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18-AMRP-0112

JUL 12 2018

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200-EA-1 OPERABLE UNIT WASTE SITE RCRA FACILITY INVESTIGATION/ CORRECTIVE MEASURES STUDY AND REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN, DOE/RL-2016-58, DRAFT A

This letter transmits for your review the 200-EA-1 Operable Unit Waste Site RCRA Facility Investigation/Corrective Measures Study and Remedial Investigation/Feasibility Study Work Plan, DOE/RL-2016-58, Draft A. This transmittal completes Tri-Party Agreement Milestone M-015-92A, due July 31, 2018. In accordance with the primary document review process described in Section 9.2.1 of the Tri-Party Agreement, please provide comments within 60 days of receipt of this letter.

If you have any questions, please contact me, or your staff may contact, Mike Cline, of my staff, on (509) 376-6070.

Sincerely,

Joe R. Franco, Assistant Manager
for the River and Plateau

AMRP:BWV

Attachment – 1249690

cc: See page 2

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DOE/RL-2016-58
Draft A

200-EA-1 OPERABLE UNIT WASTE SITE RCRA FACILITY INVESTIGATION/CORRECTIVE MEASURES STUDY AND REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

U.S. DEPARTMENT OF ENERGY | Richland Operations Office

P.O. Box 550
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413

DOE/RL-2016-58
Draft A

200-EA-1 OPERABLE UNIT WASTE SITE RCRA FACILITY INVESTIGATION/CORRECTIVE MEASURES STUDY AND REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN

Date Published
July 2018

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

U.S. DEPARTMENT OF ENERGY | Richland Operations Office
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Signature Sheet

Title: *200-EA-1 Operable Unit Waste Site RCRA Facility Investigation/Corrective Measures Study and Remedial Investigation/Feasibility Study Work Plan*

Print Name	Signature	Date
U.S. Department of Energy, Richland Operations Office		

Print Name	Signature	Date
Washington State Department of Ecology		

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Executive Summary

This is the work plan for the 200-EA-1 Operable Unit (OU) *Resource Conservation and Recovery Act of 1976* (RCRA)[1] facility investigation (RFI)/corrective measure study (CMS) and *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA)[2] remedial investigation (RI)/feasibility study (FS). The U.S. Department of Energy (DOE) performed this work under CERCLA and RCRA, as amended by the *Hazardous and Solid Waste Amendments of 1984*.[3]

The goal of the RFI/CMS and RI/FS process is to protect human health and the environment from contamination associated with the 200-EA-1 OU. This work plan is the first step in this process and represents the collaborative scoping effort between DOE and the Washington State Department of Ecology (Ecology).[4] It presents existing 200-EA-1 OU waste site information, the preliminary conceptual site model, and the future activities (such as data collection) needed to enable remedy selection and implementation.

The 200-EA-1 OU consists of 114 waste sites and is located in the Hanford Site's 25 km^2 (10 mi^2) Central Plateau Inner Area. It includes liquid and solid waste disposal and handling sites, as well as contaminated soil resulting from planned and unplanned releases (Figures ES-1 and ES-2). Five waste sites are also designated as inactive RCRA treatment, storage, and disposal units. The 200-EA-1 OU does not include the underlying groundwater; however, the activities and information developed in this work plan will be integrated with the 200-BP-5 and 200-PO-1 Groundwater OUs, which are responsible for remediating underlying groundwater. The 200-EA-1 OU intends to integrate with other Central Plateau activities, including tank farms and other source OUs (Figure ES-1).

---

[1] *Resource Conservation and Recovery Act of 1976*, 42 USC 6901, et seq. Available at: https://elr.info/sites/default/files/docs/statutes/full/rcra.pdf.

[2] *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*, 42 USC 9601, et seq., Pub. L. 107-377, December 31, 2002. Available at: https://www.csu.edu/cerc/researchreports/documents/CERCLASummary1980.pdf.

[3] *Hazardous and Solid Waste Amendments of 1984*, Public Law 98-616, Nov. 8, 1984, 98 Stat. 3221. Available at: https://www.gpo.gov/fdsys/pkg/STATUTE-98/pdf/STATUTE-98-Pg3221.pdf.

[4] 40 CFR 300.430(b), "**Remedial Investigation**/Feasibility Study and Selection of Remedy," *Code of Federal Regulations*. Available at: https://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol27/xml/CFR-2010-title40-vol27-part300.xml#seqnum300.430.

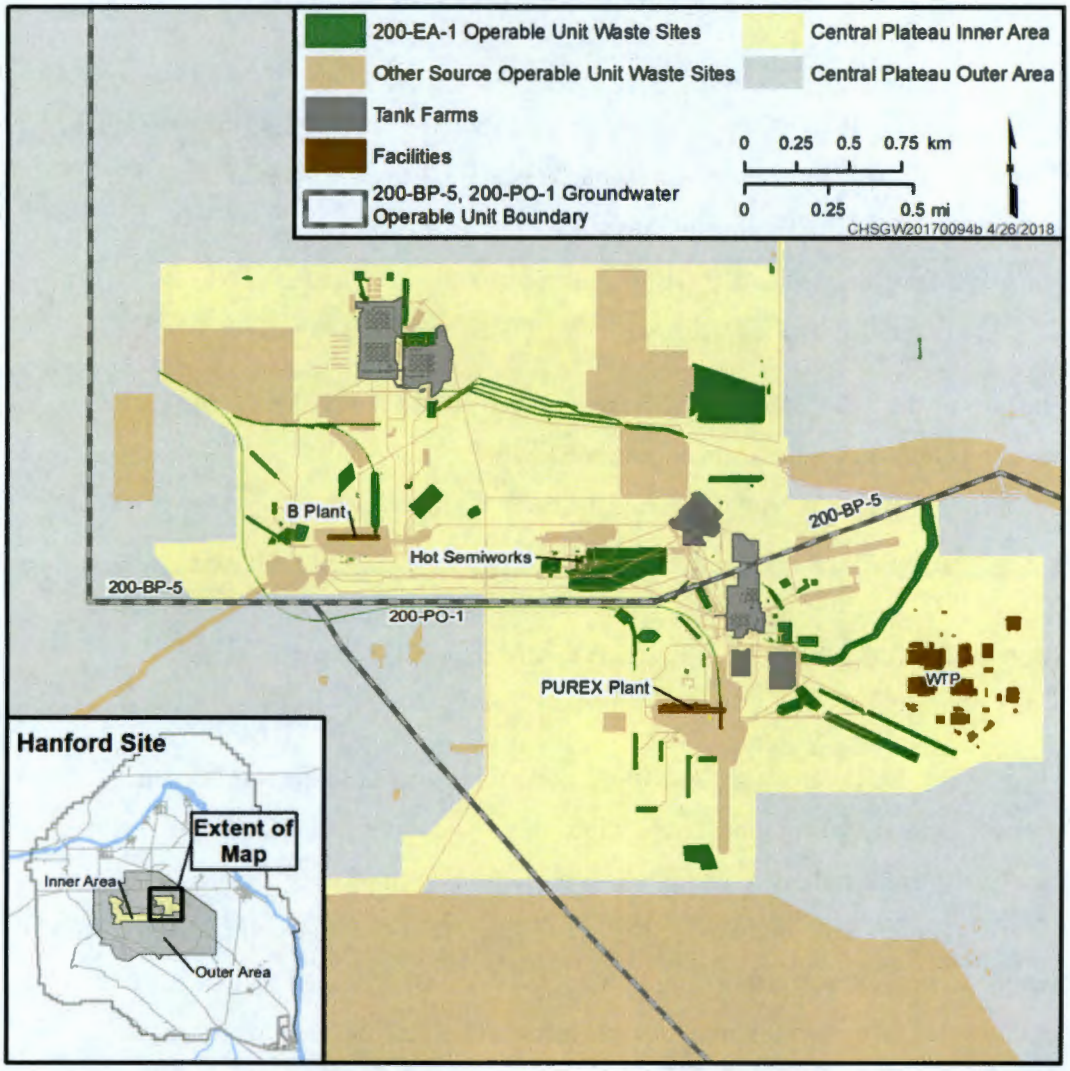
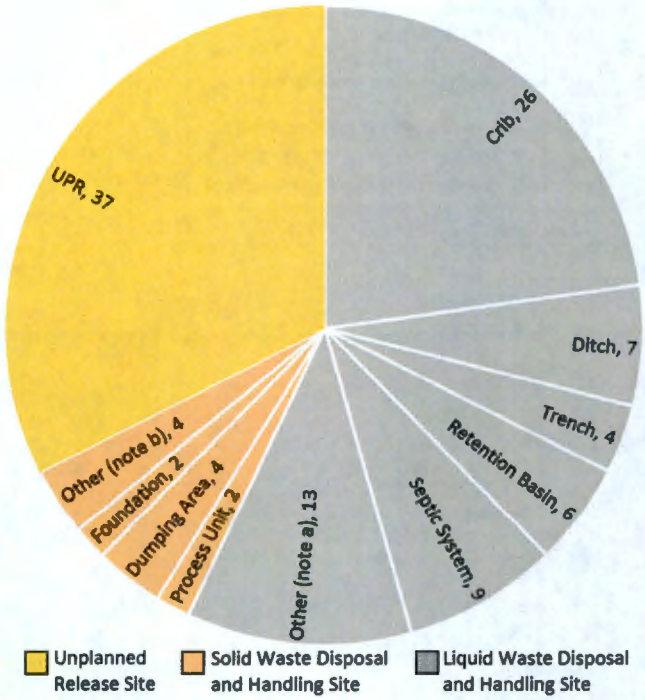


Figure ES-1. 200-EA-1 OU Waste Site Locations at the Hanford Site

The 200-EA-1 OU waste sites are associated with waste generated by numerous Hanford Site operations and facilities, including B Plant and the Plutonium-Uranium Extraction (PUREX) Plant. Based on prior investigations conducted at many 200-EA-1 OU waste sites, potential OU contamination includes radionuclides (such as cesium-137 and plutonium and uranium isotopes), inorganic chemicals (such as lead and nitrate), and organic compounds (such as polycyclic aromatic hydrocarbons). The extent of 200-EA-1 OU contamination varies greatly. Solid waste disposal and handling sites are anywhere from 0.3 m^2 (1 ft^2) to 75,000 m^2 (about 800,000 ft^2), and liquid waste disposal and handling sites received anywhere from 1,000 L (265 gal) or less of liquid effluent to as much as 296 billion L (78.2 billion gal). Figure ES-3 summarizes 200-EA-1 OU potential depths of vadose zone contamination.

DOE, Ecology, and other entities have extensively studied the physical setting of the Central Plateau (geology, weather, plant and animal species), which is well understood for the 200-EA-1 OU. The reasonably anticipated future land use for the Central Plateau Inner Area is industrial; and the associated human receptors (the outdoor worker), ecological receptors, and exposure pathways are well understood and described in this work plan.



Notes:
a. Includes french drains, pipelines, a valve pit, an injection/reverse well, and a depression.
b. Includes a burn pit, a burial vault, a burial ground, and a storage area.

Figure ES-2. 200-EA-1 OU Waste Site Types

Much of the uncertainty in the 200-EA-1 OU stems from incomplete knowledge regarding contaminant nature and extent. In order to effectively reduce and manage these and other uncertainties, DOE and Ecology met to discuss and determine, on a site-by-site basis, which uncertainties were significant enough to impact defining a basis for action or evaluating or selecting a remedy. Existing waste site process knowledge and characterization data were used to inform DOE and Ecology during this collaborative scoping process. For each significant uncertainty, DOE and Ecology determined where data collection is warranted to reduce the uncertainty.

DOE has planned field investigations to address significant uncertainties for 93 waste sites in the 200-EA-1 OU. These field investigations include more than 2,000 soil samples; numerous borings (including 30 to groundwater); geophysical logging; and multiple ground-penetrating radar, resistivity, and radiological surveys. Appendix A of this work plan presents the sampling and analysis plan, which describes the intended data collection activities. DOE has not planned field investigations for the remaining 21 waste sites. Types of sites without field investigations include, but are not limited to, sites where contamination is no longer present and sites where there were no significant uncertainties identified based on previous characterization.

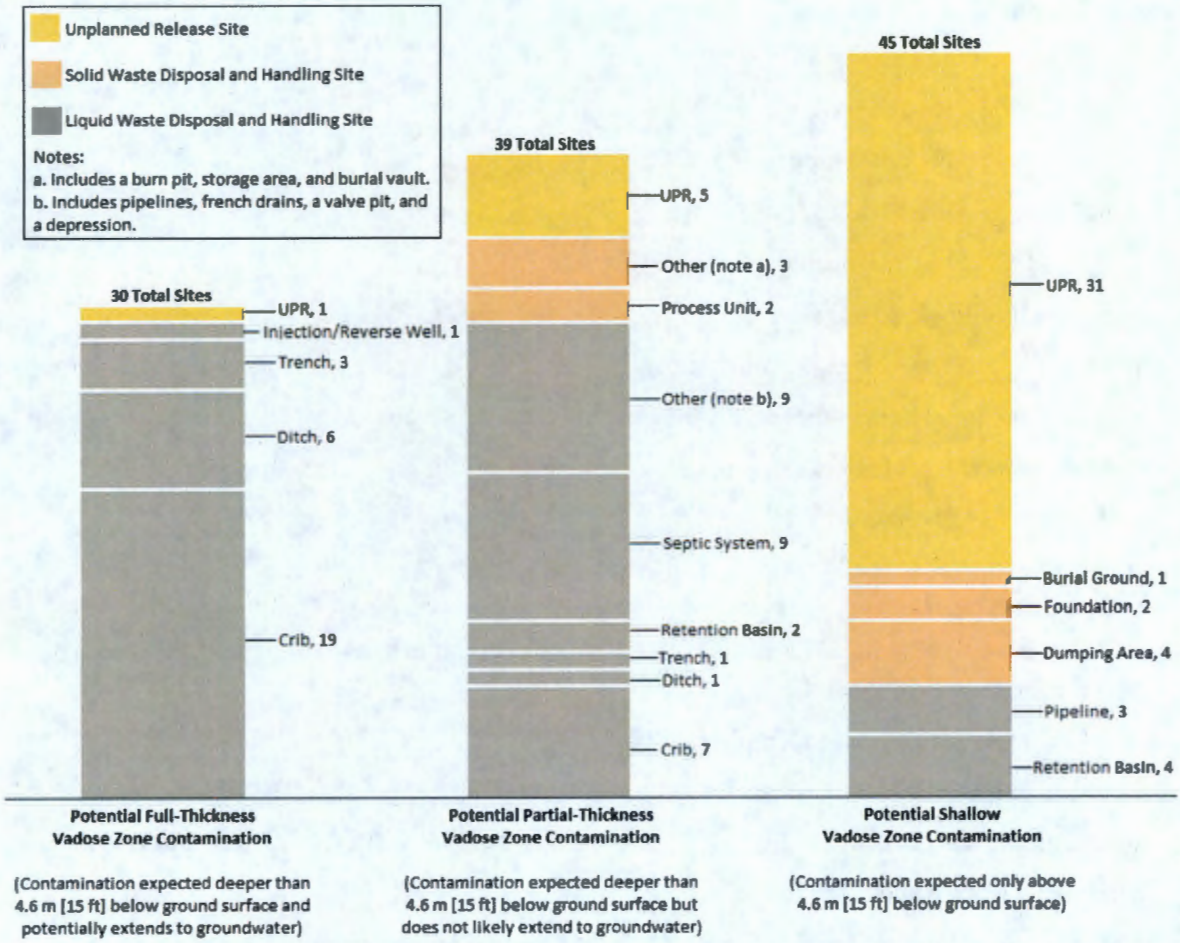


Figure ES-3. 200-EA-1 OU Potential Depths of Vadose Zone Contamination

Additional future activities for the 200-EA-1 OU include the following:

- Completing the RFI/RI to determine the final basis for action.
- Completing the CMS/FS to develop, screen, and evaluate alternative remedial actions.
- Developing the Proposed Plan/Proposed Corrective Action Decision describing the preferred remedy for each 200-EA-1 OU waste site and presenting it to the public for review and comment.
- Issuing the Corrective Action Decision/Record of Decision documenting the final remedy for each waste site. The Corrective Action Decision/Record of Decision will contain responses to public comments on the Proposed Plan/Proposed Corrective Action Decision.
- Implementing the selected remedy for each waste site.

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Terms

AAMS	aggregate area management study
AEA	*Atomic Energy Act of 1954*
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
BRA	baseline risk assessment
CAD	Corrective Action Decision
CCU	Cold Creek unit
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CIE	cumulative impacts evaluation
CMI	corrective measures implementation
CMS	corrective measures study
COC	contaminant of concern
COPEC	contaminant of potential ecological concern
COPC	contaminant of potential concern
CPP	CERCLA past practice
CSM	conceptual site model
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
DOE	U.S. Department of Energy
DOE-RL	DOE, Richland Operations Office
DQO	data quality objective
DST	double-shell tank
DUA	data usability assessment
Ecology	Washington State Department of Ecology
EE/CA	engineering evaluation/cost analysis
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERA	ecological risk assessment

ERDF	Environmental Restoration Disposal Facility
FS	feasibility study
HAB	Hanford Advisory Board
HHE	human health and the environment
HHRA	human health risk assessment
HSWA	*Hazardous and Solid Waste Amendments of 1984*
IC	institutional control
IRIS	Integrated Risk Information System
K_d	distribution coefficient
MCL	maximum contaminant level
MTCA	Model Toxics Control Act
NCP	National Contingency Plan
NPL	National Priorities List
OU	operable unit
PCAD	Proposed Corrective Action Decision
POC	point of compliance
PP	Proposed Plan
PPRTV	Provisional Peer Reviewed Toxicity Value
PRG	preliminary remediation goal
PSQ	principal study question
PUREX	Plutonium-Uranium Extraction (Plant or process)
RAGS	Risk Assessment Guidance for Superfund
RAO	remedial action objective
R-CPP	RCRA-CERCLA past practice
RCRA	*Resource Conservation and Recovery Act of 1976*
RD/RA	remedial design/remedial action
RAO	remedial action objective
REDOX	Reduction-Oxidation (Plant or process)
RESRAD	RESidual RADioactivity (dose model)
RFI	RCRA facility investigation

RI	remedial investigation
RLM	Ringold Formation lower mud unit
ROD	Record of Decision
RTD	removal, treatment, and disposal
SAP	sampling and analysis plan
SIM	Hanford Site Soil Inventory Model
SMDP	scientific-management decision point
SSL	soil screening level
SST	single-shell tank
STOMP	Subsurface Transport Over Multiple Phases
SVOC	semivolatile organic compound
TBC	to be considered
TBP	tributyl phosphate
TEDF	Treated Effluent Disposal Facility
Tri-Parties	DOE, EPA, and Ecology
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TSD	treatment, storage, and disposal
UCL	upper confidence limit
UIC	underground injection control
UNH	uranyl nitrate hexahydrate
UO_3	uranium trioxide
UPR	unplanned release
VOC	volatile organic compound
WMA	waste management area

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1 Introduction

This document presents the work plan for the remedial investigation (RI)/feasibility study (FS) and *Resource Conservation and Recovery Act of 1976* (RCRA) facility investigation (RFI)/corrective measure study (CMS) phases that support the 200-EA-1 Operable Unit (OU) at the Hanford Site. This work is being performed for the U.S. Department of Energy (DOE) under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) and RCRA, as amended by the *Hazardous and Solid Waste Amendments of 1984* (HSWA).

The Hanford Site encompasses ~1,510 km^2 (583 mi^2) in the Columbia River Basin of southeastern Washington State (Figure 1-1). In 1989, the U.S. Environmental Protection Agency (EPA) placed the 100, 200, and 300 Areas of the Hanford Site on the National Priorities List (NPL) (40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan" [NCP], Appendix B, "National Priorities List") pursuant to CERCLA.[1] Each NPL site includes multiple OUs, as outlined in Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order* (hereinafter referred to as the Tri-Party Agreement).

The 200 Area NPL site is ~195 km^2 (75 mi^2) and is commonly known as the Central Plateau. The two major Central Plateau geographic cleanup areas include the 170 km^2 (65 mi^2) Outer Area and the 25 km^2 (10 mi^2) Inner Area (Figure 1-1).

The 200-EA-1 OU is located in the Inner Area (Figure 1-1). It consists of 114 wastes sites, including the following:

- Liquid waste disposal and handling sites (e.g., cribs, ditches, trenches, retention basins, septic systems, french drains, pipelines, a valve pit, an injection/reverse well, and a depression)
- Solid waste disposal and handling sites (e.g., process units, dumping areas, foundations, a burn pit, a burial vault, a burial ground, and a storage area).
- Contaminated soil resulting from planned and unplanned releases (UPRs)

The majority of the waste sites in the 200-EA-1 OU are associated with liquid waste disposal.

[1] EPA also placed the 1100 Area of the Hanford Site on the NPL; however, it was removed from the NPL in September 1996 (40 CFR 300, Appendix B).

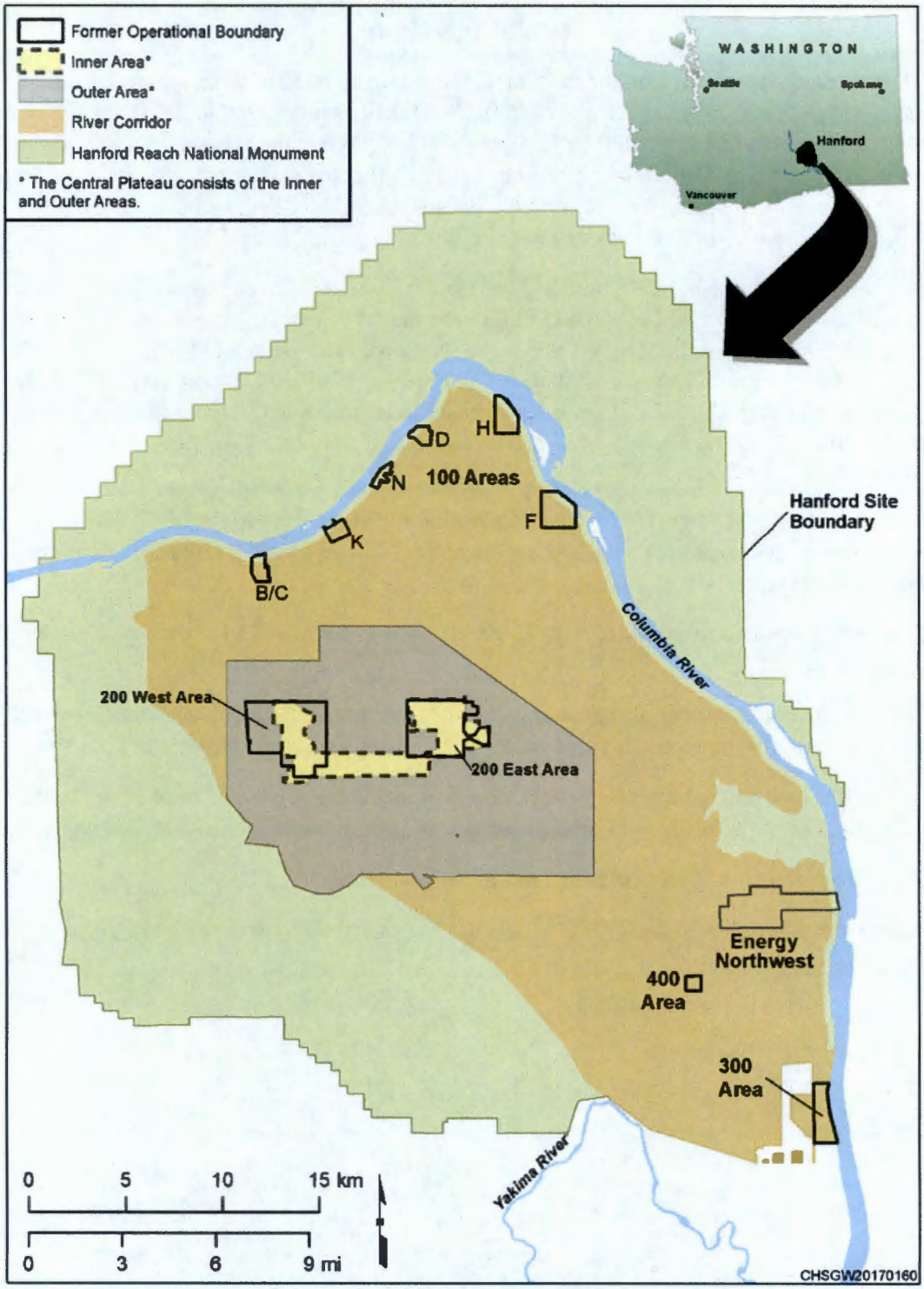

Figure 1-1. Hanford Site

This work plan was prepared in response to Tri-Party Agreement Milestone M-015-92A, which requires submittal of an RFI/CMS and RI/FS work plan for the 200-EA-1 OU to the Washington State Department of Ecology (Ecology) by July 31, 2018 (Appendix D of Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan* [hereinafter referred to as the Tri-Party Agreement Action Plan]). The work plan was prepared in accordance with the following guidance documents:

- EPA/240/B-06/001, *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA QA/G-4)
- EPA 530/SW-89-031, *Interim Final RCRA Facility Investigation (RFI) Guidance*
- EPA/540/G-89/004, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final* (Note: Section 6.2.3.7, associated with cost estimating, has been superseded by EPA 540-R-00-002, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study.*)
- EPA/540/G-91/011, *Guidance on RCRA Corrective Action Decision Documents – The Statement of Bases Final Decision and Response to Comments*
- EPA 540-R-93-057, *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA*
- DOE/EH-0506, *Phased Response/Early Actions Under CERCLA*
- DOE/EH-94007658, *Remedial Investigation/Feasibility Study (RI/FS) Process, Elements and Techniques*

1.1 Scope and Objectives

The goal of the 200-EA-1 OU project is to implement response actions that will protect human health and the environment (HHE) from contamination associated with 200-EA-1 OU waste sites. The scope of this work plan includes the waste sites that have been assigned to the 200-EA-1 OU in Appendix C of the Tri-Party Agreement Action Plan (Ecology et al., 1989b). These waste sites are depicted in Appendix B of this work plan, and details of each waste site are provided in SGW-60540, *200-EA-1 Operable Unit Scoping* (hereinafter referred to as the 200-EA-1 scoping document). The 200-EA-1 OU does not include underlying groundwater, which is addressed through the CERCLA process for the 200-BP-5 and 200-PO-1 Groundwater OUs, as described in Section 1.4 of this work plan.

Hanford waste sites have been regrouped into different OUs over time to better align with the DOE Richland Operations Office (DOE-RL) current mission for Hanford Site cleanup. As a result, many 200-EA-1 OU waste sites were previously assigned to other OUs. Figure 1-2 shows the OUs that included waste sites which are now part of the 200-EA-1 OU. The figure begins in 1998, when many current 200-EA-1 OU waste sites were added to the Tri-Party Agreement Action Plan (Ecology et al., 1989b), and depicts major OU reassignments through 2017.

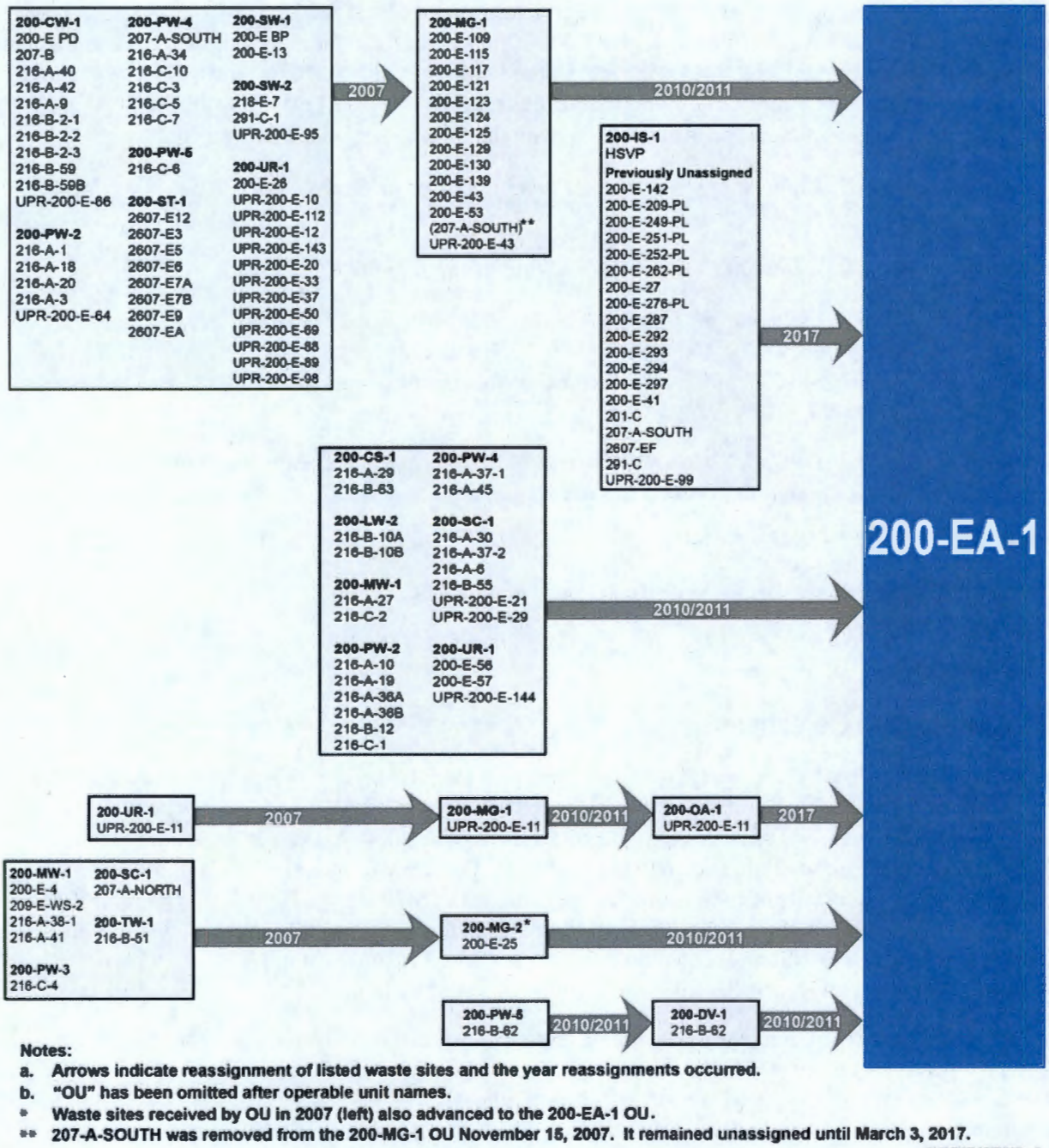

Figure 1-2. Historical OU Reassignments for 200-EA-1 OU Waste Sites (1998 to 2017)

Prior to drafting this work plan, DOE-RL and Ecology conducted a detailed review of existing information and convened numerous scoping workshops. Based on these scoping efforts, this work plan documents the following:

- 200-EA-1 OU scope
- Current waste site knowledge (e.g., physical properties, background, setting, process knowledge, and characterization data)

- Contaminant nature and extent and conceptual site model (CSM) based on existing information (e.g., potential impacts to groundwater)
- Uncertainties associated with the CSM that represent data gaps which must be filled to determine if action is warranted and to evaluate and select response actions
- Potential data collection strategies to fill the identified data gaps
- Candidate sites for early action
- Likely remedial technologies, process options, and alternatives and the basis for their evaluation
- Tasks and schedule for implementing RFI/RI and CMS/FS activities in a manner that integrates RCRA and CERCLA processes
- Coordination between 200-EA-1 OU waste sites and interfacing OUs (e.g., 200-PO-1, 200-BP-5, 200-IS-1), key facilities, and tank farms

1.2 RCRA/CERCLA Integration

RCRA and CERCLA are the principal regulatory authorities for all cleanup activities on the Hanford Site. The EPA website available at www.epa.gov/superfund provides a detailed description of the CERCLA response action process. EPA delegated the RCRA program to the state of Washington, and Ecology implements the program (which includes oversight of permitting; treatment, storage, and disposal [TSD] unit closure; and RCRA corrective action) via RCW 70.105, "Hazardous Waste Management Act"; WAC 173-303, "Dangerous Waste Regulations"; and through facility-specific permitting actions. The RCRA closure and post-closure requirements are provided in (or will be included in) WA7890008967, *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste* (hereinafter referred to as the Permit), as necessary.

The Tri-Party Agreement (Ecology et al., 1989a) details the agreement among DOE, EPA, and Ecology (referred to as the Tri-Parties) to jointly pursue CERCLA response actions, RCRA corrective actions, and RCRA TSD unit closure on the Hanford Site. DOE-RL is the lead agency responsible for conducting CERCLA response actions and RCRA corrective actions at the Hanford Site. Ecology is the lead regulatory agency for the 200-EA-1 OU CERCLA response action and RCRA corrective action processes and is responsible for the oversight of Hanford Site TSD unit closures in accordance with Section 5.6 and Appendix C of the Tri-Party Agreement Action Plan (Ecology et al., 1989b).

The Tri-Party Agreement (Ecology et al., 1989a) and the Permit (WA7890008967) both require TSD unit closure and RCRA/CERCLA past-practice (R-CPP) cleanup action process coordination. Section 5.0 of the Tri-Party Agreement defines the coordinated CERCLA response action, RCRA corrective action, and TSD unit closure processes in a manner that satisfies relevant regulatory requirements. This process leverages the past-practice investigation activities whenever possible to supplement TSD unit closure investigation activities to prevent overlap and duplication of work.

This combined RFI/CMS/RI/FS work plan represents the first step in the coordination process. The work plan defines the 200-EA-1 OU scope, identifies the waste sites that comprise the OU, assembles and evaluates existing data and information about the waste sites, and identifies the activities needed to make decisions pursuant to R-CPP unit and TSD unit investigation and cleanup activities, as well as TSD unit

closure.[2] The supporting sampling and analysis plan (SAP) (Appendix A) identifies the characterization needed to satisfy 200-EA-1 OU waste site data needs. Chapter 5 of this work plan describes the activities that will be conducted pursuant to the work plan, including details regarding how the CERCLA, RCRA corrective action, and TSD unit permitting and closure activities will be coordinated.

1.3 Hanford Site Cleanup Completion Framework and Inner Area Principles

This section discusses the framework for completing Hanford Site cleanup, as well as the cleanup principles for the Central Plateau Inner Area.

1.3.1 Hanford Site Cleanup Completion Framework

DOE/RL-2009-10, *Hanford Site Cleanup Completion Framework*, describes the DOE site cleanup strategy and approach for completing the remainder of the cleanup mission. This framework document defines the principal components of cleanup and provides the context for individual cleanup actions by establishing the approaches and common goals for decisions needed to complete the cleanup mission.

DOE/RL-2009-10 defines the overarching goals for cleanup that embody more than 20 years of dialogue among the Tri-Parties, Tribal Nations, state of Oregon, stakeholders, and the public. The goals consider key values captured in forums, such as the Hanford Future Site Uses Working Group, Tank Waste Task Force, Hanford Summits, Tribal Nation values statements, and the Hanford Advisory Board (HAB). The goals also serve as a guide for all aspects of Hanford Site cleanup and help set priorities to apply resources and sequence cleanup efforts for the greatest benefit.

To achieve these goals, cleanup is organized into three major components: River Corridor, including the Hanford Reach National Monument and the Manhattan Project National Historical Park; Central Plateau; and tank farms/tank waste. Each cleanup component is complex and challenging, involving multiple projects and contractors, and requiring many years and billions of dollars to complete. Environmental cleanup of waste sites and facilities in the River Corridor is nearing completion, with substantial progress made on groundwater remediation. Closure of tanks and tank farms was evaluated in DOE/EIS-0391, *Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington (TC & WM EIS)* (hereinafter referred to as the Tank Closure and Waste Management environmental impact statement [EIS]), with a Record of Decision (ROD) issued in December 2013 (78 FR 240, "Record of Decision for the Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington").

The Hanford Site environmental cleanup mission began in 1989, following a plutonium-production era that lasted from 1943 to 1989. During plutonium production, the Hanford Site was divided into production areas, including the 200 East and 200 West Areas in the Central Plateau, which contain the major nuclear fuel processing, waste management, and disposal facilities. The historical designations and former operational boundaries for the 200 East and 200 West Areas are used in context throughout this work plan.

[2] Chapter 3 of the Tri-Party Agreement Action Plan (Ecology et al., 1989b) describes what constitutes a TSD unit and an R-CPP unit at the Hanford Site.

The Central Plateau encompasses the 200 Area NPL (40 CFR 300, Appendix B) site and includes two principal areas, as described in Figure 1-1:

- **Inner Area:** Defined as the final footprint area of the Hanford Site, the Inner Area is dedicated to long-term waste management and containment of residual contamination. The Inner Area covers ~26 km^2 (10 mi^2) and will remain under federal ownership and control as long as potential hazards exist. The 200-EA-1 OU is located in the Central Plateau Inner Area.

- **Outer Area:** The Outer Area portion of the Central Plateau is outside the boundary of the Inner Area. Contaminated soil and debris removed as part of Outer Area cleanup will be placed in the Inner Area for final disposal. Completing cleanup of the ~170 km^2 (65 mi^2) Outer Area will shrink the active footprint of the Central Plateau to the Inner Area.

1.3.2 Central Plateau Inner Area Cleanup Principles

In 2013-2014, DOE, EPA, and Ecology undertook an initiative to develop a set of cleanup principles for the Inner Area of the Central Plateau. The outcome of this initiative is the establishment of an overarching and consistent set of cleanup principles that the Tri-Parties have agreed are the foundation for evaluating waste sites and making cleanup decisions in each of the OUs within the Inner Area pursuant to the Tri-Party Agreement (Ecology et al., 1989a).

The overarching goals of the principles are to (1) provide a consistent approach for assessment of risks to HHE and evaluation of remedial alternatives within the Inner Area; and (2) identify and implement regulatory strategies that will optimize assessment resources, streamline documentation requirements, and promote consistency in decisions.

The substantive components of these principles related to land use, baseline risk assessments, cleanup levels, points of compliance, and regulatory strategies are defined below. The principles, as they apply to the 200-EA-1 OU, are reflected in the appropriate sections of this work plan.

1.3.2.1 Land Use

- Inner Area land use is industrial.

- The agencies are in agreement that the current 25.9 km^2 (10 mi^2) Inner Area footprint will not be reduced further.

1.3.2.2 Baseline Risk Assessment (BRA)

- BRA for direct contact will use the default EPA industrial scenario (multiple pathway) to determine need for action at cumulative cancer risk level of 1 in 10,000 and 1 in 100,000 and a hazard index of 1 for noncarcinogenic effects.

- State requirement for cumulative cancer risks under the "Model Toxic Controls Act–Cleanup" (MTCA) Method C (WAC 173-340) at 1 in 100,000 will be considered because of future corrective action requirements.

- Once a basis for action is determined, cleanup standards for chemicals will be based on MTCA Method C industrial cleanup levels for direct contact.

- The only institutional control incorporated in the BRA is for industrial land use.

- BRA for direct contact will not include a residential scenario.

- BRAs for soils will be done on an OU-by-OU basis (each work plan).

- BRA for groundwater and groundwater protection will be based on beneficial use (drinking water).
- Groundwater protection evaluation will consider up-gradient contamination as evaluated through a cumulative risk evaluation tool that incorporates present and future groundwater contamination and contaminant sources in the vadose zone.
- DOE will develop RI/FS work plan sections that describe the principles and specific parameters on baseline risk assessments that will serve as guiding principles for all work plans.

1.3.2.3 Cleanup Levels

- Preliminary Remediation Goals (PRGs) for human health direct contact with radionuclides will be risk-based.
- PRGs for chemicals will be based on MTCA Method C (direct contact).
- Approach to ecological cleanup will be the same as for the River Corridor, as applied for the 100-D/H Area RI/FS (DOE/RL-2010-95, *Remedial Investigation/Feasibility Study for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units*) and 100-F/IU area RI/FS (DOE/RL-2010-98, *Remedial Investigation/Feasibility Study for the 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units*).
- Groundwater protection modeling will be based on natural recharge and will not consider irrigation.
- Groundwater protection modeling and PRG development will be based on the process defined in DOE/RL-2011-50, *Regulatory Basis and Implementation of a Graded Approach to Evaluation of Groundwater Protection*. DOE will identify specific parameters in DOE/EIS-0391 that will be applied or make adjustments, where appropriate.
- Groundwater protection PRGs will be developed, discussed, and approved through a single process to develop PRGs applicable to each of the five unique areas of the Central Plateau.

1.3.2.4 Conditional Point of Compliance for Groundwater

- FSs will present an evaluation of groundwater protection at the standard point of compliance immediately beneath each waste site or facility under consideration. DOE may also choose to perform an analysis in the first Inner Area FS to evaluate a conditional point of compliance at the boundary of the Inner Area for groundwater protection. The resulting decision will serve as the basis for the justification for the remainder of the OUs in the Inner Area.
  - The basis for the decision will be developed in the first FS, but all OUs will need to justify the decision. The subsequent OU discussions will reference the first and include an overview of similarities and differences between the first and subsequent OUs to ensure the approach is justified.

1.3.2.5 Human Health and Ecological Depth Point of Compliance

- FSs will present alternatives that will evaluate compliance with human health (direct contact) and ecological PRGs at the standard point of compliance of 4.6 m (15 ft). DOE may also choose to present alternatives in the first Inner Area FS to evaluate a conditional point of compliance for the terrestrial ecological evaluation. In addition, DOE may also choose to evaluate an alternative point of compliance for soil cleanup actions (human health [direct contact]) according to the procedures in WAC 173-340-740(6)(f).
  - A framework for decisions will be developed in the first FS, but all OUs will need to justify the decisions. All OUs in the Central Plateau are expected to present this comparison of alternatives to ensure all potential remedies are protective of human health and the environment.
- Unlike in the River Corridor, engineered structures and/or mass of contamination will not be removed unless it is a risk management decision.

1.3.2.6 Regulatory Strategies

- Similar site approach can be used with proper analysis and use of available information, data, and process knowledge.
- Characterization strategies will consider multiple remedial technologies, risk reduction, regulatory requirements, and cost avoidance. The observational approach can also be a valid strategy where removal, treatment, and disposal (RTD) is appropriate.
- The regulatory agencies are willing to consider a plug-in approach. They generally believe that it applies primarily to RTD sites but could be applied to other potential remedies if justified.
- Post-ROD characterization (meaning limited pre-ROD characterization) is a valid approach but may result in interim action RODs.

1.4 Integration with Other Activities

The 200-EA-1 OU waste sites potentially interface with other Inner Area source and groundwater OUs and tank farms, as described in Table 1-1 and shown in Figure 1-3. Coordination with other projects is intended to achieve consistency in remedial decisions and cleanup actions and to take advantage of opportunistic sampling. Specific 200-EA-1 OU waste site interfaces are depicted in Appendix B and described further in the 200-EA-1 scoping document (SGW-60540). Chapter 5 describes integration with groundwater OUs, other source OUs, and other Central Plateau operations (e.g. ongoing surveillance and maintenance) and infrastructure (e.g. utilities).

Table 1-1. Inner Area OUs and Tank Farms that Potentially Interface with the 200-EA-1 OU

OU/Tank Farm	Description
Canyon Operable Units	
200-CB-1 (B Plant) 200-CP-1 (PUREX Plant)	Canyon facilities extracted plutonium from fuel discharged from the River Corridor reactors. These canyons are no longer operating facilities and will be closed under their own CERCLA decision documents and RCRA closure documents.

Table 1-1. Inner Area OUs and Tank Farms that Potentially Interface with the 200-EA-1 OU

OU/Tank Farm	Description
Source Operable Units	
200-PW-3	Received process water directly or indirectly from PUREX Plant operations. A ROD for this OU was issued in September 2011 (EPA et al., 2011).
200-DV-1	Primarily addresses deep vadose zone contamination at cribs and trenches adjacent to and associated with the B-BX-BY, T-TX-TY, and S-SX Tank Farms. Only the waste sites adjacent to the B-BX-BY Tank Farms potentially interface with 200-EA-1 OU waste sites. The remedial decision for this OU will be made under its own CERCLA decision documents.
200-SW-2	Consists of multiple landfills and collocated waste sites (i.e., UPRs, Z Plant burn pit, T Ponds, and 216-C-9 Pond) (DOE/RL-2004-60). Several landfills potentially interface with the 200-EA-1 OU. The remedial decision for this OU will be made under its own CERCLA decision documents and RCRA closure documents.
200-IS-1	Consists of over 300 waste sites, including inactive buried waste transfer pipelines, inactive pipeline components (e.g., diversion boxes, catch tanks, valve pits, vaults, and control structures), and UPRs. Multiple waste sites may interface with the 200-EA-1 OU. The remedial decision for this OU will be made under its own CERCLA decision documents and RCRA closure documents.
Tank Farms	
SST farm WMAs DST farms	Includes 177 underground storage tanks (149 SSTs and 28 DSTs). The SSTs are grouped into WMAs which contain parts of the SST TSD unit, including tanks and ancillary equipment. The DSTs are operating TSD units. SST farm WMAs A-AX, B-BX-BY, and C; and DST farms AN, AP, AW, AY, and AZ potentially interface with the 200-EA-1 OU. Closure alternatives for the SSTs, DSTs, and tank farms were evaluated in DOE/EIS-0391, with a ROD issued in December 2013 (78 FR 240).
Groundwater OUs	
200-PO-1 200-BP-5	These groundwater OUs underlie 200-EA-1 OU waste sites. Groundwater remediation for these OUs, including contaminant migration, will be addressed under CERCLA decision documents for the associated groundwater OU. The potential for 200-EA-1 OU waste sites to impact groundwater is addressed in this work plan (Chapter 3).

