncertainty evaluated.

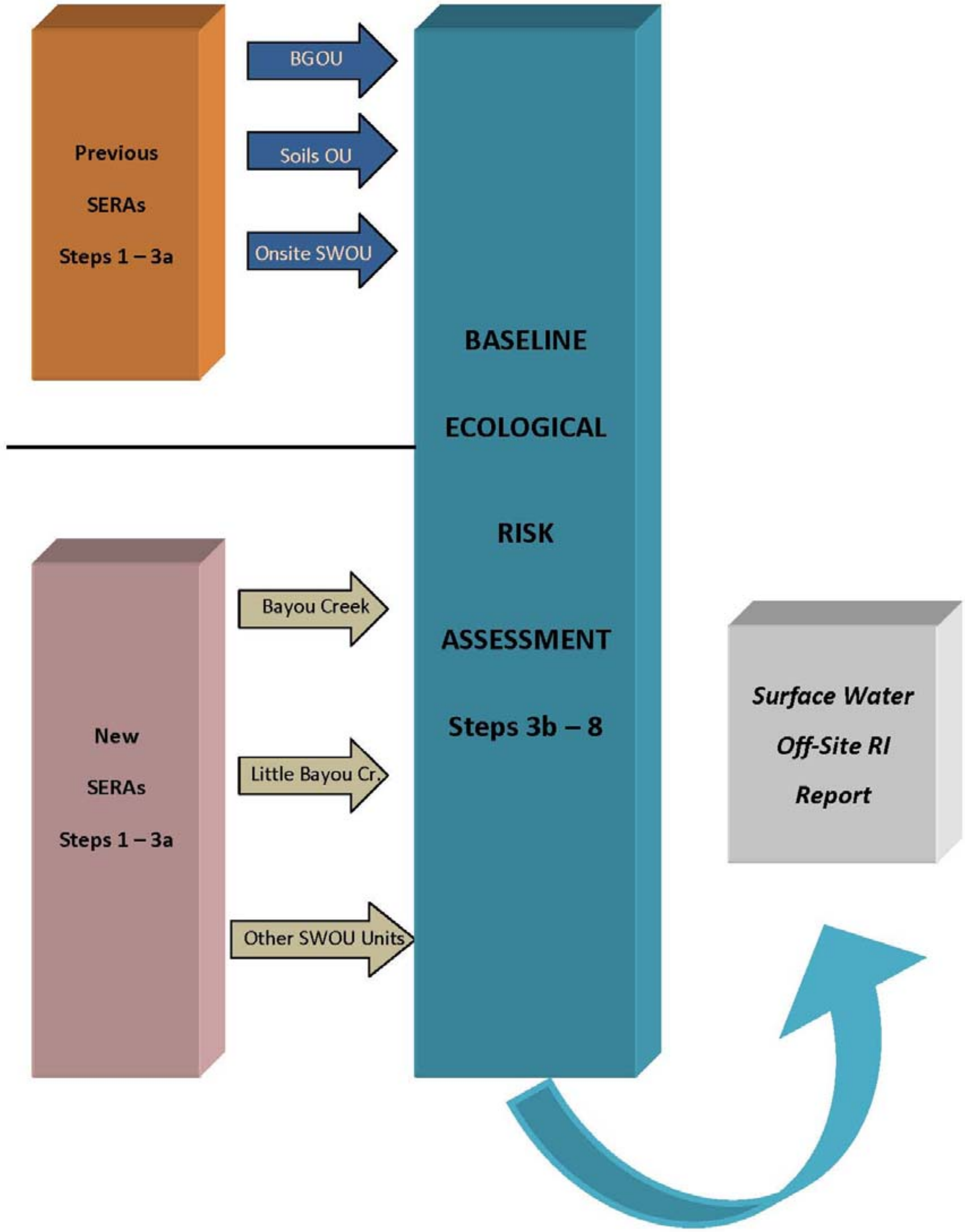
15.3.2 Ecological

The ecological risk assessment will quantitatively evaluate potential ecological risks using the eight steps presented in Volume 2 of the most recent, approved version of the Paducah Risk Methods Document (DOE 2011b; DOE 2010b). The SERAs and previous ecological assessments include steps 1 through 3a, and the BERA will include steps 3b through 8. The BERA will include ecological assessments that have occurred for other OUs representative of current site conditions, as well as the SERAs conducted for each unit of this RI utilizing the data collected during the field investigation described in this work plan (see Figure 15.1).

At minimum, this will include the following items:

- Identification of receptors that may be impacted by contaminants migrating from source areas;
- Discussion of the effects identified contamination may have on receptor populations;
- Summary of the T&E species known to be present at or near PGDP and the potential impacts upon them; and
- Comparison of medium-specific analyte concentrations and activities found at the site with ecological toxicity benchmarks.

The ecological risk assessment may include additional steps outlined in the most recent, approved version of the Paducah Risk Methods Document (DOE 2011b; DOE 2010b), as appropriate.



U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

Figure 15.1. Baseline Ecologial Risk Assessment Process

LATA Environmental Services of Kentucky, LLC

16. ENVIRONMENT, SAFETY, AND HEALTH PLAN

16.1 PURPOSE

This ES&H Plan has been developed to discuss the general ES&H requirements associated with the SWOU RI/FS Work Plan and identify some potential hazards. Site-specific hazards and controls will be established for each task and location prior to performing work. These hazards and controls will be documented in the form of Site-Specific Health and Safety Plan (HASPs), Activity Hazard Assessments (AHAs), work packages, and procedures. Personnel will be familiar with these work control documents prior to performing work in the affected areas.

16.2 INTEGRATED SAFETY MANAGEMENT/ENVIRONMENTAL MANAGEMENT

The SWOU Project will utilize an ISMS, which integrates the Safety Management System, the Environmental Management System (EMS), and the Quality Management System, to ensure personnel and environmental safety and quality are integrated into management and work practices at all levels so that missions are accomplished while protecting the public, the workers, and the environment. The concepts of ISMS/EMS will be utilized to provide a formal, organized process to ensure the safe performance of work. The ISMS/EMS Plan identifies the methodologies that will be used to address previously recognized hazards and how the hazards are mitigated using contractor-accepted ES&H practices.

The core functions and guiding principles of ISMS/EMS will be implemented by incorporating applicable programs, policies, technical specifications, and procedures from the DOE, U.S. Occupational Safety and Health Administration (OSHA), EPA, and other applicable regulatory guidance. Brief descriptions of the five ISMS/EMS core functions are provided in the following sections.

16.2.1 Define Scope of Work

Defining and understanding the scope of work is the first critical step in successfully performing any specific activity in a safe and compliant manner. Each member of the project team will participate in discussions to understand the scope and contribute to the planning of the work. The SWOU RI/FS project team will meet with personnel to ensure that everyone understands the scope of work, expectations as well as the technical and safety issues involved. These meetings are conducted to ensure all parties are in agreement on the scope and the approach to complete the work.

16.2.2 Analyze Hazards

In the course of planning the work, the project team will identify hazards including personnel safety and environmental risks associated with the performance of the work. Hazards may be identified and assessed by performing site walk downs, reviewing lessons learned, reviewing historical data, and performing activity hazard reviews (AHRs) through the hazard assessment process prescribed by the DOE Prime Contractor procedures and policies.

16.2.3 Develop and Implement Hazard Controls

After potential safety hazards and environmental risks are identified, controls necessary to protect workers, the public, and the environment are identified and implemented. These controls are identified in the work planning process that develops how the scope of work will be performed, identifies the applicable standards, requirements and controls that are needed. Then those processes must be established and implemented in the appropriate work control document such as procedures, work instructions and AHAs.

Applicable AHAs will be reviewed with the personnel who will perform the work. Participants in this review will sign and date the AHA to signify that they understand all hazards, controls, and requirements in the AHAs. Copies of the AHAs with appropriate signatures shall be maintained at the work location.

16.2.4 Perform Work Within Controls

Prior to commencement of work, the SWOU RI/FS project team will verify that the appropriate work control documents are in place and have been reviewed and approved by authorized personnel. The SWOU RI/FS project team also will ensure that all the requirements and controls have been communicated to the project team. These requirements and controls are communicated through the following methods:

- Training
- Required reading/briefings
- Pre-job meetings
- Permits
- Plan-of-the-day/pre-job briefings
- AHAs
- Radiological Work Permits (RWP)
- Signs and postings

The SWOU RI/FS project team will strictly adhere to the requirements established in approved contractor performance documents and work controls at all times. If a performance document or work control cannot be followed or clearly interpreted, the task will not be performed until a clear and operable document can be provided for the performance of the work.

16.2.5 Feedback and Continuous Improvement

Feedback and continuous improvement is accomplished through several channels including ISMS/EMS audits, self-assessments, employee suggestions, lessons learned, and pre-job/post-job briefings.

SWOU RI/FS project management will encourage employees to freely submit suggestions that offer opportunities for continuous improvement and constructive criticism on the activities. Project management will conduct periodic inspections and meetings with project personnel at the work site to discuss project status, priorities, expectations, safety/environmental issues, and/or concerns as well as other relevant topics.

During field activities, meetings and briefings will provide opportunities for project personnel to communicate the following:

- Lessons learned and any other topics relevant to the work performed
- How work steps/procedures could be modified to promote a safer working environment
- How communications could be improved within the project team
- Overall issues or concerns they may have regarding how the work was performed

16.3 FLOWDOWN TO SUBCONTRACTORS

The ISMS/EMS approach to ES&H ensures that personnel, including subcontractors, are aware of their roles, responsibilities, and authorities for worker/public safety and protection of the environment. All organizations will be responsible for compliance with the Prime Contractor's Worker Safety and Health (S&H) Program, ISMS Program, Radiation Protection Program, Environmental Protection Program, and QA Program. In addition, subcontract requirements will flow down to lower-tier subcontractors, as applicable. Personnel will have the appropriate medical qualifications and health and safety training required by appropriate federal regulations, but also will undergo site-specific pre-job training including safety and environmental to ensure that ES&H issues related to the activities to be performed or specific to the work site are clearly understood. Documentation of training will be available for review prior to starting work.

16.4 SUSPENDING/STOPPING WORK

In accordance with 10 *CFR* § 851.20 and the DOE Prime Contractor's Worker Safety and Health Program and procedures, employees and subcontractors have suspend/stop-work authority. Individuals involved in any aspect of the project have the authority and responsibility to suspend or stop work for any perceived threat to the S&H of the workers, the public, or to the environment. Concerns shall be brought to the attention of the FTM and SHR, will be evaluated by Project Management personnel, and actions will be taken to rectify or control the situation. In the case of imminent danger or emergency situations, personnel should halt activities immediately and instruct other affected workers to pull back from the hazardous area. The appropriate authority/responders shall be notified immediately in accordance the emergency response plans.

16.5 ISMS/EMS BRIEFINGS

Plan-of-the-day/pre-job briefings detailing the specific hazards of the work to be performed and safety precautions and procedures specific for the job shall be conducted by the FTM and/or SHR at the beginning of each shift. During these briefings, work tasks and the associated hazards and mitigating controls will be discussed using approved procedures, work control documents, AHAs, and/or lessons learned as guidance.

Prior to performing work on the site, personnel shall be required to read or be briefed on the DOE Prime Contractor's Worker Safety and Health Program, applicable AHAs, the work package, and other applicable documents. This shall be documented as required reading, acknowledgement forms, or briefing sheets. Visitors will also be briefed to the applicable plans and potential hazards that they may encounter.

16.6 KEY PROJECT PERSONNEL AND RESPONSIBILITIES

One of the primary underlying principles of a successful project organization is the establishment of clearly defined roles and responsibilities and effective lines of communication among employees and among the Prime Contractor, subcontractors, and other organizations involved in the project. Ensuring that personnel fully understand their roles and responsibilities and that they have a thorough understanding of the scope of work and other project requirements will provide the foundation for successful and safe completion of the project.

The roles and responsibilities of key field team members are briefly described as follows:

- The ER PM oversees the implementation of the project plans and provides the resources for the project.

- The RI PM oversees the project plans and work activities while ensuring that operations are conducted in accordance with the DOE Prime Contractor procedures, regulatory requirements, and Worker Safety and Health Program and is responsible for coordinating and assigning resources needed for the project. The RI PM also performs management audits and inspections.

- The QA Specialist provides support and oversight to the project to ensure that work is performed in accordance with the work package and other applicable plans and procedures.

- The FTM coordinates field activities and logistics and provides the communications between the project team and the field team as well as other support groups. The FTM also ensures that on-site personnel comply with the Worker Safety and Health Program, work packages, and applicable procedures.

- The SHR provides S&H support and oversight to the project to ensure that work is being performed safely and in accordance with the Worker Safety and Health Program, applicable regulations, 10 *CFR* § 851, DOE directives, and applicable plans and procedures.

- The Radiological Control Group provides support and guidance to the project and assists the FTM and SHR with implementation of radiological controls and as-low-as-reasonably-achievable (ALARA) principles. The Radiological Control Technician (RCT) observes the work area before/during activities for radiological hazards and authorizes entry into and exit from the radiological work area.

- Environmental Compliance organization provides environmental support and oversight to the project to ensure that the planning and fieldwork is being performed properly and in accordance with all applicable regulations, DOE directives, and relevant plans and procedures.

- The Waste Management Coordinator provides waste management support to the project to coordinate waste containers and removal of waste from the worksite while complying with the Worker Safety and Health Program, as well as ES&H and work control requirements.

- Field Team/Subcontractors—Samplers, drillers, operators, maintenance mechanics, and electricians perform work as specified in work packages, adhering to the Worker Safety and Health Program, HASP, RWPs, project procedures, and AHAs. Field Team personnel also participate in the identification of the hazards and development of the work controls to be utilized during the work.

16.7 SITE CONTROL

A combination of work zones will be utilized to control access. These areas will be controlled by the FTM, SHR and/or RCT to minimize the number of individuals potentially exposed to site hazards and to ensure that individuals who enter follow the required procedures. The following is a description of the different types of zones that will be established at the site.

- Exclusion Zone (EZ)—The area where work is being performed and chemical, physical, and/or radiological hazards exist. Entry into this area is controlled and the area clearly marked with barrier tape, rope, flagging and/or signage. Applicable signage will be posted to adequately communicate hazards and entry requirements. Unauthorized entry into these areas is strictly prohibited.

- Contamination Reduction Zone (CRZ)—The area between the EZ and the Contamination Zone (CZ). It serves as a buffer to reduce the possibility of the CZ becoming contaminated. It also is the area where decontamination of personnel and equipment is conducted. Entry into this area is controlled and the area clearly marked with barrier tape, rope, flagging and/or signage. Applicable signage will be posted to adequately communicate hazards and entry requirements.

- Contamination Zone (CZ)—The area outside of potential contamination, but still encompassing work activities and possible hazards associated with fieldwork activities. Entry into this area is controlled and the area clearly marked with barrier tape, rope, flagging and/or signage. Applicable signage will be posted to adequately communicate hazards and entry requirements.

- Support Zone (SZ)—The area immediately outside of the work zones. This area serves as an administrative area, a storage area for noncontaminated equipment, a break area, and an area for the consumption of food and beverages. This area does not require delineation by barricade tape/ropes.

16.7.1 Visitors

Visitors to the site shall abide by the following:

- “Visitor” is defined as nonessential personnel not involved in routine site work activities.

- Visitors shall be instructed to stay outside of the EZ, CRZ and CZ and remain within the SZ during the extent of their stay.

16.7.2 Site Communications

PGDP plant radios, two-way radios, plant phones, and cell phones will be used for on-site and off-site communications. Project personnel will be familiar with the use of plant radios and emergency numbers. Hand signals may also be utilized; these will be covered with project personnel as necessary.

16.7.3 Authorization to Enter

Personnel shall adhere to site entry and control procedures identified in the work control documents such as the work instructions RWP and AHAs. Personnel must wear the appropriate personal protective equipment (PPE); and enter the work area only after receiving authorization from the FTM, SHR, and RCT. The FTM (or designee) will verify that the appropriate training and briefing requirements are met prior to entry.

As a requirement for work on this project, workers entering the EZ or CRZ will be required to take a 24/40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training. This training must cover the requirements in 29 *CFR* § 1910.120, HAZWOPER. In addition, workers must receive annual 8-hour refresher training (if applicable) and 1/3-day on-site supervision under a trained, experienced supervisor. The FTM shall receive additional 8-hour training in hazardous waste operations supervision. Personnel entering the EZ or CRZ will be briefed in the provisions of the site specific HASP. Workers entering radiological posted work areas will have the appropriate level of Radworker training, be briefed and sign any applicable RWPs.

16.8 PERSONAL PROTECTIVE EQUIPMENT

When engineering controls are not feasible, when the administrative controls in place are not adequate, or when otherwise indicated (such as for ALARA), PPE will be specified by the work control such as the AHA and/or RWP. The required level of protection is specific to the activity being conducted but at a minimum personnel performing work in work zones may be required to wear the following standard safety apparel:

- Hard hats meeting the requirements of American National Standards Institute (ANSI) Z89.1 as prescribed in 29 *CFR* § 1910.135, Head Protection. Hard hats will be worn with the suspension properly installed. Hard hats will not be damaged, painted, or deformed.

- Safety glasses with firm side shields will meet the requirements of ANSI Z87.1, as prescribed in 29 *CFR* § 1910.133, Eye and Face Protection. Prescription glasses also will meet the ANSI standard and be provided with fixed or firm clip-on side shields. Cover glasses used over prescription glasses will be permitted. Safety glasses will be worn in any area where construction activities are taking place. Face shields will not be worn in lieu of safety glasses.

- Sturdy, safety-toed work shoes or boots meeting the requirements of ASTM-F-2412 and ASTM-F-2413, as prescribed in 29 *CFR* § 1910.136, Foot Protection, shall be worn.

Activities conducted within SZs should require normal work clothes and minimal PPE unless specified by the FTM, SHR, or RCT.

16.8.1 Task-Specific Levels of Protection

The levels of protection will be determined by the task and/or proximity of the task being performed and will be identified in the task specific AHAs and RWPs.

16.8.2 Respiratory Protection

Respiratory protection requirements will be determined by air monitoring and survey results. Personnel required to wear respiratory protection will be trained and quantitatively fit-tested prior to use of the respirator in accordance with DOE Prime Contractor procedure. Personnel required to wear respirators will inspect their respirators before and after each use and any deficiencies will be reported to the FTM or SHR immediately. Respirators will be properly stored in a bag in a clean, dry environment and routinely cleaned. Damaged respirators shall not be used.

16.9 MEDICAL SURVEILLANCE

The medical surveillance program provides for baseline and annual medical examinations for employees who work on the DOE site more than 30 days in a 12-month period or workers who are enrolled for any length of time in a medical or exposure monitoring program such as 29 *CFR* § 1910.120, HAZWOPER. Personnel performing HAZWOPER activities on this project must complete an annual HAZWOPER physical. The examining physician will document the worker's fitness for work. In addition, the physician will ensure personnel are capable of wearing a respirator through medical examination that may include a pulmonary function test.

Radiation workers, working under an RWP, may be required to submit a baseline bioassay, periodic bioassay during the project, and exit bioassay at the end of the project.

16.9.1 Exposure Monitoring

Air monitoring shall be used to identify and quantify airborne levels of hazardous substances and health hazards in order to determine the appropriate level of employee protection needed on-site.

16.9.2 Routine Air Monitoring Requirements

Air monitoring will be performed during the following activities:

- Intrusive activities such as soil excavation that may pose a risk of personnel exposure;
- Activities where there is a potential for exposure to heavy metals (lead, arsenic, beryllium, etc.), VOCs, and silica dust; and
- Personnel are opening waste containers that contain potentially contaminated material.

16.9.3 Industrial Hygiene Monitoring

Industrial hygiene monitoring and sampling will be performed by assigned project S&H support personnel. Monitoring will use direct-reading instruments, air-sampling equipment, environmental-monitoring equipment, and assessment techniques as determined appropriate by the S&H Group based on professional judgment and in accordance with OSHA, National Institute for Occupational Safety and Health (NIOSH), and American Conference of Government Industrial Hygienists (ACGIH).

Personnel sampling will be conducted to assess the potential exposure to individual employees and to ensure that the proper level of PPE has been selected for the assigned task(s). Samples will be collected in the area or in the employee's breathing zone using personnel sampling pumps and the appropriate collection media. For tasks with the potential for exposure to significantly elevated chemical concentration, it is expected that the sampling frequency will increase.

If direct reading instruments indicate levels of vapors or particulates that exceed the action level for over 15 minutes in the work area, then personnel sampling will be initiated immediately or work paused. Sampling will be conducted, at a minimum, on the worker with the highest expected exposure. Monitoring will continue until levels recorded by direct reading instruments return below the action level.

Once initiated, sampling will always continue for a period long enough to collect a volume of air sufficient to allow the laboratory to achieve an analytical detection limit no greater than one-half the OSHA permissible exposure limit or ACGIH threshold limit value, whichever is the more stringent of the two. The samples will be collected in accordance with the approved NIOSH or OSHA methodology and analyzed for the appropriate contaminant(s) of concern. All personnel exposure samples shall be analyzed by a laboratory accredited by American Industrial Hygiene Association in accordance with the appropriate NIOSH or OSHA methodology.

16.9.4 Radiological Monitoring

Radiological Control will perform personnel air monitoring during work in contamination areas and potentially at the boundary. Scanning of equipment and personnel also will be performed to minimize the possibility of the spread of contamination. Personnel working on the SWOU RI/FS project also will be monitored through dosimetry and required to wear a dosimeter when working in radiological zones and submit bioassays as required. A neutron dosimeter may be required if working in and around uranium hexafluoride cylinder storage yards, as determined by Radiological Control Organization.

16.10 EMERGENCY RESPONSE

16.10.1 Responsibilities

The PM, FTM, and SHR are responsible for the SWOU RI/FS project emergency management program and ensuring that the appropriate emergency response equipment is readily available and in proper working order. Equipment and supplies to be maintained at the work site include, at a minimum the following:

- Communication equipment
- First-aid kit
- Absorbents for spill control
- Fire extinguisher

In the event of an emergency, all site personnel shall follow the requirements and provisions of the PGDP Emergency Management Plan. Emergency response shall be provided by the PGDP emergency response organization. The FTM will be in charge of personnel accountability during emergency activities. All personnel working on-site will be trained to recognize and report emergencies to the FTM, SHR and the Plant Shift Superintendent (PSS).

The PGDP emergency response organization will be contacted for emergency response to major medical emergencies, fires, spills, or other emergencies. The PSS will coordinate 24-hour emergency response coverage. The requirements of this section will be communicated to site workers. Any new hazards or changes in the plan also will be communicated to site workers.

The DOE on-scene coordinator will provide oversight on an ongoing basis for emergency management/recovery activities.

16.10.2 Reporting an Emergency

16.10.2.1 Discovery

The person who discovers an emergency should immediately report it, then attempt to establish control ONLY if the incident is minor in magnitude. Where such measures are obviously inadequate or not successful in controlling the incident or for emergency conditions, personal injuries, or other unusual events with potential for causing personal injury, environmental releases, or property damage, the employee will initiate notification of appropriate emergency response personnel.

SWOU RI/FS project personnel will maintain a radio, telephone, or other reliable means of notifying emergency response personnel and the PSS.

16.10.2.2 Emergency contacts

- **Fire:** Fire alarm pull box, plant telephone Bell System 333, or plant radio channel 16
- **Medical:** Plant telephone Bell System 333 or plant radio channel 16
- **Security:** Plant telephone Bell System 6246 or plant radio channel 16
- **PSS:** Plant telephone Bell System 6211 or plant radio channel 16.

If using a cell phone: 270-441-6333 for emergency, for NON-emergency use 270-441-6211.

16.10.2.3 Initial emergency response

When an emergency occurs, the SHR or FMT will assume responsibility for the management of the scene and the protection of the personnel. Personnel are to be evacuated from the immediate danger area, as appropriate. Depending on the degree of emergency, radiation control controls may need to be adhered to during the emergency. For personnel injury or illness, there will be at least one person with current training in first aid and cardiopulmonary resuscitation present on-site during all field activities. This individual will provide minor first aid until other emergency personnel arrive and assume emergency response duties or it is determined to transport the injured to the hospital or medical provider.

16.10.2.4 PGDP alarms

The alarms can be heard by calling 6161 on a Bell phone.

These include the following:

- **Radiation Emergency/Criticality Accident Alarm System (CAAS):** Continuous blast on a high-pitched air whistle or electronic horn

  ACTION: Evacuate area immediately and stay away from effected building. Report to an assigned plant assembly point.

- **Attack Warning/Tornado Warning:** Intermittent 2-second blast on plant horns

  ACTION: Take cover.

- **Evacuate Signal:** Continuous blast on plant horns

  ACTION: Evacuate building.

- **Plant Emergency:** Hi-Lo Tones

  ACTION: Listen to plant public address system/radio for instructions.

- **Cascade Buildings:** Three blasts on building horns or howlers

  ACTION: Call area control room.

- **Other Buildings:** One 10-second blast on building horns or sirens

  ACTION: Follow local emergency procedures.

During field activities all personnel must participate in all PGDP accountability/assembly drills by sending all on-site project personnel to the appropriate assembly station for accountability. The FTM, SHR, or designee will be responsible for accounting for all field personnel (including sub-tier subcontractor personnel) and reporting any unaccounted-for personnel to the emergency coordinator.

16.10.3 Reporting a Spill

When a spill is discovered, the FTM or SHR will immediately contact PSS and the PM and convey as much information as possible (e.g., material involved, estimated quantity spilled/affected, location, affected personnel, other hazardous conditions).

16.10.4 Protective Actions for Spill

An effort will be made to stop the release and contain the spill using materials in the on-site spill response kit, only if it is safe to do so and if no unprotected exposures occur. A telephone contact list will be available for emergency notification.

In the event that personnel are exposed to hazardous chemicals or radioactive materials, appropriate emergency response action will be taken to remove the contaminated clothing. An emergency shower and eyewash station will be used to flush exposed skin and eyes, respectively. This emergency equipment will be maintained in a readily accessible location.

If an acute exposure to airborne chemicals occurs or is suspected and the affected personnel are unable to escape the work zone, the FTM or SHR will immediately contact PSS for assistance. Rescue operations will not be performed unless the rescuers are dressed in the appropriate protective equipment.

SWOU RI/FS Project Management will be responsible for ensuring all spills of hazardous materials are properly cleaned up and disposed of, including any material generated from the spill, unless otherwise directed.

The FTM or SHR has the following responsibilities:

- Ensure that spill containment is performed safely;
- Provide all known information to PSS to ensure proper response;
- Ensure that decontamination measures for exposed personnel are conducted safely and promptly; and
- Ensure that, if personnel are exposed to airborne chemicals and are unable to escape the work zone, rescue is not attempted unless rescue personnel are dressed in the appropriate protective equipment.

During field activities, all personnel must participate in all PGDP accountability/assembly drills by sending all on-site project personnel to the appropriate assembly station for accountability. The FTM, SHR, or designee will be responsible for accounting for all field personnel (including sub-tier subcontractor personnel) and reporting any unaccounted-for personnel to the emergency coordinator directing the drill.