Sources:

78 FR 240, "Record of Decision for the Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington."

DOE/EIS-0391, *Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington (TC & WM EIS).*

DOE/RL-2004-60, *200-SW-2 Radioactive Landfills Group Operable Unit RCRA Facility Investigation/Corrective Measures Study/Remedial Investigation/Feasibility Study Work Plan.*

EPA et al., 2011, *Record of Decision, Hanford 200 Area Superfund Site, 200-CW-5 and 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units.*

CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
DST = double-shell tank
OU = operable unit
PUREX = Plutonium-Uranium Extraction (Plant)
RCRA = *Resource Conservation and Recovery Act of 1976*
ROD = Record of Decision
SST = single-shell tank
TSD = treatment, storage, and disposal
UPR = unplanned release
WMA = waste management area

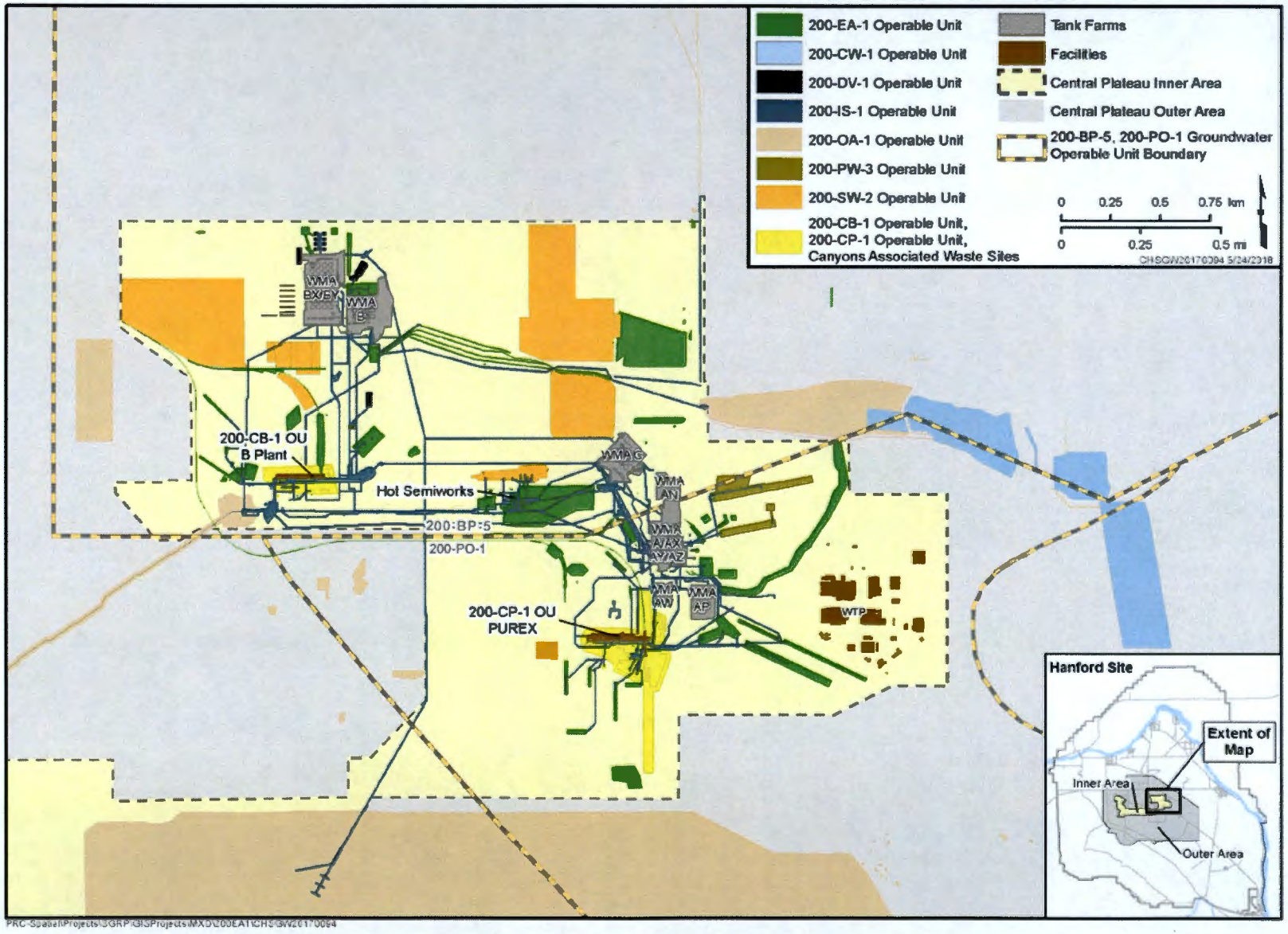

Figure 1-3. Other OUs, Key Facilities, and Tank Farms near the 200-EA-1 OU

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2 Operable Unit Background and Environmental Setting

This chapter presents an overview of Central Plateau facilities, chemical processes, and generated waste streams relevant to 200-EA-1 OU waste sites. It also provides an overview of 200-EA-1 OU waste site types and their environmental setting. Where applicable, this chapter references other documents that provide more detailed information.

2.1 Chemical Processes on the Central Plateau

Central Plateau canyons and facilities used chemical separation processes to extract plutonium from spent nuclear fuel, plutonium finishing processes to convert plutonium-bearing solutions into plutonium metal, and reprocessed high-activity waste to reduce the volume and recover uranium, cesium, and strontium. The processes described in this section produced liquid waste streams, many of which are relevant to 200-EA-1 OU waste sites.

Table 2-1 lists the major liquid waste streams produced by each relevant chemical process and presents Hanford Site historical definitions of low-, intermediate-, and high-activity waste categories. These categories were used to determine the ultimate disposal or storage location for the waste, as well as the type of conveyance system needed to transport the waste. Many waste streams relevant to the 200-EA-1 OU are considered mixed waste and may contain both regulated chemical waste and radionuclides. The 200-EA-1 scoping document (SGW-60540) provides further discussion on the waste streams.

Table 2-1. Summary of Central Plateau Liquid Waste Streams Relevant to the 200-EA-1 OU

Chemical Process	Waste Streams		
	Stored in Underground SSTs and DSTs (High Activity)[a]	**Disposed to Cribs, Dry Wells, French Drains, and Trenches (Intermediate Activity)[b]**	**Disposed to Ponds, Retention Basins, and Ditches (Low Activity)[c]**
Bismuth phosphate (B Plant, T Plant)	• Coating waste • First-cycle decontamination waste • Lanthanum fluoride process 224 Building waste • Metal waste • Second-cycle decontamination waste	• Cell 5-6 drainage waste • First-cycle high-level waste • Second-cycle high-level waste • Process condensate • Stack drainage waste • Tank farm supernatant overflow decontamination waste	• Chemical sewer waste • Cold startup waste • Cooling water • Laboratory wastewater • Steam condensate
Cesium and strontium recovery (B Plant, C Plant)	• B Plant high-activity waste • B Plant low-activity waste[d] • Cesium recovery waste • Hot Semiworks purification waste • Ion-exchange waste • Strontium recovery waste • Washed sludge	• Process condensate • Steam condensate	• Cold startup waste • Cooling water

Table 2-1. Summary of Central Plateau Liquid Waste Streams Relevant to the 200-EA-1 OU

Chemical Process	Waste Streams		
	Stored in Underground SSTs and DSTs (High Activity)[a]	**Disposed to Cribs, Dry Wells, French Drains, and Trenches (Intermediate Activity)[b]**	**Disposed to Ponds, Retention Basins, and Ditches (Low Activity)[c]**
REDOX (S Plant)	• REDOX high-level waste • Aluminum cladding waste • Zirconium cladding waste • First-cycle decontamination and coating waste • Second-cycle decontamination and coating waste	• Floor drainage wastewater • Process condensate • Steam condensate	• Chemical wastewater • Cold startup waste • Cooling water • Steam condensate
PUREX (A Plant)	• PUREX first-cycle and second-cycle high-level waste • PUREX acid waste • Neutralized high-level waste • Aluminum cladding waste • Zirconium cladding waste • PUREX ammonia scrubber feed waste • PUREX non-boiling waste • PUREX organic wash waste • Thoria process waste	• Ammonia scrubber condensate • Process condensate • Steam condensate	• Chemical sewer waste • Cold startup waste • Cooling water • Steam condensate
Uranium recovery (U Plant)	• Ferrocyanide sludge • Tributyl phosphate process waste	• Process condensate • Scavenged waste	• Cold startup waste • Cooling water • Steam condensate • Chemical sewer waste

Sources:

BHI-00174, *U Plant Aggregate Area Management Study Technical Baseline Report.*

BNWL-C-119, *Management of Radioactive Wastes at the Hanford Plant.*

HW-31000, *PUREX Technical Manual.*

ISO-100, *Waste Management Technical Manual.*

a. High-activity waste is stored in underground SSTs and DSTs. It was sometimes high-heat and was historically defined as having radionuclide concentrations >100 μCi/mL (1×10^{11} pCi/L) (BNWL-C-119).

b. Intermediate-activity waste was disposed to cribs, dry wells, french drains, and trenches and was historically defined as having radionuclide concentrations from 5×10^{-5} μCi/mL (5×10^{4} pCi/L) to 100 μCi/mL (1×10^{11} pCi/L) (BNWL-C-119).

c. Low-activity waste was routed to open ponds, retention basins, and ditches and was historically defined as having radionuclide concentrations <5×10^{-5} μCi/mL (5×10^{4} pCi/L) (BNWL-C-119).

d. B Plant low-activity waste stored in SSTs and DSTs.

DST = double-shell tank
PUREX = plutonium-uranium extraction (process)
REDOX = reduction-oxidation (process)
SST = single-shell tank

2.1.1 Chemical Separations Processes

Beginning in the 1940s, chemical separation processes were used to extract plutonium from irradiated fuel rods. These chemical separation processes eventually evolved into the bismuth phosphate batch process, which was replaced in the 1950s by the reduction-oxidation (REDOX) and plutonium-uranium extraction (PUREX) continuous solvent extraction processes (DOE/RL-97-1047, *Hanford Site Historic District History of the Plutonium Production Facilities, 1943-1990*).

The first step in each of these chemical separation processes involved dissolving the aluminum or zirconium alloy jackets from the reactor fuel rods. The resulting solution, known as coating waste or cladding waste, was stored in single-shell tanks (SSTs) and double-shell tanks (DSTs). The remaining uranium metal slugs were rinsed with water and dissolved in 50% to 60% nitric acid (PNL-6964-HEDR, *A History of Major Hanford Operations Involving Radioactive Material*). The following sections describe the remaining steps in the bismuth phosphate, REDOX, and PUREX processes.

2.1.1.1 Bismuth Phosphate Process

Bismuth phosphate operations were a batch process involving a series of precipitations, followed by centrifuging and dissolving the precipitate cake (WHC-MR-0521, *The Plutonium Production Story at the Hanford Site: Processes and Facilities History*). The batch process resulted in a dilute plutonium solution that was purified and reduced in volume, and then the carrier was switched from bismuth phosphate to lanthanum fluoride. The final product was ~98% pure plutonium. The bismuth phosphate process did not recover uranium. High-activity bismuth phosphate process waste was neutralized before transfer to SSTs (PNL-6964-HEDR). Table 2-1 lists the bismuth phosphate process waste streams.

2.1.1.2 REDOX Process

The REDOX process was a continuous solvent extraction process that replaced the bismuth phosphate process in 1952 due to its lower cost, improved throughput, and ability to recover uranium and >98% plutonium. The organic solvent hexone was used to extract uranium and plutonium from the aqueous phase into an organic solution. Salting the aqueous phase with aluminum nitrate enhanced extraction into the organic solution. While the fission products remained in the aqueous phase, the organic solution with the uranium and plutonium reacted with an aluminum nitrate solution containing ferrous ion, a reducing agent. This reaction extracted the plutonium into another aqueous solution, while the uranium remained in the organic solution.

The initial REDOX process step produced plutonium, uranium, and fission product waste streams. The plutonium stream was concentrated and shipped to the plutonium finishing facilities, the uranium stream was concentrated, and the fission product waste stream was neutralized and transferred to SSTs. Hexone was recovered and reused (PNL-6964-HEDR). Table 2-1 lists the REDOX process waste streams.

2.1.1.3 PUREX Process

The PUREX process was the second-generation, continuous solvent extraction process that extracted plutonium, uranium (depleted and slightly enriched), neptunium, and thorium (DOE/RL-97-1047). While similar to the REDOX process, the PUREX process used tributyl phosphate (TBP) in kerosene instead of hexone as the extraction agent, and strong nitric acid instead of aluminum nitrate as the salting agent.

Following extraction, the plutonium, uranium, neptunium, and thorium streams were concentrated using evaporation. The plutonium stream (plutonium nitrate) was shipped to the plutonium finishing facilities, the uranium stream (uranyl nitrate hexahydrate [UNH]) was converted to uranium trioxide, the neptunium stream (neptunium nitrate) was stored pending delivery to the Savannah River facility, and the thorium

stream (thorium nitrate) was stored in the 221U pipe gallery until truck transport to Oak Ridge National Laboratory in Tennessee (HW-31000 DEL, *PUREX Technical Manual*; RHO-MA-116, *PUREX Technical Manual*; ARH-2127, *PUREX Process Operation and Performance 1970 THORIA Campaign*). The fission product stream was neutralized and transferred to SSTs and DSTs as waste, and the nitric acid was recovered by distillation and reused (PNL-6964-HEDR). Table 2-1 lists the PUREX process waste streams.

2.1.2 Waste Reprocessing

High-activity waste stored in SSTs and DSTs was selectively reprocessed for volume reduction and to recover uranium, cesium, strontium, and select rare earth isotopes. The following sections discuss these processes.

2.1.2.1 Uranium Recovery

Due to a declining supply of mined uranium and Central Plateau tank farm waste storage issues, a TBP process was used to recover uranium from the bismuth phosphate wastes. The process produced a UNH solution that was converted to uranium trioxide (UO_3) powder by calcination at high temperatures (BHI-00174, *U Plant Aggregate Area Management Study Technical Baseline Report*). The TBP process inefficiencies resulted in increased waste volume, so the waste was concentrated in evaporators to reduce the volume. To allow disposal of TBP supernatant (i.e., scavenged waste) to cribs, a ferrocyanide scavenging process was also developed to remove the principal long-lived fission products (cesium and strontium). Table 2-1 lists the uranium recovery process waste streams.

2.1.2.2 Cesium and Strontium Recovery

Cesium and strontium were recovered from PUREX waste streams and the supernatant from REDOX waste streams that were stored in tank farms using the waste fractionization process. During this process, strontium and cesium were encapsulated as strontium fluoride and cesium chloride, and then cooled in water basins for several years (BNWL-C-119, *Management of Radioactive Wastes at the Hanford Plant*). Cesium was subsequently recovered from the supernatant solutions, while strontium was recovered from the sludge. Recovery of cesium and strontium provided radioactive material for other uses, reduced some hazards associated with high-activity waste storage in tank farms, and freed additional tank space (RPP-PLAN-47559, *Single-Shell Tank Waste Management Area C Pipeline Feasibility Evaluation*). Table 2-1 lists the cesium and strontium recovery process waste streams.

2.1.2.3 Rare Earth Separations and Recovery

Modifications to the separation and recovery processes were implemented for limited periods at B Plant, REDOX Plant, PUREX Plant, and C Plant to recover rare earth elements from high-activity waste, or to process enriched and thoria fuels (ARH-2127; ARH-SA-4, *Recovery of Am, Cm, and Pm From Shippingport Reactor Fuel Reprocessing Wastes by Successive TBP and D2EHPA Extractions*; RPP-RPT-23177, *Origin of Wastes in Tank 241-AW-105*).

2.1.3 Special Studies

Various critical mass experiments were conducted using plutonium nitrate solutions and enriched uranium. The solutions sometimes contained small amounts of neutron poisons (e.g., boron, cadmium, and gadolinium) and were contained in one of two neutron reflector tanks. After the experiments were completed, the solutions in the reflector tanks were sampled, analyzed, and discharged to the 216-C-7 Crib (WHC-EP-0342, Addendum 31, *209-E Laboratory Reflector Waste Stream-Specific Report*).

2.2 History of Operations

Processing facilities/canyon buildings (B Plant, U Plant, S Plant [REDOX], and A Plant [PUREX]) and one major operating plant (C Plant [Hot Semiworks]) are relevant to 200-EA-1 OU waste sites. B Plant, PUREX Plant, and Hot Semiworks are located in the 200 East Area. U Plant and REDOX Plant are located in the 200 West Area, but material from these facilities was transferred to the 200 East Area and is associated with some 200-EA-1 OU waste sites. The following sections describe the purpose, history, and major features for the canyon buildings and operating plant. Figure 2-1 shows an operations timeline for each facility.

2.2.1 A Plant (Plutonium-Uranium Extraction Plant)

The PUREX Plant (202A Building) was constructed in the 200 East Area between 1953 and 1955 to replace the REDOX process. The plant was also used to separate and purify strontium, cerium, and promethium from 1961 through 1967 and used again in 1966 and 1970 campaigns to reprocess thoria (thorium oxide) fuels for thorium and uranium separation and recovery (RPP-RPT-23177; ARH-2127). Operations were placed on standby in 1972, resumed in 1983, and then permanently ceased in 1992 (DOE/RL-92-04, *PUREX Source Aggregate Area Management Study Report*). Facilities that supported the PUREX Plant (HW-31000 DEL) include the following:

- **203A acid pump house:** Received and stored recovered UNH.
- **291A PUREX main exhaust system:** Handled ventilation requirements for PUREX.

Figure 2-1 provides a timeline of PUREX Plant operations and associated chemical processes, while DOE/RL-92-04 provides more information related to the operational history.

2.2.2 B Plant

The B Plant (221B Building), constructed in the 200 East Area in 1944, used the bismuth phosphate process to extract plutonium from irradiated fuel rods from 1945 until 1952 (BHI-00179, *B Plant Aggregate Area Management Study Technical Baseline Report*). B Plant was also used for strontium-90, cerium-144, and promethium-147 separation from 1963 through 1966 as part of rare earth separations and recovery (RPP-RPT-23177). In 1968, B Plant was restarted with a new process to recover cesium and strontium from the bulk salts in high-heating PUREX and REDOX waste. The plant continued this mission until 1984 (RPP-PLAN-47559; ARH-139, *Hazards Evaluation Waste Fractionization – B Plant (Project CAC-144) B-Plant Modifications for FPCE-Waste Management Integrated Facilities (Project CAC-181) and Promethium Purification – B Plant (Project AAE-207)*). Facilities that supported B Plant include the following:

- **212B fission products loadout station:** Received/shipped batch quantities of feed product.
- **222B laboratory:** Tested solutions in support of the B Plant bismuth phosphate process.
- **224B concentration facility:** Performed plutonium concentration operations and the remainder of the decontamination operation.
- **225B Waste Encapsulation and Storage Facility:** Encapsulated and stored cesium and strontium salts.
- **291B exhaust air control house:** Handled ventilation requirements for the 221B and 224B Buildings (HW-10475 ABC, *Hanford Technical Manual Sections A, B and C*)

Figure 2-1 provides a timeline of B Plant operations and chemical processes, and DOE/RL-92-05, *B Plant Source Aggregate Area Management Study Report*, provides more information related to operational history.

2.2.3 C Plant (Hot Semiworks)

The two primary facilities at C Plant were the 201C process building and the 209E Critical Mass Laboratory. The Hot Semiworks (201C process building) was constructed in the 200 East Area in 1949 as a REDOX process pilot plant. In 1954, the Hot Semiworks was converted to a PUREX process pilot plant and was used in this capacity until shutdown in 1956. After extensive cleaning and decontamination, the building was modified, and it resumed operation as the Strontium Semiworks in 1961 to recover strontium, cerium, technetium, and promethium from fission product waste. The waste recovery operations ceased in 1967 (WHC-SD-EN-ES-019, *Semiworks Aggregate Area Management Study Technical Baseline Report*). The 209E Critical Mass Laboratory was operated from 1960 to 1987 by Pacific Northwest National Laboratory. Facilities that supported the Hot Semiworks include the following:

- **201C process building:** Developed plutonium separation technology.
- **209E Critical Mass Laboratory:** Conducted criticality experiments with plutonium nitrate and enriched uranium solutions from 1960 to 1987. Criticality research was also conducted with solid special nuclear materials and fuels.
- **271C Building:** Served as the 201C process building control center and included an aqueous makeup area for cold solutions.
- **276C solvent handing building:** Contained equipment and tanks for treating and storing process solvents used in 201C process building operations.
- **291C exhaust fan house and stack:** Provided the facilities for handling the main ventilation requirements for the Hot Semiworks.

Figure 2-1 provides a timeline of C Plant operations and chemical processes, and WHC-SD-EN-ES-019 provides additional information related to operational history.

2.2.4 S Plant (Reduction-Oxidation Plant)

The REDOX Plant (202S Building), constructed in the 200 West Area in 1952, used the REDOX process to separate/extract uranium and plutonium from irradiated fuel rods until 1967 (WHC-IP-0782, *S Plant Aggregate Management Study Technical Baseline Report*; PNL-MA-588, *Resource Book – Decommissioning of Contaminated Facilities at Hanford*). From December 1966 through February 1967, the REDOX Plant was also used to reprocess enriched uranium fuel from the Shippingport, Pennsylvania, reactor and to recovery americium, curium, and promethium isotopes for shipment to Hot Semiworks for further purification (ARH-SA-4). Supernatant from REDOX waste streams stored in tank farms was transferred to B Plant (200 East Area) for cesium and strontium recovery. Facilities that supported the REDOX Plant include the following (HW-18700, *REDOX Technical Manual*):

- **203S water retention basin:** Stored recovered uranium solution.
- **222S central analytical laboratory:** Provided high- and low-level chemical and radiological analytical services for 200 Area operations.
- **233S plutonium concentration facility:** Concentrated and loaded-out plutonium nitrate product.

- **276S cold solvent storage and makeup building:** Stored and treated new and recovered hexone.
- **291S exhaust fan control house:** Handled ventilation requirements for REDOX Plant.

Figure 2-1 provides a timeline of REDOX Plant operations and associated chemical processes, and WHC-IP-0782 provides more information related to operational history.

2.2.5 U Plant

The U Plant (221U Building), constructed in the 200 West Area in 1944, was built as a bismuth phosphate process separation plant. After U Plant construction was completed, it was determined that B Plant and T Plant provided sufficient plutonium separation capacity; therefore, from 1944 to 1952, U Plant was used as a training facility for workers before they were assigned to other processing facilities/canyons. In 1952, U Plant was converted to perform uranium recovery from bismuth phosphate process waste. It was converted again in 1955 to perform uranium recovery from PUREX-generated waste. Some uranium recovery waste streams were transferred to tank farms in 200 East Area. The U Plant uranium recovery operations ceased in 1958 (DOE/RL-91-52, *U Plant Source Aggregate Area Management Study Report*). Facilities that supported U Plant include the following:

- **224U concentration facility:** Operated as a uranium reduction facility from 1952 to 1955, when it was retooled as the UO_3 Plant (DOE/RL-91-52). The UO_3 Plant ran concurrently with the PUREX Plant to convert liquid UNH from the PUREX Plant to powdered UO_3 (BHI-00174).
- **291U exhaust fan control house:** Handled ventilation needs for the 221U and 224U Buildings (HW-10475 ABC).

Figure 2-1 provides a timeline of U Plant operations and associated chemical processes, and DOE/RL-91-52 provides more information related to operational history.

2.3 Waste Site Descriptions

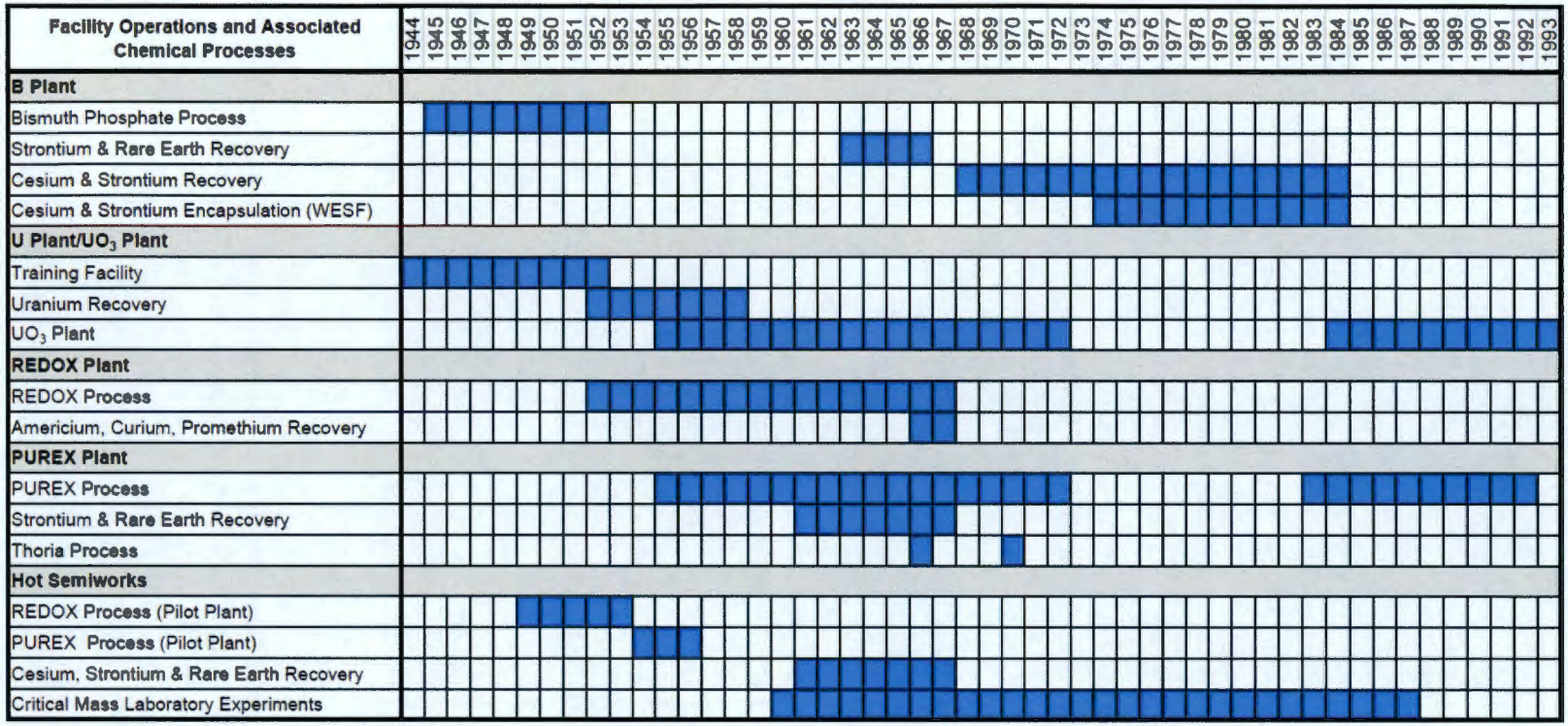
Table 2-2 describes the 200-EA-1 OU the waste site types. The 200-EA-1 scoping document (SGW-60540) provides a list of waste sites and more detailed descriptions of individual waste sites, including which 200-EA-1 OU waste sites are TSD units.

2.4 Environmental Setting

This section summarizes the environmental setting associated with the 200-EA-1 OU. The setting, along with the nature and extent of contamination (Chapter 3), provides the basis for understanding the location, fate, and transport of contamination in the local environment.

2.4.1 Physiography and Topography

The physiographic setting of the Hanford Site is relatively low relief, resulting from river and stream sedimentation filling the synclinal valleys and basins between the anticlinal ridges. Surface topography was modified within the past several million years by Pleistocene era cataclysmic flooding, Holocene eolian activity, and landslides. Cataclysmic floods during the Pleistocene eroded sediments and scoured basalt bedrock, forming "scabland" topography visible north of the Pasco Basin, and large-scale erosional channels visible on the Hanford Site Central Plateau. Figure 2-2 shows the generalized Hanford Site structural geology.



Sources:

ARH-139, *Hazards Evaluation Waste Fractionization – B Plant (Project CAC-144) B-Plant Modifications for FPCE-Waste Management Integrated Facilities (Project CAC-181) and Promethium Purification – B Plant (Project AAE-207).*

BHI-00179, *B Plant Aggregate Area Management Study Technical Baseline Report.*

DOE/RL-91-52, *U Plant Source Aggregate Area Management Study Report.*

DOE/RL-92-04, *PUREX Source Aggregate Area Management Study Report.*

DOE/RL-92-05, *B Plant Source Aggregate Area Management Study Report.*

PNL-MA-588, *Resource Book – Decommissioning of Contaminated Facilities at Hanford.*

RPP-PLAN-47559, *Single-Shell Tank Waste Management Area C Pipeline Feasibility Evaluation.*

WHC-IP-0782, *S Plant Aggregate Management Study Technical Baseline Report.*

WHC-SD-EN-ES-019, *Semiworks Aggregate Area Management Study Technical Baseline Report.*

Figure 2-1. Facility Operations and Chemical Processes Timeline

Table 2-2. 200-EA-1 OU Waste Site Types

Waste Site Type (Number of Sites)	Description
Liquid Waste Disposal and Handling Sites	
Crib (26)	Intermediate-activity waste was discharged to cribs. These engineered structures promoted waste infiltration into the vadose zone to minimize the potential for direct exposure to site workers. Cribs were relatively shallow excavations (typically <10 m [30 ft] deep) and were held open by wood cribbing, concrete culverts, or gravel.
Ditch (7)	Intermediate-activity waste was conveyed through ditches for discharge to cribs and trenches. Ditches were shallow, unlined linear depressions ranging from <100 to >1,200 m (~300 to ~4,000 ft) long.
Trench (4)	Intermediate-activity waste was discharged to trenches. These engineered structures promoted waste infiltration into the vadose zone to minimize the potential for direct exposure to site workers. Trenches were relatively shallow excavations (typically <4.6 m [15 ft] deep) and varied in length (from 7.6 to 122 m [25 to 400 ft]) and width (from 6.1 m [20 ft] to 24.4 m [80 ft]).
Retention basin (6)	High volumes (i.e., $>3.8\times10^7$ L [1×10^7 gal]) of low-activity waste were conveyed through a combination of retention basins, open ditches, and buried pipelines for discharge to ponds or cribs. Retention basins held wastewater until contaminant levels met release standards. They were generally rectangular basins constructed of rubber-lined soil or concrete and ranged in capacity from 189,000 L to $>6\times10^7$ L (~50,000 to $\sim1.6\times10^6$ gal).
French drain (4)	French drains were shallow vertical structures used for infiltration of liquid waste into the vadose zone (generally 1.5 to 4.6 m [5 to 15 ft] bgs). They were often between 0.76 and 1.5 m (2.5 and 5.0 ft) in diameter and constructed of concrete or steel culvert pipe.
Injection/ reverse well (1)	Injection/reverse wells typically consisted of a drilled and cased borehole. The lower portions of the casings were perforated to allow liquid to seep into the vadose zone at depths greater than the cribs and french drains.
Septic system (9)	Septic systems were used for sanitary wastewater disposal from various facilities. They typically consisted of a septic tank and a drain field, leaching trench, or dry well.
Pipeline (6)	The 200-EA-1 OU pipeline waste sites led to an associated crib, french drain, retention basin, or settling tank in the OU. They were constructed of carbon steel, stainless steel, cast iron, or vitrified clay. Other than the 200-E-262-PL pipeline, which was >355 m (1,165 ft) long, the 200-EA-1 OU pipelines were limited to sections <37 m (120 ft) in length.
Valve pit (1)	The HSVP waste site was a stainless-steel structure that housed pipelines systems connecting Hot Semiworks facilities to the 244CR vault.
Depression (1)	The 200-E-142 waste site consists of a depression in the ground where overflow waste drained from a paintbrush washing station. It is located north of the foundation of the demolished 2241B Building.
Solid Waste Disposal and Handling Sites	
Process unit (2)	These sites consist of the remains and below-grade features of the decommissioned 201C facility that was originally built as a pilot plant for the REDOX process, and the footprint of the former 291C filter/fan house facility and the associated ventilation system at Hot Semiworks.
Burn pit (1) Dumping area (4)	These sites are associated with known or suspected solid waste disposal, including surface dumping and construction and office waste burning (e.g., wood debris, metal debris, pipe debris, tar, asphalt, rags, and paint waste).
Burial vault (1) Burial ground (1)	The 218-E-7 burial vault consists of three former burial vaults used for disposal of solid laboratory waste from the 222B laboratory. The 291-C-1 Burial Ground contains a demolished stack that provided exhaust air ventilation for the 201C facility in the Hot Semiworks area.
Foundation (2)	These waste sites consist of potentially contaminated subgrade features and related soil remaining from former Hot Semiworks facilities that have been decommissioned and demolished.

Table 2-2. 200-EA-1 OU Waste Site Types

Waste Site Type (Number of Sites)	Description
Storage area (1)	The 200-E-43 storage area was used to stage rail cars that transported radioactive material.
Unplanned Releases*	
UPRs-liquid (13)	These UPR waste sites consist of contaminated soil resulting from known or suspected liquid releases (e.g., crib overflow and leaks, spills, and/or drips from pipelines, railcars, and/or equipment in storage or in transit. These UPR waste sites vary greatly in size, composition, and depth of release (e.g., surface or subsurface).
UPRs-solid (24)	These UPR waste sites consist of contaminated soil resulting from known or suspected airborne releases, airborne particulate contamination spread, tumbleweeds, and tumbleweed fragments. These UPR waste sites vary greatly in size and most likely have limited vertical extent of contamination.

Note: SGW-60540, *200-EA-1 Operable Unit Scoping*, provides descriptions of individual 200-EA-1 OU waste sites.

* Not all UPR waste sites contain the notation "UPR" in the waste site code.

bgs = below ground surface
HSVP = Hot Semiworks Valve Pit
OU = operable unit
REDOX = Reduction-Oxidation (Plant)
UPR = unplanned release

The 200 East Area is in a relatively flat area of the Hanford Site. Elevations range from 180 to 230 m (590 to 750 ft) (Figure 2-3), sloping to the northeast. DOE/RL-2009-85, *Remedial Investigation Report for the 200-PO-1 Groundwater Operable Unit* (hereinafter referred to as the 200-PO-1 RI report) provides additional information on topography.

2.4.2 Climate and Meteorology

Normal annual precipitation at the Hanford Meteorology Station is 18.1 cm (7.2 in.), with more than one-half of the annual precipitation falling from November through February. The normal annual relative humidity is 55.3%. Relative humidity is highest during winter (December and January), averaging 77.2%, and is lowest during summer (June through August), averaging 36.5%. Prevailing wind direction on the Central Plateau is from the northwest throughout the year, with a secondary wind from the southwest. Monthly wind speeds are lowest during winter months, averaging 3 m/s (6 to 7 mph), and highest during summer, averaging 4 m/s (8 to 9 mph). DOE/RL-2016-33, *Hanford Site Environmental Report for Calendar Year 2015* (hereinafter referred to as the 2015 environmental report) provides additional information.

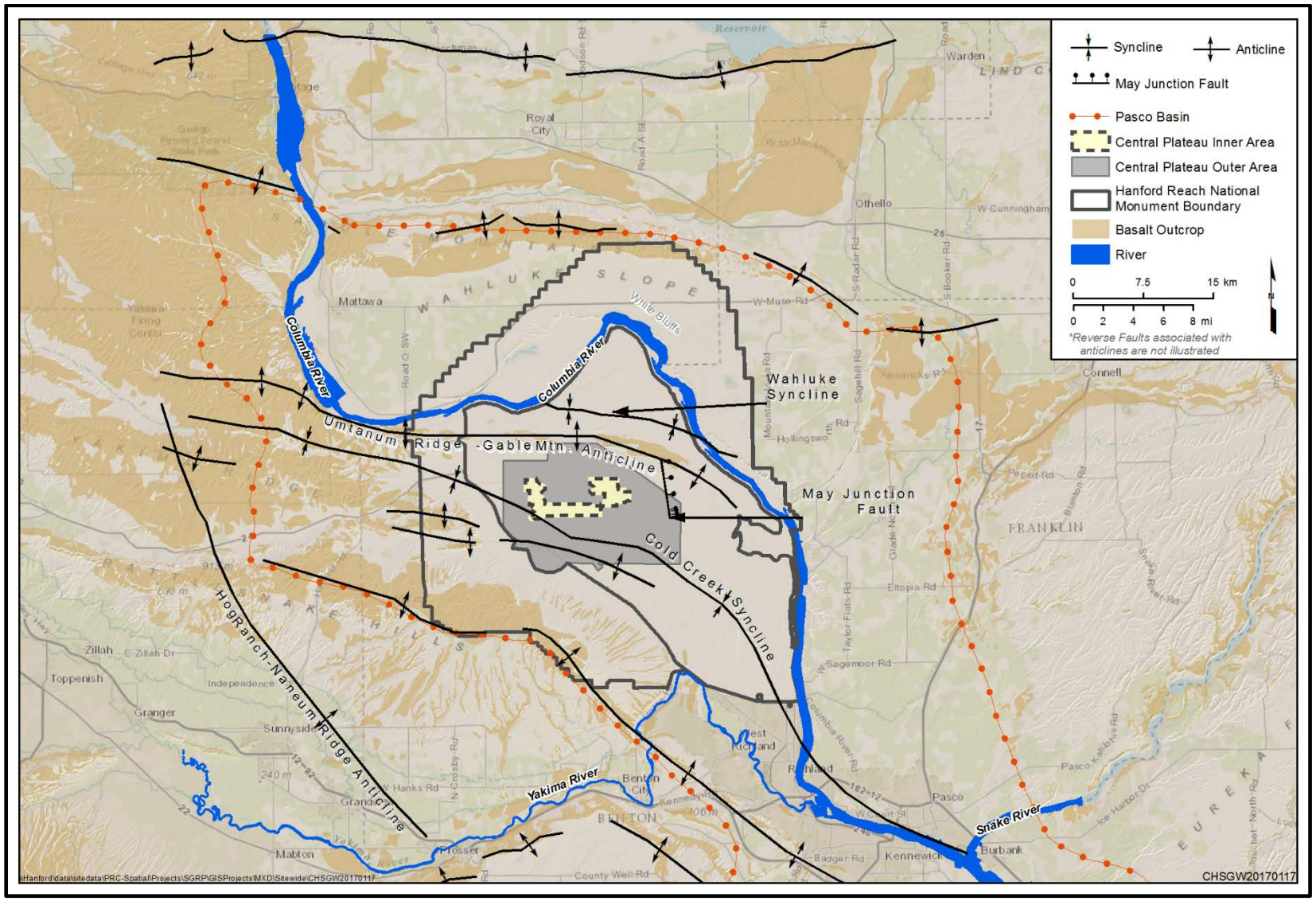


Figure 2-2. Generalized Structural Geology of the Hanford Site

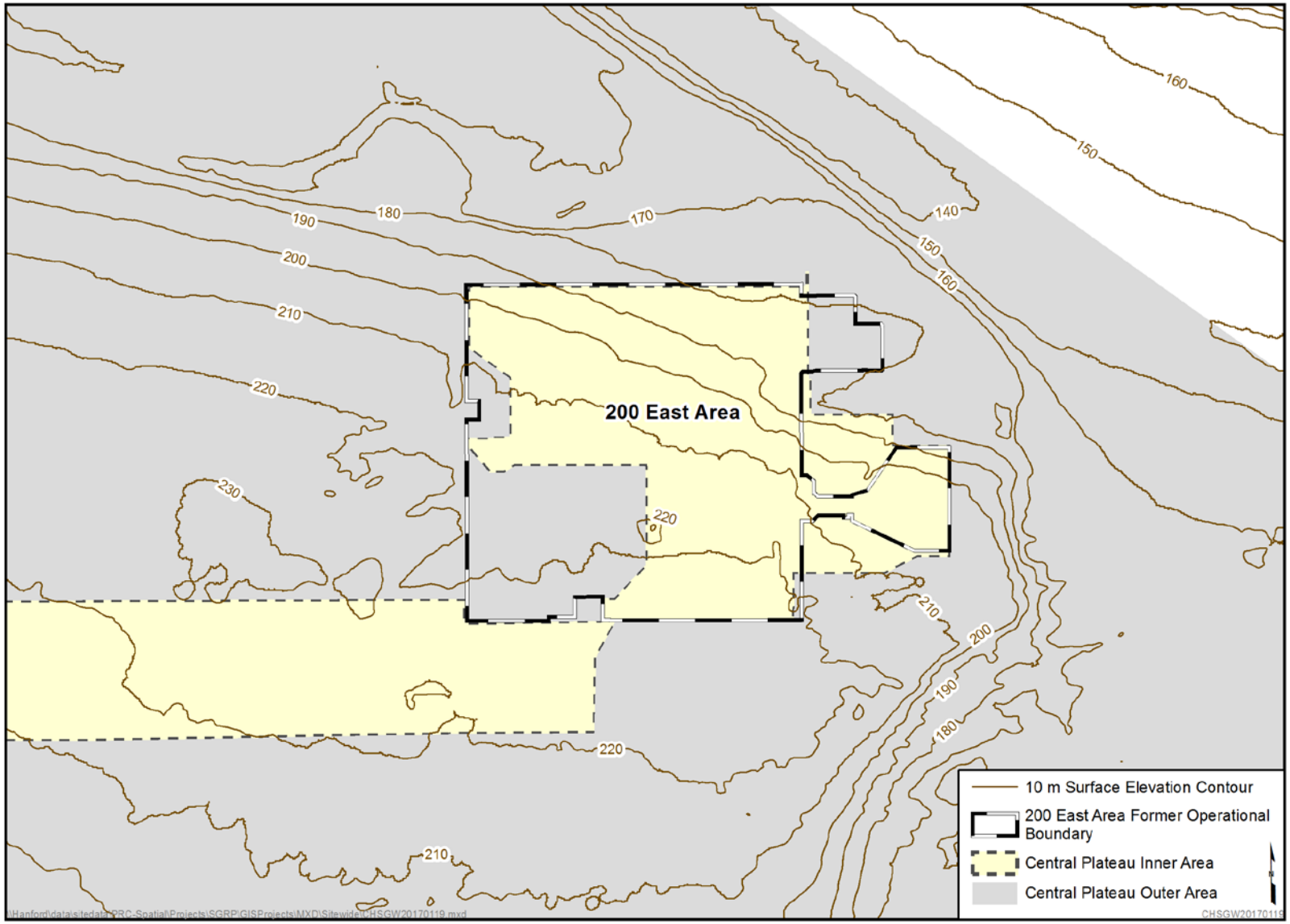


Figure 2-3. 200 East Area Topographic Map

2.4.3 Geology and Hydrogeology

This section presents general Central Plateau geologic and hydrogeologic information and provides the geologic framework for 200-EA-1 OU contaminant migration evaluations discussed in Chapter 3.

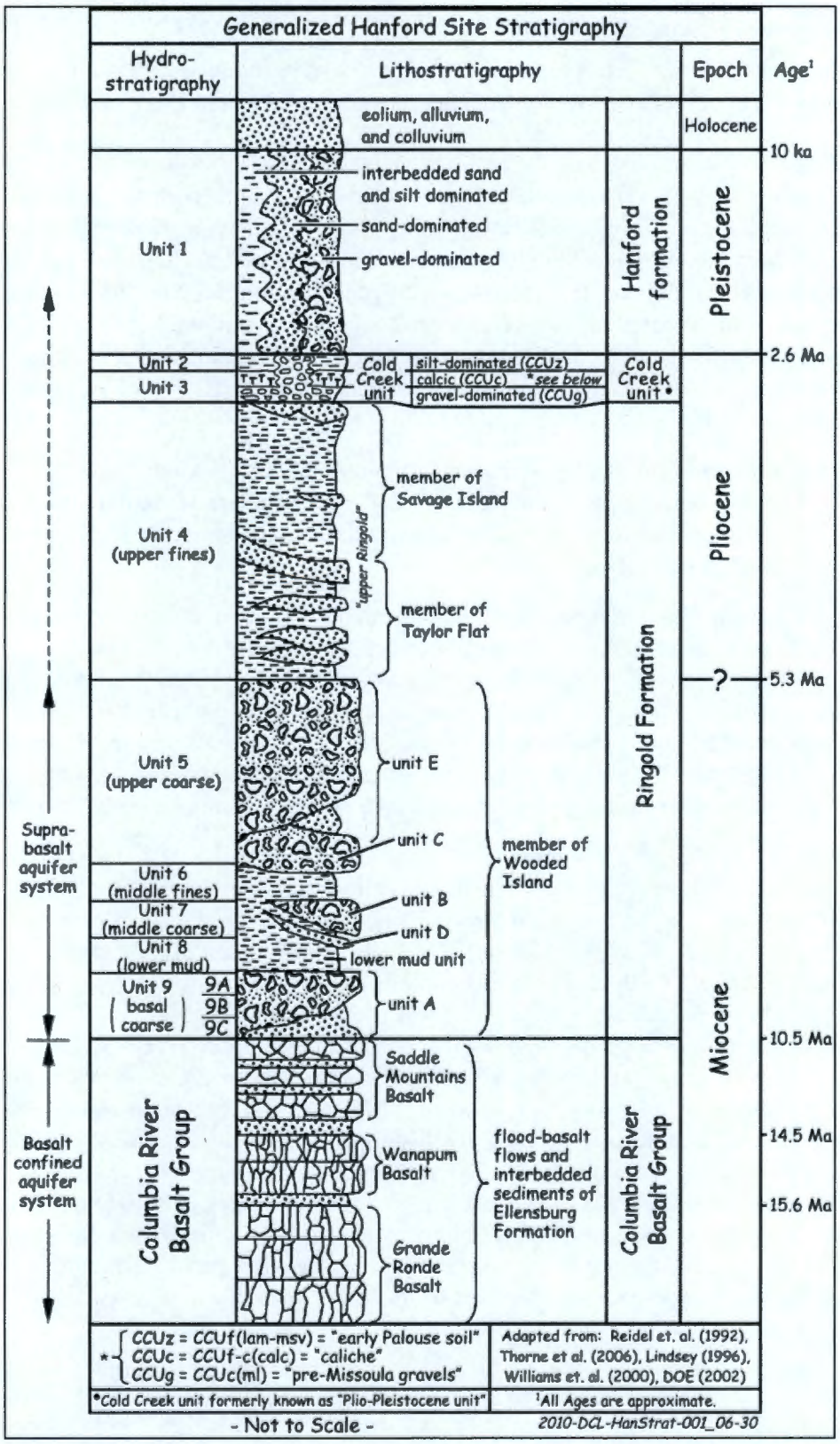
2.4.3.1 Geology

The basalt of the Columbia River Basalt Group and a sequence of suprabasalt sediments underlie the Central Plateau's Inner Area. From oldest to youngest, the major geologic units are the Elephant Mountain Basalt Member, the Ringold Formation, the Cold Creek unit (CCU), the Hanford formation, and the Holocene surficial deposits (Figure 2-4). Hydrogeologic cross sections from available borehole and seismic survey data across the Central Plateau present geologic unit boundaries, spatial relationships, and unconfined aquifer interpretations. Figure 2-5 shows cross-section locations, and Figures 2-6 and 2-7 illustrate the hydrogeologic cross sections near and in the 200 East Area. The following describes the major geologic units of interest:

- **Elephant Mountain Member:** Uppermost basalt unit of the Saddle Mountain Basalt Formation within the Columbia River Basalt Group (Figure 2-4). The Elephant Mountain Member is roughly 35 m (115 ft) thick beneath most of the Inner Area and forms the basement rock for much of the overlying sedimentary deposits.

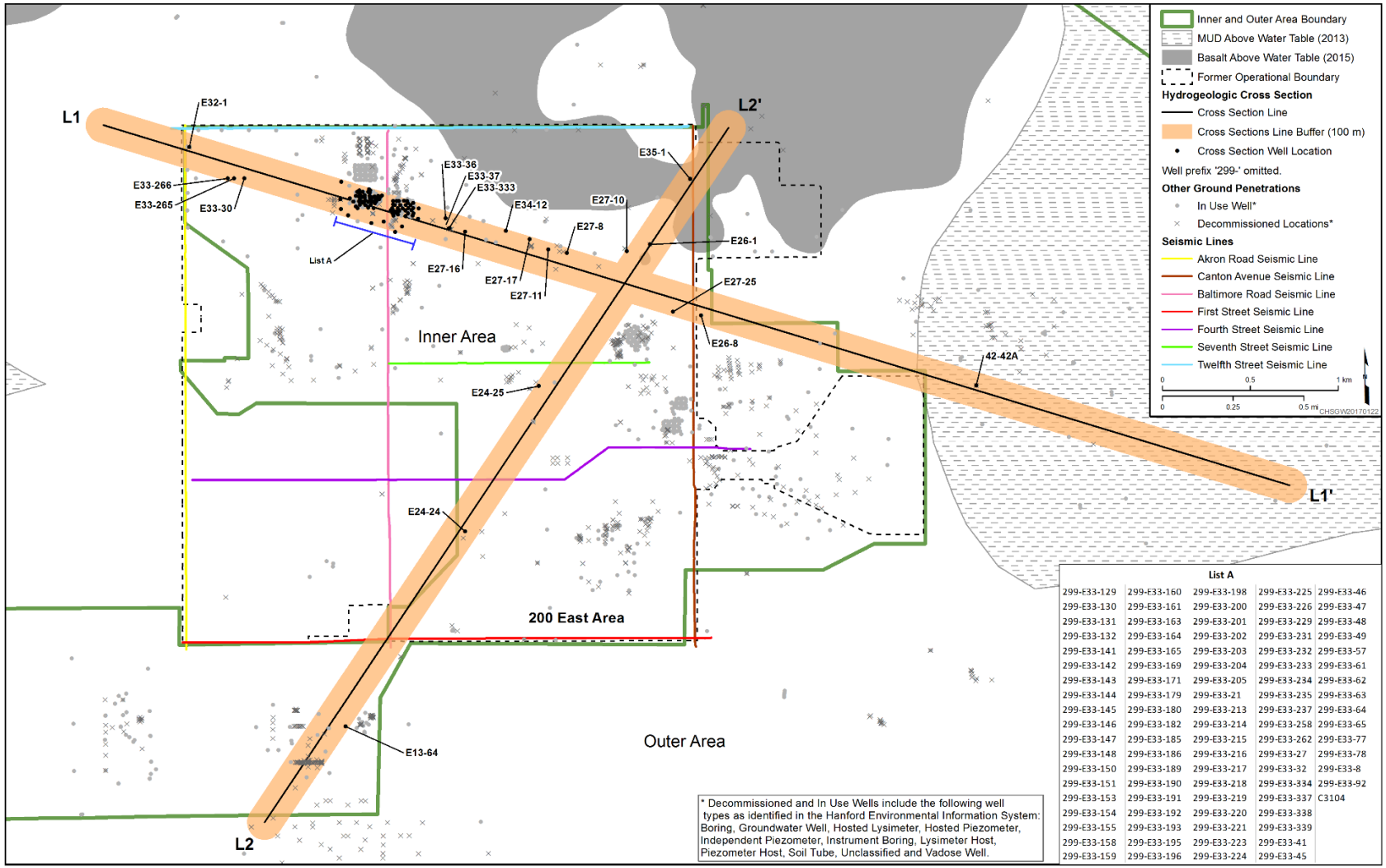
- **Ringold Formation:** Present throughout the southern portion of the 200 East Area, where it overlies basalt. It is largely absent in the northern and northeastern parts of the 200 East Area. Where present within the 200 East Area, the Ringold Formation sediments occur within the saturated zone and sometimes near the water table (Figures 2-6 and 2-7). These units typically have lower hydraulic properties than the overlying shallower and younger geologic units. Where the Ringold Formation is present in the southern 200 East Area, it can also be found beneath the 200-EA-1 OU, extending upward into the vadose zone and primarily consisting of semiconsolidated silty sandy gravel to silty sand.

- **CCU:** Includes post-Ringold Formation and pre-Hanford formation units beneath part of the Inner Area (DOE/RL-2002-39, *Standardized Stratigraphic Nomenclature for Post-Ringold-Formation Sediments Within the Central Pasco Basin*). The CCU is the thinnest of the geologic formations underlying the 200-EA-1 OU and generally exhibits fine-grained and coarse-grained sediment facies whose hydraulic properties can significantly influence groundwater contaminant plume boundaries and contaminant flow through the vadose zone. The CCU fine-grained facies has a limited extent above and below the water table beneath the 200 East Area (Figure 2-6), exhibits higher retention capacity and relatively low hydraulic properties (PNNL-19277, *Conceptual Models for Migration of Key Groundwater Contaminants Through the Vadose Zone and Into the Unconfined Aquifer Below the B Complex*), and has historically resulted in accumulation and lateral spread of perched water within the vadose zone in the CCU beneath high-volume discharge facilities (e.g., ditches, ponds, and cribs). The CCU coarse-grained facies, primarily extending beneath the eastern portion of the Inner Area, form part of the upper unconfined aquifer and exhibit very high hydraulic properties, often creating preferential groundwater flow pathways.



Source: PNNL-18819, *Hanford Site Guidelines for Preparation and Presentation of Geologic Information.*

Figure 2-4. Generalized Hanford Site Stratigraphy



List A

299-E33-129	299-E33-160	299-E33-198	299-E33-225	299-E33-46
299-E33-130	299-E33-161	299-E33-200	299-E33-226	299-E33-47
299-E33-131	299-E33-163	299-E33-201	299-E33-229	299-E33-48
299-E33-132	299-E33-164	299-E33-202	299-E33-231	299-E33-49
299-E33-141	299-E33-165	299-E33-203	299-E33-232	299-E33-57
299-E33-142	299-E33-169	299-E33-204	299-E33-233	299-E33-61
299-E33-143	299-E33-171	299-E33-205	299-E33-234	299-E33-62
299-E33-144	299-E33-179	299-E33-21	299-E33-235	299-E33-63
299-E33-145	299-E33-180	299-E33-213	299-E33-237	299-E33-64
299-E33-146	299-E33-182	299-E33-214	299-E33-258	299-E33-65
299-E33-147	299-E33-185	299-E33-215	299-E33-262	299-E33-77
299-E33-148	299-E33-186	299-E33-216	299-E33-27	299-E33-78
299-E33-150	299-E33-189	299-E33-217	299-E33-32	299-E33-8
299-E33-151	299-E33-190	299-E33-218	299-E33-334	299-E33-92
299-E33-153	299-E33-191	299-E33-219	299-E33-337	C3104
299-E33-154	299-E33-192	299-E33-220	299-E33-338	
299-E33-155	299-E33-193	299-E33-221	299-E33-339	
299-E33-158	299-E33-195	299-E33-223	299-E33-41	
299-E33-159	299-E33-196	299-E33-224	299-E33-45	

Figure 2-5. Hydrogeologic Cross-Section Locations

- **Hanford formation:** Present throughout the Central Plateau and forms the thickest geologic unit beneath the 200 East Area (Figures 2-6 and 2-7). All 200-EA-1 OU waste sites are constructed within the Hanford formation, which consists of unconsolidated gravel, sand, and silts deposited by cataclysmic paleo-floodwater. Contaminants must pass through the Hanford formation to reach the CCU or Ringold Formation and the groundwater.

- **Holocene surficial deposits overlying the Hanford formation:** Consist of recently deposited eolian (windblown) silt and sand (Figure 2-4). These surficial materials, typically extending from ground surface to 3 m (9.8 ft) below ground surface (bgs), have been removed or reworked extensively by construction or operational activities, particularly in the Inner Area.

Clastic dikes are another geologic feature found across the Central Plateau. These dikes form as cross-cutting, vertically oriented fractures and have been observed outcropping on undisturbed ground surface areas as patterned networks. The source of the dikes is assumed to be sediment from the Ringold Formation, typically filled with silt or fine sand, and found to extend through the Hanford formation and Holocene to the surface (DOE/RL-2002-39, *Standardized Stratigraphic Nomenclature for Post-Ringold-Formation Sediments Within the Central Pasco Basin*). Under highly saturated conditions, the dikes can create preferential barriers or pathways for liquids migrating downward through the vadose zone.

Previous investigations have characterized and documented Hanford Site geology. The references listed below provide more recent geologic interpretations and nomenclature, as well as the historical basis for these interpretations.

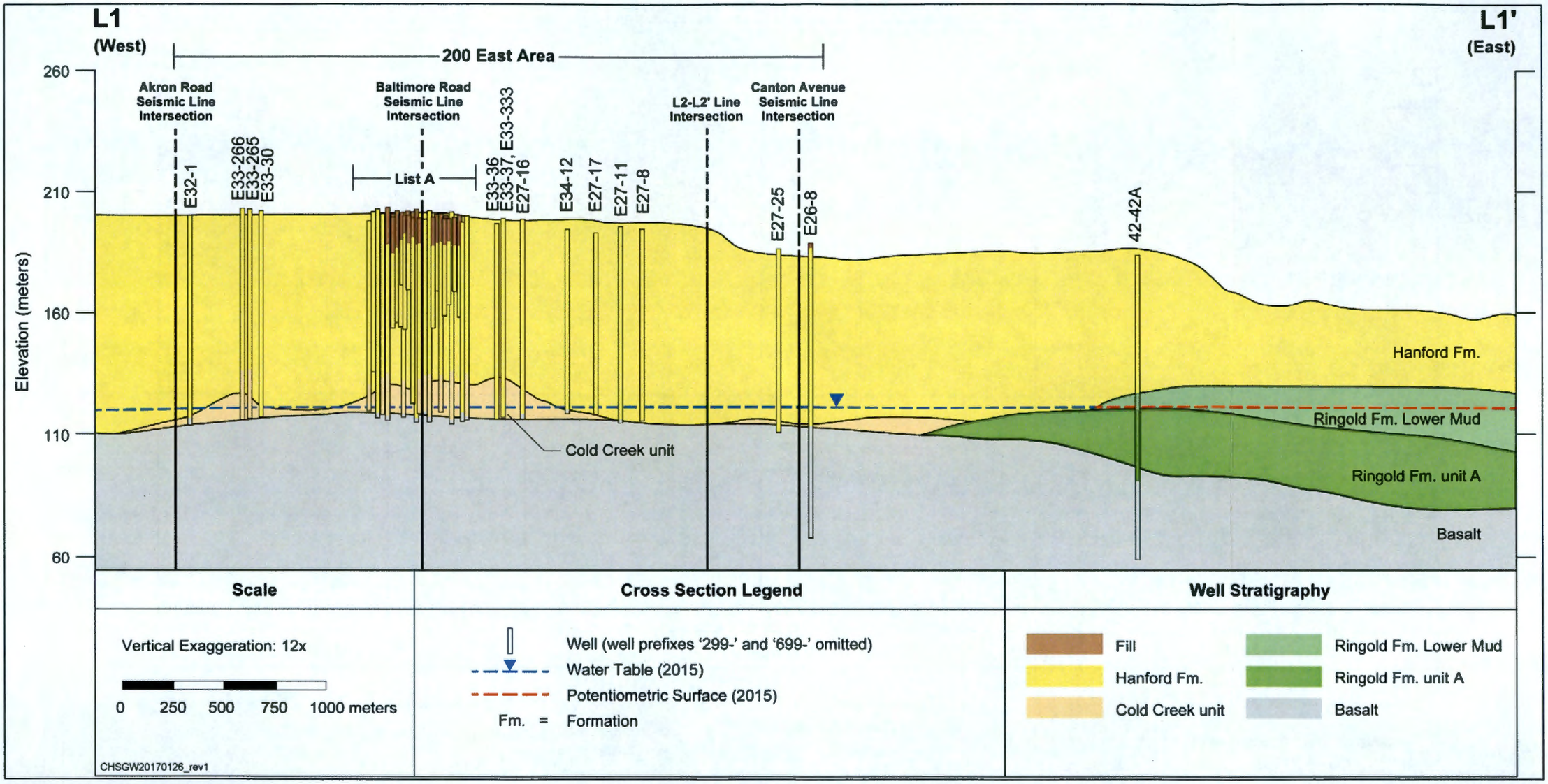
- BHI-00184, *Miocene- to Pliocene-Aged Suprabasalt Sediments of the Hanford Site, South-Central Washington*

- DOE/RL-2002-39, *Standardized Stratigraphic Nomenclature for Post-Ringold-Formation Sediments Within the Central Pasco Basin*

- ECF-Hanford-13-0029, *Development of the Hanford South Geologic Framework Model, Hanford Site Washington*

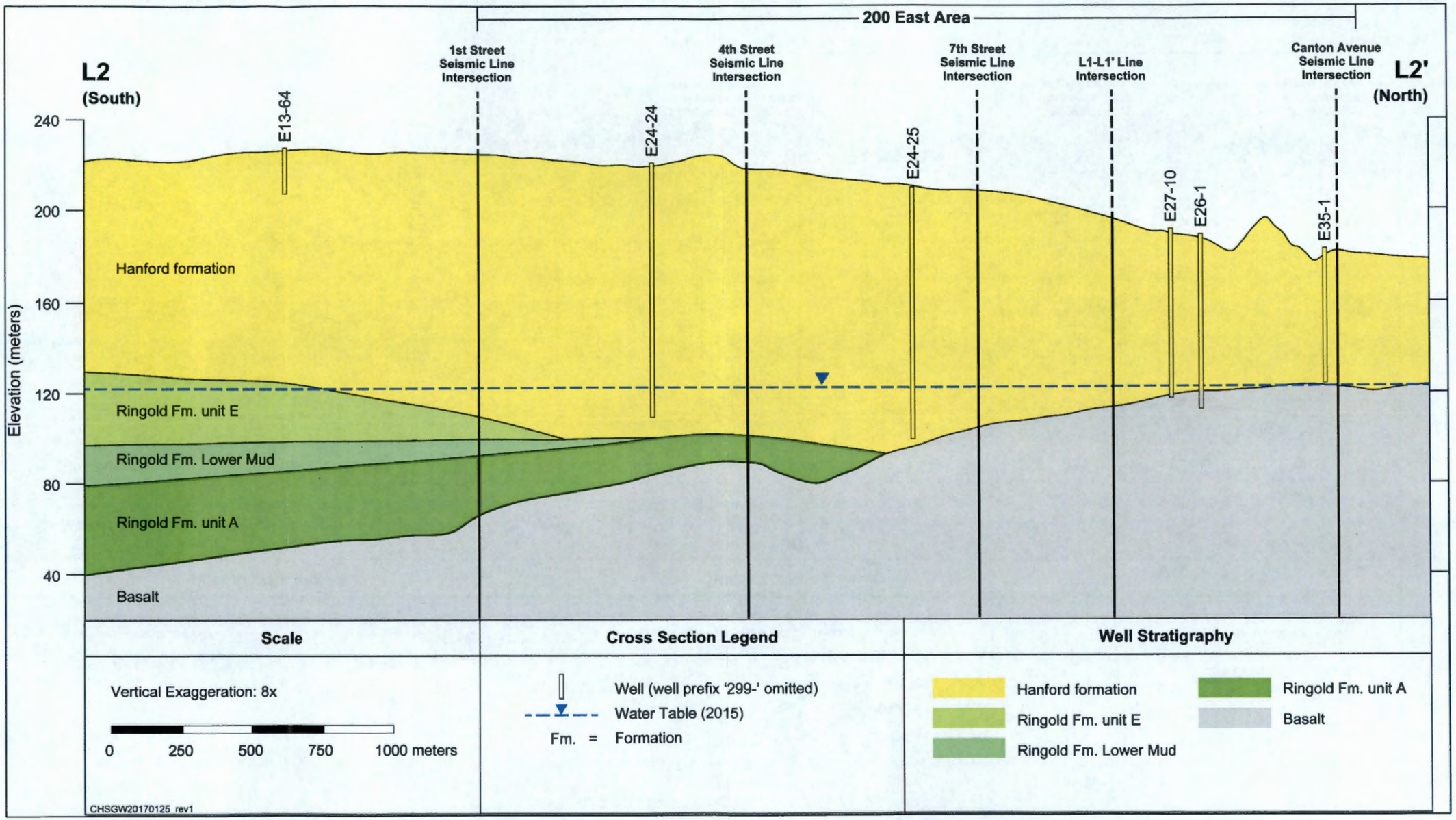
- WHC-SD-ER-TI-003, *Geology and Hydrogeology of the Hanford Site: A Standardized Text for use in Westinghouse Hanford Company Documents and Reports*

- WHC-SD-EN-TI-012, *Geologic Setting of the 200 East Area: An Update*



Note: Figure 2-5 provides well list "A" and cross-section and seismic line locations.

Figure 2-6. 200 East Area L1-L1' Hydrogeologic Cross Section



Note: Figure 2-5 provides cross-section and seismic line locations.

Figure 2-7. 200 East Area L2-L2' Hydrogeologic Cross Section

2.4.3.2 Hydrogeology

Elements of Central Plateau hydrogeology important to the 200-EA-1 OU include vadose zone stratigraphy, vadose zone thickness, perched water, depth to groundwater (i.e., water table elevation), presence of mud and basalt surfaces above the water table, and groundwater flow direction.

The hydrostratigraphic units of interest, from oldest to youngest, include the Saddle Mountain Basalt (base of the unconfined aquifer), the Ringold Formation (including the Ringold Formation lower mud unit [RLM], where present), the CCU, and the Hanford formation. The vadose zone is ~80 m (262 ft) thick in the 200 East Area, with a localized area of perched water near the B-BX-BY Tank Farms. The unconfined aquifer water table lies within either the Hanford formation, Ringold Formation, or CCU (Figures 2-6 and 2-7) (PNNL-12261, *Revised Hydrogeology for the Suprabasalt Aquifer System, 200-East Area and Vicinity, Hanford Site, Washington*). Groundwater in the unconfined aquifer generally flows from upland areas in the west, and southwest toward the Columbia River to the north and east, which is the regional discharge area (DOE/RL-2016-67, *Hanford Site Groundwater Monitoring Report for 2016*). Figures 2-8 and 2-9 show the water table elevation and groundwater flow direction for the Hanford Site and part of the Central Plateau, respectively. Figure 2-9 also shows the locations of the 200 East Area extraction wells that are either currently used or may be used in the future to remove groundwater with elevated uranium and technetium-99 for treatment at the 200 West pump-and-treat facility (DOE/RL-2017-11, Draft A, *Removal Action Work Plan for the 200-BP-5 Operable Unit Groundwater Extraction*). Other contaminants may also be removed from groundwater by the 200 West pump-and-treat system. Section 3.2.3.2 in Chapter 3 discusses groundwater monitoring and contaminant plumes.

Current and future pumping operations at 200 East Area extraction wells may impact the water table elevation and groundwater flow direction. The older Ringold Formation units (e.g., RLM), which are low-permeability hydrogeologic units, and the basalt unit are present above the water table in the northeastern 200 East Area and create barriers to groundwater flow (Figures 2-8 through 2-10). Groundwater flow may also be impacted by Treated Effluent Disposal Facility (TEDF) discharges (Figures 2-8 and 2-9), which can act as a hydraulic dam, decreasing the groundwater gradient and causing slower groundwater flow rates. Extended periods of higher TEDF discharges (as experienced in 2014 and 2015) are expected due to the underground tank retrieval program (DOE/RL-2016-67, *Hanford Site Groundwater Monitoring Report for 2016*). The basalt surface extends above the water table in other parts of the Inner Area, creating a zero-thickness aquifer boundary; however, the basalt surface in some parts of the northern 200 East Area is fractured or has a relatively permeable flow top that can be saturated and can locally extend the lateral continuity of the unconfined aquifer (PNNL-14753, *Groundwater Data Package for Hanford Assessments*; RHO-RE-ST-12 P, *An Assessment of Aquifer Intercommunication in the B Pond-Gable Mountain Pond Area of the Hanford Site*).

Figure 2-10 uses a 5 mm (0.2 in.) contour interval and illustrates the flat nature of the water table in the 200 East Area, which occurs because the current unconfined aquifer water table is present in highly permeable Hanford and CCU sediment and is impacted by very little recharge (SGW-58828, *Water Table Maps for the Hanford Site 200 East Area, 2013 and 2014*).

Natural surface stream water sources or active drainage channels are not present in the Inner Area. Infiltration and recharge rates vary depending on the soil and vegetation (e.g., bare surface infiltration rates exceed undisturbed mature shrub-steppe infiltration rates). DOE/RL-2011-50, *Regulatory Basis and Implementation of a Graded Approach to Evaluation of Groundwater Protection* (hereinafter referred to as the graded approach document) provides further discussion on the infiltration and recharge rates across the Hanford Site.

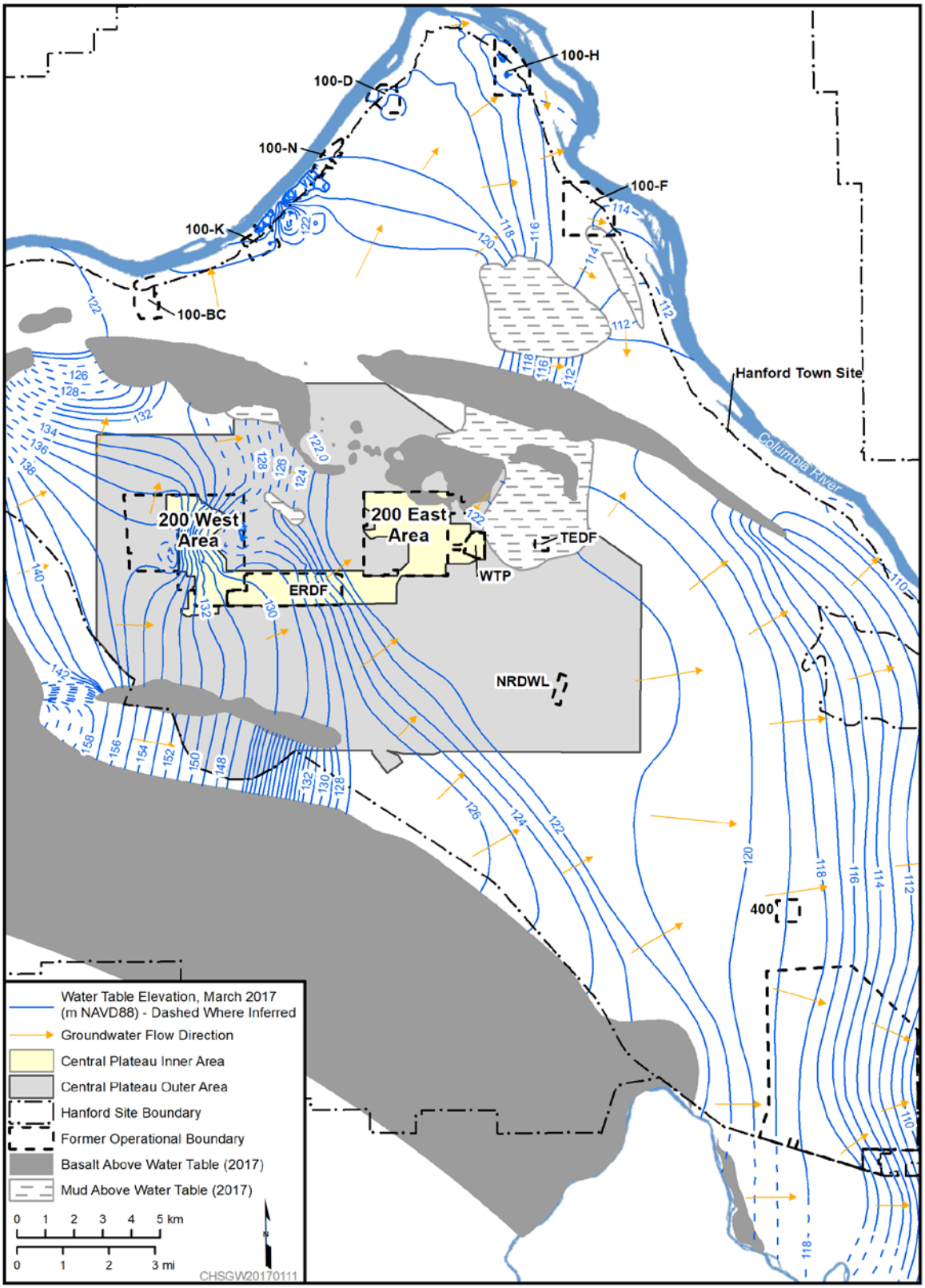


Figure 2-8. Hanford Site Water Table and Directions of Groundwater Flow, March 2015

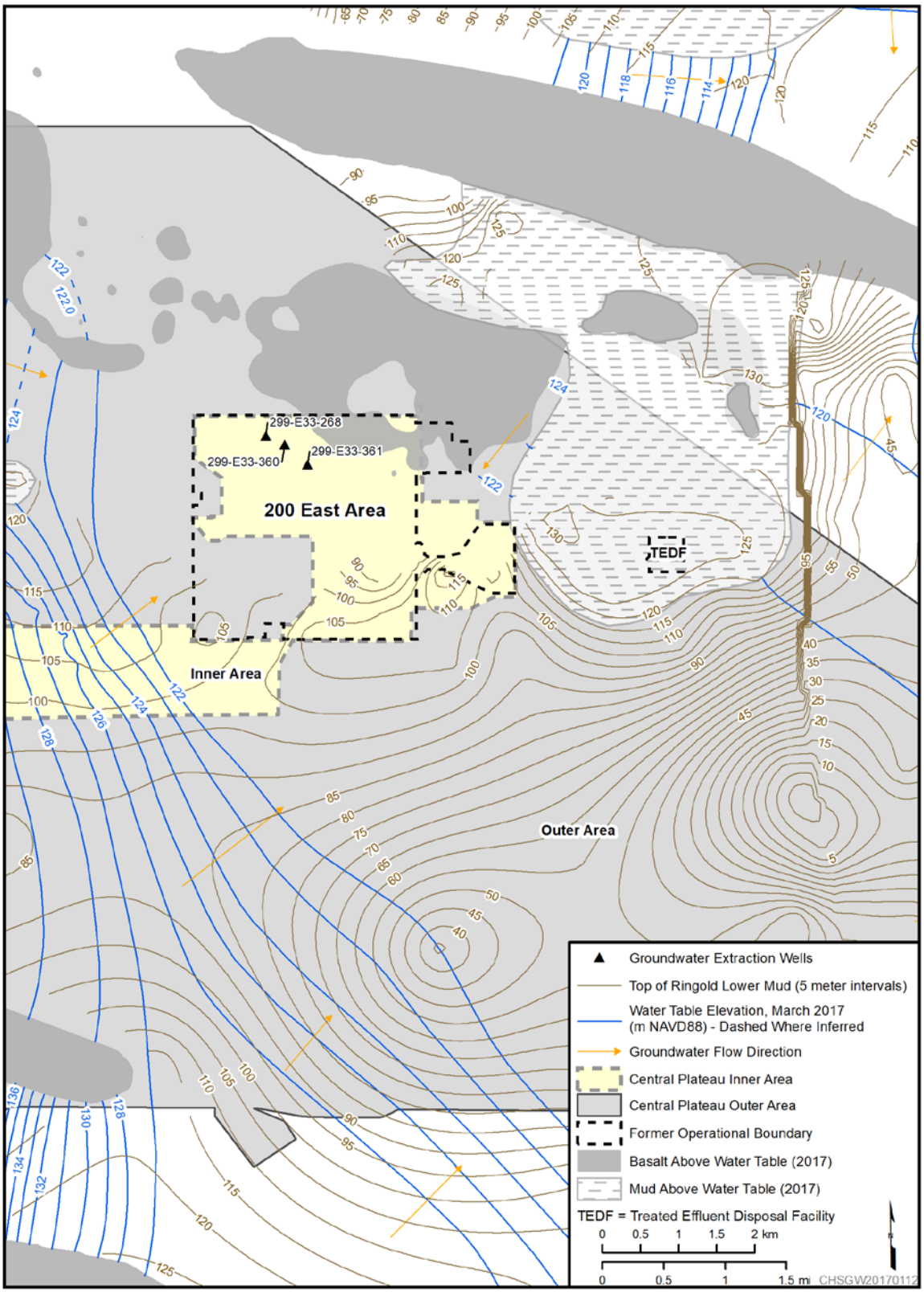


Figure 2-9. Central Plateau Inner Area Water Table and Directions of Groundwater Flow

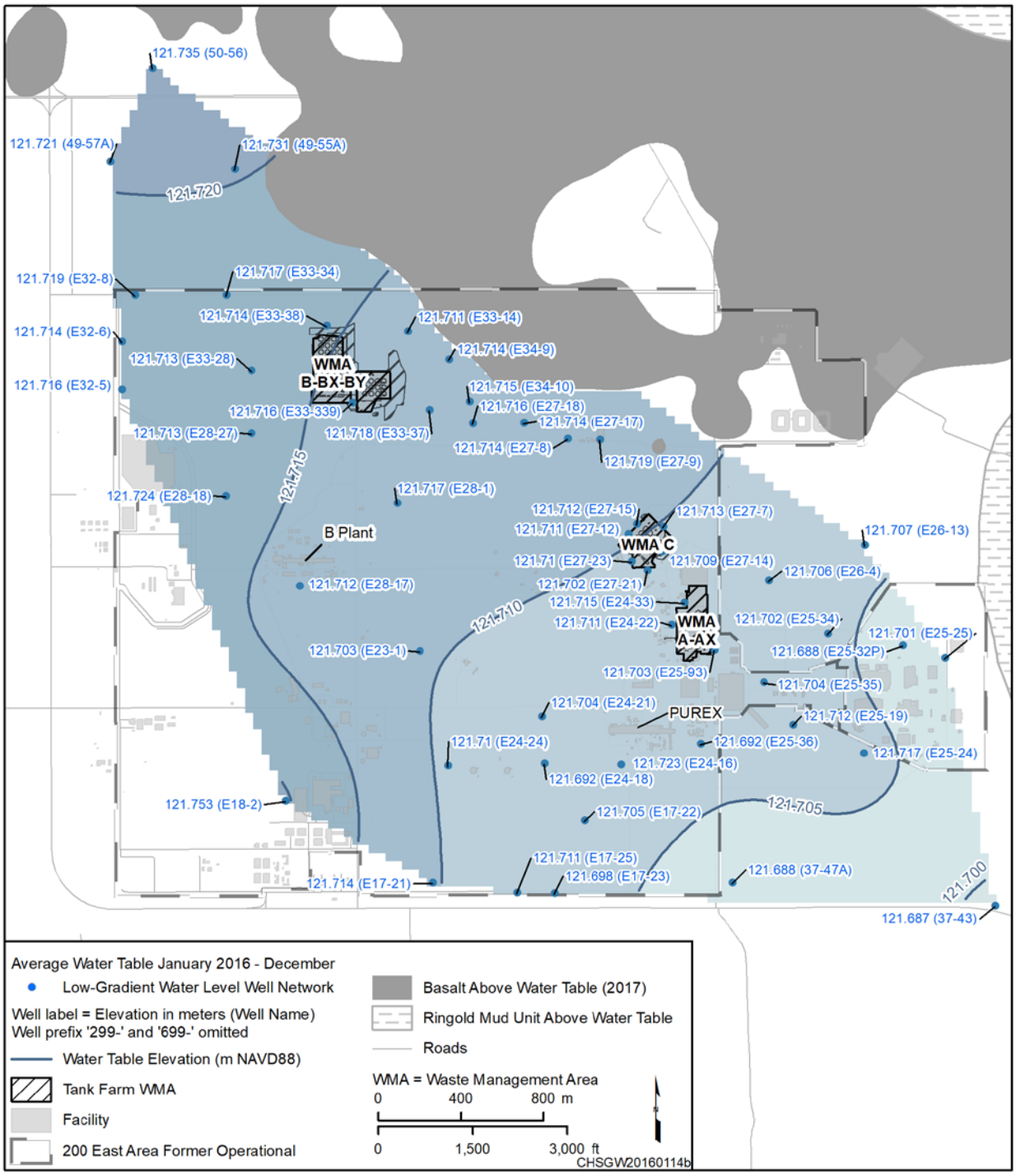


Figure 2-10. 200 East Area Average Water Table, January Through December 2015

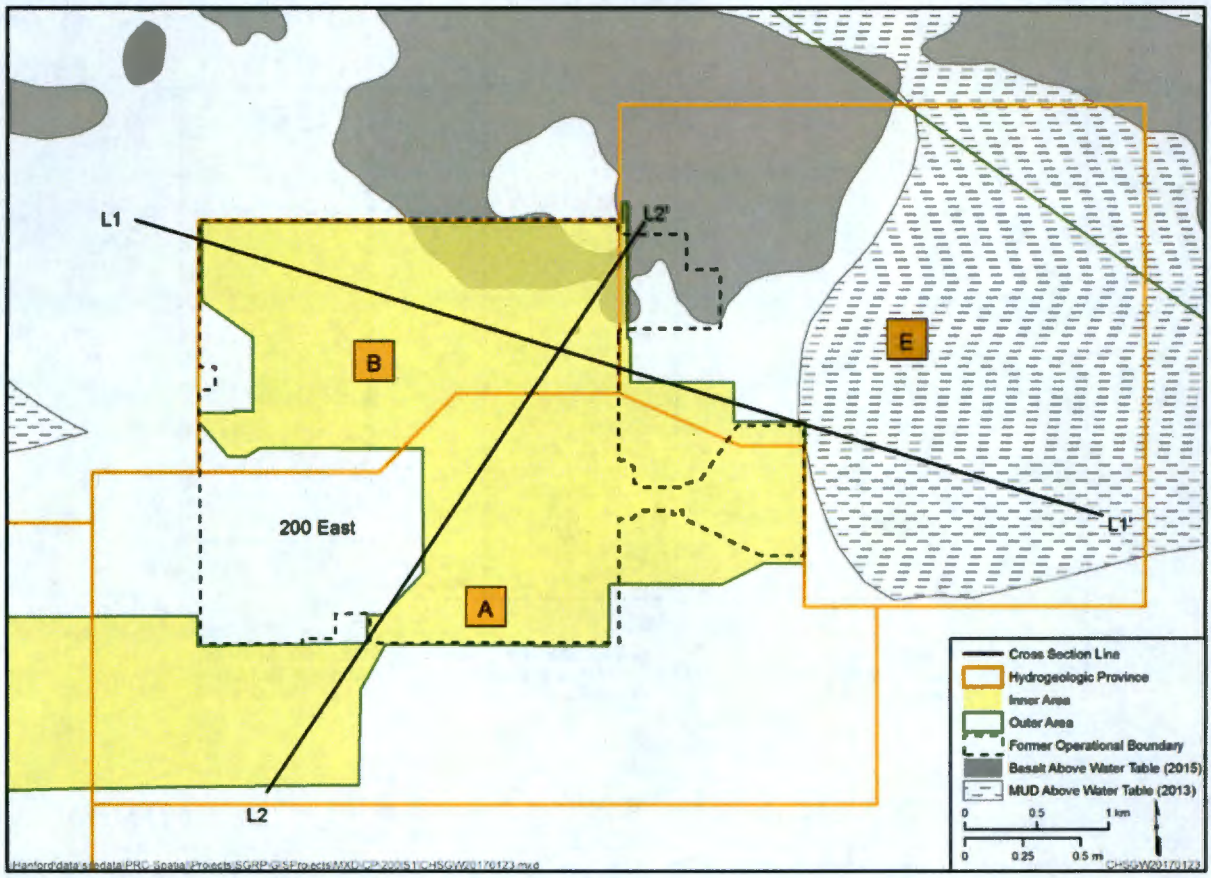
The following documents present additional information on Central Plateau Inner Area hydrogeology:

- CP-47631, *Model Package Report: Central Plateau Groundwater Model, Version 8.4.5*
- CP-57037, *Model Package Report: Plateau to River Groundwater Transport Model, Version 7.1*
- CP-60925, *Model Package Report: Central Plateau Vadose Zone Geoframework, Version 1.0*

- ECF-HANFORD-13-0029, *Development of the Hanford South Geologic Framework Model, Hanford Site, Washington*
- PNNL-12261, *Revised Hydrogeology for the Suprabasalt Aquifer System, 200-East Area and Vicinity, Hanford Site, Washington*
- PNNL-14702, *Vadose Zone Hydrogeology Data Package for Hanford Assessments*

2.4.3.3 Central Plateau Geographic Provinces

The graded approach document (DOE/RL-2011-50) describes the conceptual model for Central Plateau vadose zone fate and transport and provides the framework for future 200-EA-1 OU geologic discussions. To develop a reasonable and representative range of site hydrostratigraphic profiles for the Central Plateau, the graded approach document identified five areas that best define unique and representative hydrogeologic columns. Figure 2-11 illustrates three of these areas (designated as provinces A, B, and E), that are relevant to the 200-EA-1 OU.



Note: Modified from DOE/RL-2011-50, *Regulatory Basis and Implementation of a Graded Approach to Evaluation of Groundwater Protection.*

Figure 2-11. 200 East Area Geographic Provinces Represented by Unique Hydrogeologic Columns

Figure 2-12 presents the respective hydrogeologic columns using these provinces and the information discussed in Section 2.4.3.1 and Figures 2-6 and 2-7. Figure 2-12 illustrates the lithologic heterogeneities within the provinces. Measurement of the hydrogeochemical properties (e.g., sediment chemistry, sediment physical properties, and pore water chemistry) contributes to the understanding of contaminant

transport and attenuation, and supports transport model parameterization. Site-specific information is considered when evaluating the nature and extent of contamination (Section 3.3 in Chapter 3).

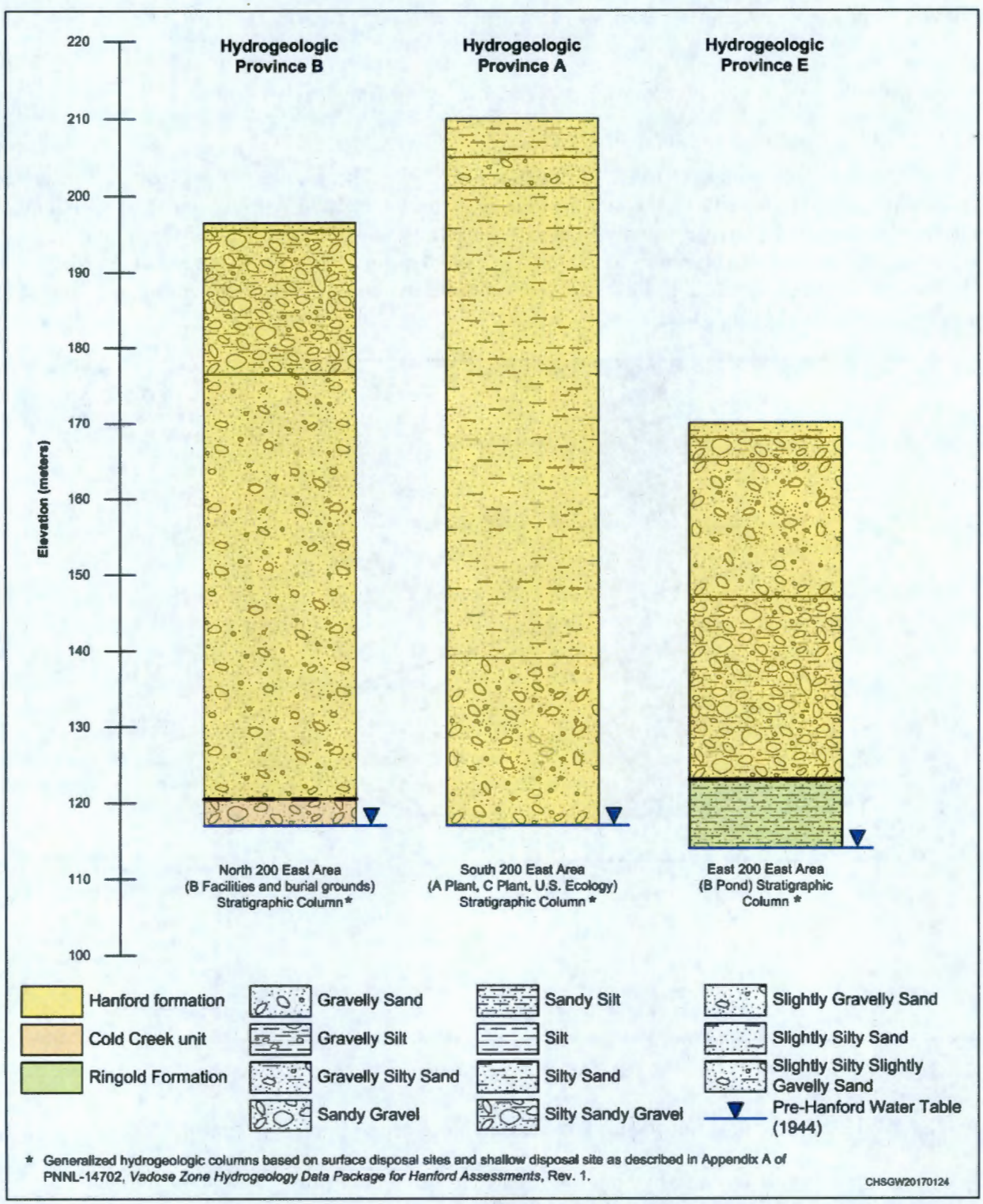


Figure 2-12. Vadose Zone Hydrogeologic Columns for the 200 East Area Geographic Provinces

2.4.4 Environmental Resources

The Hanford Site supports a biological community typical of a cool desert or a shrub-steppe environment. The ecological setting has been characterized using data from numerous inventories of plant and wildlife species and ecological characterizations, including the following:

- The Nature Conservancy of Washington sitewide geographic information system-based plant community mapping for areas outside the Hanford Site boundaries and mammal, bird, reptile, amphibian, insect, and plant biodiversity surveys between 1994 and 1998 (Pabst, 1995, *Biodiversity Inventory and Analysis of the Hanford Site, 1994 Annual Report*; Soll and Soper, 1996, *Biodiversity Inventory and Analysis of the Hanford Site, 1995 Annual Report*; Hall, 1998, *Biodiversity Inventory and Analysis of the Hanford Site, 1997 Annual Report*; Soll et al., 1999, *Biodiversity Inventory and Analysis of the Hanford Site, Final Report 1994-1999*)
- 200 Area ecological data compilation (PNNL-13230, *Hanford Site Environmental Report for Calendar Year 1999*; PNNL-13331, *Population Characteristics and Seasonal Movement Patterns of the Rattlesnake Hills Elk Herd—Status Report 2000*; PNNL-13487, *Hanford Site Environmental Report for Calendar Year 2000*; and PNNL-13745, *Hanford Site Ecological Quality Profile*)
- Hanford biological resources management plan, which provide strategies and management actions necessary to sustain Hanford Site biological resources, including the protection of species and habitats of state and federal concern (DOE/RL-96-32, *Hanford Site Biological Resources Management Plan*)
- Hanford Site bird species (WHC-EP-0402, *Status of Birds at the Hanford Site in Southeastern Washington*)
- Hanford Site vascular plants (PNNL-13688, *Vascular Plants of the Hanford Site*)
- 200 Area facilities vegetative communities characterization (WHC-SD-EN-TI-216, *Vegetation Communities Associated with the 100-Area and 200-Area Facilities on the Hanford Site*)

The following sections describe the animals and plants relevant to the 200-EA-1 OU. Section 3.11 in Chapter 3 describes federal and state requirements related to species such as swallows that are not discussed in this section.

2.4.4.1 Animals

Federally listed endangered or threatened birds, mammals, reptiles, amphibians, or invertebrates are not known to occur on the Hanford Site. However, the ferruginous hawk (*Buteo regalis*) has been listed as threatened by Washington State and may occur on the Central Plateau (2015 environmental report [DOE/RL-2016-33]). CHPRC-01311, *Tier 2 Risk-Based Soil Concentrations Protective of Ecological Receptors at the Hanford Site* (hereinafter referred to as the Tier 2 wildlife PRGs report), presents the framework for deriving risk-based concentrations in soil for use in evaluating ecological risk and identifies representative species used in Hanford Site risk assessments. The following resident receptor species are relevant to the 200-EA-1 OU, which include a range of feeding guilds, toxicological sensitivities, and mobilities (e.g., homerange[1]):

- Great Basin pocket mouse (*Perognathus parvus*)
- Badger (*Taxidea taxus*)

[1] Homerange is generally defined as the area where an animal lives, defends territory, feeds, and breeds.

- Deer mouse (*Peromyscus maniculatus*)
- Northern grasshopper mouse (*Onychomys leucogaster*)
- California quail (*Callipepla californica*)
- Red-tailed hawk (*Buteo jamaicensis*)
- Western meadowlark (*Sturnella neglecta*)
- Killdeer (*Charadrius vociferus*)

Although they are part of the Central Plateau food web, the Tier 2 wildlife PRGs report (CHPRC-01311) did not develop soil screening levels for reptiles or amphibians due to a lack of effects data (i.e., toxicity).

Animal burrowing behavior is also relevant for its potential to result in exposure to and migration of subsurface contamination. Badgers are the deepest burrowing mammal at the Hanford Site, with maximum burrow depths of 2.3 m (7.5 ft) bgs. Badgers have been implicated several times for tunneling into Central Plateau inactive burial grounds in search of prey (e.g., mice and ground squirrels). Burrow depths for other mammals did not reach >140 cm (4.6 ft) bgs. Harvester ants (*Pogonomyrmex owyheei*) are a common invertebrate resident species that has been implicated in the uptake of radionuclides from several 200 East Inner Area landfills. The maximum documented burrowing depth of harvester ants at the Hanford Site, and the depth from which ants can excavate and bring material to the surface, is 270 cm (8.9 ft) bgs, with only trivial excavations >244 cm (8.0 ft) bgs (CHPRC-00651, Draft B, *Evaluation of Biointrusion Depths at the Hanford Site for Protection of Ecological Receptors*). Animals (burrowing and nonburrowing) may also mobilize contamination through other activities including feeding on contaminated food items, spreading contaminated feces and urine, and creating contaminated nesting material. Section 2.4.4 lists the documents providing additional information on the species mentioned in this discussion and other animals found in the Central Plateau Inner Area.