17. QUALITY ASSURANCE PROJECT PLAN

QAPP Worksheet #1
Title and Approval Page

UFP-QAPP Manual Section 2.1:

Site Name/Project Name:
Site Location:

Work Plan for the Surface Water Operable Unit Remedial Investigation/Feasibility Study at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Document Title
U.S. Department of Energy
Lead Organization
LATA Environmental Services of Kentucky, LLC
Preparer's Name and Organizational Affiliation
761 Veterans Avenue, Kevil, KY, 42053: (270) 441-5000
Preparer's Address, Telephone Number, and E-mail Address
05/2011
Preparation Date (Month/Year)

Investigative Organization's Project Manager: ____________________
Signature

____
Printed Name/Organization/Date

Investigative Organization's Project QA Officer: ____________________
Signature

____
Printed Name/Organization/Date

Approval Signatures: ____________________
Signature

____
Printed Name/Title/Date

____
Approval Authority

Other Approval Signatures: ____________________
Signature

____
Printed Name/Title/Date

Document Control Number: DOE/LX/07-0361

QAPP Worksheet #2
QAPP Identifying Information

UFP-QAPP Manual Section 2.2.4:
Site Name/Project Name: *Work Plan for the Surface Water Operable Unit Remedial Investigation/Feasibility Study at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*
Site Location: Paducah Gaseous Diffusion Plant
Site Number/Code: N/A
Operable Unit: Surface Water Operable Unit
Contractor Name: LATA Environmental Services of Kentucky, LLC
Contractor Number: DE-AC30-10CC40020 (DOE-LATA Kentucky contract)
Contract Title: Paducah Gaseous Diffusion Plant Remediation Subcontract
Work Assignment Number: N/A

1. Identify guidance used to prepare QAPP: Uniform Federal Policy for Quality Assurance Project Plans

2. Identify regulatory program: CERCLA and Federal Facility Compliance Agreement for the Paducah Gaseous Diffusion Plant (DOE/OR/07-1707)

3. Identify approval entity: U.S. EPA, Commonwealth of Kentucky

4. Indicate whether the QAPP is a generic or a project-specific QAPP (circle one).

5. List dates of scoping sessions that were held: Scoping was accomplished from 2009 to 2010.

6. List dates and titles of QAPP documents written for previous site work[10], if applicable:

Title:	**Approval Date:**
Removal Action Work Plan for Soils Operable Unit Inactive Facilities at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky (DOE/LX/07-0220&D2R1)	(Latest date of regulatory approval). 11/12/2009
Title:	**Approval Date:**
Removal Action Work Plan for Contaminated Sediment Associated with the Surface Water Operable Unit (On-Site) at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky (DOE/LX/07-0221&D2R1)	(Latest date of regulatory approval). 11/12/2009
Title:	**Approval Date:**
Work Plan for the Soils Operable Unit Remedial Investigation/Feasibility Study at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky (DOE/LX/07-0120&D2R2)	(Latest date of regulatory approval). 10/06/2010

7. List organizational partners (stakeholders) and connection with lead organization:
U.S. EPA, Commonwealth of Kentucky

8. List data users: DOE, Contractor, subcontractors, U.S. EPA, Commonwealth of Kentucky

[10] Only those QAPP documents written in UPP format have been included.

QAPP Worksheet #2
QAPP Identifying Information
(Continued)

9. If any required QAPP elements and required information are not applicable to the project, then indicate the omitted QAPP elements and required information on the attached table. Provide an explanation for their exclusion below:

   Worksheets #4 and #9

QAPP elements and required information that are not applicable to the project are indicated and an explanation is provided in the QAPP.

Note: Information is only entered in the "Crosswalk to Related Documents" if the information is not contained in the QAPP worksheets as indicated in first two columns. Also, if the required QAPP element fulfills other quality requirements, that requirement is noted in the "Crosswalk to Related Documents" column.

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Worksheet No.	Crosswalk to Related Documents
Project Management and Objectives			
2.1 Title and Approval Page	- Title and Approval Page	1	
2.2 Document Format and Table of Contents 2.2.1 Document Control Format 2.2.2 Document Control Numbering System 2.2.3 Table of Contents 2.2.4 QAPP Identifying Information	- Table of Contents - QAPP Identifying Information	2	
2.3 Distribution List and Project Personnel Sign-Off Sheet 2.3.1 Distribution List 2.3.2 Project Personnel Sign-Off Sheet	- Distribution List - Project Personnel Sign-Off Sheet	3 4 Omitted	Contractor work control documentation
2.4 Project Organization 2.4.1 Project Organizational Chart 2.4.2 Communication Pathways 2.4.3 Personnel Responsibilities and Qualifications 2.4.4 Special Training Requirements and Certification	- Project Organizational Chart - Communication Pathways - Personnel Responsibilities and Qualifications Table - Special Personnel Training Requirements Table	5 6 7 8	
2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History, and Background	- Project Planning Session Documentation (including Data Needs tables) - Project Scoping Session Participants Sheet - Problem Definition, Site History, and Background - Site Maps (historical and present)	9 Omitted 10	Scoping meeting notes (2009–2010)

QAPP Worksheet #2
QAPP Identifying Information
(Continued)

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Worksheet No.	Crosswalk to Related Documents
Project Management and Objectives			
2.6 Project Quality Objectives and Measurement Performance Criteria 2.6.1 Development of Project Quality Objectives (PQOs) Using the Systematic Planning Process 2.6.2 Measurement Performance Criteria	- Site-Specific PQOs - Measurement Performance Criteria Table	11 12	
2.7 Secondary Data Evaluation	- Sources of Secondary Data and Information - Secondary Data Criteria and Limitations Table	13	
2.8 Project Overview and Schedule 2.8.1 Project Overview 2.8.2 Project Schedule	- Summary of Project Tasks - Reference Limits and Evaluation Table - Project Schedule/Timeline Table	14/15 16	
Measurement/Data Acquisition			
3.1 Sampling Tasks 3.1.1 Sampling Process Design and Rationale 3.1.2 Sampling Procedures and Requirements 3.1.2.1 Sampling Collection Procedures 3.1.2.2 Sample Containers, Volume, and Preservation 3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures 3.1.2.4 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures 3.1.2.5 Supply Inspection and Acceptance Procedures 3.1.2.6 Field Documentation Procedures	- Sampling Design and Rationale - Sample Location Map - Sampling Locations and Methods/Standard Operating Procedure (SOP) Requirements Table - Analytical Methods/SOP Requirements Table - Field Quality Control Sample Summary Table - Sampling SOPs - Project Sampling SOP References Table - Field Equipment Calibration, Maintenance, Testing, and Inspection Table	17/18/19/20 21 22	
3.2 Analytical Tasks 3.2.1 Analytical SOPs 3.2.2 Analytical Instrument Calibration Procedures 3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures 3.2.4 Analytical Supply Inspection and Acceptance Procedures	- Analytical SOPs - Analytical SOP References Table - Analytical Instrument Calibration Table - Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	23 24 25	

QAPP Worksheet #2
QAPP Identifying Information
(Continued)

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Worksheet No.	Crosswalk to Related Documents
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures 3.3.1 Sample Collection Documentation 3.3.2 Sample Handling and Tracking System 3.3.3 Sample Custody	- Sample Collection Documentation Handling, Tracking, and Custody SOPs - Sample Container Identification - Sample Handling Flow Diagram - Example Chain-of-Custody Form and Seal	26 27	
3.4 Quality Control Samples 3.4.1 Sampling Quality Control Samples 3.4.2 Analytical Quality Control Samples	- QC Samples Table - Screening/Confirmatory Analysis Decision Tree	28	
3.5 Data Management Tasks 3.5.1 Project Documentation and Records 3.5.2 Data Package Deliverables 3.5.3 Data Reporting Formats 3.5.4 Data Handling and Management 3.5.5 Data Tracking and Control	- Project Documents and Records Table - Analytical Services Table - Data Management SOPs	29 30	
Assessment/Oversight			
4.1 Assessments and Response Actions 4.1.1 Planned Assessments 4.1.2 Assessment Findings and Corrective Action Responses	- Assessments and Response Actions - Planned Project Assessments Table - Audit Checklists - Assessment Findings and Corrective Action Responses Table	31 32	
4.2 QA Management Reports	- QA Management Reports Table	33	
4.3 Final Project Report			

QAPP Worksheet #2
QAPP Identifying Information
(Continued)

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Worksheet No.	Crosswalk to Related Documents
Data Review			
5.1 Overview			
5.2 Data Review Steps 5.2.1 Step I: Verification 5.2.2 Step II: Validation 5.2.2.1 Step IIa Validation Activities 5.2.2.2 Step IIb Validation Activities 5.2.3 Step III: Usability Assessment 5.2.3.1 Data Limitations and Actions from Usability Assessment 5.2.3.2 Activities	- Verification (Step I) Process Table - Validation (Steps IIa and IIb) Process Table - Validation (Steps IIa and IIb) Summary Table - Usability Assessment	34/35 36 37	
5.3 Streamlining Data Review 5.3.1 Data Review Steps To Be Streamlined 5.3.2 Criteria for Streamlining Data Review 5.3.3 Amounts and Types of Data Appropriate for Streamlining			

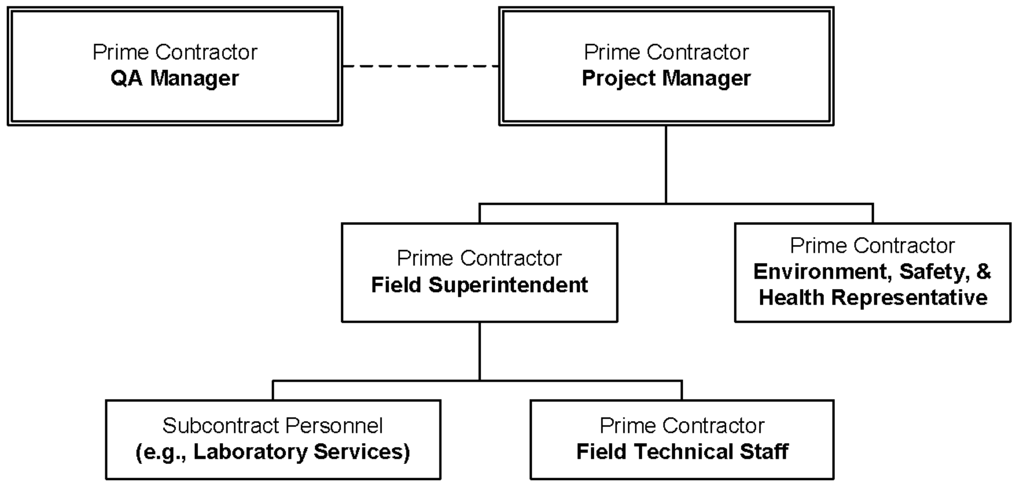
QAPP Worksheet #3
Distribution List

UFP-QAPP Manual Section 2.3.1:

QAPP Recipients	Title	Organization	Telephone Number	Fax Number	E-mail Address	Document Control Number
The QAPP is submitted in concert with the SWOU RI/FS Work Plan; thus, it will be included on the SWOU RI/FS Work Plan distribution list.	N/A	N/A	N/A	N/A	N/A	N/A

QAPP Worksheet #5
Project Contractor Organizational Chart*

UFP-QAPP Manual Section 2.4.1



* See work plan Section 2, Figure 2.1

QAPP Worksheet #6
Communication Pathways

UFP-QAPP Manual Section 2.4.2:

Note: Formal communications across company or regulatory boundaries occur via letter. Other forms of communication such as e-mail, verbal, meetings, etc., will occur throughout the project.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Federal Facility Agreement (DOE/OR/07-1707)	DOE Paducah Site Lead	N/A	N/A	All formal communication among DOE, EPA, and the Kentucky Department for Environmental Protection
Federal Facility Agreement DOE/OR/07-1707	DOE Paducah Environmental Restoration Project Manager	N/A	N/A	All formal communications between DOE and Contractor for Environmental Restoration Projects
All Project Requirements	Prime Contractor Project Manager	N/A	N/A	All formal communication between Contractor and DOE
All Project Requirements	Contractor ER Project Manager	N/A	N/A	All communications between the project and the Site Manager
All Project Requirements	Contractor Project Manager	N/A	N/A	All communication between the project and the ER/EM Director (Interim)
Project Quality Assurance Requirements	Contractor QA Manager	N/A	N/A	All quality related communications
Project Quality Assurance Requirements	Contractor QA Specialist	N/A	N/A	All project quality related communications
FFA Compliance	Contractor FFA Manager	N/A	N/A	All internal communication regarding FFA compliance
Sampling Requirements	Contractor Environmental Sampling Manager	N/A	N/A	All internal communication regarding field sampling
Analytical Laboratory Interface	Sample/Data Management Manager	N/A	N/A	All communication between Contractor and analytical laboratory
Waste Management Requirements	Contractor Waste Operations Manager	N/A	N/A	All internal communication regarding waste project waste management

QAPP Worksheet #6
Communication Pathways (Continued)

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Environmental Compliance Requirements	Contractor Regulatory Compliance and Policy Manager	N/A	N/A	All internal correspondence regarding environmental requirements and compliance
Subcontractor Requirements (if applicable)	Deputy Procurement, Subcontractors Supervisor	N/A	N/A	All correspondence between the project and subcontractors, if applicable
Health and Safety requirements	Contractor Health and Safety Representative	N/A	N/A	All internal communication regarding safety and health requirements

NA = not available as personnel may change

QAPP Worksheet #7
Personnel Responsibilities and Qualifications Table

UFP-QAPP Manual Section 2.4.3:

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
N/A	Paducah Site Lead	DOE	Overall site responsibility–liaison with EPA and Commonwealth of Kentucky	N/A
N/A	Paducah Environmental Restoration Project Manager	DOE	Environmental Restoration project responsibility	N/A
N/A	Paducah Prime Contractor Project Manager	Contractor	Contractor lead responsible for site	N/A
N/A	ER Project Manager	Contractor	Overall ER/EM project responsibility	N/A
N/A	SWOU Project Manager	Contractor	Overall soils/surface water responsibility	N/A
N/A	Quality Assurance (QA) Manager	Contractor	Overall project QA responsibility	N/A
N/A	Federal Facility Agreement Manager	Contractor	Project responsibility	N/A
N/A	Sample/Data Management Manager	Contractor	Project sample and data management	N/A
N/A	Regulatory Compliance and Policy Manager	Contractor	Project Environmental Compliance and Protection responsibility	N/A
N/A	Environmental Sampling Manager	Contractor	Project sampling responsibility	N/A
N/A	QA Specialist	Contractor	Project QA responsibility	N/A
N/A	Health and Safety Representative	Contractor	Project Safety and Health Responsibility	N/A
N/A	Waste Operations Manager	Contractor	Overall project waste management responsibility	N/A
N/A	Data Validator	Independent third party contractor	Performing data validation	N/A
N/A	Analytical Laboratory Project Manager	Analytical Laboratory	Sample analysis and data reporting	N/A

NA = not available as personnel may change

QAPP Worksheet #8
Special Personnel Training Requirements Table

UFP-QAPP Manual Section 2.4.4:

Project Function	Specialized Training–Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates[1]
Drill Rig Operator	Kentucky Certified Well Driller	State of Kentucky	TBD[1]	drill rig operator	drill rig operator/TBD	TBD[1]

[1] Information will be obtained from subcontractor once contract is awarded subsequent to the completion of the SWOU RI/FS Work Plan.

QAPP Worksheet #10
Problem Definition

UFP-QAPP Manual Section 2.5.2:

The problem to be addressed by the project: Per the Paducah Site Management Plan (SMP)–Annual Revision–FY2011, DOE/LX/07-0348&D2, *"this project includes an RI/FS (baseline risk assessment), remedy selection, and implementation of any necessary response actions for on- and off-site areas, including Bayou Creek, Little Bayou Creek, and outfalls 001, 002, 008, 010, 011, 012, and 015, as well as scoping for and completion of a baseline ecological risk assessment for the Paducah Gaseous Diffusion Plant."*

The environmental questions being asked:

(1) characterize the nature of contaminants using existing data and, if required, by collecting additional data; (2) define the extent (vertical and lateral) and magnitude of contamination and perform a multimedia evaluation (i.e., sediment, soils, surface water, and ecological receptors) to ensure that all exposure pathways for the subject units are assessed adequately to support cleanup decisions; (3) gather existing data and, if necessary, collect additional data to analyze contaminant transport mechanisms; (4) complete a baseline human health risk assessment and screening-level ecological risk assessments for the SWOU; (5) complete a sitewide baseline ecological risk assessment; and (6) determine if the existing data are sufficient to evaluate alternatives that will reduce risk to human health and the environment and support a NFA.

Observations from any site reconnaissance reports: No reports were written, consequently no observations or findings were cited; however, several site visits occurred during scoping and new pictures were taken for the scoping meetings. The information that was obtained in these site visits was used to develop the sampling strategy.

A synopsis of secondary data or information from site reports: Section 5 of the SWOU RI/FS Work Plan contains a synopsis of the secondary data being utilized.

The possible classes of contaminants and the affected matrices:

Potential classes of contaminants are VOCs, metals, PCBs, PAHs, and radiological contamination.
Affected matrices are expected to be as follows (if present):

1. Soil
2. Sediment
3. Rubble areas (e.g., debris, concrete)
4. Surface water
5. Ecological (e.g., communities, tissue, etc.)

QAPP Worksheet #10 (continued)
Problem Definition

UFP-QAPP Manual Section 2.5.2:

The rationale for inclusion of chemical and nonchemical analyses: Worksheet #11 presents rationale for inclusion of chemical and nonchemical analyses. **Information concerning various environmental indicators:** RI characterization will be conducted in a phased approach with cesium-137, uranium, and Total PCBs being used as indicator parameters during the first phase, followed by a more comprehensive list of analyte sampling (i.e., PCBs, metals, radionuclides, PAHs, and VOCs) during the second phase. **Project decision conditions ("If.., then..." statements):** Decision statements can be found throughout the SWOU RI/FS Work Plan, Sections 6 through 15.

QAPP Worksheet #11
Project Quality Objectives/Systematic Planning Process Statements

UFP-QAPP Manual Section 2.6.1:

Who will use the data? DOE, Prime Contractor, subcontractor, KY, and EPA.

What will the data be used for? To identify the nature, extent, and release of contamination to determine if there is a potential risk to human health and/or the environment and identify potential response actions to minimize the risk. Radiological surveys and field screenings will be used to identify and define the limits of potential hot spots. Field screening methods will be used to perform initial characterization of soil/sediment for metals and PCBs contamination as discussed in the SWOU RI/FS Work Plan.

What type of data are needed? (target analytes, analytical groups, field screening, on-site analytical or off-site laboratory techniques, sampling techniques) High quality toxicity, metals, PCBs, PAHs, radiological, and VOC data will be obtained from a fixed-base DOECAP-accredited laboratory to confirm field method analyses, to define the nature and extent of contamination, and to be used to complete a risk assessment. Measures of population and communities will be performed to identify extent of exposure to receptors and to be used to complete an ecological risk assessment.

How "good" do the data need to be in order to support the environmental decision? Data used for future human health risk assessment will be evaluated for use per the Risk Methods Document (DOE 2011b; DOE 2010b). Data must meet the sensitivity requirements for comparison to appropriate criteria as discussed in Section 16 of this work plan. The acquired data should be of sufficient quality and representative to allow for the correct risk-informed decision to be made regarding the contamination present at (or absent from) each SWMU and the remedial decision appropriate for that contamination.

How much data are needed? (number of samples for each analytical group, matrix, and concentration) The number of samples to be analyzed by field test methods and to be submitted to a fixed-based laboratory are identified in the SWOU RI/FS Work Plan and Worksheet #18. The areas that will undergo a radiological walkover survey are identified in the SWOU RI/RS Work Plan.

Where, when, and how should the data be collected/generated? See work plan and Appendix A.
Who will collect and generate the data? A sample team of individuals who are properly trained and skilled in the execution of screening and sampling procedures will collect samples and perform the field screening measurements.

How will the data be reported? Field data including survey data will be recorded on chain-of-custody forms, in field logbooks, and field data sheets. The fixed-base laboratory will provide data in an Electronic Data Deliverable (EDD). Project data will be reported from the Paducah Oak Ridge Environmental Information System (OREIS).
How will the data be archived? Electronic data will be archived in OREIS. Hard copy data will be submitted to the DMC.

QAPP Worksheet #12-1
Measurement Performance Criteria Table

UFP-QAPP Manual Section 2.6.2:

Matrix	Soil/Sediment
Analytical Group	Metals (aluminum, antimony, barium, beryllium, calcium, chromium, iron, magnesium, manganese, molybdenum, nickel, sodium, vanadium, and zinc)
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	SW846-6010	Precision–Lab	RPD–35%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-2
Measurement Performance Criteria Table

Matrix	Soil/Sediment
Analytical Group	Metals (arsenic, cadmium, cobalt, copper, lead, selenium, silver thallium, uranium)
Concentration Level	Low

Sampling Procedure	**Analytical Method/SOP**[1]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See Worksheet #21	SW846-6020	Precision–Lab	RPD–35%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[1]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-3
Measurement Performance Criteria Table

Matrix	Soil/Sediment				
Analytical Group	Metal (mercury)				
Concentration Level	Low				
Sampling Procedure	**Analytical Method/SOP**[1]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See Worksheet #21	SW846-7470	Precision–Lab	RPD–35%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[1]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-4
Measurement Performance Criteria Table

Matrix	Soil/Sediment
Analytical Group	PCBs
Concentration Level	Low

Sampling Procedure	**Analytical Method/SOP**[1]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See Worksheet #21	SW846-8082	Precision–Lab	RPD–43%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-5
Measurement Performance Criteria Table

Matrix	Soil/Sediment
Analytical Group	PCB Congeners
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	SW846-8082	Precision–Lab	RPD–43%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-6
Measurement Performance Criteria Table

Matrix	Soil/Sediment
Analytical Group	Radionuclides (uranium-234, uranium-235, uranium-238)
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	Alpha spectroscopy	Precision–Lab	RPD–20%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-7
Measurement Performance Criteria Table

Matrix	Soil/Sediment
Analytical Group	Radionuclides (americium-241, neptunium-237, plutonium-238, plutonium-239/240, thorium-230,)
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	Alpha spectroscopy	Precision–Lab	RPD–50%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-8
Measurement Performance Criteria Table

Matrix	Soil/Sediment
Analytical Group	Radionuclides (cesium-137)
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	Gamma spectroscopy	Precision–Lab	RPD–50%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-9
Measurement Performance Criteria Table

Matrix	Soil/Sediment
Analytical Group	Radionuclides (technetium-99)
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	Liquid scintillation	Precision–Lab	RPD–50%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-10
Measurement Performance Criteria Table

Matrix	Soil
Analytical Group	PAHs
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	SW846-8270	Precision–Lab	RPD–38%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-11
Measurement Performance Criteria Table

Matrix	Soil
Analytical Group	VOCs
Concentration Level	Low

Sampling Procedure	**Analytical Method/SOP[1]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See Worksheet #21	SW846-8260	Precision–Lab	RPD–22%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-12
Measurement Performance Criteria Table

Matrix	Soil				
Analytical Group	Explosives				
Concentration Level	Low				
Sampling Procedure	**Analytical Method/SOP[1]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See Worksheet #21	SW846-8095	Precision–Lab	RPD–38%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-13
Measurement Performance Criteria Table

Matrix	Soil/Sediment
Analytical Group	Total Organic Carbon (TOC)
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	SW846-9060	Precision–Lab	RPD–40%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-14
Measurement Performance Criteria Table

Matrix	Soil/Sediment				
Analytical Group	Grain Size				
Concentration Level	Low				
Sampling Procedure	**Analytical Method/SOP[1]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See Worksheet #21	ASTM-D422	Precision–Lab	NA	NA	A
		Accuracy/Bias	NA	NA	A
		Accuracy/Bias-Contamination	NA	NA	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-15
Measurement Performance Criteria Table

Matrix	Soil/Sediment
Analytical Group	Bulk Density
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	ASTM-D854	Precision–Lab	NA	NA	A
		Accuracy/Bias	NA	NA	A
		Accuracy/Bias-Contamination	NA	NA	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-16
Measurement Performance Criteria Table

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Matrix	Soil/Sediment				
Analytical Group	Percent Solids				
Concentration Level	Low				
See Worksheet #21	ASTM-D2216	Precision–Lab	NA	NA	A
		Accuracy/Bias	NA	NA	A
		Accuracy/Bias-Contamination	NA	NA	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-17
Measurement Performance Criteria Table

Matrix	Soil/Sediment
Analytical Group	pH
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	SW846-9045	Precision–Lab	RPD–10%	Laboratory Duplicates	A
		Accuracy/Bias	NA	NA	A
		Accuracy/Bias-Contamination	NA	NA	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-18
Measurement Performance Criteria Table

Matrix	Soil/Sediment
Analytical Group	Moisture Content
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	ASTM-D2216	Precision–Lab	NA	NA	A
		Accuracy/Bias	NA	NA	A
		Accuracy/Bias-Contamination	NA	NA	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-19
Measurement Performance Criteria Table

Matrix	Soil/Sediment
Analytical Group	Metals
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	SW846-6200 (XRF)	Precision–Lab	RPD–20%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used. Primary XRF instrument will be calibrated to Uranium.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-20
Measurement Performance Criteria Table

Matrix	Soil/Sediment
Analytical Group	Total PCB
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	HACH Pocket Colorimeter™ II Test Kit or equivalent	Manufacturer's Instruction Manual	Manufacturer's Instruction Manual	Manufacturer's Instruction Manual	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-21
Measurement Performance Criteria Table

Matrix	Soil/Sediment
Analytical Group	Radionuclides (Cesium-137)
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	*Ex Situ* Field Instrument for the Detection of Low Energy Radiation (FIDLER)	Manufacturer's Instruction Manual	Manufacturer's Instruction Manual	Manufacturer's Instruction Manual	A
		Completeness[2]	90%	Data completeness check	S&A

[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-22
Measurement Performance Criteria Table

Matrix	Surface Water
Analytical Group	Metals (aluminum, antimony, barium, beryllium, calcium, chromium, iron, magnesium, manganese, molybdenum, nickel, sodium, vanadium, and zinc)
Concentration Level	Low

Sampling Procedure	**Analytical Method/SOP[1]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See Worksheet #21	SW846-6010	Precision–Lab	RPD–20%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-23
Measurement Performance Criteria Table

Matrix	Surface Water
Analytical Group	Metals (arsenic, cadmium, cobalt, copper, lead, selenium, silver thallium, uranium)
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	SW846-6020	Precision–Lab	RPD–20%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-24
Measurement Performance Criteria Table

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Matrix	Surface Water				
Analytical Group	Metal (mercury)				
Concentration Level	Low				
See Worksheet #21	SW846-7471	Precision–Lab	RPD–20%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-25
Measurement Performance Criteria Table

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Matrix	Surface Water				
Analytical Group	PCB				
Concentration Level	Low				
See Worksheet #21	SW846-8082	Precision–Lab	RPD–21%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-26
Measurement Performance Criteria Table

Matrix	Surface Water
Analytical Group	Radionuclides (uranium-234, uranium-235, uranium-238)
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	Alpha spectroscopy	Precision–Lab	RPD–20%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-27
Measurement Performance Criteria Table

Matrix	Surface Water
Analytical Group	Radionuclides (americium-241, neptunium-237, plutonium-238, plutonium-239/240, thorium-230,)
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	Alpha spectroscopy	Precision–Lab	RPD–50%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-28
Measurement Performance Criteria Table

Matrix	Surface Water
Analytical Group	Radionuclides (cesium-137)
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	Gamma spectroscopy	Precision–Lab	RPD–50%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-29
Measurement Performance Criteria Table

Matrix	Surface Water
Analytical Group	Radionuclides (technetium-99)
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	Liquid scintillation	Precision–Lab	RPD–50%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-30
Measurement Performance Criteria Table

Matrix	Surface Water
Analytical Group	PAHs
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	SW846-8270	Precision–Lab	RPD–38%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-31
Measurement Performance Criteria Table

Matrix	Surface Water				
Analytical Group	VOCs				
Concentration Level	Low				
Sampling Procedure	**Analytical Method/SOP**[1]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See Worksheet #21	SW846-8260	Precision–Lab	RPD–13%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-32
Measurement Performance Criteria Table

Matrix	Surface Water				
Analytical Group	Explosives				
Concentration Level	Low				
Sampling Procedure	**Analytical Method/SOP**[1]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See Worksheet #21	SW846-8095	Precision–Lab	RPD–30%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-33
Measurement Performance Criteria Table

Matrix	Tissue [plant, fish(whole body)]
Analytical Group	Metals (aluminum, antimony, barium, beryllium, calcium, chromium, iron, magnesium, manganese, molybdenum, nickel, sodium, vanadium, and zinc)
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	SW846-6010	Precision–Lab	RPD–35%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-34
Measurement Performance Criteria Table

Matrix	Tissue [plant, fish(whole body)]
Analytical Group	Metals (arsenic, cadmium, cobalt, copper, lead, selenium, silver thallium, uranium)
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	SW846-6020	Precision–Lab	RPD–35%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-35
Measurement Performance Criteria Table

Matrix	Tissue [plant, fish(whole body)]
Analytical Group	Metal (mercury)
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	SW846-7470	Precision–Lab	RPD–35%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-36
Measurement Performance Criteria Table

Matrix	Tissue [plant, fish(whole body)]
Analytical Group	PCBs
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	SW846-8082	Precision–Lab	RPD–43%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-37
Measurement Performance Criteria Table

Matrix	Tissue [plant, fish(whole body)]
Analytical Group	Radionuclides (uranium-234, uranium-235, uranium-238)
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	Alpha spectroscopy	Precision–Lab	RPD–20%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-38
Measurement Performance Criteria Table

Matrix	Tissue [plant, fish(whole body)]				
Analytical Group	Radionuclides (americium-241, neptunium-237, plutonium-238, plutonium-239/240, thorium-230,)				
Concentration Level	Low				
Sampling Procedure	**Analytical Method/SOP[1]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See Worksheet #21	Alpha spectroscopy	Precision–Lab	RPD–50%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-39
Measurement Performance Criteria Table

Matrix	Tissue [plant, fish(whole body)]
Analytical Group	Radionuclides (cesium-137)
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	Gamma spectroscopy	Precision–Lab	RPD–50%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-40
Measurement Performance Criteria Table

Matrix	Tissue [plant, fish(whole body)]
Analytical Group	Radionuclides (technetium-99)
Concentration Level	Low

Sampling Procedure	**Analytical Method/SOP**[1]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
See Worksheet #21	Liquid scintillation	Precision–Lab	RPD–50%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

RPD = relative percent difference
[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #12-41
Measurement Performance Criteria Table

Matrix	Tissue
Analytical Group	PAHs
Concentration Level	Low

Sampling Procedure	Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
See Worksheet #21	SW846-8270	Precision–Lab	RPD–38%	Laboratory Duplicates	A
		Accuracy/Bias	+/- 20% recovery	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > quantitation limit	Method Blanks/Instrument Blanks	A
		Completeness[2]	90%	Data completeness check	S&A

[1] The most current version of the method will be used.
[2] Completeness is calculated as the number of samples planned to be collected divided by the number of samples results that are not rejected.