2.4.4.2 Plants

More than 100 plant species have been documented in Hanford Site native stands (PNNL-13688, *Vascular Plants of the Hanford Site*). Two plant species, Umtanum desert buckwheat (*Eriogonum codium*) and White Bluffs bladderpod (*Physaria douglasii sp. tuplashensis*) are listed as federally threatened but are not known to occur in the Central Plateau Inner Area. No other plants known to occur on the Hanford Site are currently on the federal endangered and threatened species list (2015 environmental report [DOE/RL-2016-33]). The following species have been listed as threatened by Washington State and may occur in the Central Plateau Inner Area:

- Great Basin gilia (*Aliciella [Gilia] leptomeria*)
- Rosy pussypaws (*Cistanthe [Calyptridium] rosea*)
- Desert dodder (*Cuscuta denticulata*)
- Loeflingia (*Loeflingia squarrosa*)

The following species have been listed as sensitive by Washington State and may occur in the Central Plateau Inner Area (2015 environmental report [DOE/RL-2016-33]):

- Coyote tobacco (*Nicotiana attenuata*)
- Dwarf evening primrose (*Eremothera pygmaea*)
- Gray cryptantha (*Cryptantha leucophaea*)
- Piper's daisy (*Erigeron piperianus*)

- Small-flower evening-primrose (*Eremothera minor*)
- Suksdorf's monkey flower (*Erythranthe suksdorfii*)
- Thompson's sandwort (*Eremogone franklinii var. thompsonii*)

The Central Plateau Inner Area does not contain any Washington State plant community element occurrences (i.e., priority ecosystems) or significant or rare habitat areas (DOE/RL-96-32, *Hanford Site Biological Resources Management Plan*). Disturbed plant communities are primarily the result of mechanical disturbance or range fires and are revegetated with native species in accordance with DOE/RL-2011-116, *Hanford Site Revegetation Manual*. Section 2.4.4 provides a list of documents providing additional information on Hanford Site plant species.

Plants have the potential to affect biomobilization of subsurface contamination through root uptake, translocation, and detrital decomposition. Shrubs are the deepest rooting plants, with depths to 300 cm (9.8 ft) for antelope bitterbrush (*Purshia tridentate*), a species with a very limited distribution in the Central Plateau. The two most abundant shrub species, big sagebrush (*Artemisia tridentata*) and grey rabbitbrush (*Chrysothamnus nauseosus*), do not have roots deeper than 250 cm (8.2 ft) bgs. The deepest rooted forb, Russian thistle (*Salsola kali*), had a maximum root depth of 240 cm (7.9 ft) bgs. Other forbs and grasses had rooting depths of <220 cm (7.2 ft) bgs (CHPRC-00651, Draft B).

Vegetative cover also affects precipitation infiltration and groundwater recharge rates. DOE/RL-96-32, *Hanford Site Biological Resources Management Plan,* describes Hanford Site vegetative cover types, and the graded approach document (DOE/RL-2011-50) provides further information on Hanford Site infiltration and recharge rates.

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3 Initial Evaluation

This chapter summarizes the current understanding of 200-EA-1 OU site conditions, including the nature and extent of contamination and the adequacy of existing information to support RFI/CMS/RI/FS decisions.

Based on existing information, anticipated future land and groundwater use, and potential receptor exposures, existing conditions were assessed to develop a preliminary CSM and to estimate the range of conditions that may be encountered during future characterization programs. The site-specific workshop evaluations presented in Appendix C and the preliminary CSM, risk evaluation, and potential response actions described in this chapter were used to identify 200-EA-1 OU data needs, which are presented in Chapter 4. Table 3-1 provides an overview of the chapter organization.

Table 3-1. Organization of Chapter 3 Sections and Supporting Appendices

Section/Appendix	Element Addressed
Sections 3.1 through 3.3	Existing conditions
Sections 3.4 through 3.7	Potential contaminant exposure
Sections 3.8 through 3.9; Appendices C and D	Risk characterization
Sections 3.10 through 3.13; Appendix E	Potential response actions

3.1 Contaminated Media

The 200-EA-1 OU waste sites conveyed or received waste and process liquids, resulting in the following types of contaminated media that may pose a risk to HHE:

- **Soil:** Surface and vadose zone soil contamination resulted from liquid and windblown particulate releases from 200-EA-1 OU waste sites, other OU waste sites, tank farm waste management areas (WMAs), nonwaste site facility features, and site operations. While previous surveys have likely identified contaminated surface soil from past releases, unidentified contamination may exist. The 200-EA-1 OU waste sites may result in contaminated biota where shallow zone (0 to 4.6 m [0 to 15 ft]) contamination is present.

- **Solid waste and debris:** The engineered structures that have been in direct contact with process waste streams (e.g., french drains, cribs, retention basins, and valve pits) are most likely contaminated and include materials such as concrete and infiltration gravels. Internal solids (i.e., sludge) potentially remain in the valve pits and pipelines. In addition, the 200-EA-1 OU waste sites include solid waste disposal and handling sites (e.g. burial grounds, burial vaults, dumping areas, and storage areas) that contain solid waste and debris. The 200-EA-1 OU waste sites may also include nonsoil material that has been contaminated by past releases (e.g., railroad tracks and ties).

- **Residual internal liquids:** Substantial residual liquid volumes are not expected at the 200-EA-1 OU waste sites. Waste sites where residual liquid might be present include diversion boxes, pipelines, valve pits, and septic systems. Diversion boxes, valve boxes, and valve pits were isolated and/or filled with concrete or clean soil. Most 200-EA-1 OU pipelines are short, small-diameter, gravity-drained lines that would not accumulate liquids. One pressurized pipeline system (200-E-262-PL) was isolated. Most 200-EA-1 OU septic system tanks have been abandoned and backfilled with clean fill and do not contain residual liquids, two septic system tanks are part of an active sanitary system and

likely contain residual liquids, and the abandonment status of the remaining two septic system tanks is unknown.

- **Groundwater:** Contamination in groundwater underlying the 200-EA-1 OU waste sites is known to exist and will be addressed through 200-BP-5 and 200-PO-1 OU response actions. Section 3.2.2.2 identifies the 200-EA-1 OU waste sites known or suspected to have contaminated groundwater. Section 3.3 presents additional analysis of potential ongoing or future contributions to groundwater contamination.

Section 2.3 provides general descriptions of the 200-EA-1 OU waste site types, and the 200-EA-1 scoping document (SGW-60540) describes potential contamination at individual waste sites.

3.2 Previous Investigations and Monitoring Activities

This section summarizes previous investigation and monitoring activities relevant to the 200-EA-1 OU waste sites. Most activities involving current 200-EA-1 OU waste sites were conducted when the waste sites were part of other OUs (Figure 1-2 in Chapter 1). Information from previous investigations and monitoring programs is presented in the 200-EA-1 scoping document (SGW-60540) and analyzed to identify the nature and extent of contamination (Section 3.3). This section also provides an overview of the groundwater contaminant plumes underlying the 200 East Area.

3.2.1 Previous Investigations

This section lists source documents that identify the previous evaluations and investigations relevant to 200-EA-1 OU waste sites. These evaluations and investigations were conducted before the Central Plateau Inner Area cleanup principles and associated decision criteria were developed (Section 1.3.2 in Chapter 1). Therefore, the remedial action objectives (RAOs), removal action levels, and conclusions presented in these source documents are not applicable to Central Plateau current or anticipated future land use (Section 3.5). The following discussion summarizes previous investigations:

3.2.1.1 Area Focused Investigations

Area focused investigations were initiated following the 1991 Tri-Party Agreement (Ecology et al., 1989a) revision that occurred after the 200 Area was placed on the NPL. The investigations, which included aggregate area management studies (AAMSs) and technical baseline reports, evaluated 200 Area source terms and provided the basis for initiating CERCLA RI/FS evaluations. Four 200 East Area source AAMSs and one groundwater AAMS were prepared. Technical baseline reports were prepared based on review of historical Hanford Site reports, engineering drawings, and site inspections. The 200-EA-1 scoping document (SGW-60540) summarizes relevant information (e.g., facility history, construction features, waste streams, and characterization information) from the following documents:

- DOE/RL-92-04, *PUREX Source Aggregate Area Management Study Report*
- DOE/RL-92-05, *B Plant Source Aggregate Area Management Study Report*
- DOE/RL-92-17, *200 North Aggregate Area Source AAMS Report*
- DOE/RL-92-18, *Semiworks Source Aggregate Area Management Study Report*
- DOE/RL-92-19, *200 East Groundwater Aggregate Area Management Study Report*

3.2.1.2 Previous CERCLA and RCRA Investigations

Focused characterization activities were conducted in accordance with approved work plans to determine contaminant nature and extent, and FSs or engineering evaluation/cost analyses (EE/CA) and action memoranda were prepared to define and prioritize potential remedial alternatives. The 200-EA-1 scoping document (SGW-60540) summarizes relevant information from these investigations.

The following CERCLA RI/FS and RCRA closure documents provide characterization results for the current 200-EA-1 OU waste sites:

- DOE/RL-2004-17, *Remedial Investigation Report for 200-CS-1 Chemical Sewer Group Operable Unit*
- DOE/RL-2004-25, Draft A, *Remedial Investigation Report for the 200-PW-2 Uranium-Rich Process Waste Group and the 200-PW-4 General Process Condensate Group Operable Units*[1]
- DOE/RL-2004-85, Draft A, *Feasibility Study for the 200-PW-2 Uranium-Rich Process Waste Group and the 200-PW-4 General Process Condensate Group Operable Units*[1]
- DOE/RL-2005-62, Draft A, *Remedial Investigation Report for 200-MW-1 Miscellaneous Waste Group Operable Unit*[1]
- DOE/RL-2005-88, *216-A-37-1 Crib Closure Plan (D-2-10)*[2]
- DOE/RL-2005-89, *207-A South Retention Basin Closure Plan (S-2-7)*[2]
- DOE/RL-2005-90, *216-A-36B Crib Closure Plan (D-2-4)*[2]
- DOE/RL-2006-11, *216-B-63 Trench Closure Plan (D-2-6)*[2]
- DOE/RL-2008-53, *216-A-29 Ditch Closure Plan (D-2-3)*[2]
- DOE/RL-2009-85, *Remedial Investigation Report for the 200-PO-1 Groundwater Operable Unit* (200-PO-1 RI report)
- DOE/RL-2009-127, Draft A, *Remedial Investigation Report for the 200-BP-5 Groundwater Operable Unit*[1] (hereinafter referred to as the 200-BP-5 RI report)

The following CERCLA documents presented the 200-EA-1 OU waste site remedial action alternative evaluations but did not provide new data:

- DOE/RL-2000-35, *200-CW-1 Operable Unit Remedial Investigation Report*
- DOE/RL-2003-11, *Remedial Investigation Report for the 200-CW-5 U Pond/Z Ditches Cooling Water Group, the 200-CW-2 S Pond and Ditches Cooling Water Group, the 200-CW-4 T Pond and Ditches Cooling Water Group, and the 200-SC-1 Steam Condensate Group Operable Units*
- DOE/RL-2004-39, Draft A, *200-UR-1 Unplanned Release Waste Group Operable Unit Remedial Investigation/Feasibility Study Work Plan and Engineering Evaluation/Cost Analysis*[1]

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[1] Draft document cited because Rev. 0 was not completed at the time this work plan was prepared.

[2] Closure plan unapproved and not included in the Permit (WA7890008967) at the time that this work plan was prepared.

- DOE/RL-2005-63, *Feasibility Study for the 200-CS-1 Chemical Sewer Group Operable Unit*
- DOE/RL-2005-64, *Proposed Plan for 200-CS-1 Chemical Sewer Group Unit*
- DOE/RL-2008-38, Draft A, *Remedial Investigation/Feasibility Study Report for the 200-MW-1 Miscellaneous Waste Sites Operable Unit*[3]
- DOE/RL-2008-44, *Engineering Evaluation/Cost Analysis for the 200-MG-1 Operable Unit Waste Sites*
- DOE/RL-2008-45, *Engineering Evaluation/ Cost Analysis for the 200-MG-2 Operable Unit Waste Sites*
- DOE/RL-2009-37, *Action Memorandum for Non-Time-Critical Removal Action for 200-MG-2 Operable Unit*
- DOE/RL-2009-53, *Removal Action Work Plan for 48 Waste Sites in the 200-MG-1 Operable Unit*
- DOE/RL-2009-86, *Action Memorandum for Non-Time-Critical Removal Action for 37 Waste Sites in the 200-MG-1 Operable Unit*

3.2.2 Monitoring

This section summarizes past and ongoing environmental monitoring that is relevant to the current understanding of the nature and extent of 200-EA-1 OU waste site contamination. DOE/RL-91-50, *Hanford Site Environmental Monitoring Plan*, provides additional information regarding environmental monitoring activities and governing documents.

3.2.2.1 Radiological Surveys

Radiological surveys are conducted to detect surface contamination that may result from biological intrusion, windblown tumbleweeds, animal feces, waste exposed by erosion, and site maintenance. These surveys typically provide point-location measurements of gross beta/gamma activity within an area, providing an indication of the presence or absence of surface-level contamination in soil or vegetation. Routine radiological surveys are conducted at multiple locations, including the following (DOE/RL-91-50):

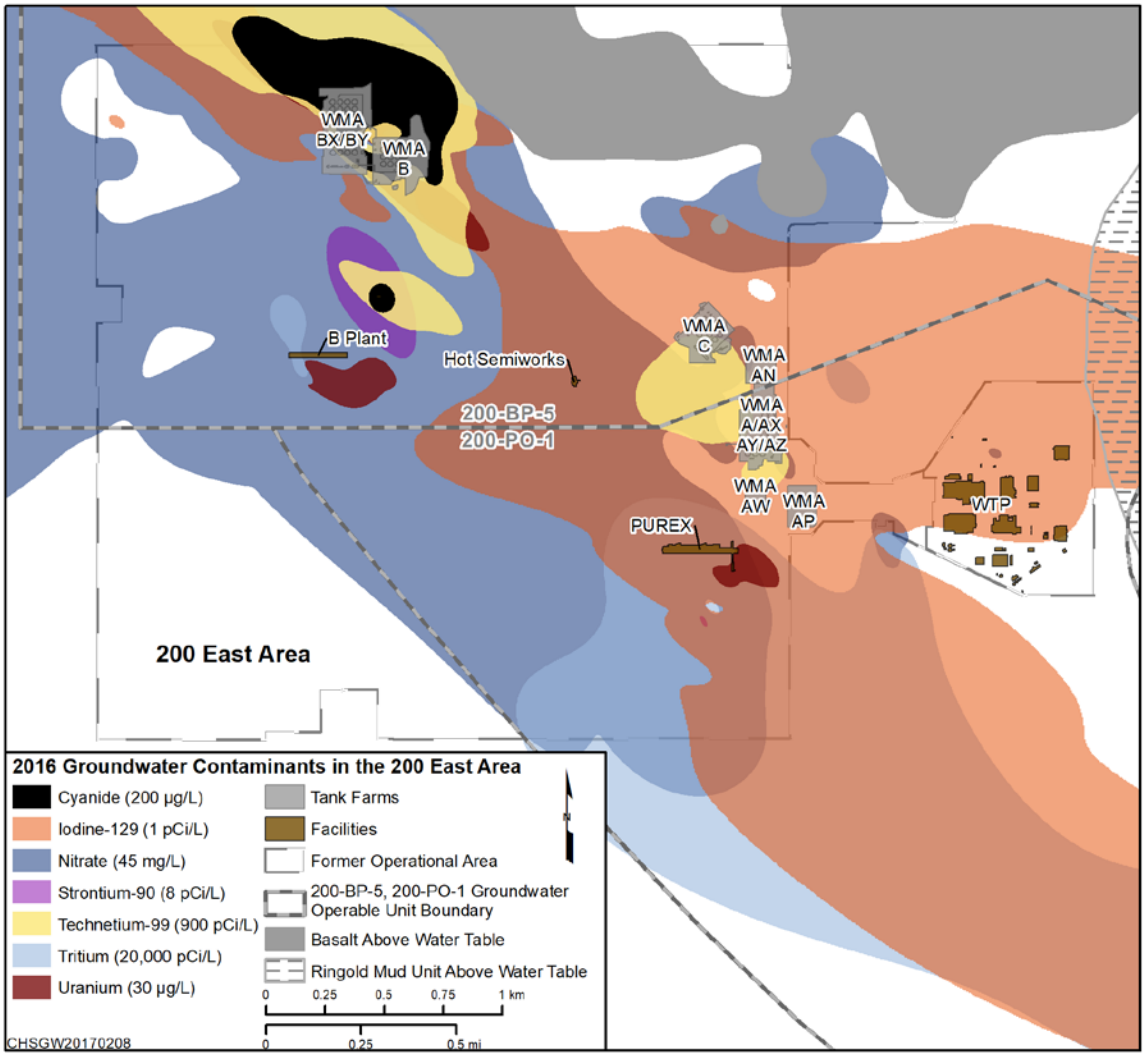
- Inactive waste sites
- Outdoor radiological control areas (including areas of known or suspected contamination deposited by tumbleweeds or other biological vectors)
- Tank farm perimeters (including diversion boxes, lift stations, and vent stations)
- Active or uncovered waste site perimeters (e.g., trenches, burial grounds, retention basins, ponds, and ditches)
- Underground pipelines
- UPRs
- Road surfaces

[3] Draft document cited because Rev. 0 was not completed at the time this work plan was prepared.

The radiological survey results are published quarterly in HNF-SP-0665, *Environmental Radiological Survey Summary*, with the fourth quarter report summarizing the surveys performed that year. Fourth quarter HNF-SP-0665 reports from 2010 through 2016 were reviewed during the 200-EA-1 OU scoping process. The 200-EA-1 scoping document (SGW-60540) presents radiological survey data for individual waste sites, including indications of biomobilization (where available and relevant) and the results from SGW-60352, *Field Summary Report for the 200-SW-2 Operable Unit and Central Plateau 2015 Aerial Survey*.

3.2.2.2 Groundwater Monitoring

The 200-BP-5 and 200-PO-1 Groundwater OUs are beneath the 200-EA-1 OU (Section 1.4 in Chapter 1). Groundwater in these OUs is routinely monitored to meet *Atomic Energy Act of 1954* (AEA), CERCLA, RCRA, and *Washington Administrative Code* requirements. Figure 3-1 shows the extent of groundwater contamination in the 200 East Area. DOE/RL-2016-67, *Hanford Site Groundwater Monitoring Report for 2016*, describes the major groundwater contaminant plumes and their likely sources.



Note: Modified from DOE/RL-2016-67, *Hanford Site Groundwater Monitoring Report for 2016*.

Figure 3-1. 200 East Area Groundwater Contaminant Distribution

The 200-PO-1 OU includes groundwater and contaminant plumes beneath the south and southeastern portions of the 200 East Area. Observed 200-PO-1 OU contamination has resulted largely from PUREX Plant and B Plant liquid waste that was discharged to cribs, ponds, and trenches. The liquid waste included tritium, iodine-129, and nitrate, which form the three major contaminant plumes in the 200-PO-1 OU. Strontium-90, technetium-99, and uranium form smaller contaminant plumes; volatile organic compounds (VOCs) are present but do not exceed maximum contaminant levels (MCLs). The 200-PO-1 RI report (DOE/RL-2009-85) identified the following 200-EA-1 OU waste sites as potential sources of 200-PO-1 OU contamination:

- 216-A-3 Crib
- 216-A-6 Crib
- 216-A-9 Crib
- 216-A-10 Crib
- 216-A-18 Trench
- 216-A-19 Trench
- 216-A-20 Trench
- 216-A-27 Crib
- 216-A-29 Ditch
- 216-A-30 Crib
- 216-A-36A Crib
- 216-A-36B Crib
- 216-A-37-1 Crib
- 216-A-37-2 Crib
- 216-A-45 Crib

Monitoring for the 200-PO-1 OU includes AEA and CERCLA requirements for more than 50 wells (near-field area) for contaminants of concern (COCs), supporting constituents; and RCRA interim status groundwater monitoring at the 216-A-29 Ditch, 216-A-36B Crib, and 216-A-37-1 Crib (200-EA-1 OU TSD units).

The 200-BP-5 OU includes groundwater and contaminant plumes beneath the northern half of the 200 East Area. Observed 200-BP-5 OU groundwater contamination resulted largely from liquid waste generated by B Plant and associated facilities and then discharged to cribs, ponds, and trenches. The liquid waste contained nitrate, iodine-129, and technetium-99, which form the major contaminant plumes in the 200-BP-5 OU. Smaller plumes of uranium, cyanide, strontium-90, and tritium are also present in the 200-BP-5 OU. The 200-BP-5 RI report (DOE/RL-2009-127, Draft A) identified the following 200-EA-1 OU waste sites as sources of 200-BP-5 OU contamination:

- 216-B-2-1 Ditch
- 216-B-2-2 Ditch
- 216-B-12 Crib
- 216-B-62 Crib
- 216-C-1 Crib

Monitoring for the 200-BP-5 OU includes AEA and CERCLA requirements for more than 90 wells for COCs and supporting constituents; and RCRA interim status groundwater monitoring at the 216-B-63 Ditch (a 200-EA-1 OU TSD unit). Section 3.3 presents a more detailed analysis of potential 200-EA-1 OU groundwater impacts.

3.2.3 Stabilization and Modification Activities

The majority of 200-EA-1 OU waste sites have been surface stabilized to mitigate potential exposure and spread of contamination. Surface stabilization typically involved covering an area with 15 to 30 cm (6 to 12 in.) of gravel, sand, or clean soil (sometimes over a biobarrier) after routine radiological surveys identified surface-level contamination. Other 200-EA-1 OU waste sites have undergone more extensive structural isolation and modification in addition to being surface stabilized. Isolation and modification included scraping/consolidating contaminated soil, backfilling sites, cutting/capping vent risers and waste distribution pipes, concrete capping of cribs, and various other site-specific activities. For seven septic system tanks, activities included pumping liquids, flushing, and filling the tank with sand and gravel. The 200-EA-1 scoping document (SGW-60540) provides information on specific site stabilization and modification activities performed.

3.3 Nature and Extent of Contamination

This section summarizes the current understanding of the nature and extent of 200-EA-1 OU waste site contamination, which was developed based on the investigation and monitoring activities described in Section 3.2 and information presented in the 200-EA-1 scoping document (SGW-60540). This section supports preliminary CSM development, risk assessment, cleanup action evaluation, and data needs identification.

The extent of 200-EA-1 OU contamination ranges from small areas (e.g., 0.3 m by 0.3 m [1 ft by 1 ft] depressions) that received solid waste construction debris, resulting in limited shallow vadose zone contamination (<4.6 m [15 ft] bgs), to larger areas that received up to 296 billion L (78 billion gal) of liquid effluent, resulting in contamination deeper than 4.6 m (15 ft) bgs with possible groundwater impacts. The 200-EA-1 OU contamination includes radionuclide and chemical constituents (i.e., metals, inorganic cations, strong mineral acids and bases, petroleum hydrocarbons, VOCs, and semivolatile organic compounds [SVOCs]). Section 3.4 describes preliminary contaminant of potential concern (COPC) development. The 200-EA-1 scoping document (SGW-60540) evaluates and provides information on the history, potential contaminants, and existing characterization data for each waste site. The 200-EA-1 scoping document and Table 2-1 in Chapter 2 of this work plan present information on the waste streams associated with the 200-EA-1 OU.

To simplify the presentation of contaminant distribution and to focus the Chapter 4 data needs assessment on waste sites with common hydrogeology, similar plant processes, and similar expected contaminants, the 200-EA-1 OU waste sites were separated into the following groups:

- A Tank Farms
- B Tank Farms
- B Plant
- Hot Semiworks
- PUREX Plant
- Miscellaneous

Table 3-2 lists 200-EA-1 OU waste sites with their associated group, and Figures 3-2 through 3-8 show the 200-EA-1 OU waste site locations within each group.

The potential depth of vadose zone contamination and the potential for groundwater impacts were evaluated for each waste site using a variety of methods, including the following:

- Reviewing available waste site vadose zone data summarized in the 200-EA-1 scoping document (SGW-60540).
- Reviewing underlying groundwater OU RI reports (200-PO-1 RI report [DOE/RL-2009-85]; 200-BP-5 RI report [DOE/RL-2009-127, Draft A]; DOE/RL-2016-67, *Hanford Site Groundwater Monitoring Report for 2016*) to determine if 200-EA-1 OU waste sites had been previously identified as known or potential contributors to groundwater contamination (Section 3.2.2.2).

- Reviewing available groundwater monitoring data near 200-EA-1 OU waste sites for the presence or absence of select contaminants during or shortly after the waste site operations. (Note: Groundwater impacts could not always be attributed to specific 200-EA-1 OU waste sites due to changes in groundwater gradient and flow direction, decreases in the 200 East Area water-level elevations, and 200-EA-1 OU waste site proximity to tank farm WMAs or high-volume liquid waste disposal sites that are not part of the 200-EA-1 OU.)

- Estimating the pore volume disposed to liquid waste disposal and handling sites where liquid effluent disposal volumes were available (e.g., cribs, ditches, and trenches) (ECF-200EA1-17-0066, *Pore Volume Calculation – 200-EA-1 OU Liquid Waste Disposal Sites*).

- Analyzing and assigning potential depths of vadose zone contamination for each 200-EA-1 OU waste site as follows:

  - **Shallow vadose zone contamination:** Sites where potential site contamination is only expected to reside >4.6 m (15 ft) bgs (e.g., liquid and solid waste disposal and handling sites constructed entirely >4.6 m [15 ft] bgs that received incidental or no liquid discharge).

  - **Partial-thickness vadose zone contamination:** Sites where potential site contamination is expected to be present >4.6 m (15 ft) bgs but does not likely extend to the water table (e.g., liquid waste disposal and handling sites that received <0.5 pore volumes of liquid discharge and sites with features extending <4.6 m [15 ft] bgs). Contamination may also be present at depths <4.6 m (15 ft) bgs.

  - **Full-thickness vadose zone contamination:** Sites where potential site contamination is expected to be present >4.6 m (15 ft) bgs and may potentially extend to the water table with possible historical or ongoing groundwater impacts (e.g., liquid waste disposal and handling sites that received >0.5 pore volumes of liquid discharge or sites that were identified in the 200-PO-1 RI report [DOE/RL-2009-85] or the 200-BP-5 RI report [DOE/RL-2009-127, Draft A] as potential sources of groundwater contamination). Contamination may also be present at depths <4.6 m (15 ft) bgs.

Table 3-2 summarizes the potential relative depths of vadose zone contamination by group and waste site. Tables in subsequent sections summarize the lines of evidence available to support the relative depth of vadose zone contamination for each waste site.

3.3.1 Nature and Extent of Contamination for 200-EA-1 Operable Unit Waste Sites in the A Tank Farms Group

The A Tank Farms group waste sites are located in the southeastern portion of the 200 East Area and include liquid waste disposal and handling cribs, ditches, trenches, retention basins, pipelines, and septic systems; a solid waste disposal and handling dumping area; and UPRs (Figure 3-2). These sites primarily handled waste generated by the PUREX Plant. Sections 2.1 and 2.2 in Chapter 2 discuss PUREX Plant operations and associated waste streams. The 200-EA-1 scoping document (SGW-60540) provides information on waste streams relevant to each 200-EA-1 OU waste site.

Table 3-2. 200-EA-1 OU Waste Sites by Group and Potential Relative Depth of Vadose Zone Contamination

Relative Depth of Vadose Zone Contamination*	200-EA-1 OU Group					
	A Tank Farms (Section 3.3.1)	B Tank Farms (Section 3.3.2)	B Plant (Section 3.3.3)	Hot Semiworks Plant (Section 3.3.4)	PUREX Plant (Section 3.3.5)	Miscellaneous (Section 3.3.6)
Shallow	200-E-27 dumping area 200-E-125 (UPR-solid) 200-E-276-PL pipeline 200-E-287 (UPR-solid) 207-A-NORTH Retention Basin 207-A-SOUTH Retention Basin UPR-200-E-66 (UPR-solid) UPR-200-E-99 (UPR-solid) UPR-200-E-143 (UPR-solid)	200-E-121 (UPR-solid) 200-E-292 dumping area UPR-200-E-43 (UPR-liquid) UPR-200-E-89 (UPR-solid) UPR-200-E-144 (UPR-solid)	200-E-26 (UPR-liquid) 200-E-117 (UPR-solid) 200-E-123 (UPR-solid) 200-E-129 (UPR-solid) 200-E-130 (UPR-solid) 200-E-297 dumping area 207-B Retention Basin 216-B-59B Retention Basin UPR-200-E-64 (UPR-solid) UPR-200-E-69 (UPR-liquid)	200-E-249-PL pipeline 200-E-251-PL pipeline 200-E-293 foundation 200-E-294 foundation 291-C-1 Burial Ground UPR-200-E-37 (UPR-solid) UPR-200-E-98 (UPR-solid)	200-E-13 dumping area 200-E-124 (UPR-liquid) UPR-200-E-10 (UPR-solid) UPR-200-E-12 (UPR-liquid) UPR-200-E-20 (UPR-solid) UPR-200-E-33 (UPR-liquid)	200-E-53 (UPR-solid) 200-E-109 (UPR-solid) 200-E-115 (UPR-solid) 200-E-139 (UPR-solid) UPR-200-E-11 (UPR-liquid) UPR-200-E-50 (UPR-solid) UPR-200-E-95 (UPR-solid) UPR-200-E-112 (UPR-liquid)
Partial thickness	200-E-262-PL pipeline 216-A-1 Crib 216-A-34 Ditch 216-A-40 Retention Basin 216-A-41 Crib 216-A-42 Retention Basin 2607-EA septic system 2607-E12 septic system UPR-200-E-21 (UPR-liquid) UPR-200-E-29 (UPR-liquid)	216-B-51 french drain 2607-EF septic system 2607-E9 septic system	200-E-25 french drain 200-E-142 depression 200-E-209-PL pipeline 216-B-10B Crib 216-B-59 Trench 218-E-7 burial vault 2607-E3 septic system	HSVP valve pit 216-C-4 Crib 216-C-5 Crib 216-C-7 Crib 200-E-252-PL pipeline 200-E-4 french drain 200-E-41 (UPR-solid) 200-E-57 (UPR-liquid) 201-C process unit 291-C process unit 2607-E5 septic system 2607-E7A septic system 2607-E7B septic system	200-E-43 storage area 216-A-38-1 Crib 2607-E6 septic system UPR-200-E-88 (UPR-liquid)	200-E BP burn pit
Full thickness	216-A-6 Crib 216-A-18 Trench 216-A-19 Trench 216-A-20 Trench 216-A-29 Ditch 216-A-30 Crib 216-A-37-1 Crib 216-A-37-2 Crib	None	216-B-2-1 Ditch 216-B-2-2 Ditch 216-B-2-3 Ditch 216-B-10A Crib 216-B-12 Crib 216-B-55 Crib 216-B-62 Crib 216-B-63 Ditch	200-E-56 (UPR-liquid) 209-E-WS-2 french drain 216-C-1 Crib 216-C-2 injection/reverse well 216-C-3 Crib 216-C-6 Crib 216-C-10 Crib	200-E PD Ditch 216-A-3 Crib 216-A-9 Crib 216-A-10 Crib 216-A-27 Crib 216-A-36A Crib 216-A-36B Crib 216-A-45 Crib	None

* Relative depths of vadose zone contamination are defined as follows:

- Shallow: Sites where potential site contamination is only expected to reside above 4.6 m [15 ft] bgs.
- Partial thickness: Sites where potential site contamination is expected to be present >4.6 m [15 ft] bgs but does not likely extend to the water table and may also be present at depths <4.6 m [15 ft] bgs.
- Full thickness: Sites where potential site contamination is expected to be present >4.6 m (15 ft) bgs with possible groundwater impacts and may also be present at depths <4.6 m [15 ft] bgs.

HSVP = Hot Semiworks Valve Pit
OU = operable unit
PUREX = plutonium-uranium extraction
UPR = unplanned release
UPR-liquid = UPR waste sites consisting of contaminated soil resulting from known or suspected overflow of cribs, pipeline leaks, leaks or spills from railcars, and leaks or drips from equipment in storage or in transit
UPR-solid = UPR waste sites consisting of contaminated soil resulting from known or suspected airborne releases, airborne spread of particulate contamination, and tumbleweeds/tumbleweed fragments.

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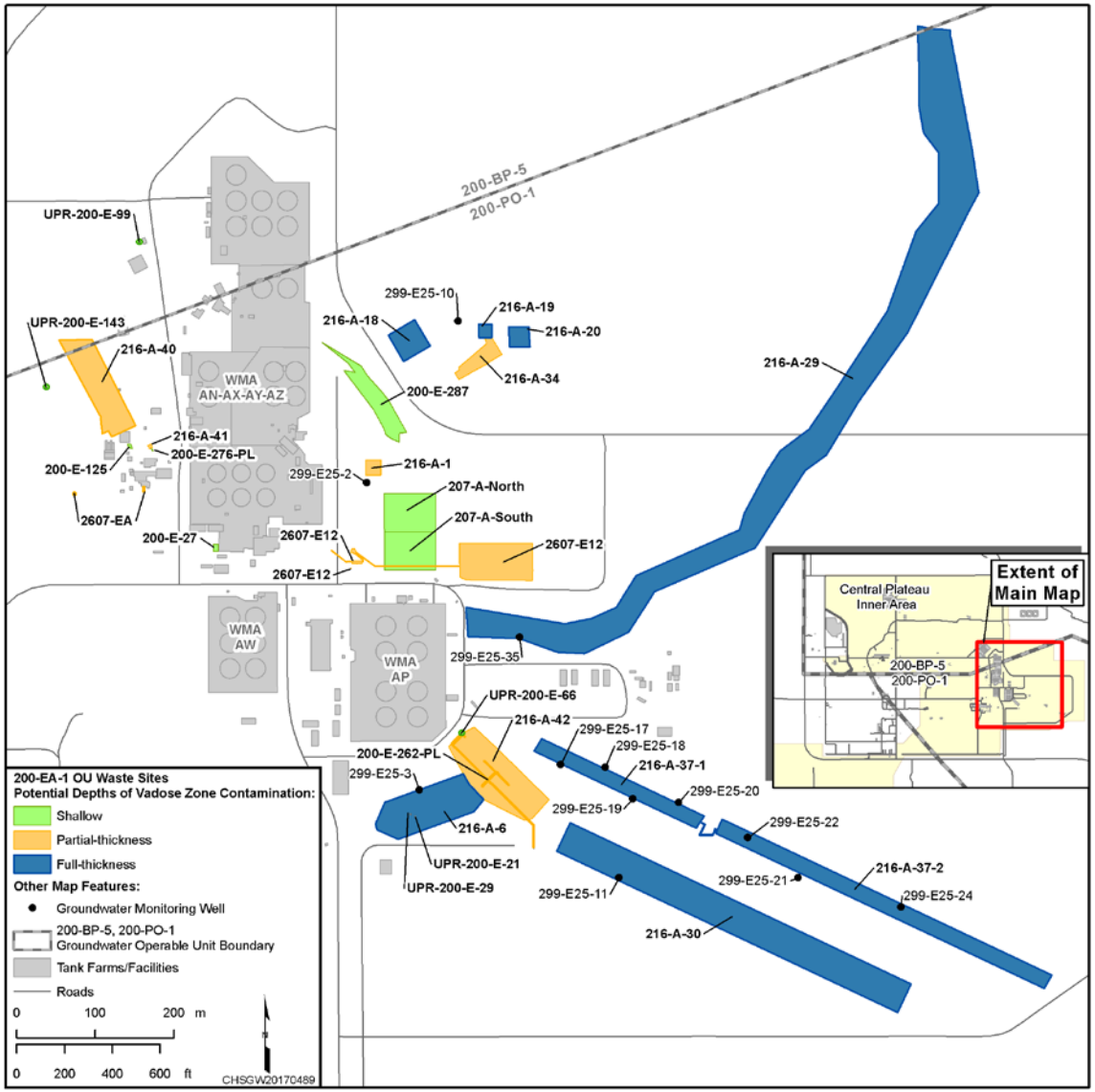