QAPP Worksheet #13
Secondary Data Criteria and Limitations Table

UFP-QAPP Manual Section 2.7:

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
Process knowledge, historical use and results of surface soil and sediment near SWOU SWMUs.	CH2M HILL 1991. *Results of the Site Investigation, Phase I, at the Paducah Gaseous Diffusion Plant*, KY/ER-4, CH2M HILL Southeast, Inc., Oak Ridge, TN, March. CH2M HILL 1992. *Results of the Site Investigation, Phase II, Paducah Gaseous Diffusion Plant, Paducah, Kentucky*. KY/Sub/13B-97777C P03/1991/1, CH2M HILL Southeast, Inc., Oak Ridge, TN, April. COE 1996. *Paducah Gaseous Diffusion Plant PCB Sediment Survey, Big Bayou Creek and Little Bayou Creek, Paducah, Kentucky, Final Report*, United States Army Corps of Engineers, Nashville District, Nashville, TN, December. DOE 1995. *Final Site Evaluation Report for the Outfall 010, 011 and 012 Areas, Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1434&D1, U.S. Department of Energy, Paducah, KY, December. DOE 1996. *Resource Conservation and Recovery Act Facility Investigation/Remedial Investigation Report for Waste Area Groupings 1 and 7 at Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1404/V1&D2, U.S. Department of Energy, Paducah, KY, April DOE 1997. *Resource Conservation and*	See reports.	Assist in planning.	Assist in planning only. Other limitations are discussed in the cited reports and work plan Section 15. Limitation will be communicated in the SWOU RI/FS Work Plan and RI Report.

QAPP Worksheet #13 (Continued)
Secondary Data Criteria and Limitations Table

UFP-QAPP Manual Section 2.7:

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
	Recovery Act Facility Investigation/Remedial Investigation Report for Waste Area Grouping 17 at Paducah Gaseous Diffusion Plant, Paducah, Kentucky, DOE/OR/07-1404&D2 DOE 2008. *Site Evaluation Report for Soil Pile I at Paducah Gaseous Diffusion Plant, Paducah, Kentucky*. (DOE/LX/07-0108&D2) November. DOE 2008. *Surface Water Operable Unit (On-Site) Site Investigation and Baseline Risk Assessment Report at the Paducah Gaseous Diffusion Plant Paducah, Kentucky* **(**DOE/LX/07-0001&D2/R1) DOE 2009. *Site Evaluation Report for Addendum 1-B Soil Piles at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*. (DOE/LX/07-0225&D2) DOE 2009. *Site Evaluation Report for Addendum 2 Soil Piles at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*. (DOE/LX/07-0188&D2) DOE 2009. *Site Evaluation Report for Rubble Areas at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*. (DOE/LX/07-0227&D1)			

QAPP Worksheet #14
Summary of Project Tasks[1]

UFP-QAPP Manual Section 2.8.1:

Sampling Tasks: Sampling will be per *Work Plan for the Surface Water Operable Unit Remediation Investigation/Feasibility Study at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0361

Analysis Tasks: Analysis will be per *Work Plan for the Surface Water Operable Unit Remediation Investigation/Feasibility Study at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0361

Quality Control Tasks: Quality Control will be per QAPP worksheets as follows:

- QC samples–Worksheets #20 and #28
- Equipment calibration–Worksheets #22 and #24
- Data review/validation–Worksheets #34, #35, #36 and #37

Secondary Data: Process knowledge, historical use and results of Creeks and Rubble Areas evaluations:

- CH2M HILL 1991. *Results of the Site Investigation, Phase I, at the Paducah Gaseous Diffusion Plant,* KY/ER-4, CH2M HILL Southeast, Inc., Oak Ridge, TN, March.
- CH2M HILL 1992. *Results of the Site Investigation, Phase II, Paducah Gaseous Diffusion Plant, Paducah, Kentucky*. KY/Sub/13B-97777C P03/1991/1, CH2M HILL Southeast, Inc., Oak Ridge, TN, April.
- COE 1996. *Paducah Gaseous Diffusion Plant PCB Sediment Survey, Big Bayou Creek and Little Bayou Creek, Paducah, Kentucky, Final Report*, United States Army Corps of Engineers, Nashville District, Nashville, TN, December.
- DOE 1995. *Final Site Evaluation Report for the Outfall 010, 011 and 012 Areas, Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/OR/07-1434&D1, U.S. Department of Energy, Paducah, KY, December.
- DOE 1996. *Resource Conservation and Recovery Act Facility Investigation/Remedial Investigation Report for Waste Area Groupings 1 and 7 at Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/OR/07-1404/V1&D2, U.S. Department of Energy, Paducah, KY, April.
- DOE 1997. *Resource Conservation and Recovery Act Facility Investigation/Remedial Investigation Report for Waste Area Grouping 17 at Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/OR/07-1404&D2.
- DOE 2008. *Site Evaluation Report for Soil Pile I at Paducah Gaseous Diffusion Plant, Paducah, Kentucky*. (DOE/LX/07-0108&D2) November.
- DOE 2008. *Surface Water Operable Unit (On-Site) Site Investigation and Baseline Risk Assessment Report at the Paducah Gaseous Diffusion Plant Paducah, Kentucky* **(**DOE/LX/07-0001&D2/R1).
- DOE 2009. *Site Evaluation Report for Addendum 1-B Soil Piles at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*. (DOE/LX/07-0225&D2).

QAPP Worksheet #14 (Continued)
Summary of Project Tasks[1]

Secondary Data: Process knowledge, historical use and results of Creeks and Rubble Areas evaluations (continued): • DOE 2009. *Site Evaluation Report for Addendum 2 Soil Piles at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*. (DOE/LX/07-0188&D2). • DOE 2009. *Site Evaluation Report for Rubble Areas at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*. (DOE/LX/07-0227&D1).
Data Management Tasks: Data Management will be per DOE Prime Contractor procedure, PAD-ENM-5007, *Data Management Coordination* and Section 19 of the *Work Plan for the Surface Water Operable Unit Remediation Investigation/Feasibility Study at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0361.
Documentation and Records: Documentation and Records will be per DOE Prime Contractor procedure, PAD-RM-1009, *Records Management, Administrative Record and Document Control.*
Assessment/Audit Tasks: Assessments and audits will be per DOE Prime Contractor procedure, PAD-QAP-1420, *Conduct of Assessments.*
Data Review Tasks: Data review tasks will be per DOE Prime Contractor procedure, PAD-ENM-5003, *Quality Assured Data.*

[1] It is understood that SOPs are contractor specific.

QAPP Worksheet #15-1
Reference Limits and Evaluation Table

UFP-QAPP Manual Section 2.8.1:

Matrix: Soil
Analytical Group: Volatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (μg/kg)[1]	Project Quantitation Limit (μg/kg)	Analytical Method[2]		Achievable Laboratory Limits[3]	
				MDLs (μg/kg)	Method QLs (μg/kg)	MDLs (μg/kg)	QLs (μg/kg)
Acetone	67-64-1	n/a	10	n/a	n/a	6.47	20
Acrolein	107-02-8	n/a	10	n/a	n/a	2.901	50**
Acrylonitrile	107-13-1	243	81	n/a	n/a	1.126	50
Benzene	71-43-2	1280	426	0.03	n/a	0.253	5
Bromodichloromethane	75-27-4	n/a	10	0.03	n/a	0.254	5
Bromoform	75-25-2	n/a	10	0.20	n/a	0.366	5
Bromomethane	74-83-9	n/a	10	0.03	n/a	0.396	10
2-Butanone	78-93-3	n/a	10	n/a	n/a	0.389	20
Carbon disulfide	75-15-0	n/a	10	n/a	n/a	0.369	5
Carbon tetrachloride	56-23-5	903	310	0.02	n/a	0.360	5
Chlorobenzene	108-90-7	n/a	10	0.03	n/a	0.382	5
Chloroethane	75-00-3	n/a	10	n/a	n/a	0.382	10
2-Chloroethyl vinyl ether	110-75-8	n/a	10	n/a	n/a	0.523	20
Chloroform	67-66-3	538	179	0.04	n/a	0.092	5
Chloromethane	74-87-3	n/a	10	0.05	n/a	0.553	10
Dibromochloromethane	124-48-1	n/a	10	0.07	n/a	0.329	5
Dibromomethane	74-95-3	n/a	10	0.01	n/a	0.405	5
Dichlorodifluoromethane	75-71-8	n/a	10	0.11	n/a	0.449	10
1,1-Dichloroethane	75-34-3	n/a	10	0.03	n/a	0.392	5
1,2-Dichloroethane	107-06-2	n/a	10	0.02	n/a	0.372	5
1,1-Dichloroethene	75-35-4	94.5	31.5	n/a	n/a	0.365	5
cis-1,2-Dichloroethene	156-59-2	7,030	2,343	0.06	n/a	0.159	5

QAPP Worksheet #15-1 (Continued)
Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Volatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/kg)[1]	Project Quantitation Limit (µg/kg)	Analytical Method[2]		Achievable Laboratory Limits[3]	
				MDLs (µg/kg)	Method QLs (µg/kg)	MDLs (µg/kg)	QLs (µg/kg)
trans-1,2-Dichloroethene	156-60-5	23,900	7,966	n/a	n/a	0.178	5
1,2-Dichloropropane	78-87-5	n/a	10	0.02	n/a	0.317	5
cis-1,3-Dichloropropene	10061-01-5	n/a	10	n/a	n/a	0.339	5
trans-1,3-Dichloropropene	10061-02-6	n/a	10	n/a	n/a	0.349	5
trans-1,4-Dichloro-2-butene (100)	110-57-6	n/a	10	n/a	n/a	0.397	10
Ethyl benzene	100-41-4	6,110	2,036	0.03	n/a	0.299	5
Ethyl methacrylate	97-63-2	n/a	10	n/a	n/a	0.240	5
Iodomethane	74-88-4	n/a	10	n/a	n/a	1.511	5
2-Hexanone	591-78-6	n/a	10	n/a	n/a	0.261	20
Methylene chloride	75-09-2	n/a	10	n/a	n/a	0.801	5
4-Methyl-2-pentanone	108-10-1	n/a	10	n/a	n/a	0.326	20
Styrene	100-42-5	n/a	10	0.27	n/a	0.347	5
1,1,1,2-Tetrachloroethane	630-20-6	n/a	10	0.07	n/a	0.238	5
1,1,2,2-Tetrachloroethane	79-34-5	n/a	10	0.20	n/a	0.272	5
Tetrachloroethene	127-18-4	326	108	0.05	n/a	0.280	5
Toluene	108-88-3	n/a	10	0.08	n/a	0.303	5
1,1,1-Trichloroethane	71-55-6	n/a	10	0.04	n/a	0.291	5
1,1,2-Trichloroethane	79-00-5	n/a	10	0.08	n/a	0.573	5
Trichloroethene	79-01-6	99.1	33	0.02	n/a	0.290	5
Trichlorofluoromethane	75-69-4	n/a	10	n/a	n/a	0.167	5
1,2,3-Trichloropropane	96-18-4	n/a	10	0.09	n/a	0.559	5**
Vinyl acetate	108-05-4	n/a	10	n/a	n/a	0.305	5

QAPP Worksheet #15-1 (Continued)
Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Volatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (μg/kg)[1]	Project Quantitation Limit (μg/kg)	Analytical Method[2] MDLs (μg/kg)	Analytical Method[2] Method QLs (μg/kg)	Achievable Laboratory Limits[3] MDLs (μg/kg)	Achievable Laboratory Limits[3] QLs (μg/kg)
Vinyl chloride	75-01-4	239	79	0.04	n/a	0.428	5
m,p-xylene[4]	NS831	406,000	135,333	0.06	n/a	0.569	5
o-xylene	95-47-6	450,000	150,000	0.06	n/a	0.318	5

n/a = not available
MDL = method detection limit
QL = quantitation limit
[1] Project Action Limits shown are no action levels for the Teen Recreator scenario from the Risk Methods Document (DOE 2011b; DOE 2010b).
[2] Analytical MDLs and QLs are those documented in validated methods. MDLs listed are taken from Table 2 of SW846-8260B.
[3] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. These limits may not reflect the contractual reporting limits agreed to with the laboratory. The actual laboratory has not been contracted; numbers shown are based on historical information from the Soils OU Remedial Investigation. Actual laboratory numbers can be reported when the laboratory has been contracted.
[4] Lowest no action limit among m-xylene and p-xylene was used.
** The laboratory will report results down to their MDL, qualifying the result as estimated, for these analytes that have a project limit below the laboratory QL. Standard practices for qualifying data will apply for any result reported below the laboratory QL.

QAPP Worksheet #15-2
Reference Limits and Evaluation Table

Matrix: Soil/Sediment
Analytical Group: PAHs
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/kg)[1]	Project Quantitation Limit (µg/kg)	Analytical Method[2]		Achievable Laboratory Limits[3]	
				MDLs (µg/kg)	Method QLs (µg/kg)	MDLs (µg/kg)	QLs (µg/kg)
Acenaphthene	83-32-9	587,000	195,666	n/a	660	33.3	330
Acenaphthylene	208-96-8	n/a	660	n/a	660	33.3	330
Anthracene	120-12-7	3,250,000	1,083,333	n/a	660	33.3	330
Benz(a)anthracene	56-55-3	554	184	n/a	660	33.3	330**
Benzo(a)pyrene	50-32-8	55.7	18.5	n/a	660	n/a	6.6*
Benzo(b)fluoranthene	205-99-2	557	185	n/a	660	33.3	330**
Benzo(ghi)perylene	191-24-2	n/a	660	n/a	660	33.3	330
Benzo(k)fluoranthene	207-08-9	5,540	1,846	n/a	660	33.3	330
Chrysene	218-01-9	54,300	18,100	n/a	660	33.3	330
Dibenz(a,h)anthracene	53-70-3	55.7	18.5	n/a	660	n/a	6.6*
Fluoranthene	206-44-0	447,000	149,000	n/a	660	33.3	330
Fluorene	86-73-7	419,000	139,666	n/a	660	33.3	330
Indeno(1,2,3-cd)pyrene	193-39-5	557	185	n/a	660	33.3	330**
Naphthalene	91-20-3	5,270	1,756	n/a	660	33.3	330
Phenanthrene	85-01-8	n/a	660	n/a	660	33.3	330
Pyrene	129-00-0	335,000	111,666	n/a	660	33.3	330

n/a = not available
[1] Project Action Limits shown are no action levels for the Teen Recreator scenario from the Risk Methods Document (DOE 2011b; DOE 2010b).
[2] Analytical MDLs and QLs are those documented in validated methods. Method QLs listed are taken from Table 2 of SW846-8270D.
[3] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. These limits may not reflect the contractual reporting limits agreed to with the laboratory. The actual laboratory has not been contracted; numbers shown are based on historical information from the Soils OU Remedial Investigation. Actual laboratory numbers can be reported when the laboratory has been contracted.
* QL for 8270C [Selective Ion Mode (SIM) Operation].
** The laboratory will report results down to their MDL, qualifying the result as estimated, for these analytes that have a project limit below the laboratory QL. Standard practices for qualifying data will apply for any result reported below the laboratory QL.

QAPP Worksheet #15-3
Reference Limits and Evaluation Table

Matrix: Soil/Sediment
Analytical Group: Metals
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (mg/kg)[1]	Project Quantitation Limit (mg/kg)	Analytical Method[2]		Achievable Laboratory Limits[3]	
				MDLs (mg/kg)	Method QLs (mg/kg)	MDLs (mg/kg)	QLs (mg/kg)
Aluminum	7429-90-5	12,000	4,000	n/a	0.0001	1.14	5.0
Antimony	7440-36-0	0.21	0.178	n/a	0.0001	0.164	0.5
Arsenic	7440-38-2	1.02	1	n/a	0.001	0.203	1.0
Barium	7440-39-3	170	56	n/a	0.0001	0.057	2.0
Beryllium	7440-41-7	0.0129	0.01	n/a	0.0001	0.011	0.1**
Cadmium	7440-43-9	0.21	0.07	n/a	0.0001	0.011	0.05
Calcium	7440-70-2	n/a	n/a	n/a	0.0001	TBD	TBD
Chromium	7440-47-3	71.5	23.8	n/a	0.0001	0.302	1.0
Cobalt	7440-48-4	8.45	2.81	n/a	0.0001	TBD	TBD
Copper	7440-50-8	19	6.3	n/a	0.0001	0.0536	1.0
Iron	7439-89-6	19,800	6,600	n/a	0.0001	3.30	5.0
Lead	7439-92-1	23	7.6	n/a	0.0001	0.026	0.3
Magnesium	7439-95-4	n/a	700	n/a	0.0001	TBD	TBD
Manganese	7439-96-5	820	273	n/a	0.0001	0.054	0.5
Mercury	7439-97-6	0.13	0.04	0.00093	n/a	0.006	0.033
Molybdenum	7439-98-7	142	47	n/a	n/a	0.077	0.5
Nickel	7440-02-0	21	7	n/a	0.0001	0.0822	0.5
Selenium	7782-49-2	0.7	0.2	n/a	0.001	0.045	0.5
Silver	7440-22-4	2.3	0.7	n/a	0.0001	0.008	0.2
Sodium	7440-23-5	320	106	n/a	0.0001	TBD	TBD
Thallium[4]	7440-28-0	0.21	0.2	n/a	0.0001	0.058	0.2**
Uranium	7440-61-1	4.6	1.5	n/a	n/a	0.012	0.1
Vanadium	7440-62-2	0.104	0.034	n/a	0.0001	0.735	1.0
Zinc	7440-66-6	60	20	n/a	0.0001	1.33	5.0

n/a = not available
MDL = method detection limit
QL = quantitation limit

QAPP Worksheet #15-3 (Continued)
Reference Limits and Evaluation Table

TBD = to be determined
[1] Project Action Limits shown are the greater of the no action levels for the Teen Recreator scenario and the background values from the Risk Methods Document (DOE 2011b; DOE 2010b).
[2] Analytical MDLs and QLs are those documented in validated methods. MDL listed for Mercury is taken from SW846-7471B (Section 2.3). Method QLs for the remaining metals are taken from SW846-6020A (Section 1.2).
[3] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. These limits may not reflect the contractual reporting limits agreed to with the laboratory. The actual laboratory has not been contracted; numbers shown are based on historical information from the Soils OU Remedial Investigation. Actual laboratory numbers can be reported when the laboratory has been contracted.
[4] The no action level for thallium chloride was used.
** The laboratory will report results down to their MDL, qualifying the result as estimated, for these analytes that have a project limit below the laboratory QL. Standard practices for qualifying data will apply for any result reported below the laboratory QL.

QAPP Worksheet #15-4
Reference Limits and Evaluation Table

Matrix: Soil/Sediment
Analytical Group: Radionuclides
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (pCi/g)[1]	Project Quantitation Limit (pCi/g)	Analytical Method[2]		Achievable Laboratory Limits[3]	
				MDCs (pCi/g)	Method QLs (pCi/g)	MDCs (pCi/g)	QLs (pCi/g)
Americium-241	14596-10-2	12.8	4.2	3	n/a	n/a	0.1
Cesium-137	10045-97-3	0.198	0.1	0.5	n/a	n/a	0.2
Neptunium-237	13994-20-2	0.1	0.05	3	n/a	n/a	0.1
Plutonium-238	13981-16-3	0.073	0.05	6	n/a	n/a	0.1
Plutonium-239/240	n/a	0.025	0.02	4	n/a	n/a	0.1
Technetium-99	14133-76-7	2.5	1	8	n/a	n/a	1
Thorium-228	14274-82-9	1.6	0.5	3	n/a	n/a	0.1
Thorium-230	14269-63-7	1.4	0.5	4	n/a	n/a	0.1
Thorium-232	n/a	1.5	0.5	3	n/a	n/a	0.1
Uranium-234	13966-29-5	1.2	0.4	3	n/a	n/a	0.1
Uranium-235	15117-96-1	0.06	0.05	2	n/a	n/a	0.1
Uranium-238	24678-82-8	1.2	0.4	2	n/a	n/a	0.1

n/a = not available
MDC = minimum detectable concentration
QL = quantitation limit
[1] Project Action Limits shown are the greater of the no action levels for the Teen Recreator scenario and the background values from the Risk Methods Document (DOE 2011b; DOE 2010b).
[2] Analytical MDCs and QLs are those documented in validated methods.
[3] Achievable MDCs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. These limits may not reflect the contractual reporting limits agreed to with the laboratory. The actual laboratory has not been contracted; numbers shown are based on historical information from the Soils OU Remedial Investigation. Actual laboratory numbers can be reported when the laboratory has been contracted.

QAPP Worksheet #15-5
Reference Limits and Evaluation Table

Matrix: Soil/Sediment
Analytical Group: PCBs
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (mg/kg)[1]	Project Quantitation Limit (mg/kg)	Analytical Method[2]		Achievable Laboratory Limits[3]	
				MDLs (mg/kg)	Method QLs (mg/kg)	MDLs (mg/kg)	QLs (mg/kg)
Aroclor 1016	12674-11-2	0.181	0.1	n/a	n/a	0.00539	0.033
Aroclor 1221	11104-28-2	0.14	0.1	n/a	n/a	0.00539	0.033
Aroclor 1232	11141-16-5	0.14	0.1	n/a	n/a	0.00539	0.033
Aroclor 1242	53469-21-9	0.183	0.1	n/a	n/a	0.00539	0.033
Aroclor 1248	12672-29-6	0.19	0.1	n/a	n/a	0.00539	0.033
Aroclor 1254	11097-69-1	0.184	0.1	n/a	n/a	0.00613	0.033
Aroclor 1260	11096-82-5	0.186	0.1	n/a	n/a	0.00613	0.033
Total PCBs	1336-36-3	0.183	0.1	n/a	n/a	0.05147	0.300
2-Chlorobiphenyl	2051-60-7	n/a	0.1	n/a	n/a	TBD	TBD
2,3-Dichlorobiphenyl	16605-91-7	n/a	0.1	n/a	n/a	TBD	TBD
2,2',5-Trichlorobiphenyl	37680-65-2	n/a	0.1	n/a	n/a	TBD	TBD
2,4',5-Trichlorobiphenyl	16606-02-3	n/a	0.1	n/a	n/a	TBD	TBD
2,2',3,5'-Tetrachlorobiphenyl	41464-39-5	n/a	0.1	n/a	n/a	TBD	TBD
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	n/a	0.1	n/a	n/a	TBD	TBD
2,3',4,4'-Tetrachlorobiphenyl	32598-10-0	n/a	0.1	n/a	n/a	TBD	TBD
2,2',3,4,5'-Pentachlorobiphenyl	38380-02-8	n/a	0.1	n/a	n/a	TBD	TBD
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	n/a	0.1	n/a	n/a	TBD	TBD
2,3,3',4',6-Pentachlorobiphenyl	38380-03-9	n/a	0.1	n/a	n/a	TBD	TBD

QAPP Worksheet #15-5 (Continued)
Reference Limits and Evaluation Table

Matrix: Soil/Sediment
Analytical Group: PCBs
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (mg/kg)[1]	Project Quantitation Limit (mg/kg)	Analytical Method[2]		Achievable Laboratory Limits[3]	
				MDLs (mg/kg)	Method QLs (mg/kg)	MDLs (mg/kg)	QLs (mg/kg)
2,2’,3,4,4,5’-Hexachlorobiphenyl	35065-28-2	n/a	0.1	n/a	n/a	TBD	TBD
2,2’,3,4,5,5’-Hexachlorobiphenyl	52712-04-6	n/a	0.1	n/a	n/a	TBD	TBD
2,2’,3,5,5’,6-Hexachlorobiphenyl	52663-63-5	n/a	0.1	n/a	n/a	TBD	TBD
2,2’,4,4’,5,5’-Hexachlorobiphenyl	35065-27-1	n/a	0.1	n/a	n/a	TBD	TBD
2,2’,3,3’,4,4’,5-Heptachlorobiphenyl	35065-30-6	n/a	0.1	n/a	n/a	TBD	TBD
2,2’,3,4,4’,5,5’-Heptachlorobiphenyl	35065-29-3	n/a	0.1	n/a	n/a	TBD	TBD
2,2’,3,4,4’,5’,6-Heptachlorobiphenyl	52663-69-1	n/a	0.1	n/a	n/a	TBD	TBD
2,2’,3,4’,5,5’,6-Heptachlorobiphenyl	52663-68-0	n/a	0.1	n/a	n/a	TBD	TBD
2,2’,3,3’,4,4’,5,5’,6-Nonachlorobiphenyl	40186-72-9	n/a	0.1	n/a	n/a	TBD	TBD

n/a = not available
TBD = to be determined
MDL = method detection limit
QL = quantitation limit
[1] Project Action Limits shown are no action levels for the Teen Recreator scenario from the Risk Methods Document (DOE 2011b; DOE 2010b).
[2] Analytical MDLs and QLs are those documented in validated methods. SW846-8082 does not list MDLs or Method QLs.
[3] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. The actual laboratory has not been contracted. Actual laboratory numbers can be reported when the laboratory has been contracted.