Figure 3-2. Location of 200-EA-1 OU Waste Sites in the A Tank Farms Group

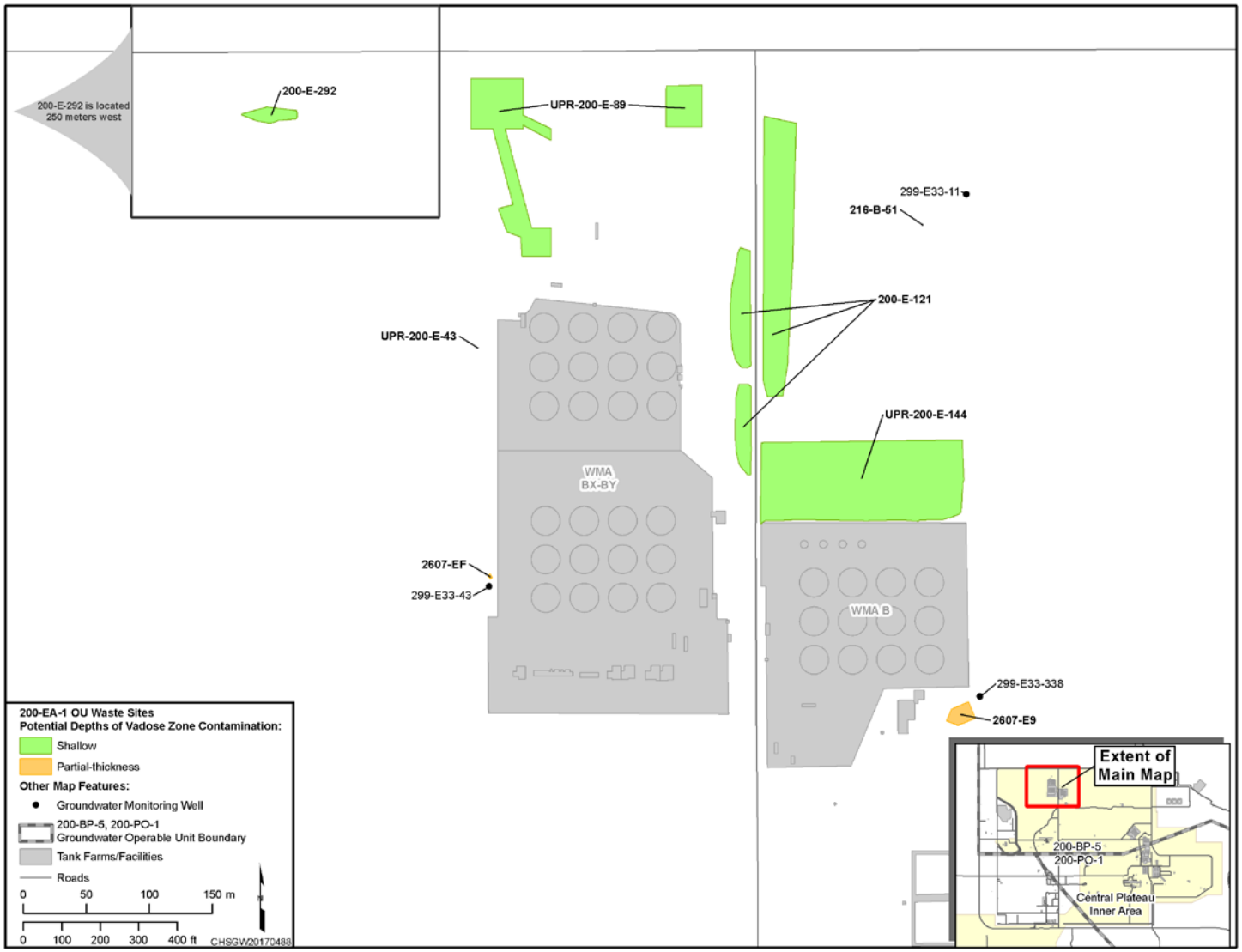


Figure 3-3. Location of 200-EA-1 OU Waste Sites in the B Tank Farms Group

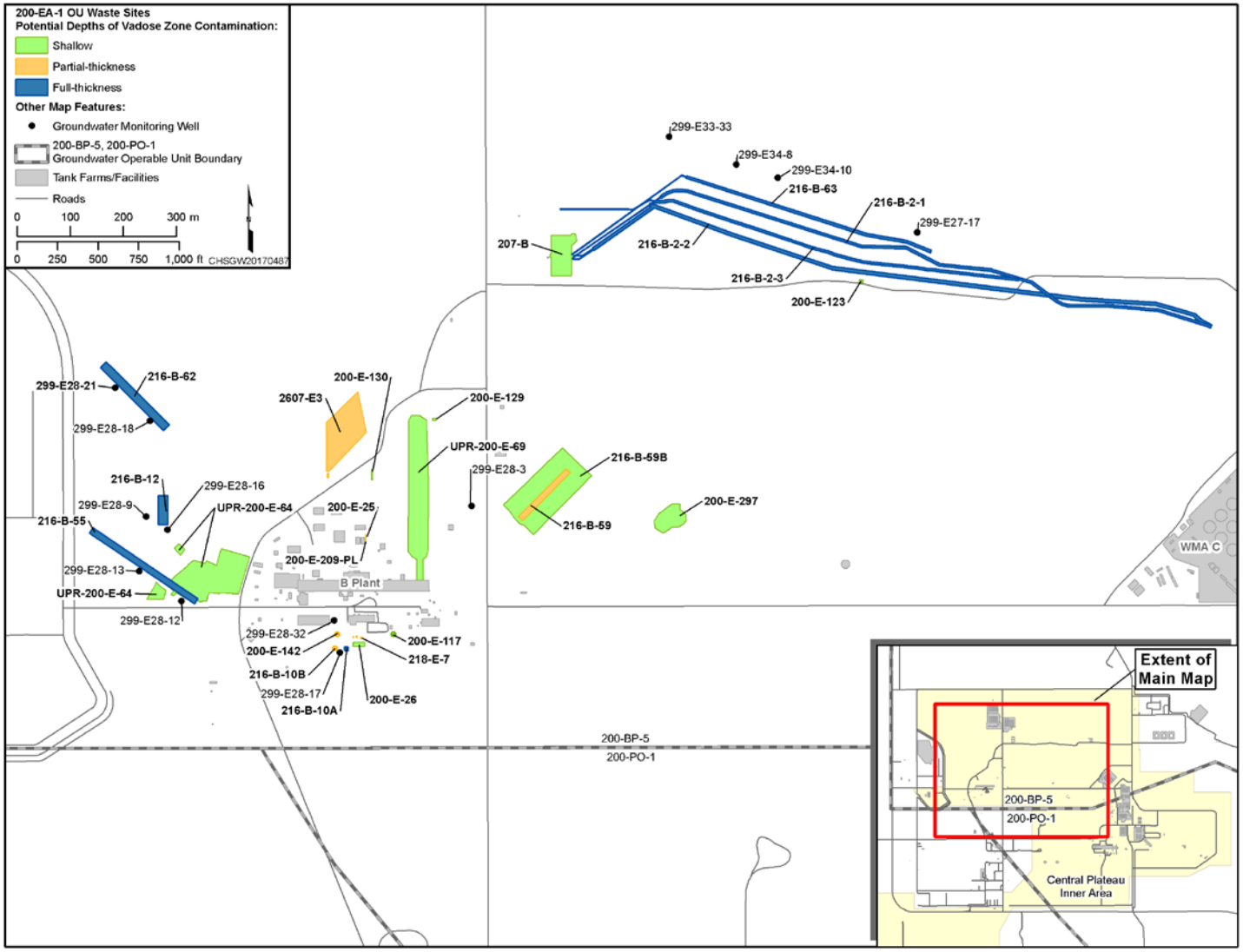


Figure 3-4. Location of 200-EA-1 OU Waste Sites in the B Plant Group

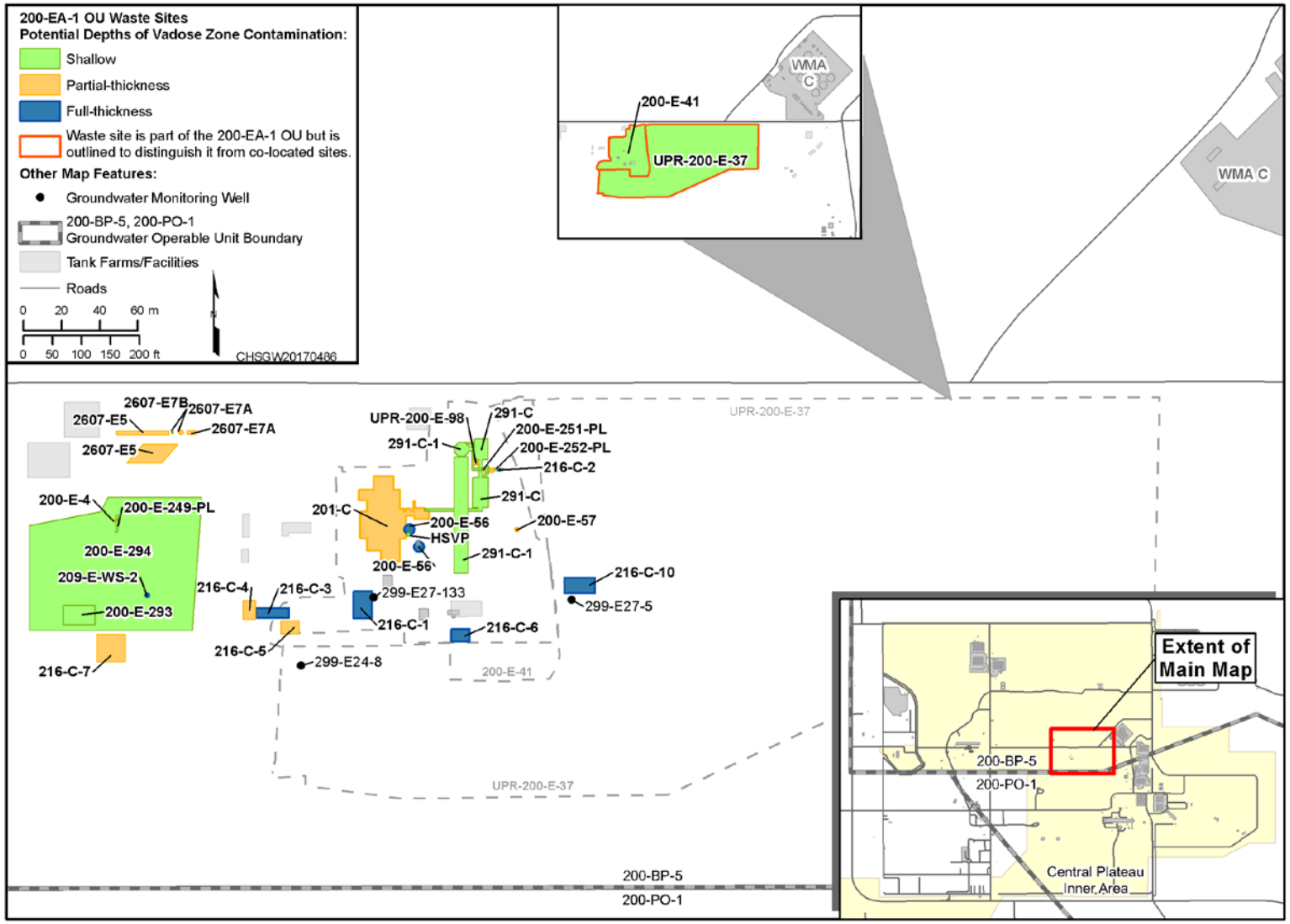


Figure 3-5. Location of 200-EA-1 OU Waste Sites in the Hot Semiworks Plant Group

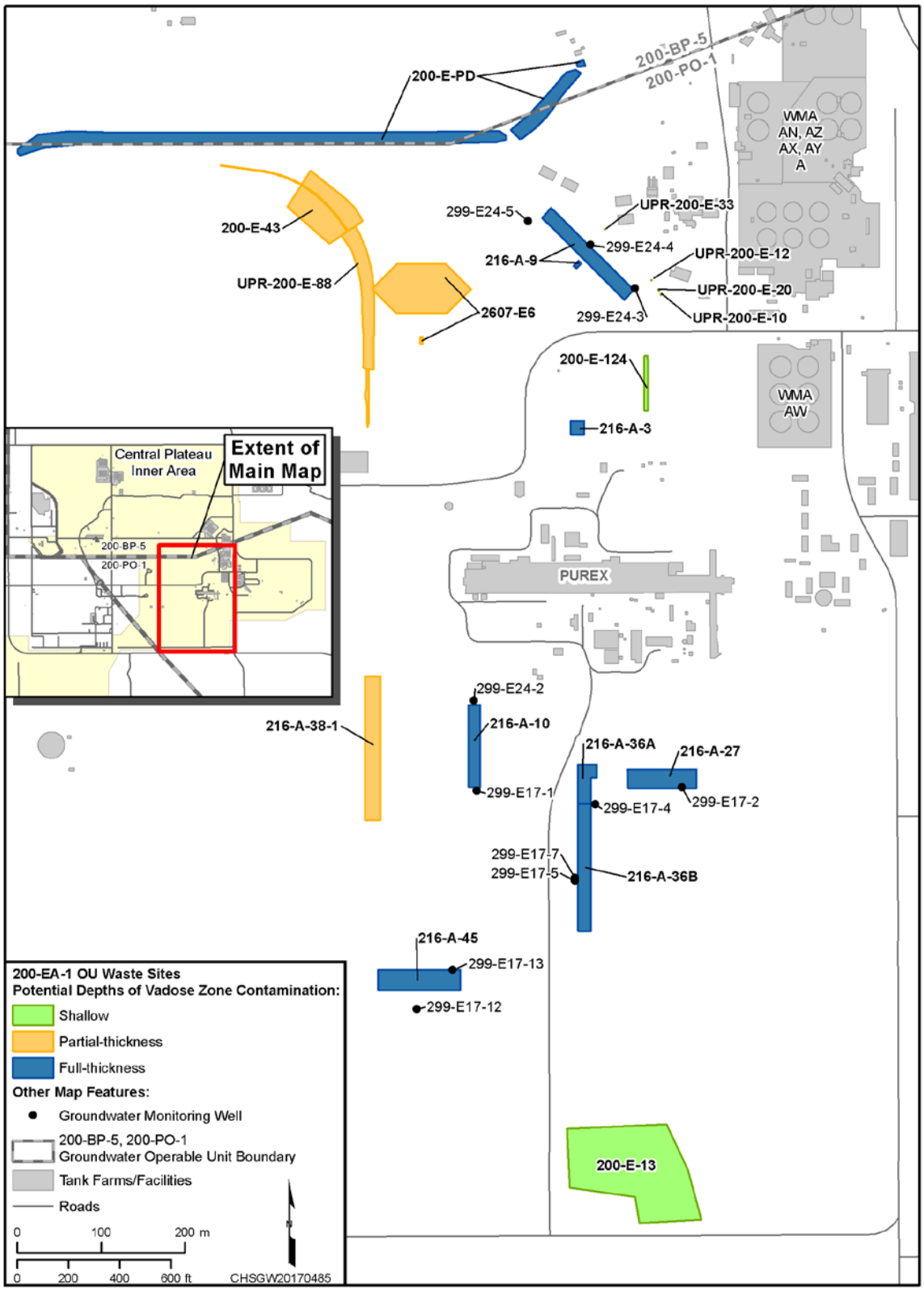


Figure 3-6. Location of 200-EA-1 OU Waste Sites in the PUREX Plant Group

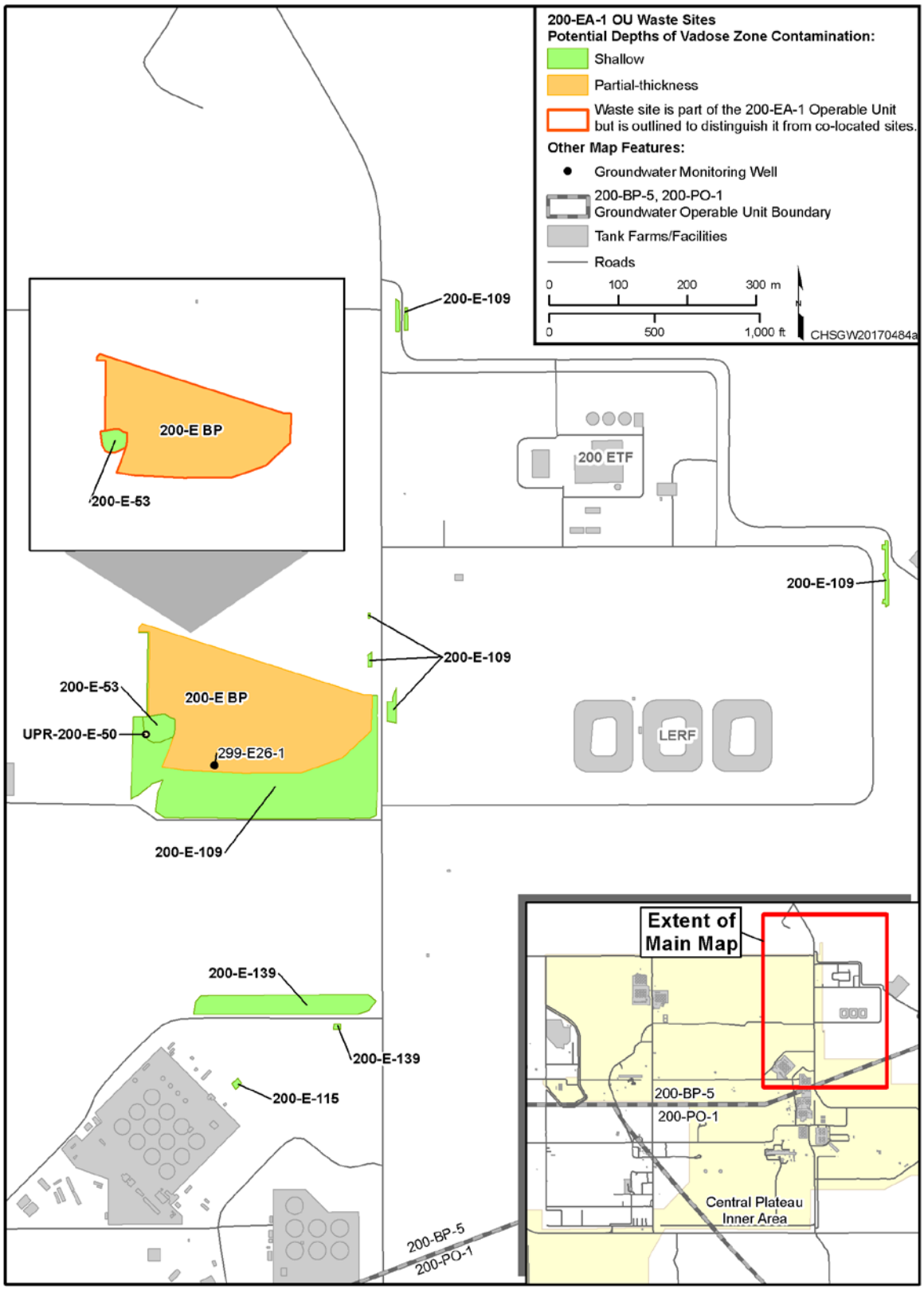


Figure 3-7. Location of 200-EA-1 OU Waste Sites in the Miscellaneous Group (Northeast)

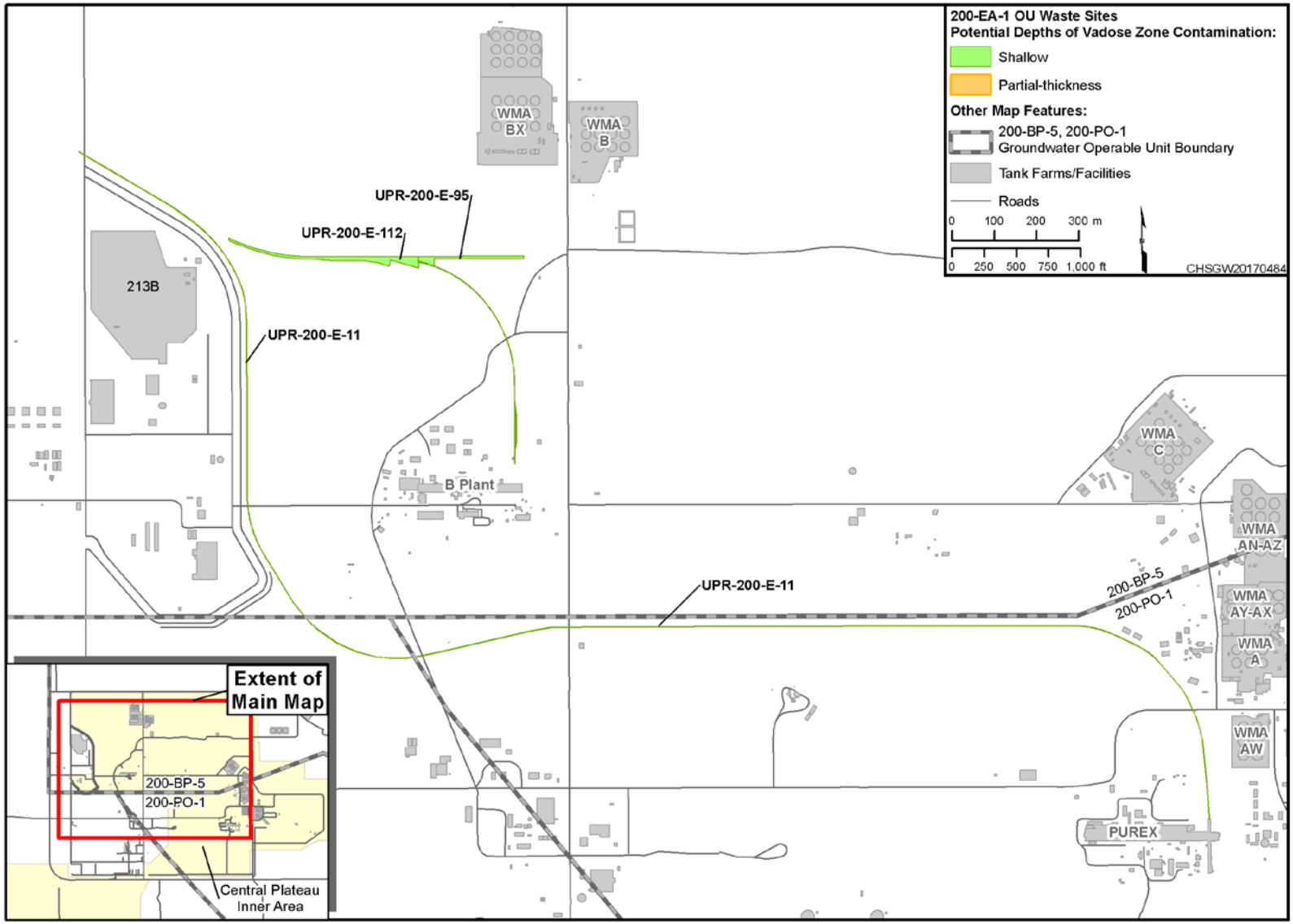


Figure 3-8. Location of 200-EA-1 OU Waste Sites in the Miscellaneous Group (Southwest)

Table 3-3 provides current information for each waste site, including the relative depth of vadose zone contamination. The 200-PO-1 OU is primarily beneath the A Tank Farms group, but a portion of the 200-BP-5 OU extends to the 216-A-29 Ditch. Table 3-3 indicates which 200-EA-1 OU waste sites were identified in the 200-PO-1 RI report (DOE/RL-2009-85) as known or potential contributors to groundwater contamination. The 200-BP-5 RI report (DOE/RL-2009-127, Draft A) did not identify any waste sites in this group as known or potential contributors to groundwater contamination.

Table 3-3. Summary of 200-EA-1 OU Waste Sites in the A Tank Farms Group

Waste Site	Waste Site Description	Current Waste Site Understanding[a]
200-E-27 dumping area	Inactive above ground dumping area; used to store and cut lead and to store equipment and other material; isolated/modified.	*Potential for only **shallow vadose zone contamination** based on the following:* Site received no liquid discharge; site contamination (e.g., lead cuttings) makes it unlikely that contaminants migrated vertically to groundwater.
200-E-125 (UPR-solid)	UPR; already a posted contamination area when discovered (no documentation describing original release).	*Potential for only **shallow vadose zone contamination** based on the following:* Contamination area posting; absence of documented liquid release.
200-E-262-PL pipeline	Inactive underground pipeline; distributed effluent among the 216-A-42 Retention Basin holding cells and transferred effluent out of the retention basin; operated from 1977 to 1997.	*Potential for **partial-thickness vadose zone contamination** based on the following:* Portions of the waste site are constructed <6.1 m (20 ft) bgs; not a suspected contributor to groundwater contamination based on absence of documented release.[b]
200-E-276-PL pipeline	Inactive drain pipeline; carried effluent to the 216-A-41 Crib; operated from 1968 to 1974.	*Potential for only **shallow vadose zone contamination** based on the following:* Entire site is constructed >4.6 m (15 ft) bgs; absence of documented release from the pipeline.
200-E-287 (UPR-solid)	UPR; contaminated windblown tumbleweed fragments.	*Potential for only **shallow vadose zone contamination** based on the following:* Contamination area posting; nature of site contamination (i.e., tumbleweed fragments) makes it unlikely that contaminants migrated vertically to groundwater; absence of documented liquid release.
207-A-NORTH Retention Basin	Inactive retention basin composed of three lined concrete storage cells; used for interim storage of 242A evaporator steam condensate; operated from 1977 to 1999; isolated/modified.	*Potential for only **shallow vadose zone contamination** based on the following:* Entire site constructed >4.6 m (15 ft) bgs; closure report for 207-A-SOUTH (and adjacent 200-EA-1 OU retention basin) identified radionuclide activity at depths <4.6 m (15 ft) bgs; tritium, nitrate, and cesium-137 detected in well 299-E25-2 during operation more likely associated with adjacent waste sites.
207-A-SOUTH Retention Basin	Inactive retention basin composed of three lined concrete storage cells; used for interim storage of 242A evaporator condensate; operated from 1977 to 1989; clean closed.	*Potential for only **shallow vadose zone contamination** based on the following:* Constructed >4.6 m (15 ft) bgs: radionuclide activity at depths <4.6 m (15 ft) bgs (DOE/RL-2016-74); tritium, nitrate, cesium-137, and strontium-90 in well 299-E25-2 during operation more likely associated with adjacent waste sites.
216-A-1 Crib	Inactive crib; received PUREX cold startup waste from November to December 1955; isolated/modified.	*Potential for **partial-thickness vadose zone contamination** based on the following:* Site received 98,400 L (26,000 gal) of liquid waste (<0.5 pore volumes of liquid discharged); portions constructed to 4.6 m (15 ft) bgs; tritium, nitrate, cesium-137, and strontium-90 above MCLs in well 299-E25-2 during operation may be associated with adjacent waste sites.

Table 3-3. Summary of 200-EA-1 OU Waste Sites in the A Tank Farms Group

Waste Site	Waste Site Description	Current Waste Site Understanding[a]
216-A-6 Crib	Inactive crib; received PUREX steam condensate, tunnel floor drainage, water-filled door drainage and slug storage basin overflow from 1955 to 1961 and again from 1964 to 1966; deactivated in 1972; isolated/modified.	*Potential for **full-thickness vadose zone contamination** based on the following:* Site received 3.36E+09 L (8.88E+08 gal) of liquid waste (>0.5 pore volumes of liquid discharged); portions of waste site constructed to 6.4 m (21 ft) bgs; potential contributor to groundwater contamination (DOE/RL-2009-85); UPR-200-E-21 and UPR-200-E-29 resulted from crib flooding and overflow; tritium, nitrate, cesium-137, and strontium-90 detected above MCLs in monitoring well 299-E25-3 during operation.
216-A-18 Trench	Inactive trench; received PUREX cold startup waste from November 1955 to January 1956; isolated/modified.	*Potential for **full-thickness vadose zone contamination** based on the following:* Site received 488,000 L (129,000 gal) of liquid waste (<0.5 pore volumes of liquid discharge); potential contributor to groundwater contamination (DOE/RL-2009-85); portions of the waste site are constructed to 4.6 m (15 ft) bgs; nitrate, cesium-137, and strontium-90 detected in well 299-E25-10 during operation (may be from adjacent 200-EA-1 OU waste sites [e.g., 216-A-19 and 216-A-20 Trenches]).
216-A-19 Trench	Inactive trench; received PUREX cold startup waste from November 1955 to December 1955; isolated/modified.	*Potential for **full-thickness vadose zone contamination** based on the following:* Site received 1,100,000 L (291,000 gal) of liquid waste (>0.5 pore volumes of liquid discharged); portions constructed to 4.6 m (15 ft) bgs; potential contributor to groundwater contamination (DOE/RL-2009-85); nitrate, cesium-137, and strontium-90 impacts observed in monitoring well 299-E25-10 during operation.
216-A-20 Trench	Inactive trench; received PUREX cold startup waste and cooling water from the 216-A-34 Ditch from November to December 1955; isolated/modified.	*Potential for **full-thickness vadose zone contamination** based on the following:* Site received 961,000 L (254,000 gal) of liquid waste (>0.5 pore volumes of liquid discharged); portions constructed to 4.6 m (15 ft) bgs; potential contributor to groundwater contamination (DOE/RL-2009-85); nitrate, cesium-137, and strontium-90 observed in well 299-E25-10 during operation.
216-A-29 Ditch	Inactive ditch; conveyed PUREX chemical sewer waste; operational from 1955 to 1991; isolated/modified.	*Potential for **full-thickness vadose zone contamination** based on the following:* Site conveyed 2.96E+11 L (7.82E+10 gal) of liquid waste, with expected associated infiltration >0.5 pore volumes; potential contributor groundwater contamination (DOE/RL-2009-85); VOCs, nitrate, hexavalent chromium, and radionuclides in waste site footprint detected; tritium above MCL observed in monitoring well 299-E25-35 from 1989 to 1995.
216-A-30 Crib	Inactive crib; received PUREX steam condensate from 1961 to 1965 and from 1970 to 1992; isolated/modified.	*Potential for **full-thickness vadose zone contamination** based on the following:* Site received 7.64E+09 L (2.02E+09 gal) of liquid waste (>0.5 pore volumes of liquid discharged); potential contributor to groundwater contamination (DOE/RL-2009-85); nitrate and tritium detected above MCLs in monitoring well 299-E-25-11 during operation; VOCs, metals, and radionuclides detected in waste site footprint and underlying vadose zone.

Table 3-3. Summary of 200-EA-1 OU Waste Sites in the A Tank Farms Group

Waste Site	Waste Site Description	Current Waste Site Understanding[a]
216-A-34 Ditch	Inactive ditch; conveyed cooling water from November 1955 to December 1957; isolated/modified.	*Potential for* ***partial-thickness vadose zone contamination*** *based on the following:* Site conveyed 488,000 L (129,000 gal) of liquid waste to the 216-A-19 Trench, with expected associated infiltration of <0.5 pore volumes; nitrate, cesium-137, and strontium-90 detected in monitoring well 299-E25-10 may be associated with adjacent waste sites.
216-A-37-1 Crib	Inactive crib; received 242A evaporator process condensate via the 207-A-SOUTH Retention Basin; operated from 1977 to 1989; isolated/modified.	*Potential for* ***full-thickness vadose zone contamination*** *based on the following:* Site received 3.68E+08 L (9.72E+07 gal) of liquid waste (>0.5 pore volumes of liquid discharged); potential contributor to groundwater contamination (DOE/RL-2009-85); tritium and nitrate detected above MCLs in wells 299-E25-17, 299-E25-18, 299-E25-19, and 299-E25-20 during operation; metals, nitrate, and radionuclides detected in site footprint and underlying vadose zone.
216-A-37-2 Crib	Inactive crib; received PUREX steam condensate; operated from 1984 to 1991; isolated/modified.	*Potential for* ***full-thickness vadose zone contamination*** *based on the following:* Site received 1.10E+09 L (2.91E+08 gal) of liquid waste (>0.5 pore volumes of liquid discharged); portions constructed to 4.9 m (16 ft) bgs; potential contributor to groundwater contamination (DOE/RL-2009-85); tritium and/or nitrate detected above MCLs in wells 299-E25-21, 299-E25-22, and 299-E25-24 during operation; uranium-235 detected in waste site footprint.
216-A-40 Retention Basin	Inactive demolished retention basin; interim storage of cooling water and steam condensate; operated from 1968 to 1979; isolated/modified.	*Potential for* ***partial-thickness vadose zone contamination*** *based on the following:* Portions of the waste site are constructed to 4.9 m (16 ft) bgs; reported bladder failure.[b]
216-A-41 Crib	Inactive crib; received process condensate; operated from 1968 to 1974.	*Potential for* ***partial-thickness vadose zone contamination*** *based on the following:* Site received 10,000 L (2,640 gal) of liquid waste (<0.5 pore volumes of liquid discharged).
216-A-42 Retention Basin	Inactive retention basin; held PUREX cooling water and steam condensate; operated from 1978 to 1997; isolated/modified.	*Potential for* ***partial-thickness vadose zone contamination*** *based on the following:* All or portions of the waste site constructed to 7.1 m (23 ft) bgs; designed as a nondischarging facility.[b]
2607-EA septic system	Inactive septic tank and associated down-pipe drywell; received sanitary wastewater and sewage from 1976 to 1978 and from 1984 to 1996; isolated/modified.	*Potential for* ***partial-thickness vadose zone contamination*** *based on the following:* Entire waste site is constructed >4.6 m (15 ft) bgs; waste site designed to promote infiltration; operational for ~15 years; ~350,000 L (92,470 gal) liquid discharge.[b,c]
2607-E12 septic system	Active septic tanks and associated drain fields, pipelines, seepage pit, and dosing chamber; received sanitary wastewater and sewage from 1982 to present; isolated/modified.	*Potential for* ***partial-thickness vadose zone contamination*** *based on the following:* Uncertain construction depth; waste site designed to promote infiltration; operational for >30 years; unknown liquid discharge volume.[b,c]
UPR-200-E-21 (UPR-liquid) UPR-200-E-29 (UPR-liquid)	UPRs; result of 216-A-6 (200-EA-1 OU crib) overflow in February 1959 and January 1961 that flooded and contaminated area next to crib.	*Potential for* ***partial-thickness vadose zone contamination*** *based on the following:* Portions of the 216-A-6 Crib are constructed to 6.2 m (21 ft) bgs; flooding and overflow of crib by unknown volumes likely resulted in liquid discharge to depths >4.6 m (15 ft) bgs; see 216-A-6 Crib.

Table 3-3. Summary of 200-EA-1 OU Waste Sites in the A Tank Farms Group

Waste Site	Waste Site Description	Current Waste Site Understanding[a]
UPR-200-E-66 (UPR-solid)	UPR; result of a 1984 contaminated windblown particulate release from the 216-A-42 Retention Basin (200-EA-1 OU waste site); isolated/modified.	*Potential for only* ***shallow vadose zone contamination*** *based on the following:* Site contamination (i.e., windblown particulates) makes it unlikely that contaminants migrated vertically to groundwater; no documented liquid release.
UPR-200-E-99 (UPR-solid)	UPR; actual date of potential historical contamination unknown.	*Potential for only* ***shallow vadose zone contamination*** *based on the following:* Absence of documented liquid release, 2015 and 2016 surface radiological surveys.
UPR-200-E-143 (UPR-solid)	UPR; radiologically contaminated rabbit feces discovered in 1990; isolated/modified.	*Potential for only* ***shallow vadose zone contamination*** *based on the following:* 2016 surface radiological survey; absence of documented liquid release; site contamination (i.e., contaminated rabbit feces) makes it unlikely that contaminants migrated vertically to groundwater.

Sources:

DOE/RL-92-19, *200 East Groundwater Aggregate Area Management Study Report.*

DOE/RL-2009-85, *Remedial Investigation Report for the 200-PO-1 Groundwater Operable Unit.*

DOE/RL-2016-74, *207A South Retention Basin Closure Report.*

Note: SGW-60540, 2017, *200-EA-1 Operable Unit Scoping*, provides additional 200-EA-1 OU waste site descriptions and information. ECF-200EA1-17-0066, *Pore Volume Calculation – 200-EA-1 OU Liquid Waste Disposal Sites*, presents the pore volume calculations and provides the sources for volume discharged and distance to groundwater.

a. Available groundwater monitoring well data near 200-EA-1 OU waste sites were reviewed for the presence or absence of the following principal indicator contaminants: nitrate, tritium, iodine-129, technetium-99, strontium-90, cesium-137, and gross beta (liquid waste disposal and handling sites); site-specific analytes such as chromium, lead, total petroleum hydrocarbons, and VOCs (solid waste disposal and handling sites).

b. Pore volume not calculated because liquid volume discharged or waste site footprint was uncertain or not applicable.

c. Construction information based on design documents; as-built documents were unavailable.

bgs = below ground surface
MCL = maximum contaminant level
OU = operable unit
PUREX = plutonium-uranium extraction (process)
UPR = unplanned release
VOC = volatile organic compound

3.3.2 Nature and Extent of Contamination for 200-EA-1 Operable Unit Waste Sites in the B Tank Farms Group

The B Tank Farms group waste sites are located in the northwestern portion of the 200 East Area and include liquid waste disposal and handling septic systems and a french drain; a solid waste disposal and handling dumping area; and UPRs (Figure 3-3). These sites are primarily associated with operations adjacent to the B-BX-BY Tank Farms, which received B Plant waste, uranium and scavenged fission product waste, and in-tank solidification condensate. Sections 2.1 and 2.2 in Chapter 2 discuss relevant waste streams and B Plant operations, respectively. The 200-EA-1 scoping document (SGW-60540) provides information on waste streams relevant to each 200-EA-1 OU waste site.

Table 3-4 provides current information for each waste site, including relative depth of vadose zone contamination. B Tank Farms group waste sites are adjacent to high-volume 200-DV-1 OU liquid disposal sites (Figure 1-3) (DOE/RL-2011-102, *Remedial Investigation/Feasibility Study and RCRA Facility Investigation/Corrective Measures Study Work Plan for the 200-DV-1 Operable Unit*). The 200-BP-5 OU is beneath the B Tank Farms group. The 200-BP-5 RI report (DOE/RL-2009-127,

Draft A) did not identify any waste sites in this group as known or potential contributors to groundwater contamination.

Table 3-4. Summary of 200-EA-1 OU Waste Sites in the B Tank Farms Group

Waste Site	Waste Site Description	Current Waste Site Understanding[a]
200-E-121 (UPR-solid)	UPR; identified in 1996 or 1997; contamination spread through the top of a containment tent; isolated/stabilized.	*Potential for only **shallow vadose zone contamination** based on the following:* Prior characterization; surface radiological surveys; site contamination (i.e., airborne releases) makes it unlikely that contaminants migrated vertically to groundwater; no documented liquid discharge.
200-E-292 dumping area	Dumping area; subsurface debris; unknown timeframe for active dumping.	*Potential for only **shallow vadose zone contamination** based on the following:* Prior characterization and surface radiological surveys; site waste (i.e., construction/demolition debris,) makes it unlikely that contaminants migrated vertically to groundwater; no documented liquid discharge.
216-B-51 french drain	Inactive; received scavenged tributyl phosphate process waste from January 1956 to January 1958.	*Potential for **partial-thickness vadose zone contamination** based on the following:* Site received 1,000 L (264 gal) of liquid waste (<0.5 pore volumes of liquid discharged); entire site constructed >4.6 m (15 ft) bgs; nitrate detected above MCLs in monitoring well 299-E33-11 during operation may be associated with adjacent waste sites.
2607-E9 septic system	Inactive septic tank and drain field; received sanitary wastewater and sewage from 1951 to at least 1993; isolated/stabilized.	*Potential for **partial-thickness vadose zone contamination** based on the following:* Waste site designed to promote infiltration; operated >40 years; construction details not located; unknown liquid discharge volume; no groundwater quality data during operation; nitrate, uranium, and technetium-99 detected above MCLs in monitoring well 299-E33-338 may be associated with adjacent waste sites.[b,c]
2607-EF septic system	Inactive steel septic tank; received sanitary wastewater and sewage; likely in service from 1951 to 1970.	*Potential for **partial-thickness vadose zone contamination** based on the following:* Construction details uncertain, portions may be constructed <4.6 m (15 ft) bgs; waste site designed to promote infiltration; operated ~20 years; unknown liquid discharge volume; no groundwater quality data during operation; iodine-129, nitrate, uranium, and technetium-99 detected above MCLs in well 299-E33-43 may be associated with adjacent waste sites.[b,c]
UPR-200-E-43 (UPR-liquid)	UPR; pump liquid dripped on the road during transport in January 1972.	*Potential for only **shallow vadose zone contamination** based on the following:* Nature of release; limited volume of contamination makes it unlikely that it migrated vertically to groundwater.
UPR-200-E-89 (UPR-solid)	UPR; airborne particulates, contaminated tumbleweeds, and concrete drill pads; isolated/stabilized.	*Potential for only **shallow vadose zone contamination** based on the following:* Nature of site contamination makes it unlikely that contaminants migrated vertically to groundwater; no documented liquid discharge.
UPR-200-E-144 (UPR-solid)	UPR; ~10 ha (~25 ac) of particulate surface contamination; first documented in 1991; isolated/stabilized.	*Potential for only **shallow vadose zone contamination** based on the following:* Prior characterization; site contamination (surface particulates) makes it unlikely that contaminants migrated vertically to groundwater; no documented liquid discharge; nitrate, technetium-99, and uranium detected above MCLs in monitoring wells located within the waste site are more likely from adjacent waste site sources.

Table 3-4. Summary of 200-EA-1 OU Waste Sites in the B Tank Farms Group

Waste Site	Waste Site Description	Current Waste Site Understanding[a]

Note: SGW-60540, 2017, *200-EA-1 Operable Unit* Scoping, provides additional 200-EA-1 OU waste site descriptions and information. ECF-200EA1-17-0066, *Pore Volume Calculation – 200-EA-1 OU Liquid Waste Disposal Sites*, presents the pore volume calculations and provides the sources for volume discharged and distance to groundwater.

a. Available groundwater monitoring well data near 200-EA-1 OU waste sites were reviewed for the presence or absence of the following principal indicator contaminants: nitrate, tritium, iodine-129, technetium-99, strontium-90, cesium-137, and gross beta (liquid waste disposal and handling sites); site-specific analytes such as chromium, lead, total petroleum hydrocarbons, and volatile organic compounds (solid waste disposal and handling sites).

b. Pore volume not calculated because liquid volume discharged or waste site footprint was uncertain or not applicable.

c. Construction information based on design documents because as-built documents were unavailable.

bgs = below ground surface
MCL = maximum contaminant level
OU = operable unit
UPR = unplanned release

3.3.3 Nature and Extent of Contamination for 200-EA-1 Operable Unit Waste Sites in the B Plant Group

The B Plant group waste sites are located in the southwestern portion of the 200 East Area and include liquid waste disposal and handling cribs, ditches, a trench, french drains, retention basins, pipelines, and a septic system; a solid waste disposal and handling burial vault/pit; and UPRs (Figure 3-4). These sites primarily handled waste generated by B Plant. Sections 2.1 and 2.2 in Chapter 2 discuss relevant waste streams and B Plant operations, respectively. The 200-EA-1 scoping document (SGW-60540) provides information on waste streams relevant to each 200-EA-1 OU waste site.

Table 3-5 provides current information for each waste site, including relative depth of vadose zone contamination. The 200-BP-5 OU is beneath the B Plant group waste sites. Table 3-5 indicates which 200-EA-1 OU waste sites were identified in the 200-BP-5 RI report (DOE/RL-2009-127, Draft A) as known or potential contributors to groundwater contamination.

Table 3-5. Summary of 200-EA-1 OU Waste Sites in the B Plant Group

Waste Site	Waste Site Description	Current Waste Site Understanding[a]
200-E-25 french drain	Inactive french drain; received insulation material waste from the 272BB insulation shop; operated from 1971 to 1991.	*Potential for* ***partial-thickness vadose zone contamination*** *based on the following:* Site received 73,900 L (19,500 gal) of liquid waste (>0.5 pore volumes); low volume discharged to site and sensitivity of the pore volume calculation to waste site footprint; portions of site are constructed to 6.1 m (20 ft) bgs.
200-E-26 (UPR-liquid)	UPR; equipment oil and diesel fuel leaks first noted in 1996.	*Potential for only* ***shallow vadose zone contamination*** *based on the following:* Nature of site contamination (low volume and natural attenuation of petroleum hydrocarbons) makes it unlikely that contaminants migrated vertically to groundwater; kerosene-range TPH or VOC not detected in groundwater monitoring wells 299-E28-17 and 299-E28-32.
200-E-117 (UPR-solid)	UPR; 3 m by 6 m (10 ft by 20 ft) posted area containing two vertical, aboveground steel pipes connected to the B Plant steam line; initial reason for posting unknown; surface stabilized.	*Potential for only* ***shallow vadose zone contamination*** *based on the following:* Nature of site contamination (fixed contamination <5,000 cpm direct beta-gamma) makes it unlikely that contaminants migrated vertically to groundwater; no documented liquid release.

Table 3-5. Summary of 200-EA-1 OU Waste Sites in the B Plant Group

Waste Site	Waste Site Description	Current Waste Site Understanding[a]
200-E-123 (UPR-solid)	UPR; source of contamination unknown; surface stabilized.	*Potential for only **shallow vadose zone contamination** based on the following:* Nature of site contamination (small, localized SCA) makes it unlikely that contaminants migrated vertically to groundwater; no documented liquid release.
200-E-129 (UPR-solid)	UPR; identified in 2001 radiological survey; unknown contaminant source; surface stabilized.	*Potential for only **shallow vadose zone contamination** based on the following:* Nature of site contamination (small, localized SCA) makes it unlikely that contaminants migrated vertically to groundwater; no documented liquid release.
200-E-130 (UPR-solid)	UPR; submitted to WIDS in 2001; unknown source of contamination; surface stabilized.	*Potential for only **shallow vadose zone contamination** based on the following:* Nature of site contamination (small, localized SCA) makes it unlikely that contaminants migrated vertically to groundwater; no documented liquid release.
200-E-142 depression	Depression in the ground where overflow waste drained from a paintbrush washing station; washing station operational dates unknown.	*Potential for **partial-thickness vadose zone contamination** based on the following:* All of the waste site is constructed >4.6 m (15 ft) bgs; unknown liquid discharge volume and operational period; TPH and VOCs not detected in groundwater monitoring wells 299-E28-17 or 299-E-28-32.[b]
200-E-209-PL pipeline	Inactive underground pipeline; served as a process sewer between the 272BB insulation shop and the 200-E-25 french drain (200-EA-1 OU); assumed operation from 1971 to 1991 (same as the 200-E-25 french drain).	*Potential for **partial-thickness vadose zone contamination** based on the following:* Constructed >4.6 m (15 ft) bgs; possible pipeline leak; release volume likely less than reported discharge to 200-E-25 french drain.[b]
200-E-297 dumping area	Inactive open pit containing possible asbestos-containing material and assorted building debris; identified in 2012.	*Potential for only **shallow vadose zone contamination** based on the following:* Nature of site contamination (possible asbestos containing material and building debris) makes it unlikely that contaminants migrated to groundwater; no documented liquid release.
207-B Retention Basin	Two inactive retention basins (i.e., north/south); served as settling basins for B Plant process sewer effluent; operated from 1945 to 1997; isolated/modified.	*Potential for only **shallow vadose zone contamination** based on the following:* Designed as a nondischarging facility; absence of documented discharge; constructed >4.6 m (15 ft) bgs.[b]
216-B-2-1 Ditch	Inactive ditch; conveyed B Plant process sewer effluent from 1945 to 1963; isolated/modified.	*Potential for **full-thickness vadose zone contamination** based on the following:* Site conveyed 1.49E+11 L (3.94E+10 gal) of liquid waste, with expected associated infiltration >0.5 pore volumes; potential contributor to groundwater contamination (DOE/RL-2009-127, Draft A); nitrate, thallium, and radionuclides detected in site footprint.
216-B-2-2 Ditch	Inactive ditch; conveyed B Plant process sewer effluent; used from 1963 to 1970; isolated/modified.	*Potential for **full-thickness vadose zone contamination** based on the following:* Site conveyed 4.97E+07 (1.31E+07 gal) of liquid waste, with expected associated infiltration >0.5 pore volumes; potential contributor to groundwater contamination (DOE/RL-2009-127, Draft A); polyaromatic hydrocarbons, PCBs, semivolatile organic compounds, and radionuclides detected in site footprint.

Table 3-5. Summary of 200-EA-1 OU Waste Sites in the B Plant Group

Waste Site	Waste Site Description	Current Waste Site Understanding[a]
216-B-2-3 Ditch	Inactive ditch; conveyed B Plant process sewer effluent; used from 1970 to 1987; isolated/modified.	*Potential for **full-thickness vadose zone contamination** based on the following:* Cumulative liquid volume conveyed is uncertain (378,500 to 1,510,000 L/d [100,000 to 400,000 gal/d] during operation); based on cumulative volume estimates, expected associated infiltration >0.5 pore volumes.
216-B-10A Crib	Inactive crib; received decontamination waste from 1949 to 1958 and floor drainage from 1949 to 1969; isolated/modified.	*Potential for **full-thickness vadose zone contamination** based on the following:* Site received 9,980,000 L (2,640,000 gal) of liquid waste (>0.5 pore volumes); gross beta and nitrate above MCLs detected in well 299-E28-17 during operation.
216-B-10B Crib	Inactive crib; received B Plant process effluent waste; operated from 1949 to 1973.	*Potential for **partial-thickness vadose zone contamination** based on the following:* Site received 28,000 L (7,400 gal) of liquid waste (<0.5 pore volumes); portions of the waste site are constructed to 6.1 m (20 ft) bgs; elevated gross beta in well 299-E28-17 during operational period may be from adjacent waste sites.
216-B-12 Crib	Inactive crib; received B Plant chemical sewer waste and U Plant process condensate from 1952 to 1957 and again from 1967 to 1973; isolated/modified.	*Potential for **full-thickness vadose zone contamination** based on the following:* Site received 1.43E+09 L (3.78E+08 gal) of liquid waste (>0.5 pore volumes); potential contributor to groundwater contamination (DOE/RL-2009-127, Draft A); nitrate, PCBs, TBP, and radionuclides in waste site footprint and vadose zone detected; cesium-137, nitrate, tritium, and strontium-90 above MCLs in monitoring well 299-E28-9 during operation; nitrate above MCL in monitoring well 299-E28-16 during operation.
216-B-55 Crib	Inactive crib; received B Plant steam condensate; operated from 1967 to 1991; isolated/modified.	*Potential for **full-thickness vadose zone contamination** based on the following:* Site received 1.23E+09 L (3.25E+08 gal) of liquid waste (>0.5 pore volumes); metals and radionuclides detected in site footprint; nitrate and tritium above MCLs in wells 299-E28-12 and 299-E28-13 during operation.
216-B-59 Trench	Inactive trench; received only one discharge of B Plant cooling water in 1968.	*Potential for **partial-thickness vadose zone contamination** based on the following:* Site received 477,000 L (126,000 gal) of liquid waste (<0.5 pore volumes); constructed >4.6 m (15 ft) bgs; cesium-137 detected above MCL in borehole geophysical log for well 299-E28-3 is likely from adjacent waste sites.
216-B-59B Retention Basin	Inactive underground retention basin; constructed over the 216-B-59 Trench (200-EA-1 OU); received B Plant cooling water; operated from 1974 to 1997; isolated/modified.	*Potential for only **shallow vadose zone contamination** based on the following:* Retention basin designed as a nondischarging facility; absence of documented discharge; constructed >4.6 m (15 ft) bgs; cesium-137 detected above MCL in borehole geophysical log for well 299-E28-3 is likely from adjacent waste sites.
216-B-62 Crib	Inactive crib; received B Plant process condensate; operated from 1973 to 1991; isolated/modified.	*Potential for **full-thickness vadose zone contamination** based on the following:* Site received 2.80E+08 L (7.40E+07 gal) of liquid waste (>0.5 pore volumes); potential contributor to groundwater contamination (DOE/RL-2009-127, Draft A); cesium-137 in site footprint borehole geophysical logs and underlying vadose zone; nitrate, tritium, and uranium above MCLs in wells 299-E28-18 and 299-E28-21 during operation.

Table 3-5. Summary of 200-EA-1 OU Waste Sites in the B Plant Group

Waste Site	Waste Site Description	Current Waste Site Understanding[a]
216-B-63 Ditch	Inactive ditch; received B Plant cooling water and chemical sewer waste; operated from 1970 to 1992; isolated/modified.	*Potential for **full-thickness vadose zone contamination** based on the following:* Site conveyed 7.98E+09 L (2.11E+09 gal) of liquid waste, with expected associated infiltration >0.5 pore volumes; metals, nitrate, VOCs, and radionuclides detected in site footprint; chromium above MCLs in wells 299-E27-17, 299-E33-33, 299-E33-34, 299-E34-8, and 299-E34-10 during or just after operation ceased.
218-E-7 burial vault	Three inactive underground burial vaults; received solid laboratory waste from 1945 to 1952; isolated/modified.	*Potential for **partial-thickness vadose zone contamination** based on the following:* Portions of waste site are constructed to 7.6 m (25 ft) bgs; site contamination (solid laboratory waste) makes it unlikely contaminants migrated vertically to groundwater.
2607-E3 septic system	Abandoned septic tank and drain field; received sanitary wastewater and sewage from 1944 to 1997; isolated/modified.	*Potential for **partial-thickness vadose zone contamination** based on the following:* Constructed >4.6 m (15 ft) bgs; waste site designed to promote infiltration; operated for >50 years; estimated 2.52E+08 L (6.65E+07 gal) liquid discharge.[b,c]
UPR-200-E-64 (UPR-solid)	UPR of radiological contamination identified in 1984; source most likely a tank farm pipeline swab riser; isolated/modified.	*Potential for only **shallow vadose zone contamination** based on the following:* Nature of site contamination (windblown particles and biomobilization) makes it unlikely that contaminants migrated to groundwater; no documented liquid release; nitrate and tritium above MCLs observed in well 299-E28-12 may be from adjacent waste sites.
UPR-200-E-69 (UPR-liquid)	UPR in 1984; burial box being transported by train from B Plant released contaminated flush water; surface stabilized.	*Potential for only **shallow vadose zone contamination** based on the following:* Limited-volume leak based on burial box capacity; no nearby groundwater monitoring wells.

Sources:

DOE/RL-92-19, *200 East Groundwater Aggregate Area Management Study Report.*

DOE/RL-2009-127, Draft A, *Remedial Investigation Report for the 200-BP-5 Groundwater Operable Unit.*

Note: SGW-60540, *200-EA-1 Operable Unit Scoping*, provides additional 200-EA-1 OU waste site descriptions and information. ECF-200EA1-17-0066, *Pore Volume Calculation – 200-EA-1 OU Liquid Waste Disposal Sites*, presents the pore volume calculations and provides the sources for volume discharged and distance to groundwater.

a. Available groundwater monitoring well data near 200-EA-1 OU waste sites was reviewed for the presence or absence of the following principal indicator contaminants: nitrate, tritium, iodine-129, technetium-99, strontium-90, cesium-137, and gross beta (liquid waste disposal and handling sites); site-specific analytes such as chromium, lead, TPH, and VOCs (solid waste disposal and handling sites).

b. Pore volume not calculated because liquid volume discharged or waste site footprint was uncertain or not applicable.

c. Construction information based on design documents because as-built documents were unavailable.

bgs = below ground surface
cpm = counts per minute
MCL = maximum contaminant level
OU = operable unit
PCB = polychlorinated biphenyls
SCA = soil contamination area
TPH = total petroleum hydrocarbons
UPR = unplanned release
VOC = volatile organic compound
WIDS = Waste Identification Data System

3.3.4 Nature and Extent of Contamination for 200-EA-1 Operable Unit Waste Sites in the Hot Semiworks Plant Group

The Hot Semiworks plant group waste sites are located in the central portion of the 200 East Area and include liquid waste disposal and handling cribs, french drains, septic systems, pipelines, a valve pit, and an injection/reverse well; solid waste disposal and handling burial grounds, dumping areas, foundations, and process units; and UPRs (Figure 3-5). These sites primarily handled waste generated by the Hot Semiworks plant and the 209E Critical Mass Laboratory. Sections 2.1 and 2.2 in Chapter 2 discuss relevant waste streams and Hot Semiworks operations, respectively. The 200-EA-1 scoping document (SGW-60540) provides information on waste streams relevant to each 200-EA-1 OU waste site.

Table 3-6 provides current information for each waste site, including relative depth of vadose zone contamination. The 200-BP-5 OU is beneath the Hot Semiworks plant group. Table 3-6 indicates which 200-EA-1 OU waste sites were identified in the 200-BP-5 RI report (DOE/RL-2009-127, Draft A) as known or potential contributors to groundwater contamination.

Table 3-6. Summary of 200-EA-1 OU Waste Sites in the Hot Semiworks Plant Group

Waste Site	Waste Site Description	Current Waste Site Understanding[a,b]
200-E-4 french drain	Inactive french drain; received 209E Critical Mass Laboratory steam condensate; operated from 1960 to 1985; isolated/modified.	*Potential for **partial-thickness vadose zone contamination** with contaminants present above 4.6 m (15 ft) bgs based on the following:* Site received 17,500 L (4,600 gal) of liquid waste (<0.5 pore volumes); constructed <4.6 m (15 ft) bgs; metals and radionuclides detected in site footprint.
200-E-41 (UPR-solid)	UPR surrounding Hot Semiworks; resulted from Hot Semiworks operations from 1949 to 1967; footprint contains or overlaps other UPR waste sites; surface stabilized.	*Potential for **partial-thickness vadose zone contamination** based on the following:* Portions of the waste site are under fly-ash cap with areas of the site >4.6 m (15 ft) bgs; strontium-90 above MCL and elevated gross beta in monitoring well 299-E27-5 in 1967 may be associated with adjacent waste sites.
200-E-56 (UPR-liquid)	UPR; resulted from a gradual release of contaminated liquid circa 1957 from a pipeline running from the Hot Semiworks facility to the C Tank Farms (WMA C).	*Potential for **full-thickness vadose zone contamination** based on the following:* Site resulted from a pipeline leak at 4.6 m (15 ft) bgs; reported leak estimated at 75,500 L (19,900 gal) of liquid waste[c,d]
200-E-57 (UPR-liquid)	UPR; resulted from a contaminated liquid release from a pipeline running from Hot Semiworks to the C Tank Farms (WMA C).	*Potential for **partial-thickness vadose zone contamination** based on the following:* Site resulted from a pipeline leak at 4.6 m (15 ft) bgs; reported leak estimated at 113,000 L (29,900 gal) of liquid waste.[c]
200-E-249-PL pipeline	Two inactive underground pipelines; transferred steam condensate from the 209E Critical Mass Laboratory to the former 200-E-4 french drain (200-EA-1 OU waste site); used from 1960 to 1985; isolated/modified.	*Potential for only **shallow vadose zone contamination** based on the following:* Entire site is constructed <4.6 m (15 ft) bgs; no documented liquid release.
200-E-251-PL pipeline	Inactive underground pipeline; transferred steam condensate from the 291C exhaust fan house and stack to the 216-C-2 injection/reverse well (200-EA-1 OU waste site) from 1949 to 1987; isolated/modified.	*Potential for only **shallow vadose zone contamination** with contaminants present above 4.6 m (15 ft) based on the following:* Site constructed <4.6 m (15 ft) bgs; no documented liquid release.