QAPP Worksheet #15-6
Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Explosives
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/kg)[1]	Project Quantitation Limit (µg/kg)	Analytical Method		Achievable Laboratory Limits[2]	
				MDLs (µg/kg)	Method QLs (µg/kg)	MDLs (µg/kg)	QLs (µg/kg)
2-Amino-4,6-dinitrotoluene (2-Am-DNT)	33572-78-2	n/a	0.03	0.003	0.03	TBD	TBD
4-Amino-2,6-dinitrotoluene (4-Am-DNT)	1946-51-0	n/a	0.03	0.003	0.03	TBD	TBD
3,5-Dinitroaniline (3,5-DNA)	618-87-1	n/a	0.03	0.2	0.03	TBD	TBD
1,3-Dinitrobenzene (1,3-DNB)	99-65-0	n/a	0.03	0.003	0.03	TBD	TBD
2,4-Dinitrotoluene (2,4-DNT)	121-14-2	n/a	0.03	0.003	0.03	TBD	TBD
2,6-Dinitrotoluene (2,6-DNT)	606-20-2	n/a	0.03	0.003	0.03	TBD	TBD
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	n/a	0.03	0.003	0.03	TBD	TBD
Nitrobenzene (NB)	98-95-3	n/a	0.03	0.2	0.03	TBD	TBD
Nitroglycerine (NG)	55-63-0	n/a	0.03	0.2	0.03	TBD	TBD
2-Nitrotoluene (2-NT)	88-72-2	n/a	0.03	0.2	0.03	TBD	TBD
3-Nitrotoluene (3-NT)	99-08-1	n/a	0.03	0.2	0.03	TBD	TBD
4-Nitrotoluene (4-NT)	99-99-0	n/a	0.03	0.2	0.03	TBD	TBD
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	n/a	0.03	0.003	0.03	TBD	TBD

QAPP Worksheet #15-6 (Continued)
Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Explosives
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/kg)[1]	Project Quantitation Limit (µg/kg)	Analytical Method[2] MDLs (µg/kg)	Analytical Method[2] Method QLs (µg/kg)	Achievable Laboratory Limits[3] MDLs (µg/kg)	Achievable Laboratory Limits[3] QLs (µg/kg)
Pentaerythritoltetranitrate (PETN)	78-11-5	n/a	0.03	0.2	0.03	TBD	TBD
1,3,5-Trinitrobenzene (1,3,5-TNB)	99-35-4	n/a	0.03	0.003	0.03	TBD	TBD
2,4,6-Trinitrophenylmethylnitramine (Tetryl)	479-45-8	n/a	0.03	0.003	0.03	TBD	TBD
2,4,6-Trinitrotoluene (2,4,6-TNT)	118-96-7	n/a	0.03	0.003	0.03	TBD	TBD

n/a = not available
TBD = to be determined
MDL = method detection limit
QL = quantitation limit
[1] Project Action Limits were not available in the Risk Methods Document (DOE 2011b; DOE 2010b).
[2] Analytical MDLs and QLs are those documented in validated methods.
[3] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. The actual laboratory has not been contracted. Actual laboratory numbers can be reported when the laboratory has been contracted.

QAPP Worksheet #15-7
Reference Limits and Evaluation Table

Matrix: Soil/Sediment
Analytical Group: Geotechnical
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/kg)[1]	Project Quantitation Limit (µg/kg)	Analytical Method[2]		Achievable Laboratory Limits[3]	
				MDLs (µg/kg)	Method QLs (µg/kg)	MDLs (µg/kg)	QLs (µg/kg)
Total Organic Carbon	n/a	n/a	n/a	n/a	n/a	TBD	TBD
Grain Size	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Bulk Density	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Percent Solids	n/a	n/a	n/a	n/a	n/a	n/a	n/a
pH	13967-14-1	n/a	n/a	n/a	n/a	n/a	n/a
Moisture Content	n/a	n/a	n/a	n/a	n/a	n/a	n/a

n/a = not available
TBD = to be determined
MDL = method detection limit
QL = quantitation limit
[1] Project Action Limits were not available in the Risk Methods Document (DOE 2011b; DOE 2010b).
[2] Analytical MDLs and QLs are those documented in validated methods. SW846-9060 does not list MDLs or Method QLs.
[3] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. The actual laboratory has not been contracted. Actual laboratory numbers can be reported when the laboratory has been contracted.

QAPP Worksheet #15-8
Reference Limits and Evaluation Table

Matrix: Soil/Sediment
Analytical Group: Metals by XRF
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (mg/kg) [1]	Project Quantitation Limit (mg/kg)	Analytical Method[2]		Achievable Laboratory Limits[3]	
				MDLs (mg/kg)	Method QLs (mg/kg)	MDLs (mg/kg)	QLs (mg/kg)
Barium	7440-39-3	170	100	100	n/a	100	n/a
Lead	7439-92-1	23	13	20	n/a	13	n/a
Uranium	7440-61-1	4.6	20	n/a	n/a	20	n/a

n/a = not available
MDL = method detection limit
QL = quantitation limit
[1] Project Action Limits shown are the greater of the no action levels for the Teen Recreator scenario and the background values from the Risk Methods Document (DOE 2011b; DOE 2010b).
[2] Analytical MDLs and QLs are those documented in validated methods. MDLs are taken from SW846-6200, Table 1, "Example Interference Free Lower Limits of Detection."
[3] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. MDLs for the XRF are based on Thermo Scientific NITON XL3t 300 Series Instruments for Environmental Analysis "Limits of Detection for Contaminants in Soil" for a typical soil matrix.

QAPP Worksheet #15-9
Reference Limits and Evaluation Table

Matrix: Soil/Sediment
Analytical Group: PCBs by Test Kit
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (mg/kg)[1]	Project Quantitation Limit (mg/kg)	Analytical Method[2]		Achievable Laboratory Limits[3]	
				MDLs (mg/kg)	Method QLs (mg/kg)	MDLs (mg/kg)	QLs (mg/kg)
Total PCBs	1336-36-3	0.183	1, 5, 10, 50	n/a	1, 5, 10, 50	n/a	1, 5, 10, 50

n/a = not available
MDL = method detection limit
QL = quantitation limit
[1] The Project Action Limit shown is the no action level for the Teen Recreator scenario from the Risk Methods Document (DOE 2011b; DOE 2010b)
[2] Analytical MDLs and QLs are those documented in validated methods.
[3] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method.

QAPP Worksheet #15-10
Reference Limits and Evaluation Table

Matrix: Soil/Sediment
Analytical Group: Radionuclides by FIDLER
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (pCi/g)	Project Quantitation Limit ((pCi/g)	Analytical Method		Achievable Laboratory Limits	
				MDC ((pCi/g)	Method QLs ((pCi/g)	MDC ((pCi/g)	QLs ((pCi/g)
Cesium-137	10045-97-3	0.099	n/a	n/a	n/a	n/a	5

MDC = minimum detectable concentration
n/a = not available

QAPP Worksheet #15-11
Reference Limits and Evaluation Table

Matrix: Surface Water
Analytical Group: Volatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L)[1]	Project Quantitation Limit (µg/L)	Analytical Method[2]		Achievable Laboratory Limits[3]	
				MDLs (µg/L)	Method QLs (µg/L)	MDLs (µg/L)	QLs (µg/L)
Acetone	67-64-1	n/a	10	n/a	n/a	TBD	TBD
Acrolein	107-02-8	n/a	10	n/a	n/a	TBD	TBD
Acrylonitrile	107-13-1	29	9	n/a	n/a	TBD	TBD
Benzene	71-43-2	22.1	7.3	0.03	n/a	TBD	TBD
Bromodichloromethane	75-27-4	n/a	10	0.03	n/a	TBD	TBD
Bromoform	75-25-2	n/a	10	0.20	n/a	TBD	TBD
Bromomethane	74-83-9	n/a	10	0.03	n/a	TBD	TBD
2-Butanone	78-93-3	n/a	10	n/a	n/a	TBD	TBD
Carbon disulfide	75-15-0	n/a	10	n/a	n/a	TBD	TBD
Carbon tetrachloride	56-23-5	12.1	4	0.02	n/a	TBD	TBD
Chlorobenzene	108-90-7	n/a	10	0.03	n/a	TBD	TBD
Chloroethane	75-00-3	n/a	10	n/a	n/a	TBD	TBD
2-Chloroethyl vinyl ether	110-75-8	n/a	10	n/a	n/a	TBD	TBD
Chloroform	67-66-3	74.1	24.7	0.04	n/a	TBD	TBD
Chloromethane	74-87-3	n/a	10	0.05	n/a	TBD	TBD
Dibromochloromethane	124-48-1	n/a	10	0.07	n/a	TBD	TBD
Dibromomethane	74-95-3	n/a	10	0.01	n/a	TBD	TBD
Dichlorodifluoromethane	75-71-8	n/a	10	0.11	n/a	TBD	TBD
1,1-Dichloroethane	75-34-3	n/a	10	0.03	n/a	TBD	TBD
1,2-Dichloroethane	107-06-2	n/a	10	0.02	n/a	TBD	TBD
1,1-Dichloroethene	75-35-4	2.44	0.8	n/a	n/a	TBD	TBD
cis-1,2-Dichloroethene	156-59-2	84.3	28.1	0.06	n/a	TBD	TBD

QAPP Worksheet #15-11 (Continued)
Reference Limits and Evaluation Table

Matrix: Surface Water
Analytical Group: Volatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L)[1]	Project Quantitation Limit (µg/L)	Analytical Method[2]		Achievable Laboratory Limits[3]	
				MDLs (µg/L)	Method QLs (µg/L)	MDLs (µg/L)	QLs (µg/L)
trans-1,2-Dichloroethene	156-60-5	843	281	n/a	n/a	TBD	TBD
1,2-Dichloropropane	78-87-5	n/a	10	0.02	n/a	TBD	TBD
cis-1,3-Dichloropropene	10061-01-5	n/a	10	n/a	n/a	TBD	TBD
trans-1,3-Dichloropropene	10061-02-6	n/a	10	n/a	n/a	TBD	TBD
trans-1,4-Dichloro-2-butene (100)	110-57-6	n/a	10	n/a	n/a	TBD	TBD
Ethyl benzene	100-41-4	32.8	10	0.03	n/a	TBD	TBD
Ethyl methacrylate	97-63-2	n/a	10	n/a	n/a	TBD	TBD
Iodomethane	74-88-4	n/a	10	n/a	n/a	TBD	TBD
2-Hexanone	591-78-6	n/a	10	n/a	n/a	TBD	TBD
Methylene chloride	75-09-2	n/a	10	n/a	n/a	TBD	TBD
4-Methyl-2-pentanone	108-10-1	n/a	10	n/a	n/a	TBD	TBD
Styrene	100-42-5	n/a	10	0.27	n/a	TBD	TBD
1,1,1,2-Tetrachloroethane	630-20-6	n/a	10	0.07	n/a	TBD	TBD
1,1,2,2-Tetrachloroethane	79-34-5	n/a	10	0.20	n/a	TBD	TBD
Tetrachloroethene	127-18-4	0.724	0.24	0.05	n/a	TBD	TBD
Toluene	108-88-3	n/a	10	0.08	n/a	TBD	TBD
1,1,1-Trichloroethane	71-55-6	n/a	10	0.04	n/a	TBD	TBD
1,1,2-Trichloroethane	79-00-5	n/a	10	0.08	n/a	TBD	TBD
Trichloroethene	79-01-6	4.04	1.34	0.02	n/a	TBD	TBD
Trichlorofluoromethane	75-69-4	n/a	10	n/a	n/a	TBD	TBD
1,2,3-Trichloropropane	96-18-4	n/a	10	0.09	n/a	TBD	TBD
Vinyl acetate	108-05-4	n/a	10	n/a	n/a	TBD	TBD

QAPP Worksheet #15-11 (Continued)
Reference Limits and Evaluation Table

Matrix: Surface Water
Analytical Group: Volatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L)[1]	Project Quantitation Limit (µg/L)	Analytical Method[2] MDLs (µg/L)	Analytical Method[2] Method QLs (µg/L)	Achievable Laboratory Limits[3] MDLs (µg/L)	Achievable Laboratory Limits[3] QLs (µg/L)
Vinyl chloride	75-01-4	3.05	1.01	0.04	n/a	TBD	TBD
m,p-xylene	NS831	1,820	606	0.06	n/a	TBD	TBD
o-xylene	95-47-6	2,040	680	0.06	n/a	TBD	TBD

n/a = not available
TBD = to be determined
MDL = method detection limit
QL = quantitation limit
[1] Project Action Limits shown are no action levels for the Teen Recreator (wading) scenario from the Risk Methods Document (DOE 2011b; DOE 2010b).
[2] Analytical MDLs and QLs are those documented in validated methods. MDLs listed are taken from Table 2 of SW846-8260B.
[3] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. The actual laboratory has not been contracted. Actual laboratory numbers can be reported when the laboratory has been contracted.

QAPP Worksheet #15-12
Reference Limits and Evaluation Table

Matrix: Surface Water
Analytical Group: PAHs
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L)[1]	Project Quantitation Limit (µg/L)	Analytical Method[2]		Achievable Laboratory Limits[3]	
				MDLs (µg/L)	Method QLs (µg/L)	MDLs (µg/L)	QLs (µg/L)
Acenaphthene	83-32-9	270	90	n/a	n/a	TBD	TBD
Acenaphthylene	208-96-8	n/a	10	n/a	n/a	TBD	TBD
Anthracene	120-12-7	715	238	n/a	n/a	TBD	TBD
Benz(a)anthracene	56-55-3	0.0227	0.007	n/a	n/a	TBD	TBD
Benzo(a)pyrene	50-32-8	0.00151	0.0005	n/a	n/a	TBD	TBD
Benzo(b)fluoranthene	205-99-2	0.0257	0.008	n/a	n/a	TBD	TBD
Benzo(ghi)perylene	191-24-2	n/a	10	n/a	n/a	TBD	TBD
Benzo(k)fluoranthene	207-08-9	0.156	0.052	n/a	n/a	TBD	TBD
Chrysene	218-01-9	2.1	0.7	n/a	n/a	TBD	TBD
Dibenz(a,h)anthracene	53-70-3	0.000958	0.0003	n/a	n/a	TBD	TBD
Fluoranthene	206-44-0	37.8	12.6	n/a	n/a	TBD	TBD
Fluorene	86-73-7	130	43	n/a	n/a	TBD	TBD
Indeno(1,2,3-cd)pyrene	193-39-5	0.00741	0.002	n/a	n/a	TBD	TBD
Naphthalene	91-20-3	188	62	n/a	n/a	TBD	TBD
Phenanthrene	85-01-8	n/a	10	n/a	n/a	TBD	TBD
Pyrene	129-00-0	43.4	14.4	n/a	n/a	TBD	TBD

n/a = not available
TBD = to be determined
[1] Project Action Limits shown are no action levels for the Teen Recreator (wading) scenario from the Risk Methods Document (DOE 2011b, DOE 2010b).
[2] Analytical MDLs and QLs are those documented in validated methods. SW846-8270D does not list Method QLs for surface water.
[3] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. The actual laboratory has not been contracted. Actual laboratory numbers can be reported when the laboratory has been contracted.

QAPP Worksheet #15-13
Reference Limits and Evaluation Table

Matrix: Surface Water
Analytical Group: Metals
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (mg/L)[1]	Project Quantitation Limit (mg/L)	Analytical Method[2]		Achievable Laboratory Limits[3]	
				MDLs (mg/L)	Method QLs (mg/L)	MDLs (mg/L)	QLs (mg/L)
Aluminum	7429-90-5	575	191	n/a	0.0001	TBD	TBD
Antimony	7440-36-0	0.0345	0.0115	n/a	0.0001	TBD	TBD
Arsenic	7440-38-2	0.0141	0.0047	n/a	0.001	TBD	TBD
Barium	7440-39-3	8.05	2.6	n/a	0.0001	TBD	TBD
Beryllium	7440-41-7	0.0000345	0.00003	n/a	0.0001	TBD	TBD
Cadmium	7440-43-9	0.00279	0.002	n/a	0.0001	TBD	TBD
Calcium	7440-70-2	n/a	10	n/a	0.0001	TBD	TBD
Chromium	7440-47-3	11.2	3.7	n/a	0.0001	TBD	TBD
Cobalt	7440-48-4	0.431	0.14	n/a	0.0001	TBD	TBD
Copper	7440-50-8	23	7	n/a	0.0001	TBD	TBD
Iron	7439-89-6	402	134	n/a	0.0001	TBD	TBD
Lead	7439-92-1	0.015	0.005	n/a	0.0001	TBD	TBD
Magnesium	7439-95-4	n/a	10	n/a	0.0001	TBD	TBD
Manganese	7439-96-5	0.552	0.18	n/a	0.0001	TBD	TBD
Mercury	7439-97-6	0.0121	0.004	0.0002	n/a	TBD	TBD
Molybdenum	7439-98-7	2.87	0.95	n/a	n/a	TBD	TBD
Nickel	7440-02-0	2.30	0.7	n/a	0.0001	TBD	TBD
Selenium	7782-49-2	2.87	0.95	n/a	0.001	TBD	TBD
Silver	7440-22-4	0.192	0.064	n/a	0.0001	TBD	TBD
Sodium	7440-23-5	n/a	10	n/a	0.0001	TBD	TBD
Thallium[4]	7440-28-0	0.046	0.015	n/a	0.0001	TBD	TBD
Uranium	7440-61-1	1.72	0.57	n/a	n/a	TBD	TBD
Vanadium	7440-62-2	0.00105	0.001	n/a	0.0001	TBD	TBD
Zinc	7440-66-6	287	95	n/a	0.0001	TBD	TBD

n/a = not available
TBD = to be determined
MDL = method detection limit
QL = quantitation limit

QAPP Worksheet #15-13 (Continued)
Reference Limits and Evaluation Table

[1] Project Action Limits shown are no action levels for the Teen Recreator (wading) scenario from the Risk Methods Document (DOE 2011b; DOE 2010b).
[2] Analytical MDLs and QLs are those documented in validated methods. MDL listed for mercury is taken from SW846-7470A (Section 2.3).
[3] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. The actual laboratory has not been contracted. Actual laboratory numbers can be reported when the laboratory has been contracted.
[4] The no action level for thallium chloride was used.

QAPP Worksheet #15-14
Reference Limits and Evaluation Table

Matrix: Surface Water
Analytical Group: Radionuclides
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (pCi/L)[1]	Project Quantitation Limit (pCi/L)	Analytical Method[2]		Achievable Laboratory Limits[3]	
				MDCs (pCi/L)	Method QLs (pCi/L)	MDCs (pCi/L)	QLs (pCi/L)
Americium-241	14596-10-2	n/a	0.05	3	n/a	TBD	n/a
Cesium-137	10045-97-3	n/a	0.1	0.5	n/a	TBD	n/a
Neptunium-237	13994-20-2	n/a	0.05	3	n/a	TBD	n/a
Plutonium-238	13981-16-3	n/a	0.05	6	n/a	TBD	n/a
Plutonium-239/240	n/a	n/a	0.05	4	n/a	TBD	n/a
Technetium-99	14133-76-7	n/a	1	8	n/a	TBD	n/a
Thorium-228	14274-82-9	n/a	0.05	3	n/a	TBD	n/a
Thorium-230	14269-63-7	n/a	0.05	4	n/a	TBD	n/a
Thorium-232	n/a	n/a	0.05	3	n/a	TBD	n/a
Uranium-234	13966-29-5	n/a	0.15	3	n/a	TBD	n/a
Uranium-235	15117-96-1	n/a	0.05	2	n/a	TBD	n/a
Uranium-238	24678-82-8	n/a	0.15	2	n/a	TBD	n/a

n/a = not available
MDC = minimum detectable concentration
QL = quantitation limit
[1] Project Action Limits shown are no action levels for the Teen Recreator (wading) scenario from the Risk Methods Document (DOE 2011b; DOE 2010b).
[2] Analytical MDCs and QLs are those documented in validated methods.
[3] Achievable MDCs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. The actual laboratory has not been contracted. Actual laboratory numbers can be reported when the laboratory has been contracted.

QAPP Worksheet #15-15
Reference Limits and Evaluation Table

Matrix: Surface Water
Analytical Group: PCBs
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (mg/L)[1]	Project Quantitation Limit (mg/L)	Analytical Method[2]		Achievable Laboratory Limits[3]	
				MDLs (mg/L)	Method QLs (mg/L)	MDLs (mg/L)	QLs (mg/L)
Aroclor-1016	12674-11-2	0.000047	0.00004	n/a	n/a	TBD	TBD
Aroclor-1221	11104-28-2	0.000208	0.0002	n/a	n/a	TBD	TBD
Aroclor-1232	11141-16-5	0.000208	0.0002	n/a	n/a	TBD	TBD
Aroclor-1242	53469-21-9	0.0000279	0.00002	n/a	n/a	TBD	TBD
Aroclor-1248	12672-29-6	0.0000259	0.00002	n/a	n/a	TBD	TBD
Aroclor-1254	11097-69-1	0.00000354	0.00002	n/a	n/a	TBD	TBD
Aroclor-1260	11096-82-5	0.00000268	0.000003	n/a	n/a	TBD	TBD
Total PCBs	1336-36-3	0.00000558	0.000005	n/a	n/a	TBD	TBD

n/a = not available
TBD = to be determined
MDL = method detection limit
QL = quantitation limit
[1] Project Action Limits shown are no action levels for the Teen Recreator (wading) scenario from the Risk Methods Document (DOE 2011b; DOE 2010b).
[2] Analytical MDLs and QLs are those documented in validated methods. SW846-8082 does not list MDLs or Method QLs.
[3] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. The actual laboratory has not been contracted. Actual laboratory numbers can be reported when the laboratory has been contracted.

QAPP Worksheet #15-16
Reference Limits and Evaluation Table

Matrix: Surface Water
Analytical Group: Explosives
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L)[1]	Project Quantitation Limit (µg/L)	Analytical Method[2]		Achievable Laboratory Limits[3]	
				MDLs (µg/L)	Method QLs (µg/L)	MDLs (µg/L)	QLs (µg/L)
2-Amino-4,6-dinitrotoluene (2-Am-DNT)	33572-78-2	n/a	0.03	0.003	0.03	TBD	TBD
4-Amino-2,6-dinitrotoluene (4-Am-DNT)	1946-51-0	n/a	0.03	0.003	0.03	TBD	TBD
3,5-Dinitroaniline (3,5-DNA)	618-87-1	n/a	0.03	0.2	0.03	TBD	TBD
1,3-Dinitrobenzene (1,3-DNB)	99-65-0	n/a	0.03	0.003	0.03	TBD	TBD
2,4-Dinitrotoluene (2,4-DNT)	121-14-2	n/a	0.03	0.003	0.03	TBD	TBD
2,6-Dinitrotoluene (2,6-DNT)	606-20-2	n/a	0.03	0.003	0.03	TBD	TBD
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	n/a	0.03	0.003	0.03	TBD	TBD
Nitrobenzene (NB)	98-95-3	n/a	0.03	0.2	0.03	TBD	TBD
Nitroglycerine (NG)	55-63-0	n/a	0.03	0.2	0.03	TBD	TBD
2-Nitrotoluene (2-NT)	88-72-2	n/a	0.03	0.2	0.03	TBD	TBD
3-Nitrotoluene (3-NT)	99-08-1	n/a	0.03	0.2	0.03	TBD	TBD
4-Nitrotoluene (4-NT)	99-99-0	n/a	0.03	0.2	0.03	TBD	TBD
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	n/a	0.03	0.003	0.03	TBD	TBD

QAPP Worksheet #15-16 (Continued)
Reference Limits and Evaluation Table

Matrix: Surface Water
Analytical Group: Explosives
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L)[1]	Project Quantitation Limit (µg/L)	Analytical Method[2]		Achievable Laboratory Limits[3]	
				MDLs (µg/L)	Method QLs (µg/L)	MDLs (µg/L)	QLs (µg/L)
Pentaerythritoltetranitrate (PETN)	78-11-5	n/a	0.03	0.2	0.03	TBD	TBD
1,3,5-Trinitrobenzene (1,3,5-TNB)	99-35-4	n/a	0.03	0.003	0.03	TBD	TBD
2,4,6-Trinitrophenylmethylnitramine (Tetryl)	479-45-8	n/a	0.03	0.003	0.03	TBD	TBD
2,4,6-Trinitrotoluene (2,4,6-TNT)	118-96-7	n/a	0.03	0.003	0.03	TBD	TBD

n/a = not available
TBD = to be determined
MDL = method detection limit
QL = quantitation limit
[1] Project Action Limits were not available in the Risk Methods Document (DOE 2011b; DOE 2010b).
[2] Analytical MDLs and QLs are those documented in validated methods.
[3] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. The actual laboratory has not been contracted. Actual laboratory numbers can be reported when the laboratory has been contracted.

QAPP Worksheet #15-17
Reference Limits and Evaluation Table

Matrix: Tissue
Analytical Group: PAHs
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/kg)[1]	Project Quantitation Limit (µg/kg)	Analytical Method[2]		Achievable Laboratory Limits[3]	
				MDLs (µg/kg)	Method QLs (µg/kg)	MDLs (µg/kg)	QLs (µg/kg)
Acenaphthene	83-32-9	57.2	19	n/a	n/a	TBD	TBD
Acenaphthylene	208-96-8	6.7	2.2	n/a	n/a	TBD	TBD
Anthracene	120-12-7	n/a	10	n/a	n/a	TBD	TBD
Benz(a)anthracene	56-55-3	108	36	n/a	n/a	TBD	TBD
Benzo(a)pyrene	50-32-8	150	50	n/a	n/a	TBD	TBD
Benzo(b)fluoranthene	205-99-2	655	218	n/a	n/a	TBD	TBD
Benzo(ghi)perylene	191-24-2	n/a	10	n/a	n/a	TBD	TBD
Benzo(k)fluoranthene	207-08-9	655	218	n/a	n/a	TBD	TBD
Chrysene	218-01-9	166	55	n/a	n/a	TBD	TBD
Dibenz(a,h)anthracene	53-70-3	33	11	n/a	n/a	TBD	TBD
Fluoranthene	206-44-0	42.3	14.1	n/a	n/a	TBD	TBD
Fluorene	86-73-7	77.4	25.8	n/a	n/a	TBD	TBD
Indeno(1,2,3-cd)pyrene	193-39-5	655	218	n/a	n/a	TBD	TBD
Naphthalene	91-20-3	176	58	n/a	n/a	TBD	TBD
Phenanthrene	85-01-8	204	68	n/a	n/a	TBD	TBD
Phenol	108-95-2	n/a	10	n/a	n/a	TBD	TBD

n/a = not available
[1] Project Action Limits shown are no further action screening values for sediment from the Risk Methods Document (DOE 2011b; DOE 2010b).
[2] Analytical MDLs and QLs are those documented in validated methods. SW846-8270D does not list MDLs or Method QLs for tissue.
[3] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. The actual laboratory has not been contracted. Actual laboratory numbers can be reported when the laboratory has been contracted.

QAPP Worksheet #15-18
Reference Limits and Evaluation Table

Matrix: Tissue
Analytical Group: Metals
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (mg/kg)[1]	Project Quantitation Limit (mg/kg)	Analytical Method[2]		Achievable Laboratory Limits[3]	
				MDLs (mg/kg)	Method QLs (mg/kg)	MDLs (mg/kg)	QLs (mg/kg)
Aluminum	7429-90-5	25,000	8,333	n/a	n/a	TBD	TBD
Antimony	7440-36-0	12	4	n/a	n/a	TBD	TBD
Arsenic	7440-38-2	7.24	2.41	n/a	n/a	TBD	TBD
Barium	7440-39-3	n/a	10	n/a	n/a	TBD	TBD
Beryllium	7440-41-7	n/a	10	n/a	n/a	TBD	TBD
Cadmium	7440-43-9	1	0.33	n/a	n/a	TBD	TBD
Calcium	7440-70-2	n/a	10	n/a	n/a	TBD	TBD
Chromium	7440-47-3	52.3	17.4	n/a	n/a	TBD	TBD
Cobalt	7440-48-4	50	16.6	n/a	n/a	TBD	TBD
Copper	7440-50-8	18.7	6.2	n/a	n/a	TBD	TBD
Iron	7439-89-6	200	66.6	n/a	n/a	TBD	TBD
Lead	7439-92-1	30.2	10.06	n/a	n/a	TBD	TBD
Magnesium	7439-95-4	n/a	10	n/a	n/a	TBD	TBD
Manganese	7439-96-5	1,673	557	n/a	n/a	TBD	TBD
Mercury	7439-97-6	0.13	0.04	n/a	n/a	TBD	TBD
Molybdenum	7439-98-7	n/a	10	n/a	n/a	TBD	TBD
Nickel	7440-02-0	15.9	5.3	n/a	n/a	TBD	TBD
Selenium	7782-49-2	0.1	0.03	n/a	n/a	TBD	TBD
Silver	7440-22-4	2	0.6	n/a	n/a	TBD	TBD
Sodium	7440-23-5	n/a	10	n/a	n/a	TBD	TBD
Thallium	7440-28-0	n/a	10	n/a	n/a	TBD	TBD
Uranium	7440-61-1	n/a	10	n/a	n/a	TBD	TBD
Vanadium	7440-62-2	0.2	0.06	n/a	n/a	TBD	TBD
Zinc	7440-66-6	124	41.3	n/a	n/a	TBD	TBD

n/a = not available
TBD = to be determined
MDL = method detection limit
QL = quantitation limit
[1] Project Action Limits shown are no further action screening values for sediment from the Risk Methods Document (DOE 2011b; DOE 2010b).

QAPP Worksheet #15-18 (continued)
Reference Limits and Evaluation Table

[2] Analytical MDLs and QLs are those documented in validated methods. SW846-6020 and SW846-7470 do not list MDLs or Method QLs for tissue.
[3] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. The actual laboratory has not been contracted. Actual laboratory numbers can be reported when the laboratory has been contracted.

QAPP Worksheet #15-19
Reference Limits and Evaluation Table

Matrix: Tissue
Analytical Group: Radionuclides
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (pCi/g)[1]	Project Quantitation Limit (pCi/g)	Analytical Method[2]		Achievable Laboratory Limits[3]	
				MDCs (pCi/g)	Method QLs (pCi/g)	MDCs (pCi/g)	QLs (pCi/g)
Americium-241	14596-10-2	5,160	1,720	n/a	n/a	TBD	n/a
Cesium-137	10045-97-3	3,130	1,043	n/a	n/a	TBD	n/a
Neptunium-237	13994-20-2	7,610	2,536	n/a	n/a	TBD	n/a
Plutonium-238	13981-16-3	5,730	1,910	n/a	n/a	TBD	n/a
Plutonium-239/240	n/a	5,870	1,956	n/a	n/a	TBD	n/a
Technetium-99	14133-76-7	42,300	14,100	n/a	n/a	TBD	n/a
Thorium-228	14274-82-9	n/a	100	n/a	n/a	TBD	n/a
Thorium-230	14269-63-7	10,400	34,666	n/a	n/a	TBD	n/a
Thorium-232	n/a	n/a	100	n/a	n/a	TBD	n/a
Uranium-234	13966-29-5	5,270	1,756	n/a	n/a	TBD	n/a
Uranium-235	15117-96-1	3,730	1,243	n/a	n/a	TBD	n/a
Uranium-238	24678-82-8	2,490	830	n/a	n/a	TBD	n/a

n/a = not available
TBD = to be determined
MDC = minimum detectable concentration
QL = quantitation limit
[1] Project Action Limits shown are no further action screening values for sediment from the Risk Methods Document (DOE 2011b; DOE 2010b).
[2] Analytical MDCs and QLs are those documented in validated methods.
[3] Achievable MDCs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. The actual laboratory has not been contracted. Actual laboratory numbers can be reported when the laboratory has been contracted.

QAPP Worksheet #15-20
Reference Limits and Evaluation Table

Matrix: Tissue
Analytical Group: PCBs
Concentration Level: Low

Analyte	CAS Number	Project Action Limit (mg/kg)[1]	Project Quantitation Limit (mg/kg)	Analytical Method[2]		Achievable Laboratory Limits[3]	
				MDLs (mg/kg)	Method QLs (mg/kg)	MDLs (mg/kg)	QLs (mg/kg)
Aroclor-1016	12674-11-2	n/a	1,375	n/a	n/a	TBD	TBD
Aroclor-1221	11104-28-2	n/a	1,375	n/a	n/a	TBD	TBD
Aroclor-1232	11141-16-5	n/a	1,375	n/a	n/a	TBD	TBD
Aroclor-1242	53469-21-9	n/a	1,375	n/a	n/a	TBD	TBD
Aroclor-1248	12672-29-6	n/a	1,375	n/a	n/a	TBD	TBD
Aroclor-1254	11097-69-1	n/a	1,375	n/a	n/a	TBD	TBD
Aroclor-1260	11096-82-5	n/a	1,375	n/a	n/a	TBD	TBD
Total PCBs	1336-36-3	33,000	11,000	n/a	n/a	TBD	TBD

n/a = not available
TBD = to be determined
MDL = method detection limit
QL = quantitation limit
[1] Project Action Limits shown are no further action screening values for sediment from the Risk Methods Document (DOE 2011b; DOE 2010b).
[2] Analytical MDLs and QLs are those documented in validated methods. SW846-8082 does not list MDLs or Method QLs.
[3] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. The actual laboratory has not been contracted. Actual laboratory numbers can be reported when the laboratory has been contracted.

QAPP Worksheet #16
Project Schedule/Timeline Table[1]

UFP-QAPP Manual Section 2.8.2:

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		

[1] See work plan Section 2, Figure 2.2.

QAPP Worksheet #17
Sampling Design and Rationale

UFP-QAPP Manual Section 3.1.1:

Describe and provide a rationale for choosing the sampling approach (e.g., grid system, biased statistical approach): The sampling strategy for this RI/FS includes elements of stratified sampling, systematic (or grid) sampling, adaptive cluster sampling, composite sampling, and random sampling (EPA 2002). These elements were selected to ensure that data is acquired from all areas ensuring that a sufficient number of samples are acquired to support informed decision making. Analysis of these samples will be a combination of field test methods and fixed-base laboratory analysis. **Describe the sampling design and rationale in terms of what matrices will be sampled, what analytical groups will be analyzed and at what concentration levels, the sampling locations (including QC, critical, and background samples), the number of samples to be taken, and the sampling frequency (including seasonal considerations) [May refer to map or Worksheet #18 for details]:** Sections 6 through 14 and Worksheet #18 of the SWOU RI/FS Work Plan presents the sampling approach.

QAPP Worksheet #18-1
Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number	Matrix	Depth (units)	Analytical Group	Concentration Level	Number of Samples (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
Sediment Stability [Little Bayou Creek (LBC), Bayou Creek (BC)]	sediment	surface	PCBs	See Appendix D for available historical information	40[2]+2 field duplicates	See Worksheet #21	See Worksheet #17, Sections 6 and 7
			Metals (Uranium and Barium)		40+2 field duplicates		
			Geotechnical[1]		40		
	sediment	subsurface	PCBs		40[2]+2 field duplicates		
			Metals (Uranium and Barium)		40+2 field duplicates		
			Geotechnical[1]		40		
Sediment Stability—Ecological	sediment	surface	PCBs		16+1 field duplicate		
			Metals (Uranium)		16+1 field duplicate		
			Geotechnical[1]		16		
			PCBs by test kit		20+1 field duplicate		
			Metals by XRF		20+1 field duplicate		
			Benthic Invertebrate toxicity—10-day *H. azteca*	N/A	12		
			Benthic invertebrate community		12		
			Benthic invertebrate uptake–28-day *L. variegates* bioaccumulation test[3]		10		

[1] Geotechnical parameters include Total Organic Carbon (TOC), grain size, bulk density, percent solids, pH, and moisture content.
[2] Assumes 2 surface and 2 subsurface samples per location.
[3] Bioaccumulation samples will be analyzed for PCBs and Uranium.

QAPP Worksheet #18-2
Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number	Matrix	Depth (units)	Analytical Group	Concentration Level	Number of Samples (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
LBC—Phase 1	sediment	surface	VOCs[1]	See Appendix D for available historical information	24+1 field duplicate	See Worksheet #21	See Worksheet #17, Sections 6 and 7
			PCBs		72+4 field duplicates		
			PCB Congeners		7+1 field duplicate		
			PAHs		72+4 field duplicates		
			Metals		72+4 field duplicates		
			Radionuclides		72+4 field duplicates		
	sediment/soil	TBD (interface)	VOCs[1]		24+1 field duplicate		
			PCBs		72+4 field duplicates		
			PCB Congeners		7+1 field duplicate		
			PAHs		72+4 field duplicates		
			Metals		72+4 field duplicates		
			Radionuclides		72+4 field duplicates		
	soil	surface	VOCs[1]		24+1 field duplicate		
			PCBs		72+4 field duplicates		
			PCB Congeners		7+1 field duplicate		
			PAHs		72+4 field duplicates		
			Metals		72+4 field duplicates		
			Radionuclides		72+4 field duplicates		
	surface water[2]	surface	VOCs[1]		24+1 field duplicate		
			Metals		54+4 field duplicates		
			Radionuclides		54+4 field duplicates		
LBC—Phase 2	sediment[3]	surface	VOCs[1, 4]		43+2 field duplicates		
			PCBs		43+2 field duplicates		
			PCB Congeners		4+1 field duplicates		
			PAHs		43+2 field duplicates		
			Metals		43+2 field duplicates		
			Radionuclides		43+2 field duplicates		
			PCBs by test kits		432+21 field duplicates		
			Metals by XRF		432+21 field duplicates		
			Cs-137 by FIDLER		432+21 field duplicates		

QAPP Worksheet #18-2 (Continued)
Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number	Matrix	Depth (units)	Analytical Group	Concentration Level	Number of Samples (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
	soil/sediment	TBD (intermediate)	VOCs[1, 4]	See Appendix D for available historical information	22+1 field duplicate	See Worksheet #21	See Worksheet #17, Sections 6 and 7
			PCBs		22+1 field duplicate		
			PCB Congeners		2+1 field duplicate		
			PAHs		22+1 field duplicate		
			Metals		22+1 field duplicate		
			Radionuclides		22+1 field duplicate		
			PCBs by test kits		216+11 field duplicates		
			Metals by XRF		216+11 field duplicates		
			Cs-137 by FIDLER		216+11 field duplicates		
LBC—Phase 2	Sediment/soil[3]	TBD (interface)	VOCs[1, 4]		22+1 field duplicate		
			PCBs		22+1 field duplicate		
			PCB Congeners		2+1 field duplicate		
			PAHs		22+1 field duplicate		
			Metals		22+1 field duplicate		
			Radionuclides		22+1 field duplicate		
			PCBs by test kits		216+11 field duplicates		
			Metals by XRF		216+11 field duplicates		
			Cs-137 by FIDLER		216+11 field duplicates		
LBC —Phase 2 Ecological	sediment	surface	Benthic Invertebrate toxicity–10-day *H. azteca*	N/A	10		
			Benthic invertebrate community		10		
			Benthic invertebrate uptake–28-day *L. vriegates* bioaccumulation test[5]		10		

QAPP Worksheet #18-2 (Continued)
Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number	Matrix	Depth (units)	Analytical Group	Concentration Level	Number of Samples (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
			Benthic Invertebrate toxicity–28-day *E. fetida*	NA	10	See Worksheet #21	See Worksheet #17, Section 6 and 7
	soil	surface	PCBs	See Appendix D for available historical information	10+1 field duplicate		
			PAHs		10+1 field duplicate		
			Metals		10+1 field duplicate		
			Radionuclides		10+1 field duplicate		
LBC —Phase 2 Ecological	surface water	surface	PCBs		10+1 field duplicate		
			PAHs		10+1 field duplicate		
			Metals		10+1 field duplicate		
			Radionuclides		10+1 field duplicate		
			Benthic Invertebrate toxicity–fathead minnow	N/A	10		
	plant	NA	Toxicity		10		
			Community		6		
			Bioaccumulation[5]		20		
	fish	NA	Bioaccumulation[5]		10		
			Community		6		

[1] Little Bayou Creek seep areas only.
[2] Physical parameters to be measured include pH, hardness, dissolved oxygen, conductivity, temperature, and turbidity.
[3] Assumed sediment is mixed.
[4] Trichloroethene only.
[5] Bioaccumulation samples will be analyzed for metals, radionuclides, PAHs, and PCBs.

QAPP Worksheet #18-3
Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number	Matrix	Depth (units)	Analytical Group	Concentration Level	Number of Samples (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
BC—Phase 1	sediment[1]	surface	PCBs	See Appendix D for available historical information	96+5 field duplicates	See Worksheet #21	See Worksheet #17, Section 6
			PCB Congeners		10+1 field duplicate		
			PAHs		96+5 field duplicates		
			Metals		96+5 field duplicates		
			Radionuclides		96+5 field duplicates		
	sediment/soil[1]	TBD (interface)	PCBs		96+5 field duplicates		
			PCB Congeners		10+1 field duplicate		
			PAHs		96+5 field duplicates		
			Metals		96+5 field duplicates		
			Radionuclides		96+5 field duplicates		
	soil	surface	PCBs		96+5 field duplicates		
			PCB Congeners		10+1 field duplicate		
			PAHs		96+5 field duplicates		
			Metals		96+5 field duplicates		
			Radionuclides		96+5 field duplicates		
	surface water[2]	surface	Metals		72+5 field duplicates		
			Radionuclides		72+5 field duplicates		
BC—Phase 2	sediment[1]	surface	PCBs		86+4 field duplicates		
			PCB Congeners		9+4 field duplicates		
			PAHs		86+4 field duplicates		
			Metals		86+4 field duplicates		
			Radionuclides		86+4 field duplicates		
			PCBs by test kits		864+43 field duplicates		
			Metals by XRF		864+43 field duplicates		
			Cs-137 by FIDLER		864+43 field duplicates		

QAPP Worksheet #18-3 (Continued)
Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number	Matrix	Depth (units)	Analytical Group	Concentration Level	Number of Samples (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
BC—Phase 2	sediment[1]	TBD (intermediate)	PCBs	See Appendix D for available historical information	29+2 field duplicates	See Worksheet #21	See Worksheet #17, Section 6
			PCB Congeners		3+2 field duplicates		
			PAHs		29+2 field duplicates		
			Metals		29+2 field duplicates		
			Radionuclides		29+2 field duplicates		
			PCBs by test kits		288+14 field duplicates		
			Metals by XRF		288+14 field duplicates		
			Cs-137 by FIDLER		288+14 field duplicates		
	sediment/soil[1]	TBD (interface)	PCBs		29+2 field duplicates		
			PCB Congeners		3+2 field duplicates		
			PAHs		29+2 field duplicates		
			Metals		29+2 field duplicates		
			Radionuclides		29+2 field duplicates		
			PCBs by test kits		288+14 field duplicates		
			Metals by XRF		288+14 field duplicates		
			Cs-137 by FIDLER		288+14 field duplicates		
BC—Phase 2 Ecological	sediment	surface	Benthic Invertebrate toxicity–10-day *H. azteca*	N/A	13		
			Benthic invertebrate community		13		
			Benthic invertebrate uptake–28-day *L. variegates* Bioaccumulation test[3]		10		
			Benthic Invertebrate toxicity–28-day *E. fetida*		10		

QAPP Worksheet #18-3 (Continued)
Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number	Matrix	Depth (units)	Analytical Group	Concentration Level	Number of Samples (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
	soil	surface	PCBs	See Appendix D for available historical information	10+1 field duplicate	See Worksheet #21	See Worksheet #17, Section 6
			Metals		10+1 field duplicate		
			PAHs		10+1 field duplicate		
			Radionuclides		10+1 field duplicate		
	surface water	surface	PCBs		10+1 field duplicate		
			PAHs		10+1 field duplicate		
			Metals		10+1 field duplicate		
			Radionuclides		10+1 field duplicate		
			Benthic Invertebrate toxicity–fathead minnow	NA	13		
BC—Phase 2 Ecological	plant	NA	Toxicity		13		
			Community		11		
			Bioaccumulation[3]		20		
	fish	NA	Bioaccumulation[3]		10		
			Community		11		

[1] Assumed sediment is mixed.
[2] Physical parameters to be measured include pH, hardness, dissolved oxygen, conductivity, temperature, and turbidity.
[3] Bioaccumulation samples will be analyzed for metals, radionuclides, PAHs, and PCBs.

QAPP Worksheet #18-4
Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number	Matrix	Depth (units)	Analytical Group	Concentration Level	Number of Samples (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
Ditches—Activity 1 (LBC and BC)	sediment/soil	surface	PCBs	See Appendix D for available historical information	39+2 field duplicates	See Worksheet #21	See Worksheet #17, Sections 6 and 7
			Metals		39+2 field duplicates		
			Radionuclides (Cs-137)		39+2 field duplicates		
			PCBs by test kits		392+2 field duplicates		
			Metals by XRF		392+2 field duplicates		
			Cs-137 by FIDLER		392+2 field duplicates		
Activity 2	sediment	surface	VOCs[1]		56+3 field duplicates		
			PCBs		56+3 field duplicates		
			PCB Congeners		6+1 field duplicate		
			PAHs		56+3 field duplicates		
			Metals		56+3 field duplicates		
			Radionuclides		56+3 field duplicates		
	sediment/soil	TBD (interface)	VOCs[1]		56+3 field duplicates		
			PCBs		56+3 field duplicates		
			PCB Congeners		6+1 field duplicate		
			PAHs		56+3 field duplicates		
			Metals		56+3 field duplicates		
			Radionuclides		56+3 field duplicates		
	soil	subsurface	VOCs[1]		56+3 field duplicates		
			PCBs		56+3 field duplicates		
			PCB Congeners		6+1 field duplicate		
			PAHs		56+3 field duplicates		
			Metals		56+3 field duplicates		
			Radionuclides		56+3 field duplicates		
Ditches—Ecological	sediment	surface	PCBs		10+1 field duplicate		
			PAHs		10+1 field duplicate		
			Metals		10+1 field duplicate		
			Radionuclides		10+1 field duplicate		

QAPP Worksheet #18-4 (Continued)
Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number	Matrix	Depth (units)	Analytical Group	Concentration Level	Number of Samples (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
			Benthic Invertebrate toxicity–10-day *H. azteca*	NA	13	See Worksheet #21	See Worksheet #17, Sections 6 and 7
			Benthic invertebrate uptake 28-day *L. variegates*		10		
	plant	NA	Bioaccumulation		10		
Seeps Area Exposure Unit—Phase 1 Ecological (LBC)	sediment	surface	VOCs[2]	See Appendix D for available historical information	10+1 field duplicate		
			Total Organic Carbon		10+1 field duplicate		
			Geotechnical[2]		10		
	surface water	surface	VOCs[3]		10+1 field duplicate		
Seeps Area Exposure Unit—Phase 2 Ecological (LBC)	sediment	surface	Benthic Invertebrate toxicity-10-day *H. azteca*	NA	7		
			Benthic Invertebrate community		7		
	surface water	surface	VOCs[1]	See Appendix D for available historical information	5+1 field duplicate		
			Benthic Invertebrate toxicity–fathead minnow	N/A	7		

[1] Trichloroethene only.
[2] Geotechnical parameters include Total Organic Carbon (TOC), grain size, bulk density, percent solids, pH, and moisture content.
[3] Trichloroethene and breakdown products only.

QAPP Worksheet #18-5
Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number	Matrix	Depth (units)	Analytical Group	Concentration Level	Number of Samples (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
Ohio River Floodplain— BC Section 1, BC Section 2 LBC Section 1,, Sediment Trap	sediment	subsurface	Metals (Uranium)	See Appendix D for available historical information	5+1 field duplicate	See Worksheet #21	See Worksheet #17, Section 6
			Metals by XRF (Uranium)		24 + 2 field duplicates		

LBC = Little Bayou Creek
BC = Bayou Creek

QAPP Worksheet #18-6
Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number	Matrix	Depth (units)	Analytical Group	Concentration Level	Number of Samples (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
Soil-Covered Rubble Dams (SWMUs 105, 107)	soil	surface	PCBs	See Appendix D for available historical information	20+1 field duplicates	See Worksheet #21	See Worksheet #17, Section 8
			PAHs		20+1 field duplicates		
			Metals		20+1 field duplicates		
			Radionuclides		20+1 field duplicates		

QAPP Worksheet #18-7
Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number	Matrix	Depth (units)	Analytical Group	Concentration Level	Number of Samples (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
Horse Crossing (SWMU 108)	sediment	surface	PCBs	See Appendix D for available historical information	8+1 field duplicate	See Worksheet #21	See Worksheet #17, Section 9
			PCB Congeners		1+1 field duplicate		
			PAHs		8+1 field duplicate		
			Metals		8+1 field duplicate		
			Radionuclides		8+1 field duplicate		
	sediment/soil	TBD (interface)	PCBs		8+1 field duplicate		
			PCB Congeners		1+1 field duplicate		
			PAHs		8+1 field duplicate		
			Metals		8+1 field duplicate		
			Radionuclides		8+1 field duplicate		

QAPP Worksheet #18-8
Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number	Matrix	Depth (units)	Analytical Group	Concentration Level	Number of Samples (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
Bank Erosion Control Riprap (SWMU 109)	Sediment	surface	PCBs	See Appendix D for available historical information	8+1 field duplicate	See Worksheet #21	See Worksheet #17, Section 10
			PCB Congeners		1+1 field duplicate		
			PAHs		8+1 field duplicate		
			Metals		8+1 field duplicate		
			Radionuclides		8+1 field duplicate		
	sediment/soil	TBD (interface)	PCBs		8+1 field duplicate		
			PCB Congeners		1+1 field duplicate		
			PAHs		8+1 field duplicate		
			Metals		8+1 field duplicate		
			Radionuclides		8+1 field duplicate		

QAPP Worksheet #18-9
Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number	Matrix	Depth (units)	Analytical Group	Concentration Level	Number of Samples (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
North-South Diversion Ditch Ecological	sediment	surface	Benthic Invertebrate toxicity–10-day *H. azteca*	N/A	13	See Worksheet #21	See Worksheet #17, Section 11
			Benthic invertebrate uptake–28-day *L. variegates* Bioaccumulation test[1]		10		

[1] Bioaccumulation samples will be analyzed for metals, radionuclides, PAHs, geotechnical parameters (total organic carbon (TOC), grain size, bulk density, percent solids, pH, and moisture content), and PCBs.

QAPP Worksheet #18-10
Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number	Matrix	Depth (units)	Analytical Group	Concentration Level	Number of Samples (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
Horseshoe Lagoon (SWMU 185) —Activity 1	sediment	surface	PCBs	See Appendix D for available historical information	1+1 field duplicate	See Worksheet #21	See Worksheet #17, Section 12
			Metals (Uranium and Lead)		1+1 field duplicate		
			Radionuclides (Cs-137)		1+1 field duplicate		
			PCBs by test kits		8+1 field duplicate		
			Metals by XRF		8+1 field duplicate		
			Cs-137 by FIDLER		8+1 field duplicate		
	surface water[1]	surface	VOCs[2]		6+1 field duplicate		
			Metals		6+1 field duplicate		
			Radionuclides		6+1 field duplicate		
Activity 2	sediment	surface	VOCs[2]		4+1 field duplicate		
			PCBs		4+1 field duplicate		
			PCB Congeners		0		
			PAHs		4+1 field duplicate		
			Metals		4+1 field duplicate		
			Radionuclides		4+1 field duplicate		
	sediment/soil	TBD (interface)	VOCs[2]		4+1 field duplicate		
			PCBs		4+1 field duplicate		
			PCB Congeners		0		
			PAHs		4+1 field duplicate		
			Metals		4+1 field duplicate		
			Radionuclides		4+1 field duplicate		
	soil	subsurface	VOCs[2]		4+1 field duplicate		
			PCBs		4+1 field duplicate		
			PCB Congeners		1+1 field duplicate		
			PAHs		4+1 field duplicate		
			Metals		4+1 field duplicate		
			Radionuclides		4+1 field duplicate		

[1] Filtered and unfiltered samples will be collected. Physical parameters to be measured include pH, hardness, dissolved oxygen, conductivity, temperature, and turbidity.
[2] Trichloroethene only.

QAPP Worksheet #18-11
Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number	Matrix	Depth (units)	Analytical Group	Concentration Level	Number of Samples (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
Isolated Structure (SWMU 113)	sediment	surface	PCBs	See Appendix D for available historical information	8+1 field duplicate	See Worksheet #21	See Worksheet #17, Section 14
			PCB Congeners		1+1 field duplicate		
			PAHs		8+1 field duplicate		
			Metals		8+1 field duplicate		
			Radionuclides		8+1 field duplicate		
	sediment/soil	TBD (interface)	PCBs		8+1 field duplicate		
			PCB Congeners		1+1 field duplicate		
			PAHs		8+1 field duplicate		
			Metals		8+1 field duplicate		
			Radionuclides		8+1 field duplicate		

QAPP Worksheet #18-12
Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number	Matrix	Depth (units)	Analytical Group	Concentration Level	Number of Samples (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
Eastern Portion of Yellow Water Line (SWMU 205)	sediment	surface	PCBs	See Appendix D for available historical information	8+1 field duplicate	See Worksheet #21	See Worksheet #17, Section 13
			PCB Congeners		0		
			PAHs		8+1 field duplicate		
			Metals		8+1 field duplicate		
			Radionuclides		8+1 field duplicate		
			Geotechnical[1]				
	sediment/soil	TBD (interface)	PCBs		8+1 field duplicate		
			PCB Congeners		1+1 field duplicate		
			PAHs		8+1 field duplicate		
			Metals		8+1 field duplicate		
			Radionuclides		8+1 field duplicate		
			Geotechnical[1]				
	soils	subsurface	VOCs		20+1 field duplicate		
			PCBs		20+1 field duplicate		
			PAHs		8+1 field duplicate		
			Metals		20+1 field duplicate		
			Radionuclides[2]		20+1 field duplicate		
			Explosives[3]	N/A	20+1 field duplicate		
	surface water[3]	surface	VOCs	See Appendix D for available historical information	3+1 field duplicate		
			Metals		3+1 field duplicate		
			Radionuclides[2]		3+1 field duplicate		
			Explosives[3]	N/A	3+1 field duplicate		

[1] Geotechnical parameters include Total Organic Carbon (TOC), grain size, bulk density, percent solids, pH, and moisture content.
[2] Includes Radium-226.
[3] Trinitrotoluene (TNT) and breakdown products.
[4] Physical parameters to be measured include pH, hardness, dissolved oxygen, conductivity, temperature, and turbidity.

QAPP Worksheet #19
Analytical SOP Requirements Table

UFP-QAPP Manual Section 3.1.1:

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference	Sample Volume[1]	Containers (number, size, and type) [1]	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Soil/Sediment	PCBs/Congeners	low	SW846-8082	TBD	TBD	cool 4°C	None
Soil/Sediment	Metals	low	SW846-6010/6020/7470	TBD	TBD	cool 4°C	180 days/28 days
Soil/Sediment	Radionuclides	low	Alpha Spec/Gamma Spec/Liquid Scintillation	TBD	TBD	cool 4°C	180 days
Soil	Volatile Organic Compounds	low	SW846-8260	TBD	TBD	cool 4°C, no headspace	14 days
Soil/Sediment	PAHs	low	SW846-8270	TBD	TBD	cool 4°C	14 days until extraction/40 days
Soil	Explosives	low	SW846-8095	TBD	TBD	cool 4°C	14 days until extraction/40 days
Soil/Sediment	Total Organic Carbon	low	SW846-9060	TBD	TBD	cool 4°C	28 days
Soil/Sediment	Grain Size	low	ASTM-D422	TBD	TBD	None	None
Soil/Sediment	Bulk Density	low	ASTM-D854	TBD	TBD	None	None
Soil/Sediment	Percent Solids	low	ASTM-D2216	TBD	TBD	None	None
Soil/Sediment	pH	low	SW846-9045	TBD	TBD	cool 4°C	24 hours
Soil/Sediment	Moisture Content	low	ASTM-D2216	TBD	TBD	cool 4°C	14 days
Soil/Sediment	PCBs	low	test kit	TBD	TBD	cool 4°C	None
Soil/Sediment	Metals	low	SW846-6200 (XRF)	TBD	TBD	cool 4°C	180 days/28 days

QAPP Worksheet #19 (Continued)
Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference	Sample Volume[1]	Containers (number, size, and type)[1]	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Soil/Sediment	Radionuclides	low	FIDLER	TBD	TBD	cool 4°C	108 days
Sediment	Toxicity	low	100.1, 100.3	TBD	TBD	dark, cool 4°C	14 days
Surface Water	Metals	low	SW846-6010/6020/7471	TBD	TBD	cool 4°C, HNO_3 to pH <2	180 days/28 days
Surface Water	Radionuclides	low	Alpha Spec/Gamma Spec/Liquid Scintillation	TBD	TBD	cool 4°C, HNO_3 to pH <2	180 days
Surface Water	Volatile Organic Compounds	low	SW846-8260	TBD	TBD	cool 4°C, HCl to pH <2, no headspace	14 days
Surface Water	Explosives	low	SW846-8095	TBD	TBD	None	7 days
Surface Water	PAHs	low	SW846-8270	TBD	TBD	cool 4°C	7 days until extraction/40 days
Surface Water	PCBs	low	SW846-8082	TBD	TBD	cool 4°C	None[2]
Surface Water	Toxicity	low	2000.0	TBD	TBD	cool 0-6°C	36 hours
Tissue	PCBs	low	SW846-8082	TBD	TBD	cool 4°C	None[2]
Tissue	Metals	low	SW846-6010/6020/7470	TBD	TBD	cool 4°C	180 days/28 days
Tissue	Radionuclides	low	Alpha Spec/Gamma Spec/Liquid Scintillation	TBD	TBD	cool 4°C	180 days
Tissue	PAHs	low	SW846-8270	TBD	TBD	cool 4°C	14 days until extraction/40 days

[1] Sample volume and container requirements will be specified by the laboratory.
[2] SW-846 Chapter 4, Revision 4, February 2007.