Table 3-6. Summary of 200-EA-1 OU Waste Sites in the Hot Semiworks Plant Group

Waste Site	Waste Site Description	Current Waste Site Understanding[a,b]
200-E-252-PL pipeline	Inactive underground group of pipelines (one main line and three duct lines); transported 291C ventilation condensate to the 216-C-2 injection/reverse well (a 200-EA-1 OU waste site); used from 1949 to 1988; isolated/modified.	*Potential for **partial-thickness vadose zone contamination** based on the following:* Portions of the site are constructed >4.6 m (15 ft) bgs.
200-E-293 foundation	Concrete foundation (slab) from the 2718E Critical Mass Storage Building storage building (constructed in 1973, demolished in 2011); isolated/modified.	*Potential for only **shallow vadose zone contamination** based on the following:* Received no liquid discharge; nature of contamination (concrete foundation and slab) makes it unlikely that contaminants migrated to groundwater; constructed <4.6 m (15 ft); fixed depleted uranium detected on slab.
200-E-294 foundation	Concrete foundation (slab and sub-slab piping) from the 209E Critical Mass Laboratory (constructed in 1960, demolished in 2011); isolated/modified.	*Potential for only **shallow vadose zone contamination** based on the following:* Received no liquid discharge; nature of contamination (concrete foundation and slab) makes it unlikely that contaminants migrated to groundwater; constructed <4.6 m (15 ft) bgs; concrete slab and the piping and soil beneath the slab potentially contaminated.
201-C process unit	Consists of the decommissioned 201C processing facility remains and below-grade features (201C was the main facility for the Hot Semiworks area and operated from 1949 to 1967); isolated/modified.	*Potential for **partial-thickness vadose zone contamination** based on the following:* Portions of the site are constructed >4.6 m (15 ft) bgs.
209-E-WS-2 french drain	Inactive french drain; received 209E Critical Mass Laboratory process condensate; operated from 1960 to 1985; isolated/modified.	*Potential for **full-thickness vadose zone contamination** based on the following:* Entire waste site constructed <4.6 m (15 ft) bgs; waste site designed to promote infiltration; operated for 25 years; unknown liquid discharge volume.[c]
216-C-1 Crib	Inactive crib; received PUREX and REDOX process condensate and high-salt, cold-run waste from 1953 to 1955; received only high-salt, cold-run waste from 1955 to 1957.	*Potential for **full-thickness vadose zone contamination** based on the following:* Site received 2.34E+07 L (6.18E+06 gal) of liquid waste (>0.5 pore volumes); potential contributor to groundwater contamination (DOE/RL-2009-127, Draft A); cesium-137 detected >4.6 m (15 ft) bgs in borehole geophysical log for well 299-E27-133.
216-C-2 injection/ reverse well	Reverse well; received drainage from the 291C exhaust fan house and stack; operated from 1953 to 1988; isolated/modified.	*Potential for **full-thickness vadose zone contamination** based on the following:* Site received 3,150,000 L (832,000 gal) of liquid waste (>0.5 pore volumes).
216-C-3 Crib	Inactive crib; received REDOX process waste; operated from 1953 to 1954; isolated/modified.	*Potential for **full-thickness vadose zone contamination** based on the following:* Site received 5,000,000 L (1,320,000 gal) of liquid waste (>0.5 pore volumes); cesium-137 detected in 1958 above MCL and elevated gross beta detected in 1957 in monitoring well 299-E24-8.

Table 3-6. Summary of 200-EA-1 OU Waste Sites in the Hot Semiworks Plant Group

Waste Site	Waste Site Description	Current Waste Site Understanding[a,b]
216-C-4 Crib	Inactive crib; received PUREX and strontium recovery organic waste; operated from 1955 to 1965; isolated/modified.	*Potential for* ***partial-thickness vadose zone contamination*** *based on the following:* Site received 170,000 L (44,900 gal) liquid waste (<0.5 pore volumes); portions of the site are constructed >4.6 m (15 ft) bgs.
216-C-5 Crib	Inactive crib; received neutralized cold-run waste and PUREX process condensate from Hot Semiworks; operated from March 1955 to June 1955; isolated/modified.	*Potential for* ***partial-thickness vadose zone contamination*** *based on the following:* Site received 38,900 L (10,300 gal) liquid waste (<0.5 pore volumes); portions of the site are constructed >4.6 m (15 ft) bgs.
216-C-6 Crib	Inactive crib; received REDOX, PUREX, and strontium recovery process condensate and 241-CX-72 storage tank vault floor drain; operated from 1955 to 1964; isolated/modified.	*Potential for* ***full-thickness vadose zone contamination*** *based on the following:* Site received 531,000 L (140,000 gal) of liquid waste (>0.5 pore volumes).
216-C-7 Crib	Inactive crib; received liquid waste from the 209E Critical Mass Laboratory; operated from 1961 to 1983; isolated/modified.	*Potential for* ***partial-thickness vadose zone contamination*** *based on the following:* Site received 59,900 L (15,800 gal) liquid waste (<0.5 pore volumes); constructed <4.6 m (15 ft) bgs.
216-C-10 Crib	Inactive crib; received strontium recovery process condensate; operated from 1964 to 1969; isolated/modified.	*Potential for* ***full-thickness vadose zone contamination*** *based on the following:* Site received 897,000 L (237,000 gal) of liquid waste (>0.5 pore volumes); strontium-90 detected above MCL and elevated gross beta detected in well 299-E27-5 during operation.
2607-E5 septic system	Inactive septic tank, leaching trench, and tile field; received sanitary wastewater and sewage from 1954 to 2011; isolated/modified.	*Potential for* ***partial-thickness vadose zone contamination*** *based on the following:* Constructed <4.6 m (15 ft) bgs; site designed to promote infiltration; operated >50 years; unknown liquid discharge volume; 1996 sewage samples from an unspecified location showed 1.69 pCi/g of cesium-137 (sludge), 47 pCi/L total alpha, 49 pCi/L total beta, and 12 pCi/L cesium-137 (composite liquid).[c,e]
2607-E7A septic system	Inactive septic tank; received sanitary wastewater and sewage from 1963 to 2011; isolated/modified.	*Potential for* ***partial-thickness vadose zone contamination*** *based on the following:* Constructed <4.6 m (15 ft) bgs; site designed to promote infiltration; operated >40 years; unknown liquid discharge volume; 1996 sewage samples collected from an unspecified location showed 1.69 pCi/g cesium-137 (sludge), 47 pCi/L total alpha, 49 pCi/L total beta, and 12 pCi/L cesium-137 (composite liquid).[c,e]
2607-E7B septic system	Inactive septic tank; received sanitary wastewater and sewage from 1963 to 2011; isolated/modified.	*Potential for* ***partial-thickness vadose zone contamination*** *based on the following:* Constructed <4.6 m (15 ft) bgs; site designed to promote infiltration; operated >40 years; unknown liquid discharge volume; 1996 sewage samples collected from an unspecified location showed 1.69 pCi/g cesium-137 (sludge), 47 pCi/L total alpha, 49 pCi/L total beta, and 12 pCi/L cesium-137 (composite liquid).[c,e]
291-C process unit	Footprint of former 291C exhaust fan house and stack and the related 201C air tunnel (the 291C facility operated from 1949 to 1987); isolated/modified.	*Potential for* ***partial-thickness vadose zone contamination*** *based on the following:* Portions of the waste site are constructed >4.6 m (15 ft) bgs.

Table 3-6. Summary of 200-EA-1 OU Waste Sites in the Hot Semiworks Plant Group

Waste Site	Waste Site Description	Current Waste Site Understanding[a,b]
291-C-1 Burial Ground	Burial trench containing the demolished 291C exhaust fan house and stack; the 291C stack operated from 1949 to 1987; isolated/modified.	*Potential for only **shallow vadose zone contamination** based on the following:* Received no liquid discharge; nature of site contamination (decontaminated and stabilized building debris) makes it unlikely that contaminants migrated to groundwater; burial trench dimensions not located.
HSVP (valve pit)	Inactive underground cylindrical valve pit; operated from 1951 to 1967; isolated/modified.	*Potential for **partial-thickness vadose zone impacts** based on the following:* Construction depth unknown, but likely >4.6 m (15 ft) based on related pipeline depths.
UPR-200-E-37 (UPR-solid)	UPR with subsites; subsite #1 (reported in 1967) is further wind spread of a pump change release; subsite #2 (reported in 1987) is 56,700 m^2 (14 ac) with detected radiation dose (source unspecified); isolated/modified.	*Potential for only **shallow vadose zone contamination** based on the following:* Site <4.6 m (15 ft) bgs; nature of site contamination (windblown particles) makes it unlikely that contaminants migrated to groundwater; no documented liquid release.
UPR-200-E-98 (UPR-solid)	UPR; unspecified date and source of contamination; isolated/modified.	*Potential for only **shallow vadose zone contamination** based on the following:* Site is <4.6 m (15 ft) bgs; nature of site contamination (windblown vapor or particles) makes it unlikely that contaminants migrated to groundwater; no documented liquid release.

Source: DOE/RL-2009-127, Draft A, *Remedial Investigation Report for the 200-BP-5 Groundwater Operable Unit.*

Note: SGW-60540, *200-EA-1 Operable Unit Scoping*, provides additional 200-EA-1 OU waste site descriptions and information. ECF-200EA1-17-0066, *Pore Volume Calculation – 200-EA-1 OU Liquid Waste Disposal Sites*, presents the pore volume calculations and provides the sources for volume discharged and distance to groundwater.

a. Available groundwater monitoring well data near 200-EA-1 OU waste sites was reviewed for the presence or absence of the following principal indicator contaminants: nitrate, tritium, iodine-129, technetium-99, strontium-90, cesium-137, and gross beta (liquid waste disposal and handling sites); site-specific analytes such as chromium, lead, total petroleum hydrocarbons, and volatile organic compounds (solid waste disposal and handling sites).

b. The Hot Semiworks Plant (C Plant) was decommissioned, decontaminated, and demolished in the mid-1980s. Aboveground features were removed, subsurface features were filled with grout, and the area was covered with a layer of fly ash of variable thickness. The actual depth below ground surface of 200-EA-1 OU waste sites beneath the fly ash may vary from the depths provided herein.

c. Pore volume not calculated because liquid volume discharged or waste site footprint was uncertain or not applicable.

d. The 200-E-56 UPR waste site was identified as a potential full-thickness vadose zone contamination site based, in part, on its proximity to 201-C process unit former effluent discharge points and the potential for future releases.

e. Construction information based on design documents because as-built documents were unavailable.

bgs = below ground surface
HSVP = Hot Semiworks Valve Pit
MCL = maximum contaminant level
OU = operable unit
PUREX = plutonium-uranium extraction (process)
REDOX = reduction-oxidation (process)
UPR = unplanned release
WMA = waste management area

3.3.5 Nature and Extent of Contamination for 200-EA-1 Operable Unit Waste Sites in the Plutonium-Uranium Extraction Plant Group

The PUREX Plant group waste sites are located in the southeastern portion of the 200 East Area and include liquid waste disposal and handling cribs, a conveyance ditch, and a septic system; a solid waste disposal and handling storage yard and dumping area; and UPRs (Figure 3-6). These sites primarily handled waste generated by the PUREX Plant. Sections 2.1 and 2.2 in Chapter 2 discuss relevant waste

streams and PUREX Plant operations, respectively. The 200-EA-1 scoping document (SGW-60540) provides information on waste streams relevant to each 200-EA-1 OU waste site.

Table 3-7 provides current information for each waste site, including relative depth of vadose zone contamination. The 200-PO-1 OU is primarily beneath the PUREX plant group waste sites (the 200-BP-5 OU is under a small area along the northern portion of the group). Table 3-7 shows which 200-EA-1 OU waste sites were identified in the 200-PO-1 RI report (DOE/RL-2009-85) as known or potential contributors to groundwater contamination. The 200-BP-5 RI report (DOE/RL-2009-127, Draft A) did not identify any waste sites in this group as known or potential contributors to groundwater contamination.

Table 3-7. Summary of 200-EA-1 OU Waste Sites in the PUREX Plant Group

Waste Site	Waste Site Description	Current Waste Site Understanding[a]
200-E PD Ditch	Active ditch; conveys cooling water from the 282E pump house and reservoir (operating), 283E water filtration plant (operating), and 284E powerhouse (demolished); operational since 1945; isolated/modified.	*Potential for **full-thickness vadose zone contamination** based on the following:* Cumulative liquid volume conveyed is uncertain (estimated at 1.32E+10 L [3.48E+09 gal]); expected associated infiltration >0.5 pore volumes.
200-E-13 dumping area	Inactive dumping area consisting of several rubble piles.	*Potential for only **shallow vadose zone contamination** based on the following:* Nature of site contamination (construction and demolition debris) makes it unlikely that contaminants migrated to groundwater.
200-E-43 storage area	Railroad spur; contamination from radioactive equipment storage and multiple releases from railcars transporting radioactive material; no specific waste stream located; surface stabilized.	*Potential for **partial-thickness vadose zone contamination** based on the following:* Nature of site contamination (i.e., tumbleweeds and low-volume liquid releases [drips] from equipment in transit); waste site inundated in December 2010 with 2,180,000 L (576,000 gal) of potable water.
200-E-124 (UPR-liquid)	UPR from railcar unloading operations; surface stabilized.	*Potential for only **shallow vadose zone contamination** based on the following:* Nature of site contamination (tumbleweeds and potentially radioactive liquid and solid waste from railcars) makes it unlikely that contaminants migrated to groundwater.
216-A-3 Crib	Inactive crib; received waste from the 203A acid pump house and uranyl nitrate hexahydrate tank farm; operated from 1956 to 1981; isolated/modified.	*Potential for **full-thickness vadose zone contamination** based on the following:* Site received 3,050,000 L (806,000 gal) of liquid waste (>0.5 pore volumes); potential contributor to groundwater contamination (DOE/RL-2009-85).
216-A-9 Crib	Inactive crib and former truck unloading station; crib received PUREX acid fractionator condensate and cooling water and N Reactor decontamination waste; operated from 1956 to 1969; truck unloading station was used for 7 months in 1966; isolated/modified.	*Potential for **full-thickness vadose zone contamination** based on the following:* Site received 9.81E+08 L (2.59 E+08 gal) of liquid waste (>0.5 pore volumes); potential contributor to groundwater contamination (DOE/RL-2009-85); elevated gross beta and cesium-137, strontium-90, and nitrate (nitrate at wells 299-E24-4 and 299-E24-5 only) above MCLs in wells 299-E24-3, 299-E24-4, and 299-E24-5 during operation.

Table 3-7. Summary of 200-EA-1 OU Waste Sites in the PUREX Plant Group

Waste Site	Waste Site Description	Current Waste Site Understanding[a]
216-A-10 Crib	Inactive crib; received acidic PUREX distillate and process condensate; operated from 1961 until April 1987; isolated/modified.	*Potential for **full-thickness vadose zone contamination** based on the following:* Site received 3.16E+09 L (8.35E+08 gal) of liquid waste (>0.5 pore volumes); potential contributor to groundwater contamination (DOE/RL-2009-85); volatile organic compounds, semivolatile organic compounds, and radionuclides detected in site footprint and vadose zone; elevated gross beta and nitrate and tritium above MCLs detected in monitoring wells 299-E17-1 and 299-E24-2 during operation.
216-A-27 Crib	Inactive crib; received various PUREX ammonia scrubber and laboratory waste streams; operated from 1965 to 1970; isolated/modified.	*Potential for **full-thickness vadose zone contamination** based on the following:* Site received 2.32E+07 L (6.13E+06 gal) of liquid waste (>0.5 pore volumes); potential contributor to groundwater contamination (DOE/RL-2009-85); elevated gross beta and nitrate and tritium above MCLs detected in monitoring well 299-E17-2 during operation.
216-A-36A Crib	Inactive crib; received PUREX ammonia scrubber waste; operated from 1965 to 1966; isolated/modified.	*Potential for **full-thickness vadose zone contamination** based on the following:* Site received 1,070,000 L (283,000 gal) of liquid waste (<0.5 pore volumes); potential contributor to groundwater contamination (DOE/RL-2009-85); portions of the waste site are constructed to 6.7 m (22 ft) bgs; radionuclides detected in vadose zone; gross beta and strontium-90 above MCL detected in well 299-E17-4 during operation.
216-A-36B Crib	Inactive crib; received PUREX ammonia scrubber waste; operational from 1966 to 1972 and again from 1982 to 1987; isolated/modified.	*Potential for **full-thickness vadose zone contamination** based on the following:* Site received 3.15E+08 L (8.32E+07 gal) of liquid waste (>0.5 pore volumes); potential contributor to groundwater contamination (DOE/RL-2009-85); nitrate and radionuclides detected in vadose zone; nitrate and tritium above MCLs (299-E17-5), nitrate above MCL (299-E17-7), and elevated gross beta (299-E17-4, 299-E17-5, and 299-E17-7) during operation.
216-A-38-1 Crib	Inactive crib; never used.	*Potential for **partial-thickness vadose zone contamination** based on the following:* Site received no liquid discharge (zero pore volumes); however, portions of the site are constructed to 11.3 m (37 ft) bgs.
216-A-45 Crib	Inactive crib; received pH-adjusted PUREX facility process condensate; operated from 1987 to 1989.	*Potential for **full-thickness vadose zone contamination** based on the following:* Site received 1.03E+08 L (2.72E+07 gal) of liquid waste (>0.5 pore volumes); potential contributor to groundwater contamination (DOE/RL-2009-85); nitrate and tritium above MCLs in wells 299-E17-12 and 299-E17-13; elevated gross beta in wells 299-E17-12 and 299-E17-13 during operation.
2607-E6 septic system	Inactive septic tank and associated tile drain fields; received sanitary wastewater and sewage from 1954 to 1997; isolated/modified.	*Potential for **partial-thickness vadose zone contamination** based on the following:* A portion of the waste site (septic tank) was constructed to 5.3 m (17.3 ft) bgs; both tile drain fields are entirely constructed above 4.6 m (15 ft); waste site designed to promote infiltration; operational for >40 years; estimated 6.03E+08 L (1.59E+08 gal) liquid discharge.[b,c]

Table 3-7. Summary of 200-EA-1 OU Waste Sites in the PUREX Plant Group

Waste Site	Waste Site Description	Current Waste Site Understanding[a]
UPR-200-E-10 (UPR-solid)	UPR from a 1957 radiological contamination spread at and around the PUREX railroad right-of-way.	*Potential for only **shallow vadose zone contamination** based on the following:* Nature of site contamination (airborne radioactive contamination spread during equipment burial) makes it unlikely that contaminants migrated to groundwater; no documented liquid release.
UPR-200-E-12 (UPR-liquid)	UPR from contaminated liquid dripping from in-transit equipment in 1957.	*Potential for only **shallow vadose zone contamination** based on the following:* Nature of site contamination (low-volume liquid releases [drips] from equipment in transit) makes it unlikely that contaminants migrated to groundwater.
UPR-200-E-20 (UPR-solid)	UPR of radiological contamination from in-transit equipment in 1959.	*Potential for only **shallow vadose zone contamination** based on the following:* Nature of site contamination (radioactive contamination from equipment in transit and subsequent cleanup) makes it unlikely that contaminants migrated to groundwater; no documented liquid release.
UPR-200-E-33 (UPR-liquid)	UPR of radiological contamination from leaking in-transit equipment in 1964.	*Potential for only **shallow vadose zone contamination** based on the following:* Nature of site contamination (low volume liquid releases [drips] from equipment in transit) makes it unlikely that contaminants migrated to groundwater.
UPR-200-E-88 (UPR-liquid)	UPR on a railroad spur from radioactive equipment storage and multiple releases between 1957 and 1989 from railcars transporting radioactive material; no specified waste stream located; isolated/modified.	*Potential for **partial-thickness vadose zone contamination** based on the following:* Nature of site contamination (tumbleweeds and low-volume liquid releases [drips] from equipment in transit); waste site inundated in December 2010 with 2,180,000 L (576,000 gal) of potable water.

Sources:

DOE/RL-92-19, *200 East Groundwater Aggregate Area Management Study Report.*

DOE/RL-2009-85, *Remedial Investigation Report for the 200-PO-1 Groundwater Operable Unit.*

Note: SGW-60540, *200-EA-1 Operable Unit Scoping*, provides additional 200-EA-1 OU waste site descriptions and information. ECF-200EA1-17-0066, *Pore Volume Calculation – 200-EA-1 OU Liquid Waste Disposal Sites*, presents the pore volume calculations and provides the sources for volume discharged and distance to groundwater.

a. Available groundwater monitoring well data near 200-EA-1 OU waste sites was reviewed for the presence or absence of the following principal indicator contaminants: nitrate, tritium, iodine-129, technetium-99, strontium-90, cesium-137, and gross beta (liquid waste disposal and handling sites); site-specific analytes such as chromium, lead, total petroleum hydrocarbons, and volatile organic compounds (solid waste disposal and handling sites).

b. Pore volume not calculated because liquid volume discharged or waste site footprint was uncertain or not applicable.

c. Construction information based on design documents because as-built documents were unavailable.

bgs = below ground surface
MCL = maximum contaminant level
OU = operable unit
PUREX = Plutonium-Uranium Extraction (Plant and process)
UPR = unplanned release

3.3.6 Nature and Extent of Contamination for 200-EA-1 Operable Unit Waste Sites in the Miscellaneous Group

The miscellaneous group waste sites are in the northeastern and the western/southwestern portions of the 200 East Area. The miscellaneous group includes a nonradioactive waste disposal burn pit and UPRs. With the exception of the 200-E BP burn pit, the "northeast miscellaneous sites" are UPRs comprised of contaminated vegetation, animal feces, and small areas of particulate contamination (Figure 3-7).

The "southwest miscellaneous sites" are UPRs associated with railroad spurs or rail lines resulting from liquid or particulate contamination releases from stored or in-transit equipment along the rail lines (Figure 3-8).

The 200-BP-5 OU is primarily beneath the miscellaneous group waste sites (the 200-PO-1 OU is beneath the southern portion of UPR-200-E-11). Table 3-8 provides current information for each waste site, including relative depth of vadose zone contamination. The 200-BP-5 RI report (DOE/RL-2009-127, Draft A) and 200-PO-1 RI report (DOE/RL-2009-85) did not identify any waste sites in this group as known or potential contributors to groundwater contamination.

Table 3-8. Summary of 200-EA-1 OU Waste Sites in the Miscellaneous Group

Waste Site	Waste Site Description	Current Waste Site Understanding
200-E BP burn pit	Inactive burn pit; received construction/office waste, paint waste, and chemical solvents (1950 to 1970).	*Potential for **partial-thickness vadose zone contamination** based on the following:* Site received 1,000 m^3 (264,170 gal) of liquid waste and chemical solvents (insufficient information to calculate pore volume); portions of the site constructed to 4.6 m (15 ft) bgs; nature of site contamination and material disposition (burning paint waste and chemical solvents) makes it unlikely that contaminants migrated to groundwater; trace perchloroethylene (tetrachloroethene) and chloroform detected in soil vapor samples, but volatile organic compounds were not detected in monitoring well 299-E26-1.
200-E-53 (UPR-solid)	UPR and aboveground storage area; established in 1978.	*Potential for only **shallow vadose zone contamination** based on the following:* Nature of site contamination (particulate contamination [specks] and tumbleweeds) makes it unlikely that contaminants migrated to groundwater.
200-E-109 (UPR-solid)	UPR consisting of multiple radiologically contaminated, windblown tumbleweed accumulations; established in 1998; surface stabilized.	*Potential for only **shallow vadose zone contamination** based on the following:* Nature of site contamination (particulate contamination [specks] and tumbleweeds) makes it unlikely that contaminants migrated to groundwater.
200-E-115 (UPR-solid)	UPR of unknown origin; contaminated vegetation and soil specks; established in 2000; surface stabilized.	*Potential for only **shallow vadose zone contamination** based on the following:* Nature of site contamination (soil specks and vegetation) makes it unlikely that contaminants migrated to groundwater.
200-E-139 (UPR-solid)	UPR from radiologically contaminated vegetation; surface stabilized.	*Potential for only **shallow vadose zone contamination** based on the following:* Nature of site contamination (contaminated vegetation) makes it unlikely that contaminants migrated to groundwater.
UPR-200-E-11 (UPR-liquid)	UPR on railroad tracks resulting from multiple contaminated liquid releases (leaks and drips) from railcars transporting radioactive material; established in 1957; isolated/modified.	*Potential for only **shallow vadose zone contamination** based on the following:* Nature of site contamination (low volume liquid releases [drips] from equipment in transit) makes it unlikely that contaminants migrated to groundwater.
UPR-200-E-50 (UPR-solid)	UPR of radiological contamination from contaminated equipment storage; established in 1974.	*Potential for only **shallow vadose zone contamination** based on the following:* Nature of site contamination (radioactive contamination from equipment on ground surface) makes it unlikely that contaminants migrated to groundwater; no documented liquid release.

Table 3-8. Summary of 200-EA-1 OU Waste Sites in the Miscellaneous Group

Waste Site	Waste Site Description	Current Waste Site Understanding
UPR-200-E-95 (UPR-solid)	UPR on a railroad spur resulting from contamination releases from railcars transporting equipment and radioactive material; railroad spur in use beginning in 1945; UPR established in 1980; surface stabilized.	*Potential for only **shallow vadose zone contamination** based on the following:* Nature of site contamination (small amounts of contamination from stored equipment) makes it unlikely that contaminants migrated to groundwater.
UPR-200-E-112 (UPR-liquid)	UPR resulting from contaminated liquid release from an in-transit cesium ion-exchange column; surface stabilized.	*Potential for only **shallow vadose zone contamination** based on the following:* Nature of site contamination (low-volume liquid release from equipment in transit) makes it unlikely that contaminants migrated to groundwater.

Source: DOE/RL-2009-127, Draft A, *Remedial Investigation Report for the 200-BP-5 Groundwater Operable Unit.*

* SGW-60540, *200-EA-1 Operable Unit Scoping*, provides additional 200-EA-1 Operable Unit waste site descriptions and information. Section 3.2.4 lists the waste sites that have been stabilized or modified.

bgs = below ground surface

UPR = unplanned release

3.4 Development of Contaminants of Potential Concern

COPCs are contaminants known or suspected to be present at a site at concentrations that potentially pose a risk to HHE. The following were reviewed to identify constituents for consideration as COPCs:

- AAMS reports and previous investigations (listed in Section 3.2).
- COPC identification for DOE/RL-2007-02, *Supplemental Remedial Investigation/Feasibility Study Work Plan for the 200 Areas Central Plateau Operable Units: Volume I: Work Plan and Appendices*
- COPC identification for the 200-MG-1 OU and 200-MG-2 OU EE/CAs (DOE/RL-2008-44 and DOE/RL-2008-45, respectively)
- Historical process knowledge information from Central Plateau facility operations presented in the 200-EA-1 scoping document (SGW-60540)

The following constituents within the 200-EA-1 OU were excluded from COPC consideration:

- Elemental isotopes that were stable, or radionuclides that had half-lives of <3 years
- Radionuclides that were naturally occurring and not generated or concentrated as part of Hanford Site operations
- Radionuclides potentially present only as trace fission products with activity yields <1% the activity yield for cesium-137 and not targeted by a separation/concentration process (insignificant contribution to dose)
- Actinides with atomic mass numbers >242 and constituting <1% of actinide activity in waste streams

Table 3-9 provides a comprehensive COPC list that is refined through a BRA (see Section 3.8.1.3). While this comprehensive list includes all the COPCs that will be considered for the 200-EA-1 OU, the list does not apply globally to individual waste sites. The SAP (Appendix A) identifies specific COPCs for characterization based on sampling objectives and waste site process knowledge.

Table 3-9. 200-EA-1 OU Master COPC List[a]

Radionuclides		
Americium-241	Hydrogen-3 (tritium)	Strontium-90
Carbon-14	Iodine-129	Technetium-99
Cesium-137	Neptunium-237	Uranium-233
Cobalt-60	Nickel-63	Uranium-234
Europium-152	Plutonium-238	Uranium-235
Europium-154	Plutonium-239	Uranium-238
Europium-155	Plutonium-240	
Inorganics		
Ammonia	Cobalt	Nitrite
Antimony	Copper	Phosphate
Arsenic	Cyanide (free and total)	Selenium
Barium	Fluoride	Silver
Beryllium	Lead	Sulfate
Cadmium	Manganese	Uranium (total)
Chloride	Mercury	Vanadium
Chromium (total)	Nickel	Zinc
Chromium (VI)	Nitrate	
Organics		
Acenaphthene	Chlordane	2-Hexanone
Acenaphthylene	Chrysene	Indeno[1,2,3-cd]pyrene
Acetone	Chlorobenzene	4-Methyl-2-pentanone (hexone, methyl isobutyl ketone)
Acetonitrile	Chloroform	Methylene chloride (dichloromethane)
alpha-BHC (alpha-HCH)	Cyclohexane	Napthalene
Aldrin	Dibenz[a,h]anthracene	Petroleum hydrocarbons (diesel to kerosene range)
Anthracene	Dibenzofuran	Total polychlorinated biphenyls
Aroclor 1254[b]	4,4'-Dichlorodiphenyldichloroethane	Phenanthrene
Aroclor 1260[b]	4,4'-Dichlorodiphenyltrichloroethane	Pyrene
Benzene	4,4'-Dichlorodiphenyldichloroethylene	Phenol
Benzo(a)anthracene	Dieldrin	Tetrachloroethene (PCE)
Benzo(a)pyrene	1,1-Dichloroethane	1,1,1-Trichloroethane
Benzo(b)fluoranthene	1,2-Dichloroethane	1,1,2-Trichloroethane
Benzo(ghi)perylene	cis-1,2-Dichloroethene	
Benzo(k)fluoranthene	trans-1,2-Dichloroethene	

Table 3-9. 200-EA-1 OU Master COPC List[a]

beta-BHC (beta-HCH)	Endrin	Toluene
n-Butanol (butyl alcohol)	Ethylbenzene	Tributyl phosphate
2-Butanone (methyl ethyl ketone)	Fluoranthene	Trichloroethene
n-Butyl benzene	Fluorene	Vinyl chloride
Carbon tetrachloride	gamma-BHC (gamma-HCH, Lindane)	Xylenes (total)
	n-Hexane	

a. This table is a comprehensive list that includes all contaminants of potential concern that may be present in the 200-EA-1 Operable Unit and should not be applied globally to individual waste sites. This list has been refined from the initial list discussed during waste site scoping on January 23, 2017.

b. Polychlorinated biphenyl.

3.5 Land and Groundwater Use

This section describes the current and future land and groundwater use for the Central Plateau Inner Area and is consistent with the Central Plateau cleanup completion framework and the Inner Area cleanup principles described in Section 1.3 of Chapter 1. Land and groundwater use information is applied in conjunction with the identification of potential exposure routes and receptors (as appropriate) to support the determination of a basis for action, establish RAOs, and define components of cleanup actions (e.g., institutional controls [ICs]).

3.5.1 Land Use

The current Central Plateau Inner Area land use activities are industrial in nature. Several Central Plateau waste management facilities continue to operate (e.g., Environmental Restoration Disposal Facility [ERDF], low-level radioactive waste burial grounds, RCRA-permitted mixed waste trenches, and the U.S. Ecology, Inc. commercial low-level waste disposal facility on 40 ha [100 ac] of land leased to Washington State). In addition, construction began in 2002 for the Waste Treatment Plant pre-treatment facilities where low-activity tank waste will be separated and vitrified for disposal at the onsite Integrated Disposal Facility.

DOE/EIS-0222-F, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement*, evaluated residential, agricultural, industrial, and recreational land uses. The reasonably anticipated future land use for the Central Plateau Inner Area is industrial. The Tri-Parties have defined the Inner Area as the final footprint area of the Hanford Site required for permanent waste management and control of residual contamination (Section 1.3.1 in Chapter 1). 64 FR 61615, "Record of Decision: Hanford Comprehensive Land Use Plan Environmental Impact Statement (HCP EIS)"; 73 FR 188, "Amended Record of Decision for the Hanford Comprehensive Land-Use Plan Environmental Impact Statement"; and DOE/EIS-0222-SA-01, *Supplement Analysis: Hanford Comprehensive Land-Use Plan Environmental Impact Statement*, provide additional information regarding this land-use determination.

Communities near the Hanford Site include the cities of Richland, West Richland, Kennewick, Pasco, and numerous smaller Benton and Franklin County towns. Available data indicate that no residence lies within 16 km (10 mi) of the 200 East Area (DOE/EIS-0189, *Final Environmental Impact Statement for the Tank Waste Remediation System, Hanford Site, Richland, Washington*).

3.5.2 Groundwater Use

Groundwater underlying the 200 East Area is contaminated; groundwater is routinely withdrawn from wells to monitor contaminants and groundwater conditions. Groundwater underlying the Central Plateau will not become a drinking water source until cleanup criteria are achieved. The DOE long-term goal is to restore Central Plateau groundwater to beneficial use unless restoration is determined to be technically impracticable.

3.6 Conceptual Exposure Models for Fate and Transport Evaluation

This section presents a qualitative understanding of contaminant fate and transport and risk to receptors for 200-EA-1 OU waste sites.

3.6.1 Exposure Pathways and Routes

The exposure pathways, exposure routes, exposure assumptions, and toxicity values that will be used for the human health exposure scenarios are described in Section 3.8.1. Human health risks will be assessed using an outdoor worker exposure scenario for the standard point of compliance (POC) (0 to 4.6 m [0 to 15 ft] bgs). A construction worker exposure scenario will be used to evaluate radiological contamination below 4.6 m (15 ft) bgs.

Ecological risks will be assessed for terrestrial receptors on the Central Plateau as described in Section 3.8.2. The ecological receptors, exposure pathways, exposure parameters, and toxicity reference values that will be used to conduct the assessment are also described in Section 3.8.2.

A conditional POC may be proposed for soil depth to evaluate ecological receptors and an alternative POC for human health (direct contact). These conditional and alternative POCs would represent the biologically active zone and would be evaluated as an alternative in the FS (or CMS, as applicable).

3.6.2 Contaminant Fate and Transport

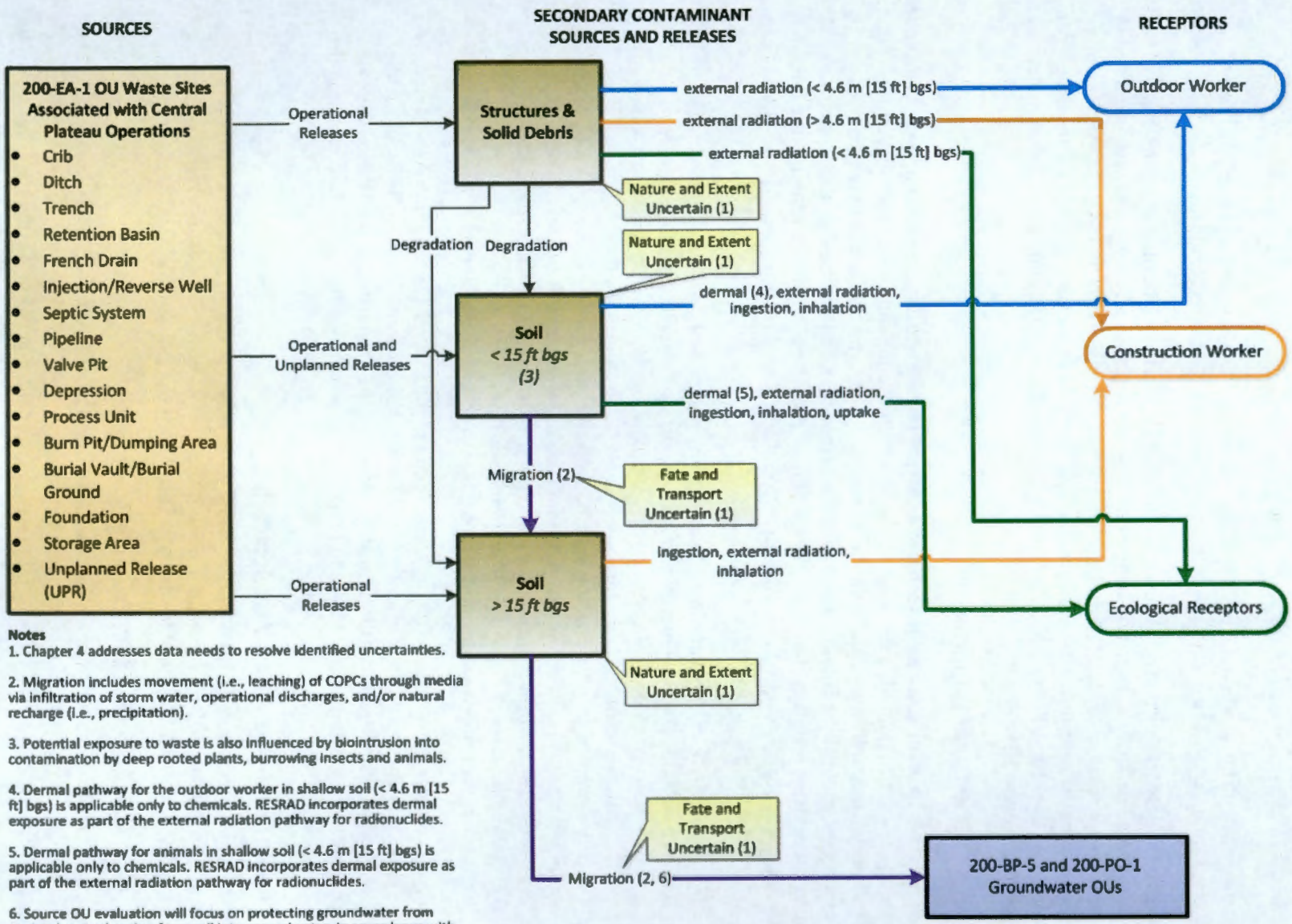
The groundwater protection modeling approach will be based on the process defined in the graded approach document (DOE/RL-2011-50). The modeling approach is detailed in Section 3.8.3.

3.7 Conceptual Site Model

The 200-EA-1 OU preliminary CSM (Figure 3-9) depicts the relationship between contaminant sources (i.e., releases to waste sites), the presence of contamination in environmental media, and the potential exposure pathways to human and ecological receptors. The CSM defines the system components being evaluated for potential risks and provides a framework for identifying uncertainties affecting basis for action determinations or cleanup action evaluation and selection. Chapter 4 addresses the uncertainties identified in Figure 3-9.

The preliminary CSM is based on currently available, site-specific knowledge provided in the following sections of this work plan:

- **Physical setting:** Section 2.4 in Chapter 2 discusses the physical setting (e.g., Inner Area geology and hydrogeology, meteorological data, and plant and animal species). Section 2.4.4 provide the basis for identifying potential ecological receptors.
- **Nature and extent:** The 200-EA-1 scoping document (SGW-60540) presents existing information, and Section 3.3 summarizes the data and analysis informing the current understanding of the nature and extent of 200-EA-1 OU waste site contamination.



Notes

1. Chapter 4 addresses data needs to resolve identified uncertainties.

2. Migration includes movement (i.e., leaching) of COPCs through media via infiltration of storm water, operational discharges, and/or natural recharge (i.e., precipitation).

3. Potential exposure to waste is also influenced by biointrusion into contamination by deep rooted plants, burrowing insects and animals.

4. Dermal pathway for the outdoor worker in shallow soil (< 4.6 m [15 ft] bgs) is applicable only to chemicals. RESRAD incorporates dermal exposure as part of the external radiation pathway for radionuclides.

5. Dermal pathway for animals in shallow soil (< 4.6 m [15 ft] bgs) is applicable only to chemicals. RESRAD incorporates dermal exposure as part of the external radiation pathway for radionuclides.

6. Source OU evaluation will focus on protecting groundwater from contaminant migration from soil into groundwater, in accordance with Section 3.8.3.

Figure 3-9. 200-EA-1 OU Preliminary CSM

- **Land use:** Section 3.5 identifies the current and reasonably anticipated future land use for the Central Plateau Inner Area. Based on the defined industrial future land use, potential human receptors include the outdoor worker and the construction worker.

- **Exposure scenarios:** Section 3.8 describes the potential pathways for exposure to 200-EA-1 OU contamination that will be considered in the human and ecological risk evaluations.

- **Fate and transport:** Section 3.8.3 describes the fate and transport modeling approach that will be used to evaluate potential impacts to underlying groundwater. The modeling approach is defined in the graded approach document (DOE/RL-2011-50), which presents the hydraulic properties and model parameters used to evaluate how contamination might move vertically and horizontally within the vadose zone. The 200-PO-1 and 200-BP-5 OUs will address contamination in groundwater and associated risks to HHE.

3.8 Risk Assessment Approach

The purposes of a BRA are to assess potential risks associated with residual contamination at a site under baseline conditions (i.e., no further action), identify key radionuclide and chemical contributors to risk, identify key exposure pathways, and determine if there is a need to take an action to reduce risks. Clarification of the role of the BRA in developing Superfund remedial alternatives and supporting risk management decisions is provided in Clay, 1991, "Role of Baseline Risk Assessment in Superfund Remedy Selection Decisions" (OSWER Directive 9355.0-30). This directive states that the BRA is part of the RI. It further states the following:

> *The baseline risk assessment should "characterize the current and potential threats to human health and the environment that may be posed by contaminants migrating to groundwater or surface water, releasing to air, leaching through soil, remaining in the soil, and bioaccumulating in the food chain" ([NCP] Section 300.430[d][4]). The primary purpose of the baseline risk assessment is to provide risk managers with an understanding of the actual and potential risks to human health and the environment posed by the site and any uncertainties associated with the assessment. This information may be useful in determining whether a current or potential threat to human health or the environment exists that warrants remedial action.*

The methods and parameters outlined in this section support the Central Plateau Inner Area cleanup principles and are based on guidance from EPA and the regulations promulgated by Ecology. These methods and parameters also are consistent with BRAs previously conducted at the Hanford Site that have been reviewed and approved by EPA and Ecology. The general methodology for conducting the BRA is described in the following sections.

3.8.1 Human Health Risk Assessment Approach

Human health risk assessment (HHRA) methods and parameters are drawn from EPA's *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A): Interim Final* (also known as Risk Assessment Guidance for Superfund [RAGS]) (EPA/540/1-89/002).

3.8.1.1 Definition of Human Health Exposure Scenario

Human health risks in the Inner Area will be assessed using the outdoor worker exposure scenario for chemicals and radionuclides within the standard POC (0 to 4.6 m [0 to 15 ft] bgs). A construction worker exposure scenario will be used to evaluate radiological contamination below 4.6 m (15 ft) bgs to inform decisions about selection of remedial alternatives, specifically site controls and the length of time site

access would need restrictions. The basis for the outdoor worker and construction worker scenarios and source of equations used to calculate cancer risks and noncancer hazards will be drawn from EPA Regional Screening Level guidance (EPA, 2018, *Regional Screening Levels for Chemical Contaminants at Superfund Sites*) for chemicals, and from EPA's radionuclide PRG guidance (EPA, 2016, *Preliminary Remediation Goals for Radionuclides*) for radionuclides. Key assumptions are as follows:

- Exposure pathways selected for the outdoor worker and construction worker scenarios are based on the assumption that direct contact exposure is potentially complete to contaminants in soil.
  - Exposure pathways to chemicals in shallow soil include incidental soil ingestion, inhalation of dust and volatiles, and dermal contact with soil. (Groundwater protection is also evaluated as detailed in Section 3.8.3.)
  - Exposure pathways for radionuclides include incidental soil ingestion, inhalation of dust, and direct (external) exposure.
- Groundwater protection is also evaluated as detailed in Section 3.8.3.
- Exposure point concentrations (EPCs) for soil will include the standard POC (i.e., 4.6 m [15 ft bgs]) based on MTCA WAC 173-340-740(6)(d) and may include an alternative POC proposed by DOE in the CMS/FS.

The exposure parameters for the outdoor worker scenario for chemicals and radionuclides are defined in Table 3-10. The exposure parameters listed in Table 3-10 reflect the EPA guidance updates.

Although only the outdoor worker scenario exposure parameters are provided in Table 3-10, cleanup levels for direct contact with chemicals in soil, structures (including pipelines), and debris will be developed using the assumptions from MTCA (WAC 173-340-745, "Soil Cleanup Standards for Industrial Properties"), as described in Section 3.8.1.8. The exposure parameters for the construction worker scenario for radionuclides are defined in Table 3-11.

In addition, the BRA will present risk characterization results for the two Native American (Tribal) scenarios for information only. Exposure assumptions for these scenarios are based on information provided in exposure scenario documents developed by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) (Harris and Harper, 2004, *Exposure Scenario for CTUIR Traditional Subsistence Lifeways*; Harris, 2008, *Application of the CTUIR Traditional Lifeways Exposure Scenario in Hanford Risk Assessments*) and the Yakama Nation (Ridolfi Inc., 2007, *Yakama Nation Exposure Scenario for Hanford Site Risk Assessment, Richland, Washington*).

3.8.1.2 Basis for Action

For protection of human health (direct contact), the CERCLA-defined basis for action for radionuclides is 1 in 10,000 cumulative excess lifetime cancer risk. The basis for action for chemicals is based on the EPA Regional Screening Levels calculation at 1 in 100,000 for cancer risks[4] or a hazard index of 1.0 for noncancer hazards. The BRA will use the outdoor worker exposure scenario to determine if remedial action is warranted. Ecological risk and groundwater protection will also be considered to determine if remedial action is warranted, as discussed in Sections 3.8.2 and 3.8.3, respectively.

[4] As stated in Section 1.3.2.2, the need for action for nonradionuclides will also be evaluated at a cumulative cancer risk of 1 in 10,000 and 1 in 100,000 and a hazard index of 1 for noncarcinogenic effects.