QAPP Worksheet #20
Field Quality Control Sample Summary Table

UFP-QAPP Manual Section 3.1.1:

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference	No. of Sampling Locations[1]	No. of Field Duplicate Pairs	Inorganic No. of MS	No. of Field Blanks	No. of Equip. Blanks	No. of PT Samples	Total No. of Samples to Lab[1]
All	PCBs	low	SW846-8082	TBD	TBD (5%)	N/A	TBD (5%)	TBD (5%)	N/A	TBD
Soil/ Sediment	PCB Congeners	low	SW846-8082	TBD	TBD (5%)	N/A	TBD (5%)	TBD (5%)	N/A	TBD
All	PAHs	low	SW846-8270	TBD	TBD (5%)	N/A	TBD (5%)	TBD (5%)	N/A	TBD
All	Metals	low	SW846-6010/6020/ 7470/7471	TBD	TBD (5%)	N/A	TBD (5%)	TBD (5%)	N/A	TBD
All	Radionuclides	low	see Worksheet 12	TBD	TBD (5%)	N/A	TBD (5%)	TBD (5%)	N/A	TBD
Soil/ Surface Water	VOCs	low	SW846-8260	TBD	TBD (5%)	N/A	TBD (5%)	TBD (5%)	N/A	TBD
Soil/ Surface Water	Explosives	low	SW846-8095	TBD	TBD (5%)	N/A	TBD (5%)	TBD (5%)	N/A	TBD
Soil/ Sediment	Total Organic Carbon	low	SW846-9060	TBD	TBD (5%)	N/A	TBD (5%)	TBD (5%)	N/A	TBD
Soil/ Sediment	Grain Size	low	ASTM-D422	TBD	TBD (5%)	N/A	TBD (5%)	TBD (5%)	N/A	TBD
Soil/ Sediment	Bulk Density	low	ASTM-D854	TBD	TBD (5%)	N/A	TBD (5%)	TBD (5%)	N/A	TBD
Soil/ Sediment	Percent Solids	low	ASTM-D2216	TBD	TBD (5%)	N/A	TBD (5%)	TBD (5%)	N/A	TBD
Soil/ Sediment	pH	low	SW846-9045	TBD	N/A	N/A	N/A	N/A	N/A	TBD
Soil/ Sediment	Moisture Content	low	ASTM-D2216	TBD	N/A	N/A	N/A	N/A	N/A	TBD
Sediment	Toxicity	low	100.1, 100.3	TBD	N/A	N/A	N/A	N/A	N/A	TBD
Surface Water	Toxicity	low	2000.0	TBD	N/A	N/A	N/A	N/A	N/A	TBD

MS = matrix spike
PT = performance test

QAPP Worksheet #20 (continued)
Field Quality Control Sample Summary Table

TBD = to be determined
N/A = not applicable
[1] Work package documents will identify the sampling locations, the matrices, the number of samples, and sample identification numbers for samples to be submitted to DOECAP-accredited laboratory. This is not applicable for samples analyzed by field methods.

QAPP Worksheet #21
Project Sampling SOP References Table[1]

UFP-QAPP Manual Section 3.1.2:

Reference Number	Title, Revision Date, and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
1	PAD-ENM-0023, *Composite Sampling*	Contractor	Sampling	N	None
2	PAD-ENM-2300, *Collection of Soil Samples*	Contractor	Sampling	N	None
3	PAD-ENR-0020, *Direct Push Technology Sampling*	Contractor	Sampling	N	None
4	PAD-ENM-2700, *Logbooks and Data Forms*	Contractor	Sampling	N	None
5	PAD-ENM-2702, *Decontamination of Sampling Equipment and Devices*	Contractor	Sampling	N	None
6	PAD-ENM-2704, *Trip, Equipment and Field Blank*	Contractor	Sampling	N	None
7	PAD-ENM-2708, *Chain-of-Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals*	Contractor	Sampling	N	None
8	PAD-ENM-5004, *Sample Tracking, Lab Coordination, and Sample Handling Guidance*	Contractor	Sampling	N	None
9	PAD-DD-2701, *Large Equipment Decontamination*	Contractor	Drilling	N	None

[1] It is understood that all SOPs are contractor specific.

QAPP Worksheet #22
Field Equipment Calibration, Maintenance, Testing, and Inspection Table

UFP-QAPP Manual Section 3.1.2.4:

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Field Instrumentation	Per the manufacturer's instructions, Section 12 and Worksheet #28 of the work plan	Per the manufacturer's instructions	Daily prior to use	Daily prior to use	Daily prior to use, Section 12 of the work plan	Daily prior to use, Section 12 and Worksheet #28 of the work plan	As needed, Section 12 and Worksheet #28 of the work plan	Equipment user, Worksheet #28 of the work plan	Field instrumentation manufacturer's manual, Worksheet #23 of the work plan

QAPP Worksheet #23
Analytical SOP References Table

UFP-QAPP Manual Section 3.2.1:

Reference Number[1]	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
6010	Inductively Coupled Plasma-Atomic Emission Spectrometry	Definitive	Metals	ICP	TBD	TBD
6020	Inductively Coupled Plasma-Mass Spectrometry	Definitive	Metals	ICP-MS	TBD	TBD
7470/7471	Mercury (Manual Cold-Vapor Technique)	Definitive	Metals	AA	TBD	TBD
Alpha Spec[2]	Alpha Spectrometry	Definitive	Radionuclides	Alpha Spectrometry	TBD	TBD
Gamma Spec[2]	Gamma Spectrometry	Definitive	Radionuclides	Gamma Spectrometry	TBD	TBD
Liquid Scintillation[2]	Tc-99 by Liquid Scintillation	Definitive	Radionuclides	Liquid Scintillation	TBD	TBD
8082	Polychlorinated Biphenyls (PCBs) by Gas Chromatography	Definitive	PCBs/PCB Congeners	GC	TBD	TBD
8260	Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry	Definitive	VOCs	GC/MS	TBD	TBD
8270	Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry	Definitive	PAHs	GC/MS	TBD	TBD
8095	Explosives by Gas Chromatography	Definitive	Explosives	GC	TBD	TBD
9060	Total Organic Carbon	Definitive	Total Organic Carbon	Carbonaceous Analyzer	TBD	TBD
D422	Standard Test Method for Particle Size Analysis of Soil	Definitive	Grain Size	Sieve/Hydrometer	TBD	TBD

QAPP Worksheet #23 (Continued)
Analytical SOP References Table

Reference Number[1]	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
D854	Standard Test Method for Specific Gravity of Soil Solids by Water Pycnometer	Definitive	Bulk Density	Water Pycnometer	TBD	TBD
D2216	Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass	Definitive	Percent Solids/ Moisture Content	Oven Drying	TBD	TBD
9045	Soil and Waste pH	Definitive	pH	pH Meter	TBD	TBD
100.1, 100.3	Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates	Definitive	Toxicity	Environmental chamber with photoperiod and temperature control	TBD	TBD
2000.0	Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms	Definitive	Toxicity	Environmental chamber with temperature control	TBD	TBD
Metals by XRF	Metals by XRF	Screening	Metals	XRF	TBD	TBD
Immunoassay PCB Soil Test	PCB by HACH Pocket Colorimeter™ II Test Kit (or equivalent)	Screening	PCBs	Colorimeter	TBD	TBD

QAPP Worksheet #23 (Continued)
Analytical SOP References Table

Reference Number[1]	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
FIDLER	Field Instrument for the Detection of Low Energy Radiation	Screening	Radionuclides	FIDLER	TBD	TBD

TBD = to be determined
[1] Analysis will be by the most recent revision.
[2] Laboratory will utilize laboratory-specific SOPs that have been audited by DOECAP. Laboratory contracting will be subsequent to the completion of the SWOU RI/FS Work Plan.

QAPP Worksheet #24
Analytical Instrument Calibration Table

UFP-QAPP Manual Section 3.2.2:

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
*						

* The laboratory is responsible for maintaining instrument calibration information per their QA Plan. This information is audited annually by the DOECAP. Laboratory(s) contracted will be DOECAP-accredited. Laboratory contracting will be subsequent to the completion of the SWOU RI/FS Work Plan. Field survey/sampling instrumentation will be calibrated according to manufacturer's instructions.

QAPP Worksheet #25
Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

UFP-QAPP Manual Section 3.2.3:

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
*								

* The laboratory is responsible for maintaining instrument and equipment maintenance, testing, and inspection information per their QA Plan. This information is audited annually by the DOECAP. Laboratory(s) contracted will be DOECAP-accredited. Laboratory contracting will be subsequent to the completion of the SWOU RI/FS Work Plan. Field survey/sampling instrumentation will be maintained, tested, and inspected according to manufacturer's instructions.

QAPP Worksheet #26
Sample Handling System

UFP-QAPP Manual Appendix A:

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT	
Sample Collection (Personnel/Organization):	Sampling Teams/DOE Prime Contractor and Subcontractors
Sample Packaging (Personnel/Organization):	Sampling Teams/DOE Prime Contractor and Subcontractors
Coordination of Shipment (Personnel/Organization):	Transportation Specialist/DOE Prime Contractor
Type of Shipment/Carrier:	Direct Delivery or Overnight/Fed Ex
SAMPLE RECEIPT AND ANALYSIS	
Sample Receipt (Personnel/Organization):	Sample Management/Contracted Laboratory
Sample Custody and Storage (Personnel/Organization):	Sample Management/Contracted Laboratory
Sample Preparation (Personnel/Organization):	Analysts/Contracted Laboratory
Sample Determinative Analysis (Personnel/Organization):	Analysts/Contracted Laboratory
SAMPLE ARCHIVING	
Field Sample Storage (No. of days from sample collection):	See Worksheet #19
Sample Extract/Digestate Storage (No. of days from extraction/digestion):	See Worksheet #19
Biological Sample Storage (No. of days from sample collection):	See Worksheet #19
SAMPLE DISPOSAL	
Personnel/Organization:	Waste Management/Contracted Laboratory
Number of Days from Analysis	N/A

See Worksheets #21 and #27 for SOPs
N/A = not available

QAPP Worksheet #27
Sample Custody Requirements[1]

UFP-QAPP Manual Section 3.3.3:

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory): Field sample custody requirements will be per DOE Prime Contractor procedure, PAD-ENM-5004, *Sample Tracking, Lab Coordination, and Sample Handling Guidance.* Laboratory Sample Custody Procedures (receipt of samples, archiving, and disposal) are per the DOECAP certified laboratory procedures. **Sample Identification Procedures:** Sample identification requirements will be specified in work package documents. **Chain-of-custody Procedures:** Chain-of-custody requirements will be per DOE Prime Contractor procedure, PAD-ENM-2708, *Chain-of-Custody Form, Field Sample Logs, Sample Labels, and Custody Seals.*

[1] It is understood that SOPs are contractor specific.

QAPP Worksheet #28
QC Samples Table

UFP-QAPP Manual Section 3.4:

Matrix	Soil/Sediment/ Surface Water
Analytical Group	All
Concentration Level	Low
Sampling SOP	See Worksheet #21
Analytical Method/ SOP Reference	EPA methods (see Worksheet #23)
Sampler's Name	TBD
Field Sampling Organization	TBD
Analytical Organization	Sample and Data Management
No. of Sample Locations	See Sections 6-14 of the work plan

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria[1]
Field Duplicates	Minimum 5%	See PAD-ENM-5003, *Quality Assured Data*	N/A	N/A	Precision	See procedure PAD-ENM-5003, *Quality Assured Data*
Split Samples	As requested by regulatory agency	N/A	N/A	N/A	N/A	N/A
Field Blanks	Minimum 5%	See PAD-ENM-5003, *Quality Assured Data*	N/A	N/A	Accuracy/Bias (Contamination)	See procedure PAD-ENM-5003, *Quality Assured Data*
Trip Blanks[2]	One per each cooler	See PAD-ENM-5003, *Quality Assured Data*	N/A	N/A	Accuracy/Bias (Contamination)	See procedure PAD-ENM-5003, *Quality Assured Data*
Equipment Rinseates	Minimum 5%	See PAD-ENM-5003, *Quality Assured Data*	N/A	N/A	Accuracy/Bias (Contamination)	See procedure PAD-ENM-5003, *Quality Assured Data*

QAPP Worksheet #28 (Continued)
QC Samples Table

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Initial Calibration	Twice each day the XRF is used	Method 6200 or per manufactures instructions	Recalibrate per Method 6200 or per manufactures instructions	Environmental Sampling Lead	Accuracy/Bias (Contamination)	See procedure PAD-ENM-5003, *Quality Assured Data*
Instrument Blank	Beginning of each day the XRF is used; every 20 samples thereafter	Method 6200 or per manufactures instructions	Recalibrate per Method 6200 or per manufactures instructions	Environmental Sampling Lead	Accuracy/Bias (Contamination)	See procedure PAD-ENM-5003, *Quality Assured Data*
Method Blank	Once each day the XRF is used	Method 6200 or per manufactures instructions	Identify and reanalyze per Method 6200	Environmental Sampling Lead	Accuracy/Bias (Contamination)	See procedure PAD-ENM-5003, *Quality Assured Data*
Internal Standards	Twice each day the XRF is used	Method 6200 or per manufactures instructions	Recalibrate per Method 6200 or per manufactures instructions	Environmental Sampling Lead	Precision	See procedure PAD-ENM-5003, *Quality Assured Data*
Zeroing Blank	Per manufacturer's instructions	HACH Pocket Colorimeter™ II Test Kit for PCB in Soil per manufactures instructions	Per manufacturer's manufactures instructions	Environmental Sampling Lead	Per manufacturer's manufactures instructions	See procedure PAD-ENM-5003, *Quality Assured Data*

QAPP Worksheet #28 (Continued)
QC Samples Table

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Low/High Standards	Per manufacturer's instructions	HACH Pocket Colorimeter^{TM} II Test Kit for PCB in Soil per manufacturer's instructions	Per manufacturer's instructions	Environmental Sampling Lead	Per manufacturer's instructions	See procedure PAD-ENM-5003, *Quality Assured Data*
Zeroing Blank	Per manufacturer's instructions	EnSys Immunoassay PCB Wipe Test Kit per manufacturer's instructions	Per manufacturer's instructions	Environmental Sampling Lead	Per manufacturer's instructions	See procedure PAD-ENM-5003, *Quality Assured Data*
Low/High Standards	Per manufacturer's instructions	EnSys Immunoassay PCB Wipe Test Kit per manufacturer's instructions	Per manufacturer's instructions	Environmental Sampling Lead	Per manufacturer's instructions	See procedure PAD-ENM-5003, *Quality Assured Data*

N/A = not available
[1] It is understood that SOPs are contractor specific.
[2] VOC analyses only.

QAPP Worksheet #29
Project Documents and Records Table

UFP-QAPP Manual Section 3.5.1:

Sample Collection Documents and Records	On-site Analysis Documents and Records	Off-site Analysis Documents and Records	Data Assessment Documents and Records[1]	Other
Data Logbooks and associated completed sampling forms Sample Chains-of-Custody	Laboratory Data Packages OREIS database & associated data packages	OREIS database & associated data packages	PAD-ENM-5003, att. G, Data Assessment Review Checklist and Comment Form included in the data assessment package, data validation reports	PAD-RM-1009, *Records Management, Administrative Record, and Document Control*

[1] It is understood that SOPs are contractor specific.

QAPP Worksheet #30
Analytical Services Table

UFP-QAPP Manual Section 3.5.2.3:

Matrix	Analytical Group	Concentration Level	Sample Locations/ID Numbers	Analytical SOP[1]	Data Package Turnaround Time	Laboratory/Organization (Name and Address, Contact Person and Telephone Number)	Backup Laboratory/Organization (Name and Address, Contact Person and Telephone Number)
All	PCBs	low	TBD	8082	28-day	TBD	TBD
Soil/Sediment	PCB Congeners	low	TBD	8082	28-day	TBD	TBD
All	Metals	low	TBD	6010/6020/7470 /7471	28-day	TBD	TBD
All	PAHs	low	TBD	8270	28-day	TBD	TBD
All	Radionuclides	low	TBD	Alpha Spec/ Gamma Spec/ Liquid Scintillation	28-day	TBD	TBD
Soil/Surface Water	VOCs	low	TBD	8206	28-day	TBD	TBD
Soil/Surface Water	Explosives	low	TBD	8095	28-day	TBD	TBD
Soil/Sediment	Total Organic Carbon	low	TBD	9060	28-day	TBD	TBD
Soil/Sediment	Grain Size	low	TBD	D422	28-day	TBD	TBD
Soil/Sediment	Bulk Density	low	TBD	D854	28-day	TBD	TBD
Soil/Sediment	Percent Solids/ Moisture Content	low	TBD	D2116	28-day	TBD	TBD
Soil/Sediment	pH	low	TBD	9045	28-day	TBD	TBD
Sediment	Toxicity	low	TBD	100.0, 100.3	28-day	TBD	TBD
Surface Water	Toxicity	low	TBD	2000.0	28-day	TBD	TBD

TBD = to be determined
[1] Analytical method SOPs for radiochemistry parameters are laboratory-specific. Laboratory contracting will be subsequent to the completion of the SWOU RI/FS Work Plan.

QAPP Worksheet #31
Planned Project Assessments Table

UFP-QAPP Manual Section 4.1.1:

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (Title and Organizational Affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA) (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (Title and Organizational Affiliation)
Independent Assessment/ Surveillance	TBD	Internal	Prime Contractor QA	QA Specialists, Contractor or Independent Assessor	Project Manager, Contractor	Project Management, Contractor	QA Specialist, Contractor
Laboratory Audit	Annual	External	DOECAP	Laboratory Assessor	Laboratory	Laboratory	DOECAP
Management Assessments	TBD	Internal	Prime Contractor Project Management	Project Management, Contractor	Project Management, Contractor	Project Management, Contractor	QA Specialist, Contractor
Management By Walking Around (MBWA)[1]	TBD	Internal	Prime Contractor Project Management	Project Management, Contractor	Project Management, Contractor	Project Management, Contractor	QA Specialist, Contractor
MBWA Follow-up surveillances	Quarterly	Internal	Prime Contractor Project Management	ER/EM Director, Project Management or designee, Contractor	Project Management/Designee, Contractor	Project Management, Contractor	QA Specialist, Contractor

TBD = to be determined
[1] Reference: PAD-QAP-1033, *Management by Walking Around (MBWA) Program*.

QAPP Worksheet #32
Assessment Findings and Corrective Action Responses[1]

UFP-QAPP Manual Section 4.1.2:

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Time frame of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Org.)	Timeframe for Response
Management, Independent, and Surveillances	Form QAP-E-004, Management/ Independent Assessment Report, and QAP-E-0710, Issue Identification Form	Project Management, Issue Owner, Contractor	Upon issuance of Form QAP-E-004, Management/ Independent Assessment Report, form QAP-E-0710, Issue Identification Form, will be completed and attached to the assessment report.	QAP-E-0710, Issue Identification Form, documents the issue response and/or corrective actions.	Action owner as designated by Issue Owner, Contractor	Fifteen days for initial issue response, corrective action schedule determined by Issue Owner, per PAD-QA-1210.

[1] It is understood that SOPs are contractor specific.

QAPP Worksheet #33
QA Management Reports Table

UFP-QAPP Manual Section 4.2:

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Performance Summary Report	1/month	By the 12th of each month	Project Manager, Contractor	Contractor Management
Site Evaluation Report	1/end of project	TBD	Project Manager, Contractor	DOE, U.S. EPA, Commonwealth of Kentucky

TBD = to be determined

QAPP Worksheet #34
Verification (Step I) Process Table

UFP-QAPP Manual Section 5.2.1:

Verification Input	Description[1]	Internal/ External	Responsible for Verification (Name, Organization)
Field Logbooks	Field logbooks are verified per DOE Prime Contractor procedure, PAD-ENM-2700, *Logbooks and Data Forms*, and PAD-ENM-5003, *Quality Assured Data*.	Internal	Project Management or designee, Contractor
Chains of custody	Chains of custody are controlled by DOE Prime Contractor procedure, PAD-ENM-5004, *Sample Tracking, Lab Coordination and Sample Handling Guidance*. Chains-of-custody will be included in data assessment packages for review as part of data verification and data assessment.	Internal	Sample and Data Management, Project Management, and QA Personnel, Contractor
Field and Laboratory Data	Field and analytical data are verified and assessed per DOE Prime Contractor procedure, PAD-ENM-5003, *Quality Assured Data*. Data assessment packages will be created per this procedure. The data assessment packages will include field and analytical data, chains-of-custody, data verification and assessment queries, and other project specific information needed for personnel to adequately review the package. Data assessment packages will be reviewed to document any issues pertaining to the data and to indicate if data met the data quality objectives of the project.	Internal	Sample and Data Management, Project Management, and QA Personnel[2], Contractor

[1] It is understood that SOPs are contractor specific.
[2] QA specialist performed general QA review.

QAPP Worksheet #35
Validation (Steps IIa and IIb) Process Table

UFP-QAPP Manual Section 5.2.2:

Step IIa/IIb	Validation Input	Description[1]	Responsible for Validation (Name, Organization)
IIa	Data Deliverables, Analytes, and Holding Times	The documentation from the contractual screening will be included in the data assessment packages, per DOE Prime Contractor procedure, PAD-ENM-5003, *Quality Assured Data*.	Sample and Data Management Personnel, Contractor
IIa	Chain-of-Custody, Sample Handling, Sampling Methods and Procedures, and Field Transcription	These items will be validated during the data assessment process as required by DOE Prime Contractor procedure, PAD-ENM-5003, *Quality Assured Data*. The documentation of this validation will be included in the data assessment packages.	Project and QA Personnel, Contractor
IIa	Analytical Methods and Procedures, Laboratory Data Qualifiers, and Standards	These items will be reviewed during the data validation process as required by DOE Prime Contractor data validation procedures. Data validation will be performed in parallel with data assessment. The data validation report and data validation qualifiers will be considered when the data assessment process is being finalized.	Data Validation Subcontractor, Sample and Data Management, Project and QA Personnel, Contractor
IIa	Audits	The audit reports and accreditation and certification records for the laboratory supporting the projects will be considered in the bidding process.	Sample and Data Management Personnel, Contractor
IIb	Deviations and qualifiers from Step IIa	Any deviations and qualifiers resulting from Step IIa process will be documented in the data assessment packages.	Sample and Data Management, Project, and QA Personnel, Contractor
IIb	Sampling Plan, Sampling Procedures, Collocated Field Duplicates, Project Quantitation Limits, Confirmatory Analyses, Performance Criteria	These items will be evaluated as part of the data verification and data assessment process per DOE Prime Contractor procedure, PAD-ENM-5003, *Quality Assured Data*. These items will be considered when evaluating whether the project met their Data Quality Objectives.	Sample and Data Management, Project, and QA Personnel, Contractor

[1] It is understood that SOPs are contractor specific.

QAPP Worksheet #36
Validation (Steps IIa and IIb) Summary Table

UFP-QAPP Manual Section 5.2.2:

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria[1]	Data Validator (title and organizational affiliation)
IIa/IIb	Soil/Sediment/Tissue	PCBs	Low	DOE Prime Contractor procedure, PAD-ENM-0811, *Pesticide and PCB Data Verification and Validation*	TBD
IIa/IIb	Soil/Sediment	PCB Congeners	Low	DOE Prime Contractor procedure, PAD-ENM-0811, *Pesticide and PCB Data Verification and Validation*	TBD
IIa/IIb	All	Metals	Low	DOE Prime Contractor procedure, PAD-ENM-5107, *Inorganic Data Verification and Validation*	TBD
IIa/IIb	All	Radionuclides	Low	DOE Prime Contractor procedure, PAD-ENM-5102, *Radiochemical Data Verification and Validation*	TBD
IIa/IIb	All	PAHs	Low	DOE Prime Contractor procedure, PAD-ENM-5105, *Volatile and Semivolatile Data Verification and Validation*	TBD
IIa/IIb	Soil/Surface Water	VOCs	Low	DOE Prime Contractor procedure, PAD-ENM-5105, *Volatile and Semivolatile Data Verification and Validation*	TBD

QAPP Worksheet #36 (Continued)
Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria[1]	Data Validator (title and organizational affiliation)
IIa/IIb	Soil/Surface Water	Explosives	Low	DOE Prime Contractor procedure, PAD-ENM-0026, *Wet Chemistry and Miscellaneous Analysis Data Verification and Validation*	TBD
IIa/IIb	Surface Water	Hardness	Low	DOE Prime Contractor procedure, PAD-ENM-0026, *Wet Chemistry and Miscellaneous Analysis Data Verification and Validation*	TBD
IIa/IIb	Soil/Sediment	Total Organic Carbon, Grain Size, Bulk Density, Percent Solids, pH, Moisture Content	Low	DOE Prime Contractor procedure, PAD-ENM-0026, *Wet Chemistry and Miscellaneous Analysis Data Verification and Validation*	TBD

TBD = to be determined
[1] It is understood that SOPs are contractor specific.

QAPP Worksheet #37
Usability Assessment[1]

UFP-QAPP Manual Section 5.2.3:

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used: Field and analytical data are verified and assessed per DOE Prime Contractor procedure, PAD-ENM-5003, *Quality Assured Data*. Data assessment packages will be created per this procedure. Data assessment packages will include field and analytical data, chains-of-custody, data verification and assessment queries, and other project specific information needed for personnel to adequately review the package. Data assessment packages will be reviewed to document any issues pertaining to the data and to indicate if data quality objectives of the project were met.

Describe the evaluative procedures used to assess overall measurement error associated with the project: Precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS) parameters will be evaluated per DOE Prime Contractor procedure, PAD-ENM-5003, *Quality Assured Data*. This information will be included in the data assessment packages for review by project personnel. Data assessment also will include documentation of QC exceedances, trends, and/or bias in the data set. Data assessment will document any statistics used.

Identify the personnel responsible for performing the usability assessment: Project and QA personnel.

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies: Data assessment packages will be created, which will include data assessment comments/questions and laboratory comments. Data verification and assessment queries indicating any historical outliers and background soil exceedances also will be included in the data assessment packages.

[1] It is understood that SOPs are contractor specific.

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18. DATA MANAGEMENT IMPLEMENTATION PLAN

The purpose of this DMIP is to identify and document data management requirements and applicable procedures, expected data types and information flow, and roles and responsibilities for all data management activities associated with the SWOU RI/FS project at PGDP. Data management provides a system for efficiently generating and maintaining technically and legally defensible data that provide the basis for making sound decisions regarding the environmental and waste characterization at PGDP.

Data management for this project is implemented throughout the life cycle for environmental measurements data. This life cycle occurs from the planning of data for environmental and waste characterization, through the collection, review, and actual use of the data for decision-making purposes, to the long-term storage of data.

Data types to be managed for the project include field data and analytical data. Historical data is downloaded from Paducah OREIS, if available. Field data are collected in field logbooks or field data forms and are entered into Paducah Project Environmental Measurements System (PEMS), as appropriate, for storage. Analytical data are planned and managed through Paducah PEMS and transferred to Paducah OREIS for long-term storage and reporting.

To meet current regulatory requirements for DOE environmental management projects, complete documentation of the information flow is established. Each phase of the data management process (planning, collecting, analyzing, managing, verifying, assessing, reporting, consolidating, and archiving) must be appropriately planned and documented. The SWOU RI/FS project team is responsible for data collection and data management for this project.

The scope of this DMIP is limited to environmental information generated under the SWOU RI/FS project. This information includes electronic and/or hard copy records obtained by the project that describe environmental conditions. Information generated by the project (e.g., laboratory analytical results from samples collected) and obtained from sources outside the project (e.g., historical data) falls within the scope of this DMIP. Certain types of information, such as personnel or financial records, are outside the scope of this DMIP.