Table 3-10. Summary of Outdoor Worker Scenario Exposure Parameters

Exposure Parameter	Symbol	Units	Radiological		Chemicals	
			Value	Source	Value	Source
Excess lifetime cancer risk	Risk	unitless	Isotope-specific	Calculated	Analyte-specific	Calculated
Hazard quotient	HQ	unitless	N/A	N/A	Analyte-specific	Calculated
Chronic daily intake	CDI	mg/kg-day, pCi, mg/m^3, or $\mu g/m^3$	Isotope-specific	Calculated	Analyte-specific	Calculated
Soil concentration	Cs	mg/kg or pCi/g	Isotope-specific	Measured value	Analyte-specific	Measured value
Averaging time – carcinogens	ATc	days	N/A	—	25,550	Default; EPA/540/1-89/002
Averaging time – noncarcinogens	ATnc	days	N/A	—	9,125	Default; EPA/540/1-89/002
Body weight – adult	BW_a	kg	N/A	—	80	EPA/600/R-090/052F, Table 8-3
Exposure frequency	EFow	days/year	225	OSWER 9355.4-24 (Exhibit 1-2)	225	OSWER 9355.4-24 (Exhibit 1-2)
Exposure duration	EDow	year	25	OSWER Directive 9285.6-03 (page 15)	25	OSWER Directive 9285.6-03 (page 15)
Exposure time	ETow	hr/day	8	OSWER Directive 9200.1-120, Attachment 1	8	OSWER Directive 9200.1-120, Attachment 1
Soil ingestion rate	IRSow	mg/day	100	OSWER Directive 9285.6-03 (page 15)	100	OSWER Directive 9285.6-03 (page 15)
Unit correction factor 1	CF1	g/mg	0.001	Calculated	N/A	N/A
Unit correction factor 2	CF2	kg/mg	N/A	N/A	0.000001	Calculated
Unit correction factor 3	CF3	year/day	0.00274	Calculated	N/A	N/A
Unit correction factor 4	CF4	g/kg	1,000	Calculated	N/A	N/A
Unit correction factor 5	CF5	day/hour	0.0417	Calculated	0.0417	Calculated
Unit correction factor 6	CF6	µg/mg	N/A	N/A	1,000	Calculated

Table 3-10. Summary of Outdoor Worker Scenario Exposure Parameters

Exposure Parameter	Symbol	Units	Radiological		Chemicals	
			Value	Source	Value	Source
Area correction factor	ACF	unitless	Isotope-specific	Eckerman, 2007	N/A	N/A
Gamma shielding factor	GSF	unitless	1	EPA/540-R-00-007	N/A	N/A
Dermal absorption fraction	ABSd	unitless	N/A	N/A	Analyte-specific	EPA/540/R/99/005
Skin surface area	SA_{OW}	cm^2	N/A	N/A	3,527	OSWER Directive 9200.1-120, Attachment 1
Soil adherence factor	AF_{OW}	mg/cm^2-day	N/A	N/A	0.12	OSWER Directive 9200.1-120, Attachment 1
Gastrointestinal absorption factor	ABS_{GI}	unitless	N/A	N/A	Analyte-specific	EPA/540/R/99/005
Inhalation rate – adult	INH_a	m^3/day	20	OSWER Directive 9285.6-03	N/A	N/A
Particulate emission factor	PEF	m^3/kg	7.30E+10	OSWER 9355.4-24	7.30E+10	OSWER 9355.4-24
Volatilization factor	VF	m^3/kg	N/A	N/A	Analyte-specific	EPA*
Carcinogenic slope factor for soil ingestion	SF_{si}	risk/pCi	Isotope-specific	EPA*	N/A	N/A
Carcinogenic slope factor for external exposure	SF_x	risk/year per pCi/g	Isotope-specific	EPA*	N/A	N/A
Carcinogenic slope factor for inhalation	SF_{inh}	risk/pCi	Isotope-specific	EPA*	N/A	N/A
Oral carcinogenic slope factor	SF_o	$(mg/kg\text{-}day)^{-1}$	N/A	N/A	Analyte-specific	EPA*
Oral reference dose	RfD_o	(mg/kg-day)	N/A	N/A	Analyte-specific	EPA*
Unit risk factor	IUR	$(\mu g/m^3)^{-1}$	N/A	N/A	Analyte-specific	EPA*
Reference concentration	RfC	mg/m^3	N/A	N/A	Analyte-specific	EPA*

Table 3-10. Summary of Outdoor Worker Scenario Exposure Parameters

Exposure Parameter	Symbol	Units	Radiological		Chemicals	
			Value	Source	Value	Source
Decay constant	λ	unitless	0.693	EPA/540-R-00-007	N/A	N/A
Time	Tow	years	25	OSWER Directive 9285.6-03	N/A	N/A

Sources:

Eckerman, 2007, *Ratios of Dose Rates for Contaminated Slabs.*

EPA/540-R-00-007, *Soil Screening Guidance for Radionuclides: User's Guide* (OSWER Directive 9355.4-16A).

EPA/540/1-89/002, *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A): Interim Final.*

EPA/540/R/99/005, *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Assessment): Final.*

EPA/600/R-090/052F, *Exposure Factors Handbook: 2011 Edition.*

OSWER 9355.4-24, *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.*

OSWER Directive 9200.1-120, *Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors.*

OSWER Directive 9285.6-03, *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual Supplemental Guidance, "Standard Default Factors," Interim Final.*

* Values will be obtained from the sources described in Section 3.8.1.5.

EPA = U.S. Environmental Protection Agency

N/A = not applicable

Table 3-11. Summary of Construction Worker Scenario Exposure Parameters

Exposure Parameter	Symbol	Units	Value	Source
Excess lifetime cancer risk	Risk	unitless	Isotope-specific	Calculated
Chronic daily intake	CDI	pCi	Isotope-specific	Calculated
Soil concentration	Cs	pCi/g	Isotope-specific	Measured value
Exposure frequency – construction worker	EF_{CW}	days/year	30	Site-specific assumption (5 days per week for 6 weeks); DOE/RL-2007-27; Section A3.3.1
Exposure duration – construction worker	ED_{CW}	year	1	OSWER 9355.4-24, Exhibit 5-1
Exposure time – construction worker	ET_{CW}	hr/day	8	Site-specific assumption, 8 hours per 24-hour day
Soil ingestion rate – construction worker	IRS_{CW}	mg/day	330	OSWER 9355.4-24 (Exhibit 5-1)
Inhalation rate – construction worker	INH_{CW}	m^3/day	60	EPA/600/P-95/002Fa (page 5-11), based on a rate of 2.5 m^3/hr for 24 hours
Unit correction factor 1	CF1	g/mg	0.001	1 gram = 1,000 mg
Unit correction factor 2	CF2	day/hour	0.0417	1 day = 24 hours
Unit correction factor 3	CF3	g/kg	1,000	1,000 grams = 1 kg
Unit correction factor 4	CF4	year/day	0.00274	1 year = 365 days
Area correction factor – soil volume	$ACF_{ext\text{-}sv}$	unitless	Isotope-specific	ORNL/TM-2013/00
Gamma shielding factor	GSF	unitless	1	EPA/540-R-00-007
Subchronic particulate emission factor	PEF_{sc}	m^3/kg	1.28×10^6	OSWER 9355.4-24
Carcinogenic slope factor for soil ingestion	SF_{si}	risk/pCi	Isotope-specific	EPA*
Carcinogenic slope factor for external exposure	SF_x	risk/year per pCi	Isotope-specific	EPA*
Carcinogenic slope factor for inhalation	SF_{inh}	risk/pCi	Isotope-specific	EPA*
Decay constant	λ	unitless	0.693	EPA/540-R-00-007
Time – construction worker	t_{cw}	years	1	OSWER 9355.4-24, Exhibit 5-1

Sources:

DOE/RL-2007-27, *Feasibility Study for the Plutonium/Organic-Rich Process Condensate/Process Waste Group Operable Unit: Includes the 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units.*

EPA/540-R-00-007, *Soil Screening Guidance for Radionuclides: User's Guide* (OSWER Directive 9355.4-16A).

EPA/600/P-95/002Fa, *Exposure Factors Handbook Volume 1: General Factors.*

ORNL/TM-2013/00, *Area Correction Factors for Contaminated Soil for Use in Risk and Dose Assessment Models.*

OSWER 9355.4-24, *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.*

* Values will be obtained from the sources described in Section 3.8.1.5.

EPA = U.S. Environmental Protection Agency

3.8.1.3 Identification of Contaminants of Potential Concern

For protection of human health (direct contact), a COPC is defined as an analyte suspected of being associated with site-related activities that represents a potential threat to human health and for which data are of sufficient quality for use in a quantitative HHRA. A broad list of contaminants (radionuclides and chemicals) (see Section 3.4) will initially be evaluated in a quantitative HHRA.

The risk characterization will discuss elevated soil background concentrations and their contribution to site risks, as well as naturally occurring elements that are not CERCLA hazardous substances, pollutants, and contaminants. The contribution from naturally occurring metals and radioisotopes as well as widespread anthropogenic radioisotopes will be evaluated in accordance with EPA 540-R-01-003, *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites.*

The approach used for the evaluation of soil background concentrations will be the same as that used in the BRA in the River Corridor OUs. A summary of the 90th percentile and maximum Hanford Site soil background concentrations is provided in Table 3-12.

Table 3-12. Hanford Site Soil Background Concentrations

Analyte Name	Analyte Class	Units	90th Percentile Background Value	Maximum Background Value	Source of Background Value
Anthropogenic Radionuclides[a]					
Cesium-137	RAD	pCi/g	1.1	1.6	DOE/RL-96-12
Cobalt-60	RAD	pCi/g	0.0084	0.039	DOE/RL-96-12
Europium-154	RAD	pCi/g	0.033	0.079	DOE/RL-96-12
Europium-155	RAD	pCi/g	0.054	0.098	DOE/RL-96-12
Gross beta	RAD	pCi/g	23	25	DOE/RL-96-12
Plutonium-238	RAD	pCi/g	0.0038	0.019	DOE/RL-96-12
Plutonium-239/240	RAD	pCi/g	0.025	0.033	DOE/RL-96-12
Radium-228	RAD	pCi/g	1.8	2.3	DOE/RL-96-12
Strontium-90	RAD	pCi/g	0.18	0.37	DOE/RL-96-12
Thorium-228	RAD	pCi/g	1.4	1.6	DOE/RL-96-12
Total beta radiostrontium	RAD	pCi/g	0.18	0.37	DOE/RL-96-12
Naturally Occurring Radionuclides					
Potassium-40	RAD	pCi/g	17	20	DOE/RL-96-12
Radium-226	RAD	pCi/g	0.82	1.2	DOE/RL-96-12
Thorium-232	RAD	pCi/g	1.3	1.6	DOE/RL-96-12
Uranium-233/234	RAD	pCi/g	1.1	1.5	DOE/RL-96-12
Uranium-234	RAD	pCi/g	1.1	1.5	DOE/RL-96-12
Uranium-235	RAD	pCi/g	0.11	0.39	DOE/RL-96-12
Uranium-238	RAD	pCi/g	1.1	1.2	DOE/RL-96-12

Table 3-12. Hanford Site Soil Background Concentrations

Analyte Name	Analyte Class	Units	90th Percentile Background Value	Maximum Background Value	Source of Background Value
Metals					
Aluminum	METAL	mg/kg	11,800	28,800	DOE/RL-92-24, Vol. 1
Antimony	METAL	mg/kg	0.13	0.385	ECF-HANFORD-11-0038
Arsenic[b]	METAL	mg/kg	6.47	27.7	DOE/RL-92-24, Vol. 1
Barium	METAL	mg/kg	132	480	DOE/RL-92-24, Vol. 1
Beryllium	METAL	mg/kg	1.51	10	DOE/RL-92-24, Vol. 1
Boron	METAL	mg/kg	3.89	5.86	ECF-HANFORD-11-0038
Cadmium	METAL	mg/kg	0.563	2.98	ECF-HANFORD-11-0038
Calcium	METAL	mg/kg	17,200	105,000	DOE/RL-92-24, Vol. 1
Chromium	METAL	mg/kg	18.5	320	DOE/RL-92-24, Vol. 1
Cobalt	METAL	mg/kg	15.7	110	DOE/RL-92-24, Vol. 1
Copper	METAL	mg/kg	22	61	DOE/RL-92-24, Vol. 1
Iron	METAL	mg/kg	32,600	68,100	DOE/RL-92-24, Vol. 1
Lead	METAL	mg/kg	10.2	74.1	DOE/RL-92-24, Vol. 1
Lithium	METAL	mg/kg	13.3	19.2	ECF-HANFORD-11-0038
Magnesium	METAL	mg/kg	7,060	32,300	DOE/RL-92-24, Vol. 1
Manganese	METAL	mg/kg	512	1,110	DOE/RL-92-24, Vol. 1
Mercury	METAL	mg/kg	0.013	0.029	ECF-HANFORD-11-0038
Molybdenum	METAL	mg/kg	0.47	3.17	ECF-HANFORD-11-0038
Nickel	METAL	mg/kg	19.1	200	DOE/RL-92-24, Vol. 1
Potassium	METAL	mg/kg	2,150	7,900	DOE/RL-92-24, Vol. 1
Selenium	METAL	mg/kg	0.78	0.84	ECF-HANFORD-11-0038
Silver	METAL	mg/kg	0.167	0.273	ECF-HANFORD-11-0038
Sodium	METAL	mg/kg	690	6.06E+03	DOE/RL-92-24, Vol. 1
Thallium	METAL	mg/kg	0.185	0.523	ECF-HANFORD-11-0038
Uranium	METAL	mg/kg	3.21	4.04	Isotopic activity conversion based on DOE/RL-96-12 values
Vanadium	METAL	mg/kg	85.1	140	DOE/RL-92-24, Vol. 1
Zinc	METAL	mg/kg	67.8	366	DOE/RL-92-24, Vol. 1
Anions					
Ammonia	ANIONS	mg/kg	9.23	26.4	DOE/RL-92-24, Vol. 1
Chloride	ANIONS	mg/kg	100	1,480	DOE/RL-92-24, Vol. 1
Fluoride	ANIONS	mg/kg	2.81	73.3	DOE/RL-92-24, Vol. 1
Nitrate	ANIONS	mg/kg	52	906	DOE/RL-92-24, Vol. 1
Phosphate	ANIONS	mg/kg	0.785	225	DOE/RL-92-24, Vol. 1
Sulfate	ANIONS	mg/kg	237	12,600	DOE/RL-92-24, Vol. 1

Table 3-12. Hanford Site Soil Background Concentrations

Analyte Name	Analyte Class	Units	90th Percentile Background Value	Maximum Background Value	Source of Background Value

Sources:

DOE/RL-92-24, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes.*

DOE/RL-96-12, *Hanford Site Background: Part 2, Soil Background for Radionuclides.*

ECF-HANFORD-11-0038, *Soil Background for Interim Use at the Hanford Site.*

a. The background values listed for fission products that are related to global fallout are only for shallow soils (less than 4.6 m [15 ft] below ground surface). Background values listed for naturally occurring radionuclides and nonradionuclides apply to the entire vadose zone.

b. Ecology, 2013, "Issues Associated with Establishing Soil Cleanup Levels for Arsenic," (memorandum to J. Hedges and J. Price, Nuclear Waste Program, from D. Bradley), Toxics Cleanup Program, Washington State Department of Ecology, Olympia, Washington, June 11, indicates that the Method A soil cleanup level of 20 mg/kg can be used to define natural background levels when developing soil cleanup levels for the Hanford Site.

Certain analytes are known to be unrelated to Hanford Site wastes or will not contribute significantly to human health risks. These analytes will not be carried into a quantitative risk assessment: (1) radionuclides with a half-life of less than 3 years; (2) essential trace elements; (3) soil physical property measurements; and (4) background (naturally occurring) radionuclides (potassium-40, thorium-232 and daughters, and radium-226 and daughters). This approach is the same as used in the River Corridor OUs.

Quantitative risks will be assessed for analytes with toxicity values from the sources presented in Section 3.8.1.5. Analytes without toxicity values will be discussed qualitatively as part of the risk characterization.

3.8.1.4 Exposure Assessment

The exposure assessment will address (1) methods for developing EPCs in soil and, (2) methods for calculating concentrations in air from EPCs in soil using EPA screening models, as described below.

Development of Exposure Point Concentrations in Soil

During the baseline risk assessment process, spatial exposure areas will be defined, and sampling and analytical data will be grouped for calculating EPCs, taking into consideration factors such as the nature and extent of contamination and process knowledge. Depths in soil will be identified for grouping samples based on the characterization strategy.

The EPA software, ProUCL Version 5.1 or later (available at https://www.epa.gov/land-research/proucl-software), shall be used to calculate EPCs for the statistical sample design. The highest "suggested upper confidence limit (UCL) to use" provided in the ProUCL output file shall be used as the EPC, unless the software provides a warning indicating that the "recommended UCL exceeds maximum observation". When this warning is provided, or when ProUCL cannot calculate a UCL value or does not provide a "suggested UCL to use", the maximum observed concentration will be used as the EPC. For judgmental samples, risk characterization will be performed on a sample by sample basis.

Development of Exposure Point Concentrations in Air from Soil

Particulate emission factors for windblown dust and volatilization factors for VOCs (when appropriate) will be calculated in accordance with EPA guidance (OSWER 9355.4-24, *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites*).

3.8.1.5 Toxicity Assessment

The toxicity criteria used for the human health cancer risk and noncancer hazard calculations will be obtained from the sources described in the following sections.

Toxicity Values for Nonradionuclides

For nonradionuclides, the analyte-specific toxicity values are determined using the recommended reference hierarchy, as described in Cook, 2003, "Human Health Toxicity Values in Superfund Risk Assessments" (OSWER Directive 9285.7-53). The hierarchy is the same as used in the baseline risk assessments for the River Corridor OUs and is summarized below.

- Tier 1 – EPA Integrated Risk Information System (IRIS)
- Tier 2 – EPA Provisional Peer Reviewed Toxicity Values (PPRTVs)
- Tier 3 – Other Toxicity Values

Tier 1 – IRIS. The preferred source of toxicity data is the EPA Integrated Risk Information System (IRIS) database (available at: https://www.epa.gov/iris). Expert toxicologists at EPA have derived the values in this database, and the values have undergone thorough review and validation to develop slope factors and reference dose values both within and outside of the EPA. If a toxicity value is available in IRIS, that value is used in preference to values published in Tier 2 and Tier 3 sources.

Tier 2 – PPRTVs. If a toxicity value is not available in IRIS, the next source is the EPA PPRTVs. This source includes toxicity values that have been developed by the Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center. This database is available to the general public (http://hhpprtv.ornl.gov) and is also accessible to EPA risk assessors via the EPA intranet. These values are also published at the EPA Regional Screening Levels website (available at: http://www.epa.gov/reg3hscd/risk/human/rb-concentration_table/). Tier 2 values are used in preference to Tier 3 values.

Tier 3 – Other Toxicity Values. Tier 3 includes additional EPA and non-EPA sources of toxicity information, including the following:

- The California EPA Toxicity Criteria Database (available at: http://oehha.ca.gov/tcdb/index.asp) provides toxicity values that are peer reviewed and address both carcinogenic and noncarcinogenic effects.
- The Agency for Toxic Substances and Disease Registry minimal risk levels (available at: http://www.atsdr.cdc.gov/mrls/index.html) for hazard substances are peer-reviewed estimates of the daily human exposure to hazardous substances that is likely to be without appreciable risk of adverse noncarcinogenic health effects over a specified duration of exposure.
- Toxicity values from *Health Effects Assessment Summary Tables (HEAST)* (available at: https://epa-heast.ornl.gov).
- National Center for Environmental Assessment (NCEA) toxicity values found in the Risk Assessment Information System (available at: http://rais.ornl.gov).

Toxicity Values for Radionuclides

The default dose coefficient file package, (DCFPAK) 3.02 morbidity risk factors within the RESidual RADioactive (RESRAD) dose model (available at: http://resrad.evs.anl.gov/) will be used for selecting the risk coefficients for radiological COPCs.

3.8.1.6 Risk Characterization

Risk estimates will be presented by exposure area and depth in soil. The BRA will also discuss risk estimates relative to Hanford Site background levels. The risk characterization identifies the COPCs that are risk drivers.

3.8.1.7 Discussion of Uncertainties

Uncertainties in the HHRA calculations or conclusions will be specifically discussed in uncertainty sections in the RI/FS (and RFI/CMS, as applicable) document. The discussions will identify whether risks from contaminants in soil are likely overstated or understated.

3.8.1.8 Methods for Calculating Human Health Cleanup Levels

Cleanup levels for direct contact with radionuclides in soil, structures (including pipelines), and debris will be developed using parameters for the outdoor worker scenario identified in Section 3.8.1.1, as well as the toxicity values identified in Section 3.8.1.5. The outdoor worker PRG will be used to represent reasonable maximum exposure for industrial worker exposure to contaminated soil. For pipelines, structures, and debris, the two-dimensional outdoor worker external exposure will be used to represent reasonable maximum exposure. The two-dimensional method is developed to evaluate risks from exposure to structures with surface radioactive contamination. In this method, the outdoor worker is exposed to radioactively contaminated dust settled on finite slabs. The only pathway considered is external exposure to ionizing radiation (EPA, 2016). Table 3-10 provides the exposure parameters that will be used. PRGs corresponding to a 10^{-4} acceptable cancer risk level will be used for radionuclides. The methodology used to calculate soil PRGs for radionuclides is consistent with the methodology used in BRAs for the River Corridor OUs.

Cleanup levels for direct contact with chemicals in soil, structures (including pipelines), and debris will be developed using the assumptions from MTCA (WAC 173-340-745, Equations 745-1 and 745-2), along with toxicity values identified in Section 3.8.1.5. The PRGs will be developed based on a 10^{-5} acceptable cancer risk level or a noncancer hazard quotient of 1. MTCA equations will be used to calculate PRGs based on direct contact (soil ingestion) and, where relevant, the PRG value will be based on the inhalation exposure pathway when it is lower than soil ingestion. The cumulative cancer risk threshold for chemicals is also 10^{-5}, so adjustment to cleanup levels based on cumulative risk may be relevant. Adjustments for multiple contaminants having a similar mode of action or multiple pathways of exposure will be made where appropriate.

3.8.2 Ecological Risk Assessment Approach

The ecological risk assessment (ERA) approach will follow EPA guidance and the terrestrial ecological evaluation procedures developed by Ecology (MTCA). The ERAs will include, as appropriate, explanations of how the methodology conforms to guidance and requirements identified in MTCA. The ERA approach is the same as that used in the BRAs for the River Corridor OUs.

3.8.2.1 Identification of Contaminants of Potential Ecological Concern

Contaminants of potential ecological concern (COPECs) will be identified using the same process developed for the HHRA (Section 3.8.1.3) but will consider ecological pathways and screening levels.

3.8.2.2 Conceptual Site Model for Ecological Exposure

The CSM for ecological exposure pathways will include the elements described by EPA 540-R-97-006, *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments: Interim Final*. Although not specifically referred to as a CSM, these same elements are also part of the simplified terrestrial ecological evaluation procedures (WAC 173-340-7492, "Simplified

Terrestrial Ecological Evaluation Procedures") and site-specific terrestrial ecological evaluation procedures under MTCA (WAC 173-340-7493). Previously developed evaluations will be used, including the conceptual model of ecological exposure pathways and receptors developed for the Tier 1 and Tier 2 ecological PRGs (CHPRC-00784, *Tier 1 Risk-Based Soil Concentrations Protective of Ecological Receptors at the Hanford Site* [hereinafter referred to as Tier 1 ecological SSLs]; Tier 2 wildlife PRGs (CHPRC-01311); ECF-HANFORD-11-0158, *Tier 2 Terrestrial Plant and Invertebrate Preliminary Remediation Goals (PRGs) for Nonradionuclides for Use at the Hanford Site* [hereinafter referred to as Tier 2 plant/invertebrate PRGs]).

3.8.2.3 Evaluation of Biointrusion

The ERA will include a discussion of the depth of soil to which ecological receptors are exposed. This discussion will use the analysis presented in CHPRC-00651, *Evaluation of Biointrusion Depths at the Hanford Site for Protection of Ecological Receptors*. If a conditional POC for soil depth is proposed, both the standard POC and the conditional POC will be presented as remedial action alternatives in the FS (and CMSs, as applicable).

3.8.2.4 Exposure Assessment

The exposure assessment will use exposure parameters, representative species, and transfer factors found in Tier 1 ecological SSLs (CHPRC-00784) and Tier 2 wildlife PRGs (CHPRC-01311) that have already been evaluated and used in ERAs for the River Corridor OUs. Estimation of EPCs in soil will use the same data and parallel the methods as presented for the HHRA.

3.8.2.5 Effects Assessment

The effects assessment will be the same as that employed for the River Corridor OU BRAs. The assessment will use toxicity reference values for wildlife that have been developed in Tier 1 ecological SSLs (CHPRC-00784) and Tier 2 wildlife PRGs (CHPRC-01311). The same soil thresholds protective of wildlife that were developed from these toxicity reference values will be used for wildlife in the Central Plateau. For nonradiological contaminants, effect values for terrestrial plants and invertebrates will be the soil threshold concentrations presented in Tier 1 ecological SSLs (CHPRC-00784) and Tier 2 plant/invertebrate PRGs (ECF-HANFORD-11-0158). The DOE's background concentration guidelines (BCGs) for terrestrial plants and animals represent the radiological ecological screening levels for radionuclides in soil.

3.8.2.6 Risk Characterization

Ecological risk characterization will use standard methods and approaches already employed along the River Corridor, including the following:

- Calculation of ecological hazard quotients
- Evaluation of risk relative to established background levels to aid in identifying risk drivers
- Methods for characterizing risks when a scientific-management decision point (SMDP) is reached

The SMDP is reached when exposures are higher than an ecological hazard quotient of 1 (i.e., an EPC is higher than a PRG). The potential for population-level risks to wildlife and community-level risks to plants and invertebrates will be evaluated, and a risk management decision will be made using the SMDP. The approach is the same as was used for the River Corridor OU BRAs. The SMDP will consider the following:

- Spatial characteristics of the remediated waste site (area and depth of the waste site)
- Proximity and size of other waste sites and unaffected habitat

- Extent of site characterization (sample density and characterization of lateral extent of contamination)
- Data quality (presence of qualifiers, adequacy of detection limits)
- Frequency that risk-based thresholds are exceeded and the locations of those exceedances
- Chemical-specific properties of each COPEC (potential to biomagnify, persistence)
- Ecological receptors specific details
- Feeding guild that is affected (plants; insects; and omnivorous, herbivorous, insectivorous, or carnivorous wildlife)
- Proportion of receptors affected
- Likelihood of population- or community-level effects
- Home range of the receptors at risk relative to the area exceeding PRG
- Evaluation of PRG (level of confidence, basis, relation to other PRGs such as those for human health or groundwater protection)

In the preparation of the ERA, risk assessors will evaluate potential risks to populations of mammals and birds and to communities of plants and invertebrates. Risk assessors will then propose conclusions through the SMDP. Risk managers from DOE and the regulatory agencies will review and concur or revise the SMDP conclusions.

3.8.2.7 Methods for Calculating Ecological Cleanup Levels

PRGs have been developed for individual feeding guilds (for birds and mammals) and for plants and invertebrates. The PRGs for chemicals are based on the lowest observed adverse effect levels and are found in Tier 2 wildlife PRGs (CHPRC-01311) and Tier 1 ecological SSLs (CHPRC-00784) (for birds and mammals) and Tier 2 plant/invertebrate PRGs (ECF-HANFORD-11-0158).

Based on guidance from ICRP-60, *1990 Recommendations of the International Commission on Radiological Protection*; IAEA 332, *Effects of Ionizing Radiation on Plants and Animals at Levels Implied by Current Radiation Protection Standards*; and UNSCEAR, 2000, *Sources and Effects of Ionizing Radiation*, two radiological effect threshold criteria were considered during the development of both generic and Tier 1 SSLs:

1. Radiological doses to aquatic animals and to terrestrial plants should not exceed 1.0 rad/day, and
2. Radiological doses to terrestrial animals should not exceed 0.1 rad/day.

It should be noted that DOE has adopted these effect thresholds and integrated them into DOE-STD-1153-2002, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota*.

No Tier 2 PRGs for radionuclides were calculated. Hence, Tier 1 ecological SSLs (CHPRC-00784) will be used for decision making.

3.8.3 Evaluation of Groundwater Protection

The evaluation of groundwater protection will be based on the graded approach document (DOE/RL-2011-50), which will form the basis for all groundwater evaluations on the Central Plateau. The development of soil screening levels (SSLs) and PRGs for groundwater protection will be based on protecting groundwater directly below each waste site. In addition, cumulative impacts from all waste sites and other sources within the Central Plateau will also be evaluated.

The graded approach document (DOE/RL-2011-50) establishes the use of Subsurface Transport Over Multiple Phases (STOMP) (PNNL-12030, *STOMP: Subsurface Transport Over Multiple Phases Version 2.0: Theory Guide*) as the fate and transport model to be used for groundwater protection evaluations. To facilitate the modeling approach for the Central Plateau, five hydrogeologic provinces were identified in the graded approach document based on vadose zone hydrogeologic similarity. The characteristics, thickness, and vertical distribution of the vadose zone sediments of the five provinces are provided in the graded approach document, and Section 2.4.3.3 of this work plan discusses the hydrogeologic provinces relevant to the 200-EA-1 OU. Other parameter values used for the groundwater protection evaluation include ranges of distribution coefficient (K_d) values and net infiltration rates.

For evaluation of groundwater protection for waste sites on the Central Plateau (including those within the 200-EA-1 OU), K_d values identified for the River Corridor (DOE/RL-2010-95, *Remedial Investigation/Feasibility Study for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units*) will be used. Because DOE/RL-2010-95 did not identify a K_d value for uranium, a K_d value of zero will be used for all waste sites unless site-specific information is available.

Long-term net infiltration rates will be defined as documented in the graded approach document (DOE/RL-2011-50). To summarize, 4 mm/yr will be used as the long-term infiltration rate for two scenarios based on two future end states:

- **Native land cover scenario:** Assumes revegetation with native plants that will mature within about 30 years of remediation and vegetation, consistent with the graded approach document (DOE/RL-2011-50).
- **Evapotranspiration barrier scenario:** Assumes installation of an evapotranspiration barrier[5] at the waste site(s). After the barrier is installed, the effective infiltration rate will be reduced to 0.5 mm/yr. The barrier will be assumed to have a design life of 500 years. After that, net infiltration rates will return to the natural land cover rate of 4 mm/yr.

Table 3-13/Figure 3-10 and Table 3-14/Figure 3-11 illustrate the native vegetation and barrier scenarios, respectively, based on the input and evaluations provided in the graded approach document (DOE/RL-2011-50).

To establish compliance of the groundwater protection evaluation approach with the requirements of WAC 173-340-747(8), "Deriving Soil Concentrations for Groundwater Protection," a single crosswalk for waste sites applicable across the Central Plateau will be developed. This crosswalk will follow the structure documented in DOE/RL-2010-95, *Remedial Investigation/Feasibility Study for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units*. Following this development, and within each of the OUs, each risk assessment will identify unique application aspects for waste sites and demonstrate how *Washington Administrative Code* requirements are met.

[5] See Section 3.13 for discussion of potential barrier technologies currently being considered.

Table 3-13. Central Plateau Inner Area Native Vegetation Recharge Scenario Phases and Recharge Rates (mm/yr)

Surface Soil Type	Historic Simulation (pre-2015) (Initial Hydraulic Conditions)		Predictive Simulation (post-2015) (Calculation of Peak Groundwater Concentration)		
	Pre-Hanford Phase (Before 1944)	Hanford Operations Phase (1944–2014)	Bare Soil Phase (2015–2049)	Developing Shrub-Steppe Phase (2050–2079)	Mature Shrub-Steppe Phase (After 2080)
Hanford sand, disturbed	4.0[a]	63.0[b]	63.0[b]	8.0[c]	4.0[d]

Source: PNNL-14702, *Vadose Zone Hydrogeology Data Package for Hanford Assessments*.

a. PNNL-14702, Table 4-15; S (southern 200 West Area), T (northern 200 West Area), and A (southern 200 East Area) areas, shrub-steppe.

b. PNNL-14702, Table 4-15; all areas with soils disturbed by excavations; no vegetation.

c. PNNL-14702, Table 4-15; all areas with soils disturbed by excavations; young shrub-steppe.

d. PNNL-14702, Table 4-15; all areas with soils disturbed by excavations; shrub-steppe.

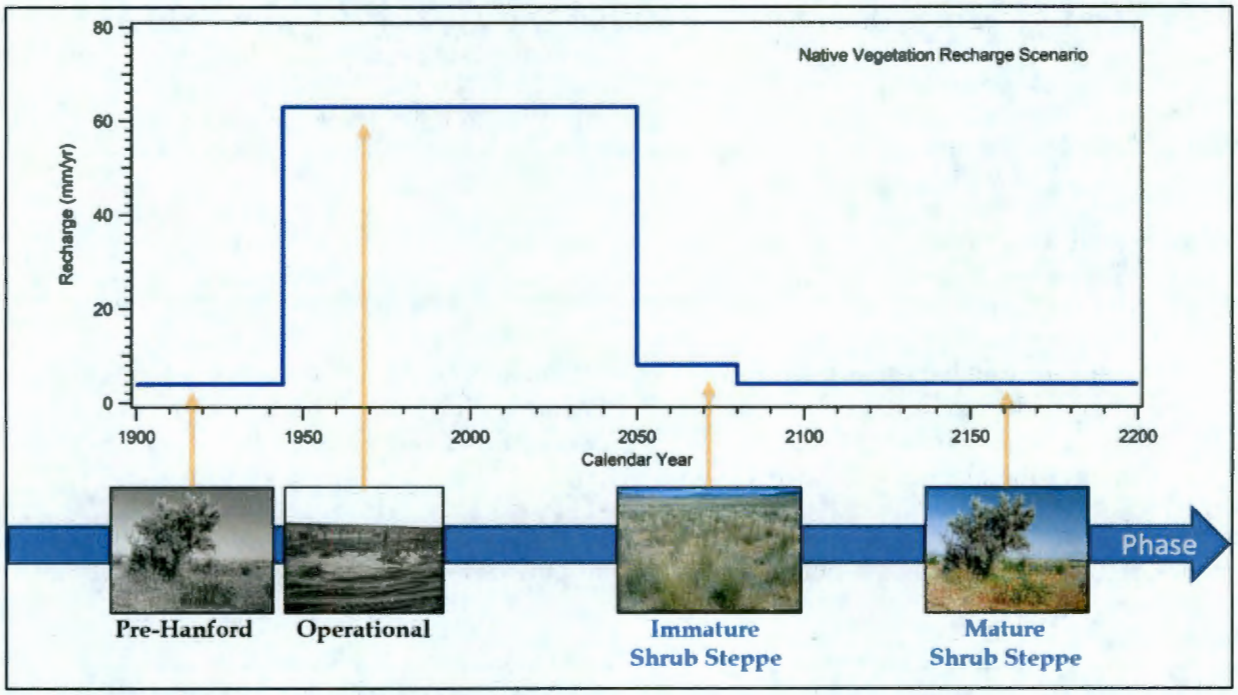


Figure 3-10. Central Plateau Inner Area Native Vegetation Recharge Scenario

Table 3-14. Central Plateau Inner Area Barrier Recharge Scenario Phases and Recharge Rates (mm/yr)

Surface Soil Type	Historic Simulation (pre-2015) (Initial Hydraulic Conditions)		Predictive Simulation (post-2015) (Calculation of Peak Groundwater Concentration)		
	Pre-Settlement Phase (Before 1944)	Hanford Operations Phase (1944–2014)	Bare Soil Phase (2015–2049)	Barrier Design Life Phase (2050–2549)	Post-Barrier Phase (Mature Shrub-Steppe) (After 2550)
Hanford sand, disturbed	4.0[a]	63.0[b]	63.0[b]	0.5[c]	4.0[d]

Sources:

DOE, 2005, *Technical Guidance Document for Tank Closure Environmental Impact Statement Vadose Zone and Groundwater Revised Analyses*.

PNNL-14702, *Vadose Zone Hydrogeology Data Package for Hanford Assessments*.

a. PNNL-14702, Table 4-15; S (southern 200 West Area), T (northern 200 West Area), and A (southern 200 East Area) areas, shrub-steppe.

b. PNNL-14702, Table 4-15; all areas with soils disturbed by excavations; no vegetation.

c. DOE, 2005, Section 4.4; barrier during design life.

d. PNNL-14702, Table 4-15; all areas with soils disturbed by excavations; shrub steppe.

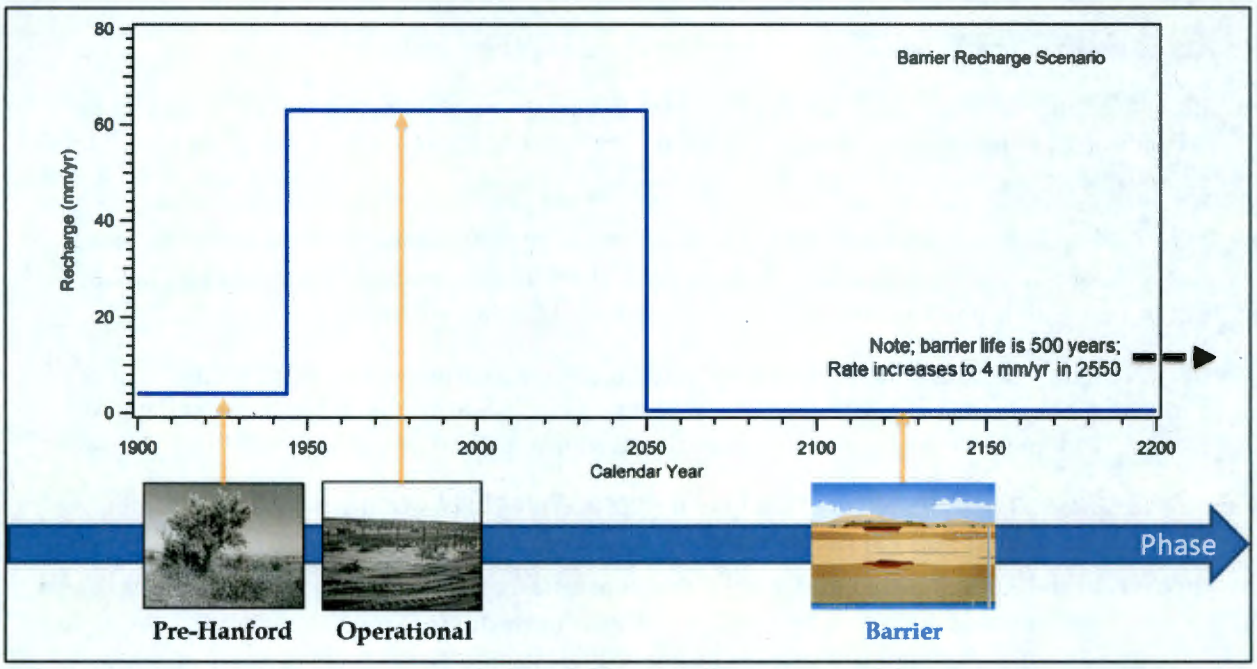


Figure 3-11. Central Plateau Inner Area Barrier Recharge Scenario

3.8.3.1 Basis for Calculation of Soil Screening Levels and Preliminary Remediation Goals

The evaluation of groundwater protection approach involves the evaluation of the potential for groundwater contamination from a given waste site (with known or assumed waste geometry) or the calculation of SSLs or PRGs. The SSLs and PRGs are soil and vadose zone concentrations that would not impact groundwater above pre-defined levels. Consistent with the graded approach document (DOE/RL-2011-50, Figure 3-1), the SSLs will be used to identify COPCs, and the PRGs will be used to set cleanup levels.

For the SSLs calculation, these soil concentrations would not impact groundwater concentrations above the lowest value from the following:

- Chemicals; concentrations calculated for the EPA tap water scenario based on carcinogenic effects calculated at a target risk level of 1×10^{-6}, as applicable
- Radionuclides; concentrations calculated for the EPA tap water scenario based on carcinogenic effects calculated at a target risk level of 1×10^{-5}
- Concentrations calculated for the EPA tap water scenario based on noncarcinogenic effects calculated at a hazard quotient value of 0.1, as applicable

The groundwater protection PRGs would be calculated as soil concentrations that would not impact groundwater concentrations above the lowest value from the following:

- The federal and state maximum contaminant level values, where available
- EPA screening levels for radionuclides for which no maximum contaminant level is available; the groundwater cleanup level is calculated using the tap water scenario at an individual target risk level of 1×10^{-4}
- MTCA Method B cleanup levels for groundwater based on carcinogenic effects calculated at a target risk level of 1×10^{-6}, as applicable, with downward adjustment to maintain cumulative risk below 1×10^{-5} for multiple contaminants in accordance with WAC 173-340-708(5) and (6)
- MTCA Method B cleanup levels for groundwater based on noncarcinogenic effects calculated at a hazard quotient value of 1, as applicable, with downward adjustment to maintain a total hazard index of 1 for multiple contaminants in accordance with WAC 173-340-708(5) and (6)

3.8.3.2 Evaluation of Cumulative Impacts and Approach for Evaluation of Conditional Point of Compliance

An alternative can be developed in the CMS/FS that considers a conditional POC in groundwater. The detailed evaluation of this alternative will consider the evaluation of cumulative impacts, taking into consideration the upgradient groundwater contamination through the same comprehensive approach as PNNL-11800, *Composite Analysis for Low-Level Waste Disposal in the 200 Area Plateau of the Hanford Site*, and the cumulative impact analysis conducted for the Tank Closure and Waste Management EIS (DOE/EIS-0391). The following considerations will be defined for this evaluation:

- The conditional POC process will define a model domain (in space and time) that covers all the source waste sites within the boundary, as well as existing groundwater contamination. An example of this boundary is shown in Figure 3-12. This example boundary encompasses all of the liquid effluent disposal sites and the existing concentrated groundwater contamination areas within the Central Plateau. The actual boundary will be determined through the RFI/CMS/RI/FS process for source OUs. The evaluation will be conducted for 1,000 years.

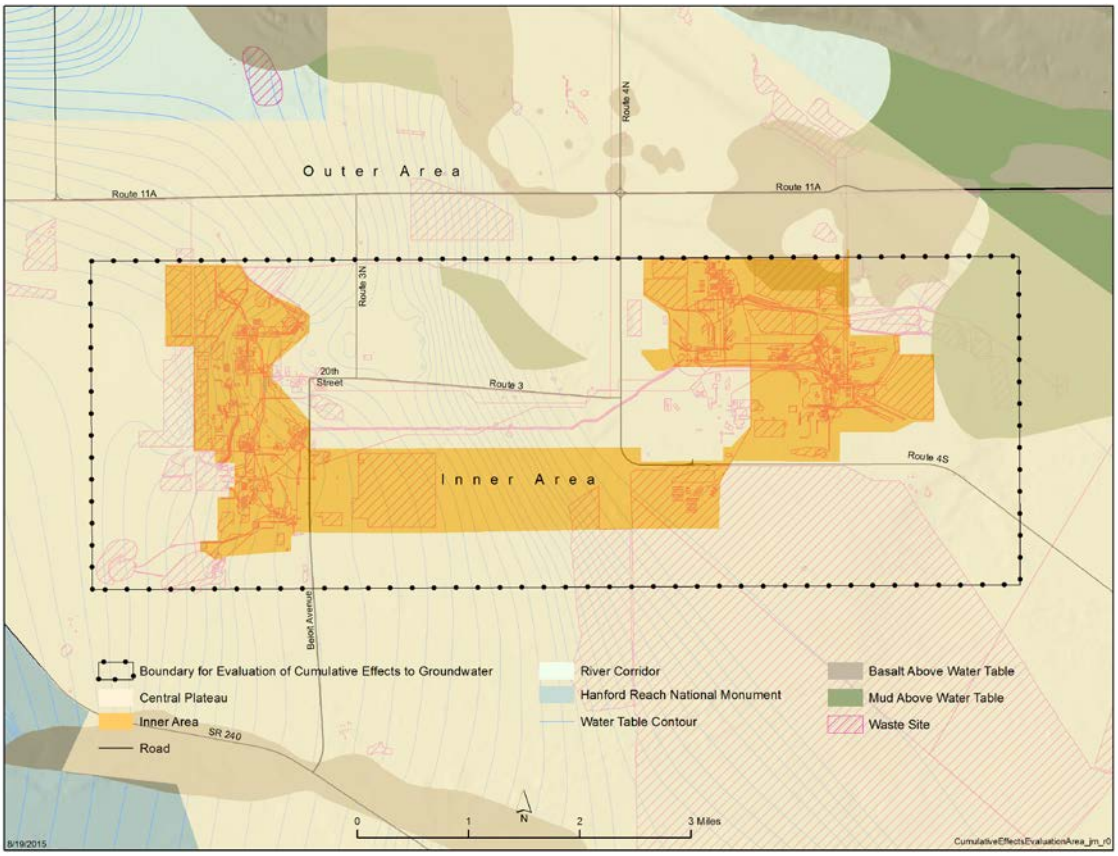


Figure 3-12. Example Boundary for the Evaluation of Conditional Point of Compliance for Groundwater Protection

- Inventory estimates for waste sites will include measurements for surface soils and the vadose zone, as well as the following sources:

  – **Liquid disposal sites:** Hanford Site Soil Inventory Model (SIM) mean values (PNNL-16940, *Hanford Soil Inventory Model (SIM), Revision 2, Software Documentation – Requirements, Design, and Limitations*) will be used for the base case. Ranges of effluent volumes and associated contaminant concentrations provided by the SIM will be used to evaluate the uncertainties.

  – **Solid waste disposal sites:** Inventory estimates will be developed based on available information and available characterization measurements.

  – **Tank farms sources:** Data will be obtained from the most recent leak assessment reports and the tank waste and ancillary equipment inventory estimates.

- A range of end-state conditions for waste sites and groundwater will be evaluated using the same approach documented in PNNL-14027, *An Initial Assessment of Hanford Impact Performed with the System Assessment Capability*, which will be updated to reflect the current decisions and response actions that have already been implemented for the groundwater contamination on the Central Plateau, including perched water removal.

Cumulative impacts from waste sites, tank farms, and other sources within the Central Plateau will be assessed and documented in a single primary Tri-Party Agreement (Ecology et al., 1989a) document. This document will be prepared following the approval of the first work plan and prior to completion of the first RI/FS (and RFI/CMS, as applicable) for the source OUs within the Hanford Site Central Plateau. Following the issuance of this document, each source OU RI report will reference this application document, evaluate any necessary updates based on new information or updated elements of the CSMs, and evaluate how the conclusions can change. Similarly, the composite analysis (required in accordance with DOE O 435.1 Chg. 1, *Radioactive Waste Management*) will reference the same application document, evaluate any necessary changes, and demonstrate the performance metrics required under this DOE order.