18.1 PROJECT MISSION

Requirements and responsibilities described in this plan apply to activities conducted by the project team in support of the SWOU RI/FS project. Specific activities involving data include, but are not limited to, sampling of sediment, soil and biota; storing, analyzing, and shipping samples, when applicable; and evaluation, verification, validation, assessment, and reporting of analytical results.

18.2 DATA MANAGEMENT ACTIVITIES

Data management activities for the SWOU RI/FS project include the following:

- Acquire existing data
- Plan data collection
- Prepare for sampling activities
- Collect field data
- Collect field samples

- Submit samples for analysis
- Process field measurement and laboratory analytical data
- Laboratory Contractual Screening
- Verify data
- Validate data
- Assess data
- Consolidate, analyze, and use data and records
- Submit data to the Paducah OREIS

Section 18.7 contains a detailed discussion of the activities listed above.

18.3 DATA MANAGEMENT INTERACTIONS

The Data Manager interfaces with the Data Coordinator to oversee the use of Paducah PEMS and to ensure that data deliverables meet DOE's standards. The Data Coordinator enters information into Paducah PEMS related to the fixed-base laboratory data once the samples have been delivered and the Lab Coordinator has verified receipt of the samples. The fixed-base laboratory hard-copy data and the EDDs are loaded into Paducah PEMS by the Data Coordinator. The Data Coordinator will perform electronic data verification. The SWOU RI/FS project team is responsible for data assessment. The Data Coordinator is responsible for preparing the data for transfer from Paducah PEMS to Paducah OREIS. The Data Manager is responsible for transferring the data from the ready-to-load (RTL) files to the Paducah OREIS database.

The Lab Coordinator develops the Statement of Work (SOW) to be performed by an analytical laboratory in the form of a project-specific laboratory SOW. Analytical method, reporting limits, and deliverable requirements are specified in this SOW.

The Lab Coordinator receives EDDs, performs contractual screenings, and distributes data packages. The Lab Coordinator interacts with the Data Manager to ensure that hard copy and electronic-deliverable formats are properly specified and interfaces with the contract laboratory to ensure that the requirements are understood and met.

18.3.1 Data Needs and Sources

Multiple data types will be generated and/or assessed during this project. These data types include field data, analytical data (including environmental data), and geographic information system (GIS) data.

18.3.2 Historical Data

Historical data that are available electronically will be downloaded from Paducah OREIS as needed and will be evaluated when necessary.

18.3.3 Field Data

Field data for the project includes sample collection information and field screen measurement results, such as PCB test kits and XRF.

18.3.4 Analytical Data

Analytical data for the project consist of laboratory analyses for environmental and waste characterization.

18.3.5 GIS Coverage

The Paducah GIS network is used for preparing maps used in data analysis and reporting of both historical and newly generated data. Coordinates will be recorded as state plane coordinates. Coverage for use during the project is as follows:

- Stations (station coordinates are downloaded from Paducah OREIS)
- Facilities
- Plant roads
- Plant fences
- Streams
- Topographic contours

18.4 DATA FORMS AND LOGBOOKS

Field logbooks, site logbooks, chain-of-custody forms, data packages with associated QA/QC information, and field forms are maintained according to the requirements defined in procedure PAD-RM-1009, *Records Management, Administrative Records, and Document Control*.

Duplicates of field records are maintained until the completion of the project. Logbooks and field documentation are copied periodically. The originals are forwarded to the DMC and copies are maintained in the field office.

18.4.1 Field Forms

Sample information is environmental data describing the sampling event and consists of the following: station (or location), date collected, time collected, and other sampling conditions. This information is recorded in logbooks, chain-of-custody forms, or sample labels. This information is entered directly into Paducah PEMS by the Data Coordinator.

Sample chain-of-custody forms contain sample-specific information recorded during collection of the sample. Any deviations from the sampling plan are noted on the sample chain-of-custody form or logbook. The Sampling Team Leader reviews each sample chain-of-custody form for accuracy and completeness as soon as practical following sample collection.

Sample chain-of-custody forms are generated from Paducah PEMS with the following information:

Information that is preprinted:	Information that is entered manually:
- Lab chain-of-custody number	- Sample date and time
- Project name or number	- Sample comments (optional)
- Sample ID number	
- Sampling location	
- Sample type (e.g., REG = regular sample)	
- Sample matrix (e.g., SO = soil)	
- Sample preservation type	
- Analysis (e.g., TCE)	
- Sample container (volume, type)	

Sample identification numbers are identified in Paducah PEMS and are assigned by the Data Coordinator. In order to prevent confusion with historical projects, and so that SWOU RI/FS sample numbers do not coincide with sample numbers already existing in Paducah OREIS, the letters SWOU will be added to the beginning of the sample number. An example of the sample numbering schemes used for the SWOU RI/FS project is provided below.

SWOUsssMA000

where SWOU Designates the SWOU RI/FS

sss Identifies the SWMU/AOC being investigated

M Identifies the media type (W identifies the sample as water, S identifies the sample as soil)

A Identifies the sequential sample (usually "A" for a primary sample and "B" for a secondary sample). If additional rounds of sampling are required, the sequential letter designations will continue.

000 Identifies the planned depth of the sample in ft bgs

18.4.2 Lithologic Description Forms

Lithologic description forms will be used as necessary for this project.

18.4.3 Well Construction Detail Forms

These forms are not necessary for use during this project.

18.4.4 Logbook Sample Collection Sheets

Sample collection sheets are utilized as an aid for recording sampling information in the field. Logbooks are kept in accordance with PAD-ENM-2700, *Logbooks and Data Forms*.

18.5 DATA AND DATA RECORDS TRANSMITTALS

18.5.1 Paducah OREIS Data Transmittals

Data to be stored in Paducah OREIS is submitted to the Data Manager prior to reporting. Official data reporting will be generated from data stored in Paducah OREIS.

18.5.2 Data Records Transmittals

The SWOU RI/FS project personnel will make records transfers to the DMC.

18.6 DATA MANAGEMENT SYSTEMS

18.6.1 Paducah PEMS

Paducah PEMS is the data management system that supports the project's sampling and measurement collection activities and generates Paducah OREIS RTL files. The data management staff accesses

Paducah PEMS throughout the life cycle of the project. The project uses Paducah PEMS to support the following functions:

- Initiate the project
- Plan for sampling
- Record sample collection and field measurements
- Record the dates of sample shipments to the laboratory (if applicable)
- Receive and process analytical results
- Verify data
- Access and analyze data
- Transfer project data (in RTL format) to Paducah OREIS

Paducah PEMS is used to generate sample chain-of-custody forms, import laboratory-generated data, update field and laboratory data based on data verification, data validation if applicable, data assessment, and transfer data to Paducah OREIS. Requirements for addressing the day-to-day operations of Paducah PEMS include backups, security, and interfacing with the Sample and Data Management organization.

The Information Technology group performs system backups daily. The security precautions and procedures implemented by the data management team are designed to minimize the vulnerability of the data to unauthorized access or corruption. Only members of the data management team have access to the project's Paducah PEMS and the hard-copy data files. Members of the data management team have installed password-protected screen savers.

18.6.2 Paducah OREIS

Paducah OREIS is the centralized, standardized, quality assured, and configuration-controlled data management system that is the long-term repository of environmental data (measurements and geographic) for Paducah environmental management projects. Paducah OREIS is comprised of hardware, commercial software, customized integration software, an environmental measurements database, a geographic database, and associated documentation. The SWOU RI/FS project will use Paducah OREIS for the following functions:

- Access to existing data
- Spatial analysis
- Report generation
- Long-term storage of project data (as applicable)

18.6.3 Paducah Analytical Project Tracking System

The Paducah Analytical Project Tracking System is the business management information system that manages analytical sample analyses for Paducah environmental projects. The Paducah Analytical Project Tracking System provides cradle-to-grave tracking of sampling and analysis activities. The Paducah Analytical Project Tracking System generates the SOW, tracks collection and receipt of samples by the laboratory, flags availability of the analytical results, and allows invoice reconciliation. The Paducah Analytical Project Tracking System interfaces with Paducah PEMS (output from the Paducah Analytical Project Tracking System is automatically transferred to Paducah PEMS).

18.7 DATA MANAGEMENT TASKS AND ROLES AND RESPONSIBILITIES

18.7.1 Data Management Tasks

The following data management tasks are numbered and grouped according to the activities summarized in Section 18.2. An explanation of the data review process is provided in the following sections.

18.7.2 Acquire Existing Data

The primary background data for this project consists of historical analytical data from previous sampling events in the SWOU SWMUs/AOCs. Paducah OREIS and the Paducah OREIS Data Catalog were queried for the existing information that is provided in Appendix D.

18.7.3 Plan Data Collection

Other documents for this project provide additional information for the tasks of project environmental data collection, including sampling and analysis planning, QA, waste management, and health and safety. Also, a laboratory SOW will be developed for this project in accordance with PAD-ENM-5004, *Sample Tracking Lab Coordination, and Sample Handling Guidance*.

18.7.4 Prepare for Sampling Activities

The data management tasks involved in sample preparation, as specified in PAD-ENM-5004, *Sample Tracking, Lab Coordination, and Sample Handling Guidance*, include identifying all sampling locations, preparing descriptions of these stations, identifying sample containers and preservation, developing field logbooks, preparing sample kits and chains-of-custody, and coordinating sample delivery to the laboratory. The Lab Coordinator conducts activities associated with the analytical laboratories. Coordinates for sample locations will be obtained using a GPS, which will have sub-meter accuracy.

18.7.5 Collect Field Data and Samples

Paducah PEMS is used to identify, track, and monitor each sample and associated data from the point of collection through final data reporting. Project documentation includes field logbooks, chain-of-custody records, and hard-copy analytical results.

Data management requirements for field logbooks and field forms specify that (1) sampling documentation must be controlled from initial preparation to completion, (2) sampling documentation generated must be maintained in a project file, and (3) modifications to planned activities and deviations from procedures shall be recorded.

Before the start of sampling, the Lab Coordinator specifies the contents of sample kits, which includes sample containers provided by the laboratories, labels, preservatives, and chain-of-custody records. Sample labels and chains of custody are completed according to PAD-ENM-2708, *Chain-of-Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals*.

The SWOU RI/FS project field team will collect samples for the project. The field team will record pertinent sampling information on the chain-of-custody and in the field logbook. The Data Coordinator enters the information from the chain-of-custody forms into Paducah PEMS.

18.7.6 Submit Samples for Analysis

Before the start of field sampling, the FTM or designee coordinates the delivery of samples with the Lab Coordinator who, in turn, coordinates with the analytical laboratories, according to PAD-ENM-5004, *Sample Tracking, Lab Coordination, and Sample Handling Guidance*. The Lab Coordinator presents a general sampling schedule to the analytical laboratories. The Lab Coordinator also coordinates the receipt of samples and containers with the laboratories. The Lab Coordinator ensures that hard-copy deliverables and EDDs from the laboratories contain the appropriate information and are in the correct format.

18.7.7 Process Field Measurement and Laboratory Analytical Data

Data packages and EDDs received from the laboratory are tracked, reviewed, and maintained in a secure environment. Paducah PEMS is used for tracking project-generated data. The following information is tracked, as applicable: sample delivery group number, date received, number of samples, sample analyses, receipt of EDD, and comments. The laboratory EDDs are checked as specified in PAD-ENM-5007, *Data Management Coordination*.

The field screen measurement data will be provided by the SWOU RI/FS project team to the Data Manager for loading into Paducah PEMS. This data will be provided in a format specified by the Data Manager. Once this data has been loaded to Paducah PEMS, it will be compared to the original files submitted by the project to ensure that it was loaded correctly.

18.7.8 Laboratory Contractual Screening

Laboratory contractual screening is the process of evaluating a set of data against the requirements specified in the analytical SOW to ensure that all requested information is received. The contractual screening includes, but is not limited to, the analytes requested, total number of analyses, method used, EDDs, units, holding times, and reporting limits achieved. Contractual screening is performed for 100 percent of the data. The Lab Coordinator is primarily responsible for the contractual screening upon receipt of data from the analytical laboratory according to PAD-ENM-5003, *Quality Assured Data.*

18.7.9 Data Verification

Data verification is the process for comparing a data set against a set standard or contractual requirement. Verification is performed by the Data Coordinator electronically, manually, or by a combination of both according to PAD-ENM-5003, *Quality Assured Data*. Verification is performed for 100% of data. Data verification includes contractual screening and criteria specific to the SWOU RI/FS project. Verification qualifiers may be applied to the data based on holding time exceedance, criteria exceedance, historical exceedance, or background exceedance. Verification qualifiers are stored in Paducah PEMS and transferred with the data to Paducah OREIS.

18.7.10 Data Validation

Data validation is the process performed by a third-party, qualified individual. Third party validation is defined as validation performed by persons independent from sampling, laboratory, and decision making for the program/project (i.e., not the program/PM). Data validation evaluates the laboratory adherence to analytical-method requirements. Data validation is managed and coordinated with the Sample and Data Management organization. The Data Validator performs data validation according to approved procedures. Data validation is documented in a formal deliverable from the data validator. Validation qualifiers are input and stored in Paducah PEMS and transferred to Paducah OREIS.

A minimum of 10% percent of the total number of RI/FS samples will be validated for this project. Data Validation will apply only to the definitive data. Data packages chosen for data validation will be validated at 100%.

18.7.11 Data Assessment

Data assessment is the process for assuring that the type, quality, and quantity of data are appropriate for their intended use. It allows for the determination that a decision (or estimate) can be made with the desired level of confidence, given the quality of the data set. Data assessment follows data verification and data validation (if applicable) and must be performed at a rate of 100% to ensure data is useable.

The data assessment is conducted by the SWOU RI/FS project according to PAD-ENM-5003, *Quality Assured Data.* Assessment qualifiers are stored in Paducah PEMS and transferred with the data to Paducah OREIS. Any problems found during the review process are resolved and documented in the data assessment package.

18.7.12 Data Consolidation and Usage

The data consolidation process consists of the activities necessary to prepare the evaluated data for the users. The Data Coordinator prepares files of the assessed data from Paducah PEMS to Paducah OREIS for future use in accordance with PAD-ENM-1001, *Transmitting Data to OREIS*. The Data Manager is responsible for transferring the data to Paducah OREIS. Data used in reports distributed to external agencies is obtained from data in Paducah OREIS and has been through the data review process. All data reported has the approval of the Data Manager.

18.7.13 Data Management Roles and Responsibilities

The following project roles are defined, and the responsibilities are summarized for each data management task described in the previous subsection.

18.7.13.1 RI PM

The RI PM is responsible for the day-to-day operation of the SWOU RI/FS project. The RI PM ensures the requirements of policies and procedures are met. The RI PM, or designee assesses data in accordance with PAD-ENM-5003, *Quality Assured Data*. The RI PM is responsible to flowdown data management requirements to subcontractors as required.

18.7.13.2 Project team

The project team consists of the technical staff and support staff (including the data management team) that conducts the various tasks required to successfully complete the project.

18.7.13.3 Data user

Data users are members of the project team who require access to project information to perform reviews, analyses, or ad hoc queries of the data. The data user determines project data usability by comparing the data against predefined acceptance criteria and assessing that the data are sufficient for the intended use.

18.7.13.4 Data coordinator

The Data Coordinator enters the data into Paducah PEMS, including chain-of-custody information, field data, data assessment and data validation qualifiers, and any pertinent sampling information. After receiving a notification that a fixed-base laboratory EDD is available to download, the Data Coordinator loads the EDD to Paducah PEMS, performs electronic verification of the data, and then compiles the data assessment package. The Data Coordinator also prepares data for transfer from Paducah PEMS to Paducah OREIS.

18.7.13.5 Project records coordinator

The Project Records Coordinator is responsible for the long-term storage of project records. The SWOU RI/FS project team will interface with the Project Records Coordinator and will transfer documents and records in accordance with DOE requirements.

18.7.13.6 QA specialist

The QA Specialist is part of the project team and is responsible for reviewing project documentation to determine if the project team followed applicable procedures.

18.7.13.7 Data manager

The Data Manager is responsible for long-term storage of project data and for transmitting data to external agencies according to the *Data and Documents Management and Quality Assurance Plan for Paducah Environmental Management and Enrichment Facilities,* DOE/OR/07-1595&D2, and the Paducah Data Management Policy. The Data Manager ensures compliance to procedures relating to data management with respect to the project and that the requirements of PAD-ENM-5003, *Quality Assured Data,* are followed.

18.7.13.8 Lab coordinator

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

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19. WASTE MANAGEMENT PLAN

19.1 OVERVIEW

This Waste Management Plan (WMP) is the primary document for management and final disposition of investigation-derived waste (IDW), decontamination water, and waste water that will be generated during the SWOU RI/FS. The RI entails the collection of sediment and soil samples at 18 SWMUs and along areas adjacent to Little Bayou Creek and Bayou Creek, which are located outside the secured area of PGDP. Previous investigations and process knowledge indicate elevated levels of radiological contamination, PCBs, and RCRA hazardous metals may be present at these locations.

This WMP addresses the management of wastes generated during the RI from the point of generation through final disposition. Waste generated will be managed according to applicable procedures and DOE requirements. Additionally, this WMP will comply with all applicable regulatory directives of CERCLA, RCRA, TSCA, and PGDP RADCON policies, as appropriate.

A copy of the WMP will be available on-site during execution of the RI. The Waste Management Coordinator will be responsible for daily oversight of waste management activities and for ensuring compliance with the WMP.

The WMP emphasizes the following objectives:

- Manage of the waste in a manner that is protective of human health and the environment.
- Minimize of waste generation thereby reducing unnecessary costs (analytical, storage, disposal, etc.).
- Comply with ARARs.
- Select storage and/or disposal alternatives for the waste.

All waste management activities must comply with this WMP, applicable contractor procedures, ARARs, and *Waste Acceptance Criteria for the Department of Energy Treatment, Storage and Disposal Units at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* PAD-WD-011 (WAC), for on-site treatment, storage, and disposal facilities that may be designated to receive SWOU OU RI waste.

During the course of the RI, additional contractor and DOE waste management requirements may be identified. If necessary, revisions will be made to the WMP to ensure waste management personnel's compliance with all pertinent requirements.

19.2 WASTE PLANNING AND GENERATION

19.2.1 Waste Planning

Items to be identified for each waste stream include waste description, volume (ft^3), container type and an estimate of the number of each type, preliminary waste category, characterization method, analytes, potential treatment options, and future disposition, refer to Table 19.1 for information on each waste stream. Using information from documents such as the SAP and the PGDP landfill WAC, waste types, and volumes are identified. Characterization methods, planned analyses, and suitable containers also can be identified in this manner. The Waste Generation Plan (WGP) must be signed by the generator and the Waste Operations Manager. A revised WGP must be submitted to the Waste Operations Manager if the amount of waste to be generated changes significantly during the RI. These are changes that could affect the treatment, storage, and disposal of project IDW. For example, if additional samples are added to the project, a new WGP would need to be formulated.

Table 19.1. Waste Plan per Waste Type

Waste type	Volume (ft^3)	Container Type	Estimated Number of Containers	Preliminary Waste Category	Characterization Method	Analytes	Potential Treatment Method	Expected Disposition
Soil/sediment	1,720	55-gal drum	12	L	See Section 17—QAPP	See Section 17—QAPP	NA	On-site landfill
PPE/plastic	754	55-gal drum	6	L	Characterized using soil data	See Section 17—QAPP	NA	On-site landfill
Sampling equipment	86	55-gal drum	2	S	Characterized using soil data	See Section 17—QAPP	NA	On-site landfill
Decontamination water	1,131	55-gal drum	8		Waste characterization SAP	as required per KDWM permit	Carbon filter	KPDES outfall
Waste water	470	55-gal drum	4	S	Waste characterization SAP	as required per KDWM permit	Carbon filter	KPDES outfall
Field laboratory reagents	0.67	5-gal drum	2	R	Waste characterization SAP	RCRA metals, RCRA VOAs, RCRA semivolatile organic analytes, and PCBs	NA	WCS
Field laboratory extraction residuals	2.68	5-gal drum	2	S	Waste characterization SAP	RCRA metals, RCRA VOAs, RCRA semivolatile organic analytes, and PCBs	NA	On-site landfill
Glass	1.34	Sharps container	2	S	Visual inspection and process knowledge	NA	NA	On-site landfill

19.2.2 Waste Generation

A variety of IDW is expected to be generated during the RI. All waste generated has the potential to contain contaminants related to known or suspected past operational or disposal practices. IDW generated during sampling activities may include soil, PPE, plastic, sampling residuals and returns, metal sampling equipment, field laboratory waste, waste water, and decontamination water or sludge. Waste will be stored at the designated CERCLA waste storage areas during the waste characterization period prior to disposal. Brief descriptions of each waste stream are outlined in the following sections.

19.2.2.1 Soil/Sediment

Soil/sediment samples obtained from the SWMUs/AOCs, Little Bayou Creek, and Bayou Creek, a majority of which are located outside the secured area of the PGDP. Each samples' waste material must be segregated exclusive of other waste to facilitate waste characterization at the conclusion of field activities. Soil/sediment will be containerized in 55-gal drums.

PPE will be worn by project personnel as specified in the HASP and will be characterized concurrently with contacting waste materials. Plastic sheeting and other plastic used during sampling activities also can be included in this waste stream. To facilitate waste characterization, this waste must be segregated and labeled per individual boring number. PPE and plastic will be containerized in 55-gal drums.

19.2.2.2 Sampling Equipment, Sample Residuals

Sampling residuals will be generated from sampling activities. Sample returns and containers will be containerized in 55-gal drums and characterized per associated analytical results. Disposable sampling equipment may be generated as waste. Sampling equipment also will be characterized per associated analytical results.

19.2.2.3 Field Laboratory Waste

A small amount of field laboratory waste will be generated. Three waste streams are expected to be generated. These include laboratory reagents, extraction residuals, and glass. The waste streams will be characterized using process knowledge (i.e., material safety data sheets, test method information, etc.), visual inspection, and analytical data. Each waste steam will be segregated and will be stored in an approved container.

19.2.2.4 Decontamination Water and Sludge

Decontamination water and sludge (soil/water) will be generated during drilling/sampling equipment decontamination. The decontamination water will be containerized and stored at a permitted storage facility. The water will be sampled and, if necessary, treated before it is disposed of in accordance with KPDES permit requirements. The sludge will be containerized in 55-gal drums and characterized with soil waste.

19.2.2.5 Waste Water

Waste water may be generated by excess sample residues or decontamination of equipment. The waste water will be containerized and stored at a permitted storage facility. The water will be sampled and, if necessary, treated before it is disposed of in accordance with KPDES permit requirements.

19.3 WASTE MANAGEMENT ROLES AND RESPONSIBILITIES

19.3.1 Waste Management Tracking Responsibilities

Waste generated during the RI sampling activities will require the implementation of a comprehensive waste tracking system to maintain waste inventory. The tracking system will document waste container numbers and locations, waste description, generation date, sampling, treatment and disposal date, and disposal location. To prevent inappropriate disposal of waste, generation data and information necessary to determine the amount of contamination present will be documented so that proper disposal methods can be implemented. Determination of the ultimate disposal method is the responsibility of the RI Project Manager.

19.3.2 Waste Management Coordinator

The WMC will ensure that all waste management activities comply with ARARs, contractor requirements, and the WMP, as appropriate. Responsibilities of the WMC include coordination of activities with field personnel, oversight of waste management operations, and maintenance of the waste management logbook that contains a complete history of generated waste and the current status of individual waste containers.

The WMC will ensure that procurement and inspection of equipment, material, or services critical for shipments of waste to off-site treatment, storage, and disposal facilities are conducted in accordance with procedure PAD-WD-3012, *Procurement and Inspection of Items Critical for Paducah Off-Site Waste Shipments.* Additionally, the WMC will ensure that wastes expected to be disposed of at the C-746-U Landfill are packaged and managed according to the WAC.

Additional responsibilities of the WMC include the following:

- Maintaining an adequate supply of labels
- Maintaining drum inventories
- Interfacing with necessary personnel
- Preparing Requests for Disposal (RFDs)
- Tracking generated waste
- Ensuring waste containers are properly labeled
- Coordinating waste disposal or transfers
- Coordinating sampling of waste containers to characterize wastes
- Ensuring that waste storage areas are properly established, maintained, and closed in accordance with ARARs

The WMC or designee will maintain the waste inventory system such that all waste generated during the RI is properly tracked and identified. The waste inventory database shall include the following:

- Generation date
- RFD number
- Origin location
- Waste type
- Description
- Quantity
- Storage location
- Sampling status
- Analytical results
- Resampling status
- Disposal date, location

19.3.3 RI Field Crew

The RI sampling crew must coordinate closely with the WMC concerning daily sampling locations. The WMC will contact the Waste Operations Manager or designee and have waste containers delivered to the sampling location.

19.3.4 Waste Operations

When necessary, the WMC will be responsible for interfacing with sampling personnel to schedule characterization sampling of waste for on-site disposal. Samplers will complete all chain-of-custody forms and are responsible for packaging and submitting samples to the contracted laboratory.

19.4 INVESTIGATION-DERIVED WASTE SEGREGATION, CONTAINERIZATION AND STORAGE

19.4.1 IDW Segregation

To facilitate waste characterization at the conclusion of field activities, each sample of waste must be segregated until analytical results are obtained. Since it is impractical to use an exclusive 55-gal drum for each samples waste, soil waste will be placed in appropriately sized 6-mil plastic bags, labeled with the sample number, and then placed in a 55-gal drum for storage. PPE and plastic also will be placed in a 55-gal drum.

19.4.2 Container Labeling and Identification

Each waste stream (soil, PPE and plastic, sample residuals, etc.) will be tracked and labeled with the RFD (form WSD-F-0014) system. All containers of a single waste stream will be tracked under the same RFD number and each container's contents represented on a Waste Item Container Log (form WSD-F-0015). Containers will be labeled per the WAC.

19.4.3 IDW Storage

The WMC will establish and maintain an appropriate waste storage area for the RI in accordance with contractor procedure PAD-WD-3010, *Waste Generator Responsibilities for Temporary On-Site Storage of Regulated Waste Materials at Paducah*, and applicable ARARs.

19.5 TRANSPORTATION OF INVESTIGATION-DERIVED WASTE

Transportation of waste at PGDP will comply with PAD-WD-0661, *Transportation Safety Document for On-Site Transportation Within the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, PAD-WD-0019, *On-site Transportation and Movement of Waste Containers and other Support Equipment*, and applicable ARARs. The WMC will interface with Waste Operations personnel to schedule transportation of waste containers. Waste handling will be carried out by United Steelworkers craft personnel.

19.5.1 Required Equipment

Equipment that will be used to move or handle IDW must be inspected by procedure PAD-ESH-2007, *Powered Industrial Trucks*. Equipment that does not pass this inspection will be tagged out-of-service until corrective actions have been completed and the equipment reinspected.

Transportation of waste will require the use of forklift trucks, flatbed trailers, and flatbed trucks. A drum grabber will be mounted on the forklift to place drums onto pallets for transport.

19.5.2 Containerization and Transportation of Solid IDW

Solid waste must be containerized in U.S. Department of Transportation 1A2/X drums and must contain a 12-mil plastic liner and absorbent clay material prior to transporting waste material to a treatment, storage, or disposal facility in accordance with PAD-WD-3015, *Waste Packaging*, and applicable ARARs.

19.5.3 Containerization and Transportation of Liquid IDW

Liquid waste must be containerized in U.S. Department of Transportation 1A1 closed-top drums in accordance with PAD-WD-3015, *Waste Packaging*, and applicable ARARs.

19.6 IDW CHARACTERIZATION, SAMPLING, AND ANALYSIS

Sampling and analysis of all RI waste shall comply with the RI SAP and the WAC. Since all waste will be segregated according to sample number, the waste will be characterized according to analytical results of the environmental samples. The potential COCs for this RI include radionuclides, PCBs, PAHs, and metals. PPE will be characterized based on analytical results of the sample on which it was used

For solid waste, the "20 times" rule will be used to determine if the waste is characteristically hazardous. If the total concentration of RCRA constituents is greater than 20 times the TCLP limits in 40 *CFR* § 261.24, then the waste will be considered characteristically hazardous and placed into RCRA storage until further TCLP analysis can be performed for complete analysis.

19.7 SAMPLE RESIDUALS AND MISCELLANEOUS WASTE MANAGEMENT

Sample residuals and returns shall be returned to the waste stream prior to final waste disposition. Any hazardous waste returns will be included with waste to be shipped off-site for proper treatment and/or disposal.

19.8 WASTE MINIMIZATION

Waste minimization requirements that will be implemented, as appropriate, include those established by the 1984 Hazardous and Solid Waste Amendments of RCRA; DOE orders 5400.1, 5400.3, and 435.1; and the Contractor. Requirements specified in the Contractor's WMP, PAD-PLA-ENV-001, *Waste Management Plan for the Paducah Environmental Remediation Project*, and the contractor's *Pollution Prevention/Waste Minimization Program Plan for the U.S. Department of Energy Paducah Remediation Project*, PAD-PROG-0015, concerning waste generation, tracking, and reduction techniques will be followed. To support the commitment to waste reduction, an effort will be made during all field activities to minimize waste generation, largely through ensuring that potentially contaminated waste material is localized and is not allowed to come into contact with clean material. Such an event could create more contaminated waste. Waste minimization also will be facilitated through waste segregation, selection of PPE, and waste handling practices. Solid wastes such as Tyvek coveralls and packaging materials will be segregated. An attempt will be made to separate visibly soiled coveralls from clean coveralls. In some instances, partially soiled coveralls can be cut up and segregated. Other solid waste will not be allowed to contact potentially contaminated soil waste. Efforts will be made to keep Tyvek coveralls clean, reuse clean coveralls, and use coveralls only when necessary. Proper waste handling and spill control techniques will help minimize waste, particularly around decontamination areas where water must be containerized.

19.9 HEALTH AND SAFETY ISSUES RELATED TO IDW ACTIVITIES

Waste management activities will be conducted in compliance with health and safety DOE Prime Contractor procedures and general requirements as described in the ES&H plan, included as Chapter 16 of this work plan.

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20. COMMUNITY RELATIONS PLAN

SWOU RI/FS information will be included in the appropriate stakeholder-related activities as described in the *Community Relations Plan Under the Federal Facility Agreement at the U.S. Department of Energy, Paducah Gaseous Diffusion Plant* and any subsequent updates of the Community Relations Plan (DOE 2009c).

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APPENDIX A

POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND TO BE CONSIDERED GUIDANCE

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ACRONYMS

ARAR	applicable or relevant and appropriate requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
COE	U.S. Army Corps of Engineers
EPA	U.S. Environmental Protection Agency
FR	*Federal Register*
FS	feasibility study
KAR	*Kentucky Administrative Record*
NWP	Nationwide Permit
PCB	polychlorinated biphenyl
PGDP	Paducah Gaseous Diffusion Plant
RI	remedial investigation
SWOU	Surface Water Operable Unit
T&E	threatened and endangered
TBC	To Be Considered
U.S.C	United States Code
U.S.C.A	United States Code Annotated

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A.1 INTRODUCTION

Congress specified in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) § 121(d) (42 U.S.C.A. § 9621) that remedial actions for cleanup of hazardous substances must either comply with requirements or standards under federal or more stringent state environmental laws that are applicable or relevant and appropriate to the hazardous substances or particular circumstances at a site or obtain a waiver [see also 40 *CFR* § 300.430(f) (1) (ii) (B)]. Inherent in the application of applicable or relevant and appropriate requirements (ARARs) is the assumption that protection of human health and the environment is ensured.

This appendix supplies a preliminary discussion of available federal and state chemical-, location-, and action-specific ARARs that may be associated with potential remedial actions at the Surface Water Operable Unit (SWOU) at the Paducah Gaseous Diffusion Plant (PGDP). The process of ARAR identification is an iterative one that is continually changing as the remedial investigation/feasibility study (RI/FS) progresses; therefore, the ARARs that are identified represent a compilation of potential ARARs that are subject to change as site-specific contamination at the SWOU is further characterized and alternatives are further evaluated. Site-specific ARARs will be identified further during the remedial action selection for the FS.

The U.S. Environmental Protection Agency (EPA) differentiates ARARs as either "applicable" or "relevant and appropriate" to a site. The terms and conditions of these categories are as follows:

- *Applicable requirements* are "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site" (40 *CFR* § 300.5); and

- *Relevant and appropriate requirements* are "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site" (40 *CFR* § 300.5).

The EPA also categorizes ARARs based on whether they are specific to the chemical(s) present at the site (chemical-specific), the remedial action being evaluated (action-specific), or the location of the site (location-specific). The EPA designated these categories to assist in the identification of ARARs; however, they are not necessarily precise [53 *FR* 51437 (1988)]. Some ARARs may fit into more than one category, while others may not definitively fit into any one category. Terms and conditions relevant to this categorization are included in the list that follows:

- *Chemical-specific ARARs* usually are "health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical values" [53 *FR* 51437 (1988)]. These values establish the acceptable amount or concentration of a chemical that may remain in, or be discharged to, the ambient environment.

- *Action-specific ARARs* usually are "technology- or activity-based requirements or limitations placed on actions taken with respect to hazardous wastes, or requirements to conduct certain actions to address particular circumstances at a site" [53 *FR* 51437 (1988)]. Selection of a particular remedial action at a site will trigger action-specific ARARs that specify appropriate technologies and performance standards.

- *Location-specific ARARs* "generally are restrictions placed upon the concentration of hazardous substances or the conduct of activities solely because they are in special locations" [53 *FR* 51437 (1988)]. Some examples of special locations include floodplains, wetlands, historic places, and sensitive ecosystems or habitats.

Chemical-specific ARARs include concentration limits for contaminants such as maximum contaminant levels. Action-specific ARARs include performance and design standards, such as the Resource Conservation and Recovery Act minimum technology requirements. Location-specific ARARs include regulations covering preservation of historic sites and protection of wetlands and floodplains.

Pursuant to CERCLA § 121(e) [42 U.S.C.A. § 9621(e) (1)], response actions, or portions of response actions conducted entirely on-site, as defined in 40 *CFR* § 300.5, must comply with the substantive portions of ARARs, but not the procedural or administrative requirements. Additionally, CERCLA § 121(d)(4) [42 U.S.C.A. § 9621(d) (4)] provides six ARAR waiver options that may be invoked, provided that human health and the environment are protected.

Published unpromulgated information that does not meet the specific definition of an ARAR may be necessary, under certain circumstances, to determine what is protective of human health and the environment or may be useful in developing CERCLA remedies. This type of information is known as To Be Considered (TBC) guidance. Because ARARs do not exist for every chemical or circumstance that may be found at a CERCLA site, the EPA believes that it may be necessary, when determining cleanup requirements or designing a remedy, to consult reliable information that otherwise would not be considered a potential ARAR. Criteria or guidance developed by EPA, other federal agencies, or states may assist in determining, for example, health-based levels for a particular contaminant or the appropriate method for conducting an action for which there are no ARARs. The TBC guidance generally falls within four categories: (1) health effects information; (2) technical information on how to perform or evaluate investigations or response actions; (3) policy; and (4) proposed regulations, if the proposed regulation is noncontroversial and likely to be promulgated as drafted.

The EPA requires compliance with Occupational Safety and Health Association standards through § 300.150 of the National Oil and Hazardous Substances Pollution Contingency Plan, not through the ARARs process. Worker health and safety requirements typically are not addressed as ARARs. The regulations at 29 *CFR* § 1910.120 are designed to protect workers involved in cleanup operations at uncontrolled hazardous waste sites and to provide for worker protection during initial site characterization and analysis, monitoring activities, materials handling activities, training, and emergency response.

The remainder of this appendix will address those requirements that apply to remedial actions through the CERCLA (i.e., ARARs) process. As mentioned above, ARARs identification is an iterative process that continually changes as the RI/FS progresses. Based on the remedial action ultimately selected, ARARs specific to that action will be identified later in the remedial action process.

A.2 ACTION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

A.2.1 RADIONUCLIDE EMISSION STANDARDS

Radionuclides have been detected in soil/sediment at some of the SWOU solid waste management units. Activities involved with the implementation of any remedial action selected may produce airborne pollutants. If radionuclide emissions were to occur, emission standards for DOE facilities would apply. The regulations promulgated pursuant to the Clean Air Act of 1970, as amended by the Clean Air Act of 1990, set emission standards for radionuclides, other than radon, from DOE facilities. This regulation requires that DOE ensure that airborne emissions from its facilities do not exceed those amounts that would cause any member of the public to receive, in any year, an effective dose equivalent in excess of 10 mrem/yr (40 *CFR* § 61.92). These regulations in 40 *CFR* § 61.92 would be applicable relevant and appropriate to any activity that would result in radionuclide emissions.

A.2.2 POLYCHLORINATED BIPHENYLS

Soils/sediments contaminated with polychlorinated biphenyls (PCBs) are considered “bulk PCB remediation waste” under 40 *CFR* § 761.3. Cleanup and removal of bulk PCB remediation waste will be conducted in accordance with ARARs of 40 *CFR* § 761.61.

A.3 LOCATION-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

A.3.1 THREATENED OR ENDANGERED SPECIES

Threatened and endangered (T&E) species or their potential habitats or critical habitats have been identified in the area to be investigated. It is prohibited (50 *CFR* § 17.21) to take endangered or threatened species, as designated in 50 *CFR* § 17.11 and § 17.12, or to jeopardize the continued existence of any endangered species or threatened species of cause the destruction or adverse modification of critical habitat of such species [16 U.S.C. 1536 (a)(2)]. Kentucky has no T&E species regulations promulgated at this time. A list of plant and animal species identified for monitoring purposes is maintained by the Kentucky State Nature Preserves Commission. Since T&E species have been discovered in the area, potential impacts to the species should be considered for this action.

A.3.2 CULTURAL RESOURCES

Cultural resources will be managed consistent with the Archaeological Historic Preservation Act.

A.3.3 FLOODPLAINS/WETLANDS

Although all ARARs discussed in this section are either applicable or TBC, they will be met by avoidance of the resource to the extent practicable. If impacts become apparent, however, mitigation measures will be addressed and/or initiated during the remedial design and/or remedial action phase to comply with the ARARs.

Construction activities must avoid or minimize adverse impacts on wetlands and act to preserve and enhance their natural and beneficial values [Executive Order 11990; 40 *CFR* § 6.302(a); 40 *CFR* § 6, Appendix A; and 10 *CFR* § 1022]. In addition, construction activities must minimize potential harm to the 100-year floodplain [Executive Order 11988 and 10 *CFR* § 1022].

40 *CFR* § 230.10(b) prohibits discharges of dredged or fill material that cause or contribute to violations of state water quality standards, violate toxic effluent standards or discharge prohibitions (33 U.SC. § 1317), or jeopardize T&E species or their critical habitat under the Endangered Species Act (16 U.S.C. § 1531, *et seq.*). If it becomes apparent that impacts to wetlands are unavoidable, the substantive requirements of 61 *FR* 65920 Nationwide Permits (NWPs), or 40 *CFR* § 230 [Clean Water Act Section 404(b)(1) guidelines for general permits], governing discharges of dredged or fill material into waters of the United States would become applicable.

Specific requirements applicable to all NWPs are defined in 72 *FR* 11092, (March 12, 2007). The substantive requirements of NWP 38 (cleanup of hazardous and toxic waste) are applicable to this action, but the specific requirement of notification is not required for CERCLA actions under this NWP. Consequently, although wetlands should be delineated and avoided, the delineation does not have to be sent to the U.S. Army Corps of Engineers (COE), and the COE does not have to be notified for this action [61 *FR* 65905-65906 (1996)].

As provided by 401 *KAR* 4:060, activities or structures exempted by 401 *KAR* 4:020, that includes activities covered by a COE NWP, may be placed within the regulatory floodway limit of a stream only if they are not of such nature as to result in increases in flood elevations.

APPENDIX B

DOCUMENT OUTLINES

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INTEGRATED RFI/RI REPORT

Executive Summary

1. Introduction
   - 1.1 Purpose of Report
   - 1.2 Site Background
     - 1.2.1 Site Description
     - 1.2.2 Site History
     - 1.2.3 Previous Investigations
   - 1.3 Report Organization
2. Study Area Investigation
   - 2.1 Includes all field activities associated with site characterization. These may include physical and chemical monitoring of some of the following:
     - 2.1.1 Surface Features
     - 2.1.2 Contaminant Source Investigations
     - 2.1.3 Meteorological Investigations
     - 2.1.4 Surface Water and Sediment Investigations
     - 2.1.5 Geological Investigations
     - 2.1.6 Soil and Vadose Zone Investigations
     - 2.1.7 Groundwater Investigations
     - 2.1.8 Human Population Surveys
     - 2.1.9 Ecological Investigations
   - 2.2 If technical memoranda documenting field activities were prepared, they may be included in an appendix and summarized in this report section.
3. Physical Characteristics of the Study Area
   - 3.1 Includes results of the field activities to determine physical characteristics. These may include some of the following:
     - 3.1.1 Surface Features
     - 3.1.2 Meteorology
     - 3.1.3 Surface Water Hydrology
     - 3.1.4 Geology
     - 3.1.5 Soils
     - 3.1.6 Hydrogeology
     - 3.1.7 Demography and Land Use
     - 3.1.8 Ecology
4. Nature and Extent of Contamination
   - 4.1 Presents the results of site characterization, both natural chemical components and contaminants of the following media:
     - 4.1.1 Sources (Lagoons, Sludges, Tanks, etc.)
     - 4.1.2 Soils and Vadose Zone
     - 4.1.3 Groundwater
     - 4.1.4 Surface Water and Sediments
     - 4.1.5 Air
5. Fate and Transport
   - 5.1 Potential Routes of Migration (i.e., Air, Groundwater, etc.)
   - 5.2 Contaminant Persistence
     - 5.2.1 Describe estimated persistence in the study area environment and physical, chemical, and/or biological factors of importance for the media of interest.
   - 5.3 Contaminant Migration
     - 5.3.1 Describe factors affecting contaminant migration for the media of importance (e.g., sorption onto soils, solubility in water, movement of groundwater, etc.).

5.3.2 Describe modeling methods and results, if applicable.

6. Baseline Risk Assessment
    6.1 Human Health Evaluation
        6.1.1 Exposure Assessment
        6.1.2 Toxicity Assessment
        6.1.3 Risk Characterization
    6.2 Environmental Evaluation
        6.2.1 Site-Specific Screening-Level Ecological Evaluation
        6.2.2 Sitewide Ecological Evaluation
7. Summary and Conclusions
    7.1 Summary
        7.1.1 Nature and Extent of Contamination
        7.1.2 Fate and Transport
        7.1.3 Risk Assessment
    7.2 Conclusions
        7.2.1 Data Limitations and Recommendations for Future Work
        7.2.2 Recommended RA Objectives

Appendices
- A Technical Memoranda on Field Activities
- B Analytical Data and QA/QC Evaluation Results
- C Baseline Risk Assessment

NOTE: Elements included in this outline shall be considered and discussed, as appropriate, prior to the development of the referenced document.

INTEGRATED FS/CMS REPORT

Executive Summary
1. Introduction
    1.1 Purpose and Organization of Report
    1.2 Background Information (Summarized from RI/RFI Report)
        1.2.1 Site Description
        1.2.2 Site History
        1.2.3 Nature and Extent of Contamination
        1.2.4 Contaminant Fate and Transport
        1.2.5 BRA
2. Identification and Screening of Technologies
    2.1 Introduction
    2.2 RA Objectives—Presents the development of RA objectives for each medium of interest. For each medium, the following should be discussed:
        2.2.1 Contaminants of Interest
        2.2.2 Allowable Exposure Based upon Risk Assessment (including ARARs)
        2.2.3 Development of Remediation Goals
    2.3 General Response Actions—For each medium of interest, describe the estimation of areas or volumes to which treatment, containment, or exposure technologies may be applied.
    2.4 Identification and Screening of Technology Types and Process Options—For each medium of interest, describe:
        2.4.1 Identification and Screening of Technologies
        2.4.2 Evaluation of Technologies and Selection of Representative Technologies
3. Development and Screening of Alternatives
    3.1 Development of Alternatives—Describes rationale for combination of technologies/media into alternatives.
    3.2 Screening of Alternatives (if conducted)
        3.2.1 Introduction
        3.2.2 Alternative 1
            3.2.2.1 Description
            3.2.2.2 Evaluation
        3.2.3 Alternative 2 (etc.)
        3.2.4 Alternative 3 (etc.)
4. Detailed Analysis of Alternatives
    4.1 Introduction
    4.2 Individual Analysis of Alternatives
        4.2.1 Alternative 1
            4.2.1.1 Description
            4.2.1.2 Assessment
        4.2.2 Alternative 2 (etc.)
        4.2.3 Alternative 3 (etc.)
    4.3 Comparative Analysis
Bibliography
Appendices

NOTE: Elements included in this outline shall be considered and discussed, as appropriate, prior to the development of the referenced document.

BASELINE HUMAN HEALTH RISK ASSESSMENT OUTLINE

1. Results of Previous Studies
2. Identification of Chemicals of Potential Concern
    - 2.1 Sources of Data
    - 2.2 General Data Evaluation Considerations
    - 2.3 Risk Assessment Specific Data Evaluation
    - 2.4 Evaluation of Data from Other Sources
    - 2.5 Summary of Chemicals of Potential Concern
3. Exposure Assessment
    - 3.1 Characterization of Exposure Setting
    - 3.2 Identification of Exposure Pathways
    - 3.3 Quantification of Exposure
    - 3.4 Summary of Exposure Assessment
4. Toxicity Assessment
    - 4.1 Inorganics
    - 4.2 Organics
    - 4.3 Radionuclides
    - 4.4 Chemicals for Which No EPA Toxicity Values Are Available
    - 4.5 Uncertainties Related to Toxicity Assessment
    - 4.6 Summary
5. Risk Characterization
    - 5.1 Determination of Noncancer Effects
    - 5.2 Determination of Excess Cancer Risk
    - 5.3 Risk Characterization for Current Use Scenario(s)
    - 5.4 Risk Characterization for Future Use Scenario(s)
    - 5.5 Risk Characterization for Lead (if needed)
    - 5.6 Identification of Use Scenarios, Contaminants, Pathways, and Media of Concern
    - 5.7 Summary of Risk Characterization
6. Uncertainty in the Risk Assessment
    - 6.1 Uncertainties Associated with Data
    - 6.2 Uncertainties Associated with Exposure Assessment
    - 6.3 Uncertainties Associated with Toxicity Assessment
    - 6.4 Uncertainties Associated with Risk Characterization
    - 6.5 Summary of Uncertainties
7. Conclusions and Summary
    - 7.1 Chemicals of Potential Concern
    - 7.2 Exposure Assessment
    - 7.3 Toxicity Assessment
    - 7.4 Risk Characterization
    - 7.5 Observations

NOTE: Elements included in this outline shall be considered and discussed, as appropriate, prior to the development of the referenced document.

APPENDIX C

ALTERNATIVES DEVELOPMENT

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ALTERNATIVES DEVELOPMENT

This section explains the process that will be used to develop and evaluate alternatives during the SWOU FS. A description of the general approach to developing and evaluating potential remedies, the overall objective of the study, a discussion of preliminary identification of general response actions and remedial technologies, remedial alternatives development and screening, and the detailed analysis of remedial alternatives are topics addressed in this section of the work plan. The format for the FS report and the schedule for conducting the FS also are discussed.

C.1. DESCRIPTION OF THE GENERAL APPROACH TO INVESTIGATING AND EVALUATING REMEDIAL ALTERNATIVES DEVELOPMENT

Under CERCLA the Feasibility Study (FS) is conducted in conjunction with the Remedial Investigation (RI). The process for conducting a CERCLA FS begins with scoping of the RI/FS. Development and screening of alternatives are performed after site characterization. Treatability studies may be performed, if necessary, to adequately evaluate the effectiveness of technologies on particular site-specific waste streams. Before a remedy is selected, the alternatives undergo a detailed evaluation using the nine evaluation criteria outlined in 40 *CFR* § 300.430(e)(9)(iii). A preliminary preferred alternative may be identified in the FS report.

The draft generic baseline schedule includes an activity entitled prepare draft FS report. Five steps are identified under this report-preparation activity: (1) alternatives development, (2) preliminary technology screening, (3) detailed evaluation of alternatives, (4) document consolidation, and (5) issuance of a draft D1 FS report to the regulators. The first three steps are intended to parallel the CERCLA FS process and the last two lead to preparation of an FS report.

C.2. OVERALL OBJECTIVE OF THE FEASIBILITY STUDY

The primary objective of the FS is to ensure that appropriate remedial alternatives are developed and evaluated such that relevant information concerning the remedial action options can be presented to a decision maker and an appropriate remedy can be selected [40 *CFR* § 300.430(e)(1)]. This information must be adequate to ensure that an appropriate remedy can be selected. An appropriate remedy must provide protection of human health and the environment by eliminating, reducing, or controlling risks.

C.3. DEVELOPMENT OF REMEDIAL ALTERNATIVES

This section summarizes the first phase of the SWOU FS, which is developing preliminary remedial alternatives. The following steps are involved in developing remedial action alternatives:

- Developing general response actions;

- Identifying and screening technology types for each general response action;

- Identifying and evaluating process options to select a representative process for each technology type; and

- Assembling the selected representative technologies into alternatives.

Remedial action objectives will be developed after the COCs, exposure routes, receptors, and remedial goal options (RGOs) for each COC have been identified. As part of the RI/FS scoping process, DOE has identified the following general response actions to be considered:

(1) No action;
(2) Treatment;
(3) Soil excavation, treatment, and/or disposal;
(4) LUCs (land use controls); and
(5) A combination of these actions.

As information is obtained from the RI, areal and volumetric estimates of contaminated media to which general response actions may be applied will be prepared and refined. The DOE will evaluate a combination of technology types and process options including innovative technologies, as appropriate, as specified in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). Potentially applicable technologies initially will be identified by referring to the alternatives evaluation section of the *Summary of Alternatives for Remediation of Off-site Contamination at the Paducah Gaseous Diffusion Plant* (DOE 1991), the technology preferences and guidelines presented in DOE's preferred alternatives matrix (DOE 1997b),[11] and in EPAs presumptive remedies initiative, if applicable.

Published literature including EPA guidance documents and electronic databases such as the Electronic Encyclopedia of Remedial Action Options and the Vendor Information System for Innovative Treatment Technologies also will be queried to identify additional technologies. The technologies and process options will be screened based on technical implementability.

Process options determined to be technically implementable then will be screened using three criteria: (1) effectiveness, (2) implementability, and (3) cost. Following this screening step, a representative process option will be selected from each technology type. The representative process options will be assembled into preliminary remedial alternatives that address contamination of each medium on a sitewide basis within the SWOU. As required by 40 *CFR* § 300.430(e)(3), a limited number of remedial alternatives will be developed that achieve remediation goals within different restoration time periods using one or more different technologies. In addition, one or more innovative technologies will be developed for detailed evaluation, to the extent required by 40 *CFR* § 300.430(e)(5). A no action alternative will also be evaluated.

C.4. SCREENING OF REMEDIAL ALTERNATIVES

This section summarizes the screening of preliminary remedial alternatives that represents the second phase of the SWOU FS. The preliminary alternatives may undergo a screening evaluation, an optional step in the FS process that may be used to reduce the number of remedial alternatives, if deemed necessary for this project. If conducted, the screening evaluation will consist of an effectiveness assessment, an implementability appraisal, and a cost evaluation. (This screening will not be identical to the previously conducted screening of process options during the alternative-development phase.) A

[11] Available on the World Wide Web at http://www.em.doe.gov/stakepages/wmdi_prefalt.aspx

general definition of each preliminary alternative will be developed. Information to be considered includes: size and configuration of treatment systems, time frames for achieving remedial goals, flow rates into treatment units, spatial requirements for construction activities, transport distances for disposal technologies, and substantive permit and report requirements for off-site waste management actions and limitations. Those preliminary alternatives with the most favorable composite evaluation of all factors will be retained for further analysis. If practicable, the retained alternatives will preserve the range of treatment and containment technologies specified in the NCP.

C.5. DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

This section summarizes the detailed analysis of remedial alternatives that comprises the third phase of the SWOU FS. Each of the remedial alternatives that remain will undergo a detailed evaluation using the nine criteria specified in the NCP to evaluate their expected performance. The criteria are categorized as threshold, balancing, and modifying criteria. Because this Work Plan is intended to integrate both RCRA and CERCLA requirements, state acceptance is listed as one of the modifying criteria. The nine criteria are described in the following sections.

A. Threshold criteria

According to 40 *CFR* § 300.430(f)(l)(i)(A), threshold criteria must be met. An alternative must satisfy the two criteria below to be selected as the remedy.

(1) Overall protection of human health and the environment. This criterion requires that the alternative adequately protect human health and the environment over both the short and the long term. Protection must be demonstrated by the elimination, reduction, or control of unacceptable risks [40 *CFR* § 300.430(e)(9)(iii)(A)].

(2) Compliance with ARARs. Congress specified in CERCLA 121 that remedial actions for cleanup of hazardous substances must comply with requirements, criteria, standards, or Limitations under federal or more stringent state environmental laws that are applicable or relevant and appropriate to the hazardous substances or circumstances at a site. The ARARs for the SWOU are presented in Appendix A.

B. Balancing criteria

These next five criteria are considered in determining which alternative best achieves or comes closest to achieving the threshold criteria [40 *CFR* § 5 300.430(f)(l)(i)(B)]. The balancing criteria evaluate the alternatives in terms of the following aspects.

(1) Long-term effectiveness and permanence. This criterion focuses on the magnitude and nature of the risks associated with untreated waste/treatment residuals. This criterion includes consideration of the adequacy and reliability of any associated engineering controls such as monitoring and maintenance requirements [40 *CFR* § 300.430(e)(9)(iii)(C)].

(2) Reduction of contaminant toxicity, mobility, or volume through treatment. This criterion evaluates the degree to which the alternative employs treatment to reduce the toxicity, mobility, or volume of contamination [40 *CFR* § 300.430(e)(9)(iii)(D)].

(3) Short-term effectiveness. This criterion evaluates the effect of implementing the alternative relative to potential risks to the general public, potential threat to workers, and time required until protection is achieved [40 *CFR* § 300.430(e)(9)(iii)(E)].

(4) Implementability. This criterion reviews potential difficulties associated with implementing the alternative. These difficulties may involve technical feasibility, administrative feasibility, and availability of services and materials [40 *CFR* § 300.430(e)(9)(iii)(F)].

(5) Cost. This criterion weighs the capital cost, annual operating cost, annual maintenance cost, and the combined net present value of these three costs [40 *CFR* § 300.430(e)(9)(iii)(G)].

C. Modifying criteria

The final two criteria allow for the influence of the aspects described as follows.

(1) Community acceptance. This criterion requires the consideration of any formal comments by the community regarding any action to be performed [40 *CFR* § 300.430(e)(9)(iii)(I)].

(2) State acceptance. This criterion requires the consideration of any formal comments by the state regarding any action to be performed [40 *CFR* § 5 300.430(e)(9)(iii)(H)].

A preferred alternative will be identified in accordance with the requirements of the NCP [40 *CFR* § 300.430(f)(1)(ii)**]**. Selection of a preferred alternative will be based on analyses of technical, human health, and environmental criteria. The remedy selection process must meet the requirements of 40 *CFR* § 300.430(e) including those for a proposed plan, community involvement, and preparation of a ROD.

D. Potential alternatives to be evaluated

Based on investigation data currently available for the SWOU, the following potential remedial actions might be appropriate for the SWOU SWMUs:

- No action;
- LUCs;
- Soil excavation and disposal without treatment;
- Soil excavation with treatment using; and
- Containment to reduce infiltration or precipitation.

These potential remedial actions are subject to change, which may include the addition or deletion of specific actions as the RCRA/CERCLA process proceeds.

C.6. FORMAT FOR THE FEASIBILITY STUDY REPORT

Outlines for Primary Documents are contained in an appendix of the FFA. Appendix B of this work plan contains the FS report outline as presented in the FFA.

C.7. SCHEDULE/TIMING FOR CONDUCTING THE STUDY

The schedule for the FS, with respect to the RI, is presented in Section 2.4 of this work plan.

APPENDIX D

HISTORICAL DATA SUMMARY

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APPENDIX D

HISTORICAL DATA SUMMARY

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