3.9 Initial Evaluation

As described in Sections 3.2 and 3.3 and detailed in the waste site-specific summaries presented in the 200-EA-1 scoping document (SGW-60540), many 200-EA-1 OU waste sites have been previously investigated and evaluated pursuant to CERCLA or RCRA. Through a series of workshops, DOE-RL and Ecology conducted an initial evaluation of this information to indicate the following for each waste site:

- Potential threats to HHE that may drive action
- Likely exposure pathways associated with potential threats
- Likely response scenarios to consider in future alternative evaluations to respond to potential threats
- Uncertainties (i.e., data needs) and associated approach to address data needs

Appendix C presents the site-specific workshop evaluation results for each of the 200-EA-1 OU waste sites. Chapter 4 identifies the data needs resulting from the evaluation of existing data conducted as part of the initial evaluation.

3.10 Preliminary Remedial Action Objectives

This section describes the preliminary 200-EA-1 OU RAOs, which are based on the reasonably anticipated future land use of the Central Plateau, potential receptors, known or expected contaminants, and impacted media. The following preliminary RAOs may be refined during the RFI/RI to support the CMS/FS, with final RAOs established in the Corrective Action Decision (CAD)/ROD:

- **RAO #1:** Prevent or mitigate unacceptable risk to human health and ecological receptors associated with radiological exposure to waste or soil contaminated above risk-based criteria.
- **RAO #2:** Prevent or mitigate unacceptable risk to human health and ecological receptors associated with chemical exposure to waste or soil contaminated at or above risk-based criteria.
- **RAO #3:** Control the sources of potential groundwater contamination to support the Central Plateau groundwater goal of restoring and protecting the beneficial uses of groundwater.

3.11 Potential Applicable or Relevant and Appropriate Requirements

Any remedial action implemented for 200-EA-1 OU waste sites will be required to meet applicable or relevant and appropriate requirements (ARARs). Accordingly, alternatives developed and evaluated in the CMS/FS will be assessed based on their ability to comply with ARARs. Appendix E describes the potential ARARs and to-be-considered (TBC) criteria for the 200-EA-1 OU.[6] The potential ARARs and TBCs are subject to further review and will be revised, if necessary, in the RFI/CMS/RI/FS report.

3.12 Preliminary Remediation Goals

Radiological and chemical PRGs for direct contact human health exposure, ecological exposure, and groundwater protection will be established for the receptors and exposure pathways described in Sections 3.8.1 through 3.8.3. These PRGs will be the numeric representation of protective contaminant concentrations consistent with the RAOs (Section 3.10) and will be based on the methods and input parameters summarized in this chapter. The supporting calculations listed in Appendix D document currently available PRG values.

3.13 Potential Response Actions and Associated Technologies

Understanding potential response actions and a preliminary range of associated remedial technologies supports the data needs identification for the RFI/CMS/RI/FS alternative evaluations (Chapter 5). The following describe potential response actions for the 200-EA-1 OU:

- **RTD:** RTD alternatives involve excavating soil and structures with contamination above PRGs and placing them at approved disposal facilities for long-term management. RTD planning requires an understanding of soil chemical and physical properties, waste site structural integrity, and the depth and nature of contamination. Waste disposition requires that the receiving disposal facility and disposal criteria be identified to meet waste acceptance and disposal requirements (e.g. land disposal restrictions). Following excavation and closure, waste sites are typically backfilled using overburden and layback materials stockpiled onsite and/or borrow materials from locally identified sources. Site surface restoration is performed considering the future use of the surrounding area. Site grading and backfilling requires an understanding of regulatory requirements for access, borrow material use and transport, and borrow material chemical and physical properties.

- **Leave-in-place alternatives:** Leave-in-place alternatives physically and administratively restrict potential contaminant migration and contaminant accessibility to receptors. These alternatives generally involve one or a combination of the following scenarios:

  - **Leave in place with void grouting and/or soil stabilization and appropriate ICs:**[7] Involves injecting a stabilizing medium into contaminated soil or internal voids of below-grade pipelines and structures. ICs may be used to further manage potential exposure (e.g., to prevent site access). Grouting larger void spaces also minimizes the potential subsidence of overlying soil. This alternative is most appropriate for pipeline and structure waste sites where there is confidence to deliver uniform grouting to void spaces.

[6] TBC information is nonpromulgated advisories or guidance issued by federal or state governments that is not legally binding and does not have the status of potential ARARs.

[7] The BRA will use the construction worker exposure scenario to inform decisions about the selection of remedial alternatives, specifically site controls and the length of time that site access would need restriction.

- **Leave in place with engineered cover or containment system and appropriate ICs:** Involves placing a barrier over contaminated structures or soil with appropriate ICs to manage barrier performance. This alternative is particularly relevant for waste sites that are located near other facilities or waste sites that will have (or are anticipated to have) engineered surface barriers as a remedy (e.g., canyon facilities). Barrier use may also be appropriate for waste site locations not immediately adjacent to other facilities and waste sites.

- **Leave in place with appropriate ICs only:** Leaves contaminated soil and structures in place with appropriate ICs to restrict exposure (e.g., programmatic exposure monitoring and access control, deed restrictions, fencing, and signage). This alternative is most appropriate for waste sites where potential exposure can be effectively managed using only ICs.

Table 3-15 identifies a range of process options developed in accordance with EPA/540/G-89/004, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final*, to support identifying additional data needs associated with remedial technology evaluation and selection. Table 3-15 is not intended to comprehensively identify or evaluate potential technologies. A detailed evaluation of remedial action alternatives and associated technologies will be completed as part of the CMS/FS. Sections 5.9 and 5.10 in Chapter 5 present additional remedial alternative development and screening information.

Table 3-15. Technologies Associated with Potential 200-EA-1 OU Response Actions

Technology[a]	Process Option[b]	COPC Applicability[c]	State of Technology Development[d]	Technology Description and Limitations
Removal, Treatment, and Disposal Response Actions				
Removal – excavation	Shallow excavation[e] – standard	All	Mature technology used at the Hanford Site and other NPL sites	Source area soil and/or structural elements are removed using conventional construction equipment. Excavated soil can be segregated to determine disposal or treatment requirements, or for return of clean layback material to the excavation. Site backfill and restoration following remediation typically requires a backfill material source to replace removed material volume.
	Shallow excavation[e] – suction	All	Mature technology used in the construction industry	Source area soil is removed using construction vehicle-mounted vacuum equipment. Offers more precise control of excavations where interference considerations would restrict standard excavation but is likely not as effective as other excavation options for larger scale excavations. Cannot effectively remove structural elements.
	Deep excavation[f] – engineered layback	All	Mature technology used at the Hanford Site and other NPL sites	Source area soil and/or structural elements are removed using conventional construction equipment and sloping and benching for side slope stability. Requires a significantly increasing lateral surface footprint with increasing excavation depth. Excavated soil can be segregated to determine disposal or treatment requirements, or for return of clean layback material to the excavation. Site backfill and restoration following remediation typically requires a backfill material source to replace removed material volume. May be limited by potential impacts to nearby infrastructure, foundations, and utilities, and may require significant planning for management of material stockpiles.
	Deep excavation[f] – engineered subsurface walls (multiple process options)	All	Mature technology used in the construction industry	Source area soil and/or structural elements are removed using conventional construction equipment and engineered barriers for sidewall stability. Available process options include sheet piling, soldier piles, concrete piles, slurry walls, reinforced-concrete walls, caissons, and jet grouting. Typically requires a smaller lateral footprint than deep excavation with an engineered layback but requires additional design and installation effort. Excavated soil can be segregated to determine disposal or treatment requirements, or for return of clean layback material to the excavation. Site backfill and restoration following remediation typically requires a backfill material source to replace removed material volume. Some process options will be limited or precluded by excessive cobble/gravel in the soil and/or presence of adjacent subsurface interferences (e.g., utilities and building foundations).
	Deep excavation[f] – dragline	All	Mature technology used in the construction and mining industries	Source area soil and/or structural elements are removed using large buckets and dragline cables. May require a smaller surface footprint than deep excavation with an engineered layback but offers less precision during excavation and material segregation. Will not perform effectively where significant subsurface engineered features require removal. Site backfill and restoration following remediation typically requires a backfill material source to replace removed material volume.
	Deep excavation[f] – drilling (multiple process options)	All	Mature technology used in the construction and mining industries	Source area soil is removed and replaced with clean material using drilling techniques such as auguring, coring, rotary drilling, and vibratory hammers. Such excavation may be effective where small lateral areas of contamination cannot be readily accessed by other deep excavation techniques but is likely not practical for larger areas of contamination. Cannot effectively remove structural elements.
Removal – pore water extraction	Vacuum extraction	Mobile COPCs present in pore water	Technology is in the pilot-testing stage	Subsurface-contaminated pore water within the unsaturated zone is extracted using high-vacuum application. This technology is still under development to evaluate effectiveness and would only be applicable for removing contaminated pore water.
Removal – soil flushing	Soil flushing with contaminant recovery (multiple process options)	COPCs with high to moderate mobility	Mature technology used at other NPL sites	Source area soil contamination is mobilized using amended water, captured in the liquid phase, and removed from the subsurface. Requires significant evaluation for effective delivery and capture, as soil flushing is highly specific to the contaminants and associated soil types. Not applicable to contaminated structures or internal contents.
Treatment (ex situ) – physical/chemical	Soil sorting/screening (multiple process options)	All	Mature and prototype technologies used at the Hanford Site, other NPL sites, and in the construction and mining industries	Contaminated and clean soil and/or structural elements are separated using observation and field instrumentation. Separation can range from gross segregation at the excavation point to staging, spreading, and separating at a different location.
	Soil washing	COPCs with high to moderate solubility	Mature technology used at other NPL sites and pilot-tested at the Hanford Site	Contamination in the soil is removed (via dissolution or by separating the fine and coarse soil particle size fractions) using a water-based treatment. Wash water and/or fine particles are then considered for further separate treatment and/or disposal. Heterogeneous soil and mixtures of contaminants with varying characteristics require complex soil-washing treatment trains that are generally not suited to large-scale production rates.
	Solidification/stabilization (multiple process options)	All	Mature technology used at the Hanford Site and other NPL sites	Contamination in the soil is physically and/or chemically stabilized using a treatment process that reduces or eliminates contaminant mobility. Typically applied as part of disposal at a landfill.
Treatment (ex situ) – thermal	Ex situ vitrification	All	Developed technology with limited field-scale application history for soil	Contamination in the soil is immobilized for disposal when high temperatures are used to create a vitrified soil/contaminant matrix. Creation of an effective matrix is sensitive to soil properties, especially particle-size distribution. Generally higher implementation success than in situ vitrification.
Disposal	Backfill treated soil	All	Mature technology used at other NPL sites	Excavation and ex situ treatment followed by onsite disposal (backfill). Effective application is subject to treatment process.
	Onsite landfill	All	Mature technology used at other NPL sites and Hanford Site operable units	Disposal of excavated soil, debris, and/or structural elements at the ERDF. Treatment performed at the facility as required to meet land disposal restrictions. Waste acceptance criteria for ERDF must be met.
	Offsite landfill	All	Mature technology used at the Hanford Site and other NPL sites	Disposal of excavated soil, debris, and/or structural elements at offsite landfills. Waste acceptance criteria for ERDF must be met.
	Offsite repository (Waste Isolation Pilot Plant)	TRU waste[g]	Mature technology used at the Hanford Site and other NPL sites	TRU waste must be packaged and shipped to the Waste Isolation Pilot Plant in Carlsbad, New Mexico.

Table 3-15. Technologies Associated with Potential 200-EA-1 OU Response Actions

Technology[a]	Process Option[b]	COPC Applicability[c]	State of Technology Development[d]	Technology Description and Limitations
Leave-in-Place Response Actions				
Treatment (in situ) – chemical	Chemical amendment (multiple process options for delivery/distribution)	Reactant/contaminant dependent	Mature technology used at the Hanford Site and other NPL sites	Source area contamination is immobilized or destroyed when chemical amendments are delivered to the soil. Multiple delivery and distribution process options are available, depending on target contaminants and extent of contamination. Not applicable to contaminated structures or internal contents; impacts to collocated contaminants in soil must be considered.
Treatment (in situ) – physical	Soil stabilization/ jet grouting	All	Mature technology used in the construction industry; limited field-scale application history for contaminant treatment	Source area contamination is immobilized in a cured grout/soil matrix when grout is injected into the soil under pressure. Amendments may be included in the grout mixture to support destruction of target contaminants. Individual grout injection typically has a limited radius of influence. Difficult to implement effectively over a large lateral area, and effective delivery is subject to subsurface soil conditions and interferences (e.g., utilities and building foundations). (Note: This technology process option only addresses potential application to contaminated soil; void-fill grouting for structural elements is addressed separately.)
	Void-fill (multiple process options)	All	Mature technology used in the construction industry; some specific process options have limited field-scale application history	Contamination within pipelines or other voids is immobilized using grout or foam injected under pressure. Application is sensitive to the length, diameter, and internal condition of a pipeline or void and must consider incorporation or capture of internal liquids.
	Internal fixative	All	Mature technology in other industries; further development may be necessary for contaminant treatment	Contamination within pipelines or other voids is immobilized when a fixative is applied to internal surfaces. Various delivery and distribution techniques are available. Application is sensitive to the length, diameter, and internal condition of a pipeline or void. Effectiveness of long-term stabilization is not well known.
Treatment (in situ) – biological	In situ biological reduction	Uranium, technetium-99, hexavalent chromium, and nitrate	Prototype technology; limited field-scale application history	Contamination in the soil is converted to a less mobile and/or toxic form when chemical and biological amendments are delivered to the soil to enhance biological metabolic processes. Not applicable to contaminated structures or internal contents and must consider impacts to collocated contaminants in soil. The basic technology is understood, but effective delivery and control methods are not completely established.
Treatment (in situ) – thermal	In situ thermal desorption	Select organic compounds	Developed technology; limited application history	Contamination in the soil is volatilized and/or destroyed when direct heat is applied to the soil to increase the in situ soil temperature. Implementation is challenging and highly site-specific, and management of off-gassing must be considered. Field implementation history is limited. Potentially applicable only for organic soil contamination.
	In situ vitrification	All	Developed technology at pilot scale; limited field-scale application history	Contamination in the soil is immobilized when high temperatures are used to create a subsurface vitrified soil/contaminant matrix. Creation of an effective matrix is sensitive to soil properties (particularly particle-size distribution), and management of off-gassing must be considered. Application depth limitations are unknown.
Containment – surface barriers	Maintain existing soil cover	All	Mature technology used at the Hanford Site and other NPL sites	The existing soil cover over contaminated media is maintained and/or augmented as needed to provide protection from exposure to underlying contamination. Augmentation may include applying additional soil cover, contouring, and/or soil stabilization amendments in cover material.
	Asphalt/concrete cap	All	Mature technology used at other NPL sites and in the construction industry	An asphalt/concrete cap consisting of asphalt and aggregate is placed over contaminated media to provide a surface barrier between the underlying contamination and the environment. These caps can help control drainage and restrict infiltration or intrusion into the subsurface. Asphalt/concrete caps are typically simple to construct with shorter intended lifespans than other cap types.
	RCRA barrier	All	Mature technology used at other NPL sites	RCRA barriers are generally designed to be impermeable to prevent surface water infiltration through the vadose zone and to limit contaminant leaching to groundwater, as well as restricting intrusion or other direct contact with subsurface material.
	Prototype Hanford barrier	All	Prototype technology used at the Hanford Site	A prototype, nine-layer earthen barrier with a total thickness of 4.5 m (11.8 ft). Constructed over a Hanford waste site in 1994 to provide long-term protection of radioactive waste in a semiarid environment. Designed to be impermeable to prevent surface water infiltration through the vadose zone and limit contaminant leaching to groundwater. Also prevents intrusion or other direct exposure to subsurface material.
	Evapotranspiration cap	All	Mature technology used at other NPL sites	Construction of a capillary barrier consisting of a fine-grained soil layer overlying a relatively coarse-grained soil layer, creating a distinct textural interface that increases the water-holding capacity of the fine-grained soil over that associated with unimpeded vertical drainage. Vegetative cover is then used to promote evapotranspiration to restrict further infiltration of precipitation and to reduce potential subsurface contaminant migration.
Containment – subsurface barriers	Grouting (multiple process options)	All	Prototype to mature technologies	Injection of grout to develop a subsurface horizontal barrier. Barriers may be used to restrict infiltration and access to underlying contaminated media or may be placed to provide a migration barrier beneath contaminated media. There are limitations in effective radius of influence that may be further restricted by subsurface characteristics.
	Soil freezing	All	Developed technology with proven application for temporary containment in the construction industry	Cryogenic barriers constructed by freezing injected cooling media and soil pore water beneath contaminated media. Barriers may have application in limiting contaminant migration but would require further evaluation/development for long-term use.

Table 3-15. Technologies Associated with Potential 200-EA-1 OU Response Actions

Technology[a]	Process Option[b]	COPC Applicability[c]	State of Technology Development[d]	Technology Description and Limitations
Natural attenuation	Natural attenuation	Radionuclides with reasonable decay timeframes; select organic compounds and metals	Mature technology used at the Hanford Site and other NPL sites	Contamination in the soil is allowed to attenuate over time from natural biological processes, chemical processes, radioactive decay, and/or advection/dispersion from surface water infiltration. Contaminant migration rates must be low enough that groundwater standards are not exceeded. May be combined with other technologies that manage the source areas and mitigate exposure.

a. Provides general remedial technology categories.

b. Provides specific processes within a remedial technology.

c. Indicates the contaminants that can be addressed by a technology based on geochemical properties. A COPC applicability of "All" indicates implementation of a technology is not dependent on the nature of a chemical.

d. Technologies are generally categorized as mature, developed, or prototype. Mature technologies are those with a demonstrated field-scale performance history for environmental remediation at the Hanford Site or other locations or with a demonstrated field-scale performance history in the industry indicated. Developed technologies are those that have some field-scale performance demonstrations, but generally have not been used significantly in remediation or related industries. Prototype technologies are those that have advanced beyond a lab/theoretical scale but lack any demonstrated field-scale performance demonstration.

e. From 0 to ~6 m (0 to 20 ft) below ground surface.

f. Greater than 6 m (20 ft) below ground surface (additional considerations are necessary for excavations at these depths).

g. Radioactive waste (generated since 1970) containing more than 100 nCi (3,700 Bq) of alpha-emitting TRU isotopes per gram of waste. Contributing isotopes have half-lives >20 years and include elements with atomic numbers >92 (e.g., neptunium, plutonium, americium, and curium).

COPC = contaminant of potential concern
ERDF = Environmental Restoration Disposal Facility
NPL = National Priorities List
RCRA = *Resource Conservation and Recovery Act of 1976*
TRU = transuranic

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4 RCRA Facility Investigation/Corrective Measures Study and Remedial Investigation/Feasibility Study Data Needs

This chapter describes the 200-EA-1 OU data quality objective (DQO) process implemented for the 200-EA-1 OU to define principal study questions (PSQs) and the resulting data needs, and to identify data gaps that must be filled to address uncertainty in the CSM (Figure 3-9).[1] The data needs assessment provides the foundation for the field and analytical tasks (described in Chapter 5 and the SAP [Appendix A]) that are necessary to address data gaps. Additional data needs may be identified and addressed throughout the RFI/CMS/RI/FS process.

4.1 Data Quality Objectives Process

The 200-EA-1 OU data needs and related data gaps were developed based on the DQO process (EPA/240/B-06/001, *Guidance on Systematic Planning Using the Data Quality Objectives Process*) and review of key documents and investigations conducted at the Hanford Site. During the DQO process, DOE-RL completed the following major activities, which were sometimes conducted in parallel based on information availability:

- Compiled 200-EA-1 OU existing information (provided in Chapter 3 and the 200-EA-1 scoping document [SGW-60540]).
- Evaluated 200-EA-1 OU existing information during a series of workshops with Ecology from October 2016 through June 2017. Evaluations and workshops focused on determining the data gaps (i.e., type, quantity, and quality of data) to resolve decision-making uncertainties. The overarching workshop objectives were to determine if a basis for action exists and to understand the potential response actions for each waste site. Appendix C documents the outcomes of the preliminary evaluations and workshops for each waste site.
- Conducted additional waste-site specific analysis to bound the range of potential site impacts and focus waste site-specific investigation activities (ECF-200EA1-17-0046, *Assessment and Presentation of Available Waste Site Data for the 200-EA-1 Operable Unit*; ECF-200EA1-17-0066, *Pore Volume Calculation – 200-EA-1 OU Liquid Waste Disposal Sites*). Chapter 3 synthesizes the Appendix C workshop evaluations with the additional analysis that occurred following the workshops.
- Evaluated existing information to assess sufficient understanding of the CSM. Section 3.7 in Chapter 3 describes the preliminary CSM, and Table 4-1 summarizes the data completeness evaluation for the CSM elements. The data completeness evaluation informed the problem statement (Section 4.2) that underpins the DQO process.
- Defined PSQs and related data needs (Section 4.2) associated with completing the understanding of the CSM.

[1] As used in this work plan, data needs are information required to answer PSQs to support cleanup decision making. Data gaps result when existing information cannot practically fill data needs, and they serve as the basis for new data collection and technical evaluations.

- Identified waste site specific data gaps based on data needs and the evaluations documented in Chapter 3 and Appendix C. Section 4.2.1 discusses the 200-EA-1 OU waste sites with data gaps and the planned field investigations.
- Defined waste site-specific investigation activities to address data gaps (SAP [Appendix A]).

Table 4-1. Data Completeness Evaluation for the 200-EA-1 OU CSM Elements

CSM Element	Existing Information Completeness Summary
Physical setting	Section 2.4 in Chapter 2 presents physical setting information (e.g., Central Plateau Inner Area geology and hydrogeology, meteorological data, and threatened or endangered species) and is **sufficient** to define this CSM element.
Nature and extent	Section 3.3 in Chapter 3 synthesizes the data presented in Appendix C, ECF-200EA1-17-0046, ECF-200EA1-17-0066, and the 200-EA-1 scoping document (SGW-60540). The initial evaluation determined that data are **insufficient** for many waste sites (Table 4-3). Supplemental information related to contaminant nature and extent is needed to refine this CSM element.
Land use	Section 3.5 in Chapter 3 identifies the current and reasonably anticipated future land use for the Central Plateau Inner Area and is **sufficient** to define this CSM element.
Exposure scenarios	Sections 3.6 through 3.8 in Chapter 3 identify the exposure scenarios and associated potential exposure pathways and is **sufficient** to define this CSM element. Supplemental information related to contaminant nature and extent (as identified above) will facilitate the final determination of complete exposure pathways.
Fate and transport	The graded approach document (DOE/RL-2011-50) presents the hydraulic properties and model parameters required to evaluate vadose zone flow and contaminant transport vertically and horizontally within the system (including potential groundwater impacts). The existing data and analysis are **insufficient** for this CSM element. Supplemental information related to contaminant nature and extent (as identified above) is needed to adequately define source terms. Additionally, supplemental information related to hydraulic properties, contaminant attenuation, geochemistry, and transformation and mobility are needed to support modeling and preliminary remediation goal development. Supplemental information collection is planned as part of 200-DV-1, 200-WA-1, and 200-EA-1 OU characterization efforts. Activities are ongoing to integrate data collection strategies between the 200-EA-1, 200-DV-1, 200-WA-1, and 200-IS-1 OUs.

Sources:

DOE/RL-2011-50, *Regulatory Basis and Implementation of a Graded Approach to Evaluation of Groundwater Protection.*

ECF-200EA1-17-0046, *Assessment and Presentation of Available Waste Site Data for the 200-EA-1 Operable Unit.*

ECF-200EA1-17-0066, *Pore Volume Calculation – 200-EA-1 OU Liquid Waste Disposal Sites.*

SGW-60540, 2017, *200-EA-1 Operable Unit Scoping.*

CSM = conceptual site model
OU = operable unit

4.2 Data Needs for 200-EA-1 Operable Unit Waste Sites

Table 4-2 identifies the 200-EA-1 OU PSQs and data needs associated with completing the understanding of the CSM (Table 4-1). Where applicable, existing data were identified to fill data needs and answer the PSQs listed in Table 4-2. Where existing data could not fill a data need, a data gap was identified for the 200-EA-1 OU RFI/CMS/RI/FS. Field investigations to address data gaps are included in the SAP (Appendix A) and summarized in Section 4.2.1.

4.2.1 200-EA-1 Operable Unit Waste Sites with Planned Field Investigations

Table 4-3 identifies the 93 waste sites where field investigations are identified to address data gaps. These field investigations support the data needs defined in Table 4-2 and include the following types of activities:

- **Organic vapor monitoring:** Used to field screen sampling locations, waste site penetration cuttings, trenches, and test pits for the presence of VOCs.
- **Visual inspections:** Supports sampling and analysis efforts by identifying evidence of potential contamination (e.g., soil staining).
- **Ground-penetrating radar and electromagnetometry surveys:** Supports understanding of subsurface features and lateral contaminant distribution gradients.
- **Resistivity surveys:** used to estimate lateral extent of subsurface contamination; supports soil sampling location identification.
- **Radiological and x-ray fluorescence surveys:** Used to confirm the presence or absence of surface contamination and define surface contamination boundaries.
- **Concrete sampling:** Used to evaluate residual contamination in concrete structures (e.g., retention basins and residual foundations).
- **Discrete soil sampling:** Used to confirm the presence of contamination within the vadose zone; select samples are analyzed for contaminant attenuation, transformation, and mobility.
- **Geophysical logging:** Used to determine the vertical and horizontal distribution and concentration of radiological contaminants based on gamma-activity levels; used to define physical conditions such as moisture content and lithofacies distribution (e.g., sand, silt, and gravel units); will be performed at all boreholes
- **Geologist/driller field logs:** Used to identify physical conditions such as lithofacies distribution (e.g., sand, silt, gravel units).

As indicated in Table 4-3, sample designs include statistical and judgmental approaches. The statistical approach is based on a random or systematic selection process. The judgmental approach is based on expert knowledge and professional judgment. The SAP (Appendix A) provides additional field investigation descriptions and waste site-specific characterization objectives.

Table 4-2. 200-EA-1 OU PSQs, Data Needs, and Decision Rules

Principal Study Question	Data Need	Decision Rule
Problem Statement: *Contaminant nature and extent must be sufficiently understood to determine if chemical or radiological COPCs pose an unacceptable risk to HHE and to support potential groundwater impacts and response scenario evaluations in the FS/CMS.*		
PSQ #0a: Did this septic system receive hazardous substance other than sanitary discharges that require additional investigations?	**DN #0a-1:** Collect sufficient data to determine if chemical or radiological contaminants were discharged to the septic system.	If the septic system received chemical or radiological contaminants, then address PSQ #1; if not, reclassify waste site as rejected using the MP-14 process (RL-TPA-90-0001).
PSQ #0b: Did the UPR-200-E-43 or UPR-200-E-99 waste sites receive radiological constituents that require additional investigations?	**DN #0b-1:** Collect sufficient data to determine if radiological contaminants are present.	If the UPR-200-E-43 or UPR-200-E-99 waste site received radiological contaminants, then address PSQ #1 for that site; if not, then no further action is required.
PSQ #1: Do chemical or radiological COPCs in the vadose zone associated with 200-EA-1 OU waste sites pose an unacceptable risk to HHE under current or potential future land use?	**DN #1-1:** Collect sufficient data to determine if chemical and/or radiological contaminants associated with 200-EA-1 OU waste sites exceed applicable risk-based values for human (outdoor worker) and ecological receptors in the vadose zone from 0 to 4.6 m (0 to 15 ft) bgs.	If chemical or radiological COPCs in the vadose zone pose an unacceptable risk to human or ecological receptors, then develop and evaluate response alternatives. If there is no unacceptable risk, then no action is required.
PSQ #2: Do chemical or radiological COPCs in the vadose zone associated with 200-EA-1 OU waste sites pose an unacceptable risk to groundwater under current or potential future land use in the next 1,000 years?	**DN #2-1:** Collect sufficient chemical and radiological contaminant data to support fate and transport analysis for groundwater protection evaluations.	If chemical or radiological COPCs in the vadose zone pose an unacceptable risk to groundwater, then develop and evaluate response alternatives and communicate to the groundwater OU. If there is no unacceptable risk, then no action is required.
	DN #2-2: Collect sufficient lithology, hydraulic property, contaminant mobility, and geochemical information to support fate and transport analysis for groundwater protection evaluations, including Central Plateau groundwater protection PRG calculations.	
PSQ #3: What is the lateral and vertical extent of chemical and radiological COPCs associated with 200-EA-1 OU waste sites that pose an unacceptable risk to HHE under current or potential future land use?	**DN #3-1:** Collect data to reduce uncertainty associated with the lateral and vertical extent of radiological and/or chemical contaminants posing an unacceptable risk to HHE for FS/CMS remedy evaluation.	If the lateral and vertical extent of chemical or radiological COPCs in the vadose zone is delineated sufficiently to support viable response alternative development, then proceed with defining potential response actions. If not, then plan supplemental data collection to fill remaining data gaps.

Table 4-2. 200-EA-1 OU PSQs, Data Needs, and Decision Rules

Principal Study Question	Data Need	Decision Rule
PSQ #4: Will the identified remedial responses meet overall protection of HHE under current or potential future land use?	**DN #4-1:** Collect sufficient supplemental lithology, hydraulic property, contaminant mobility, and geochemical information to support fate and transport analysis for FS/CMS remedy evaluation, including Central Plateau groundwater protection PRG calculations.	If the remedial responses will meet soil and groundwater cleanup levels within the performance expectation timeframe, then fully develop the remedial responses into alternatives for further evaluation in the FS. If not, eliminate nonviable remedial responses from further consideration.
	DN #4-2: Collect sufficient contaminant data to define how much time is required to meet cleanup levels for FS/CMS remedy evaluation.	
	DN #4-3: Collect sufficient data to determine if radiological contaminants associated with 200-EA-1 OU waste sites exceed short term (acute) exposure for human receptors (construction worker) in the vadose zone >4.6 m (15 ft) bgs.	

Reference: RL-TPA-90-0001, *Tri-Party Agreement Handbook Management Procedures,* Guideline Number TPA-MP-14, "Maintenance of the Waste Information Data System (WIDS)."

bgs = below ground surface
CMS = corrective measures study
COPC = contaminant of potential concern
DN = data need
FS = feasibility study
HHE = human health and the environment
OU = operable unit
PRG = preliminary remediation goal
PSQ = principal study question

Table 4-3. 200-EA-1 OU Waste Sites with Data Gaps and Planned Field Investigation

Waste Site	Data Need Constituting a Data Gap[a]	Planned Field Investigation to Address Data Gap[b]
A Tank Farms Group		
200-E-262-PL pipeline	See the 216-A-42 retention basin (investigations at this retention basin encompasses investigation at the 200-E-262-PL site).	
200-E-276-PL pipeline	See the 216-A-41 crib (investigations at this crib encompasses investigation at the 200-E-276-PL site).	
207-A-NORTH Retention Basin	DN #1-1, DN #3-1, DN #4-2	Perform systematic radiological survey.
216-A-1 Crib	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Collect soil samples (>4.6 m [15 ft] bgs; random locations; standard depth intervals).
216-A-6 Crib[c]	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Perform resistivity survey; collect soil samples (<4.6 m [15 ft] bgs; judgmental and random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform resistivity survey; collect soil samples (>4.6 m [15 ft] bgs; judgmental and random locations; judgmental depth intervals).
216-A-18 Trench	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Perform systematic radiological and resistivity surveys; collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform systematic radiological and resistivity surveys; collect soil samples (>4.6 m [15 ft] bgs; random locations; standard and judgmental depth intervals).
216-A-19 Trench	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Perform GPR and/or EM surveys; perform resistivity survey; collect soil samples (<4.6 m [15 ft] bgs; judgmental and random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform GPR and/or EM surveys; perform resistivity survey; collect soil samples (>4.6 m [15 ft] bgs; judgmental and random locations; standard depth intervals).
216-A-20 Trench	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Perform GPR and/or EM surveys; perform resistivity survey; collect soil samples (<4.6 m [15 ft] bgs; judgmental and random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform GPR and/or EM surveys; perform resistivity survey; collect soil samples (>4.6 m [15 ft] bgs; judgmental and random locations; standard depth intervals).
216-A-29 Ditch[f]	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Collect soil samples (>4.6 m [15 ft] bgs; random locations; standard depth intervals).
216-A-30 Crib	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Perform resistivity survey; collect soil samples (<4.6 m [15 ft] bgs; judgmental and random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform resistivity survey; collect soil samples (>4.6 m [15 ft] bgs; judgmental and random locations; judgmental depth intervals).
216-A-34 Ditch	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Perform GPR and/or EM surveys; perform resistivity survey; collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals).

Table 4-3. 200-EA-1 OU Waste Sites with Data Gaps and Planned Field Investigation

Waste Site	Data Need Constituting a Data Gap[a]	Planned Field Investigation to Address Data Gap[b]
216-A-34 Ditch (continued)	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform GPR and/or EM surveys; perform resistivity survey; soil samples (>4.6 m [15 ft] bgs; random locations; standard depth intervals).
216-A-37-1 Crib	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Collect soil samples (>4.6 m [15 ft] bgs; random locations; judgmental depth intervals).
216-A-37-2 Crib	DN #1-1, DN #2-1 DN #3-1, DN #4-2	Perform resistivity survey; collect soil samples (<4.6 m [15 ft] bgs; judgmental and random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform resistivity survey; collect soil samples (>4.6 m [15 ft] bgs; judgmental and random locations; judgmental depth intervals).
216-A-40 Retention Basin	DN #1-1, DN #2-1, DN #3-1	Perform GPR and/or EM surveys; collect soil samples (<4.6 m [15 ft] bgs; judgmental and random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform GPR and/or EM surveys; collect soil samples (>4.6 m [15 ft] bgs; judgmental and random locations; judgmental depth intervals).
216-A-41 Crib[d]	DN #1-1	Collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Collect soil sample (>4.6 m [15 ft] bgs; random location; judgmental depth interval).
216-A-42 Retention Basin[e]	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Perform GPR and/or EM surveys; collect concrete corings; collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals below concrete).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform GPR and/or EM surveys; collect soil samples (>4.6 m [15 ft] bgs; random locations; standard depth intervals).
2607-EA septic system	DN #0a-1	Perform GPR and/or EM surveys; collect soil samples (<4.6 m [15 ft] bgs; judgmental location; standard depth intervals from bottom of structure). As warranted, complete contingency sampling as described in Appendix A.
2607-E12 septic system	DN #0a-1	Perform GPR and/or EM surveys; collect soil samples (<4.6 m [15 ft] bgs; random locations; judgmental depth intervals at base of structure). As warranted, complete contingency sampling as described in Appendix A.
UPR-200-E-21 (UPR–liquid)	See the 216-A-6 Crib (investigations at this crib encompasses investigation at UPR-200-E-21).	
UPR-200-E-29 (UPR–liquid)	See the 216-A-6 Crib (investigations at this crib encompasses investigation at UPR-200-E-29).	
UPR-200-E-66 (UPR–solid)	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15] ft bgs; random locations; standard depth intervals below stabilization material).
UPR-200-E-99 (UPR–solid)	DN #0b-1	Perform systematic radiological survey. As warranted, complete contingency sampling as described in Appendix A.

Table 4-3. 200-EA-1 OU Waste Sites with Data Gaps and Planned Field Investigation

Waste Site	Data Need Constituting a Data Gap[a]	Planned Field Investigation to Address Data Gap[b]
B Tank Farms Group		
200-E-121 (UPR–solid)	DN #1-1, DN #3-1, DN #4-2	Perform systematic radiological survey; collect soil samples (<4.6 m [15 ft] bgs; random locations on systematic grids; judgmental and standard depth intervals).
200-E-292 dumping area	DN #1-1, DN #3-1 DN #4-2	Perform GPR and/or EM surveys; collect soil samples (<4.6 m [15 ft] bgs; random locations on a systematic grid; judgmental and standard depth intervals).
216-B-51 french drain	DN1-1, DN #2-1, DN3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3.	Collect soil samples (>4.6 m [15 ft] bgs; random locations; standard depth intervals).
2607-EF septic system	DN #0a-1	Perform GPR and/or EM surveys; collect soil samples (<4.6 m [15 ft] bgs; random location; standard depth intervals below discharge point). As warranted, complete contingency sampling as described in Appendix A.
2607-E9 septic system	DN #0a-1	Perform GPR and/or EM surveys; collect soil samples (<4.6 m [15 ft] bgs; random location; standard depth intervals below discharge point). As warranted, complete contingency sampling as described in Appendix A.
UPR-200-E-43 (UPR–liquid)	DN #0b-1	Perform systematic radiological survey.
UPR-200-E-89 (UPR–solid)	DN #1-1, DN #3-1, DN #4-2	Perform systematic radiological survey; collect soil samples (<4.6 m [15 ft] bgs; random locations on a systematic grid; judgmental and standard depth intervals).
UPR-200-E-144 (UPR–solid)	DN #1-1, DN #3-1, DN #4-2	Perform systematic radiological survey; collect soil samples (<4.6 m [15 ft] bgs; random locations on a systematic grid; judgmental and standard depth intervals).
B Plant Group		
200-E-26 (UPR–liquid)	DN #1-1, DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; random locations on a systematic grid; judgmental and standard depth intervals).
200-E-117 (UPR–solid)	DN #1-1, DN #3-1. DN #4-2	Perform GPR and/or EM surveys; collect soil samples (<4.6 m [15 ft] bgs; random and judgmental locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform GPR and/or EM surveys; collect soil samples (>4.6 m [15 ft] bgs; random and judgmental locations; judgmental depth intervals).
200-E-142 depression	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Collect concrete and soil samples (<4.6 m [15 ft] bgs; random and judgmental locations; judgmental and standard depth intervals).
200-E-297 dumping ground	DN #1-1, DN #3-1, DN #4-2	Perform systematic radiological survey; perform GPR and/or EM, and systematic XRF surveys; collect soil samples (<4.6 m [15 ft] bgs; random locations on a systematic grid; judgmental and standard depth intervals).
207-B Retention Basin	DN #1-1, DN #3-1, DN #4-2	Perform systematic radiological survey; collect concrete corings; collect soil samples (< 4.6 m [15 ft] bgs; judgmental and random locations; standard depth intervals below basin).

Table 4-3. 200-EA-1 OU Waste Sites with Data Gaps and Planned Field Investigation

Waste Site	Data Need Constituting a Data Gap[a]	Planned Field Investigation to Address Data Gap[b]
216-B-2-1 Ditch	DN #1-1, DN #2-1 DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; judgmental and random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Collect samples (>4.6 m [15 ft] bgs; judgmental and random locations; judgmental and standard depth intervals).
216-B-2-2 Ditch	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Collect soil samples (>4.6 m [15 ft] bgs; random location; standard depth intervals).
216-B-2-3 Ditch	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Collect soil samples (>4.6 m [15 ft] bgs; random location; standard depth intervals).
216-B-10A Crib	DN #1-1, DN #2-1 DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Collect soil samples (>4.6 m [15 ft] bgs; random location; judgmental depth intervals).
216-B-10B Crib	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Collect soil samples (>4.6 m [15 ft] bgs; random location; standard depth intervals).
216-B-12 Crib	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Perform resistivity survey; collect soil samples (<4.6 m [15 ft] bgs; judgmental and random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform resistivity survey; collect soil samples (>4.6 m [15 ft] bgs; judgmental and random locations; judgmental depth intervals).
216-B-55 Crib	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Collect soil samples (>4.6 m [15 ft] bgs; random locations; judgmental depth intervals).
216-B-59 Trench	DN #1-1, DN #3-1, DN #4-2	Perform systematic radiological or systematic XRF survey; collect soil samples (<4.6 m [15 ft] bgs; random locations; judgmental and standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform systematic radiological or XRF survey; collect soil samples (>4.6 m [15 ft] bgs; random locations; judgmental depth intervals).
216-B-59B Retention Basin	See the 216-B-59B Trench (investigations at this site encompass investigation at the 216-B-59B retention basin).	
216-B-62 Crib	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Collect soil samples (>4.6 m [15 ft] bgs; random locations; judgmental depth intervals).
218-E-7 burial vault	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Perform GPR and/or EM surveys; collect soil samples (<4.6 m [15 ft] bgs; judgmental and random locations; judgmental and standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform GPR and/or EM surveys; collect soil sample (>4.6 m [15 ft] bgs; judgmental location; judgmental depth interval).

Table 4-3. 200-EA-1 OU Waste Sites with Data Gaps and Planned Field Investigation

Waste Site	Data Need Constituting a Data Gap[a]	Planned Field Investigation to Address Data Gap[b]
2607-E3 septic system	DN #0a-1	Perform GPR and/or EM surveys; collect soil samples (<4.6 m [15 ft] bgs; random location; standard depth intervals below discharge point). As warranted, complete contingency sampling as described in Appendix A.
UPR-200-E-64 (UPR–solid)	DN #1-1, DN #3-1 DN #4-2	Perform systematic radiological survey; collect soil samples (<4.6 m [15 ft] bgs; random locations on a systematic grid; judgmental and standard depth intervals).
UPR-200-E-69 (UPR–liquid)	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Perform systematic radiological survey; collect soil samples (<4.6 m [15 ft] bgs; judgmental and random locations; judgmental and standard depth intervals).
Hot Semiworks Group		
200-E-41 (UPR–solid)	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Perform systematic radiological survey; collect soil samples (<4.6 m [15 ft] bgs; judgmental locations and random locations on a systematic grid; judgmental and standard depth intervals below ash).
200-E-56 (UPR–liquid)	DN #1-1, DN #3-1, DN #4-2	Perform GPR and/or EM surveys; collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals below ash).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform GPR and/or EM surveys; collect soil samples (>4.6 m [15 ft] bgs; random locations; judgmental and standard depth intervals).
200-E-57 (UPR–liquid)	DN #1-1, DN #3-1, DN #4-2	Perform GPR and/or EM surveys; collect soil samples (< 4.6 m [15 ft] bgs; random locations; standard depth intervals).
200-E-293 foundation	DN #1-1, DN #3-1, DN #4-2	Perform systematic radiological survey; collect concrete corings; collect soil samples (<4.6 m [15 ft] bgs; (random locations; standard depth intervals below slab).
200-E-294 foundation	DN #1-1, DN #3-1, DN #4-2	Perform systematic radiological survey; collect concrete corings; collect soil samples (<4.6 m [15 ft] bgs; (judgmental and random locations; standard depth intervals below slab).
201-C process unit	DN #1-1, DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals below ash).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Collect soil samples (>4.6 m [15 ft] bgs; random location; judgmental depth intervals).
216-C-1 Crib	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Perform resistivity survey; collect soil samples (<4.6 m [15 ft] bgs; judgmental and random locations; judgmental and standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform resistivity survey; collect soil samples (>4.6 m [15 ft] bgs; judgmental and random locations; judgmental depth intervals).
216-C-2 injection/reverse well	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Perform GPR and/or EM surveys; perform resistivity survey; collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform GPR and/or EM surveys; perform resistivity survey; collect soil samples (>4.6 m [15 ft] bgs; random locations; judgmental depth intervals).
216-C-3 Crib	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Collect soil samples (>4.6 m [15 ft] bgs; random location; judgmental depth intervals).

Table 4-3. 200-EA-1 OU Waste Sites with Data Gaps and Planned Field Investigation

Waste Site	Data Need Constituting a Data Gap[a]	Planned Field Investigation to Address Data Gap[b]
216-C-4 Crib	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Collect soil samples (>4.6 m [15 ft] bgs; random locations; judgmental and standard depth intervals).
216-C-5 Crib	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Collect soil samples (>4.6 m [15 ft] bgs; random locations; judgmental and standard depth intervals).
216-C-6 Crib	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Perform GPR and/or EM surveys; collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform GPR and/or EM surveys; collect soil samples (>4.6 m [15 ft] bgs; random locations; judgmental depth interval).
216-C-7 Crib	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Perform GPR and/or EM surveys; collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform GPR and/or EM surveys; collect soil samples (>4.6 m [15 ft] bgs; random location; judgmental depth interval).
216-C-10 Crib	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Perform resistivity survey; collect soil samples (<4.6 m [15 ft] bgs; judgmental and random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform resistivity survey; collect soil samples (>4.6 m [15 ft] bgs; judgmental location; judgmental depth intervals).
2607-E5 septic system	DN #0a-1	Perform GPR and/or EM surveys; collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals below discharge point). As warranted, complete contingency sampling as described in Appendix A.
291-C-1 Burial Ground	DN #1-1, DN #3-1, DN #4-2	Perform GPR and/or EM surveys; collect soil samples (<4.6 m [15 ft] bgs; random locations; judgmental and standard depth intervals below ash).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform GPR and/or EM surveys; collect soil samples (>4.6 m [15 ft] bgs; random locations; standard depth intervals).
UPR-200-E-37 (UPR–solid)	DN #1-1, DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; random locations on a systematic grid; judgmental and standard depth intervals).
UPR-200-E-98 (UPR–solid)	DN #1-1, DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; random locations; judgmental and standard depth intervals).
PUREX Plant Group		
200-E PD Ditch	DN #1-1, DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Collect soil samples (>4.6 m [15 ft] bgs; random locations, standard depth intervals).
200-E-13 dumping area	DN #1-1, DN #3-1, DN #4-2	Perform GPR and/or EM, and systematic XRF surveys; collect soil samples (<4.6 m [15 ft] bgs; random locations on a systematic grid; judgmental and standard depth intervals).
200-E-43 storage area	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals).

Table 4-3. 200-EA-1 OU Waste Sites with Data Gaps and Planned Field Investigation

Waste Site	Data Need Constituting a Data Gap[a]	Planned Field Investigation to Address Data Gap[b]
200-E-124 (UPR–liquid)	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; judgmental and random locations; judgmental and standard depth intervals).
216-A-3 Crib	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Perform GPR and/or EM surveys; perform resistivity survey; collect soil samples (<4.6 m [15 ft] bgs; judgmental and random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform GPR and/or EM surveys; perform resistivity survey; collect soil samples (>4.6 m [15 ft] bgs; judgmental and random locations; judgmental depth intervals).
216-A-9 Crib	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Perform resistivity survey; collect soil samples (<4.6 m [15 ft] bgs; judgmental and random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform resistivity survey; collect soil samples (>4.6 m [15 ft] bgs; judgmental location; judgmental depth intervals).
216-A-10 Crib	DN #1-1, DN #3-1, DN #4-2	Perform systematic radiological survey; perform resistivity survey.
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform systematic radiological survey; perform resistivity survey; collect soil samples (>4.6 m [15 ft] bgs; judgmental and random locations, judgmental depth intervals).
216-A-27 Crib	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Perform resistivity survey; collect soil samples (<4.6 m [15 ft] bgs; judgmental and random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform resistivity survey; collect soil samples (>4.6 m [15 ft] bgs; judgmental and random locations, judgmental depth intervals).
216-A-36A Crib	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depths intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Collect soil samples (>4.6 m [15 ft] bgs; random locations; standard and judgmental depth intervals).
216-A-36B Crib	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals).
	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Collect soil samples (>4.6 m [15 ft] bgs; random locations; standard depth intervals).
216-A-38-1 Crib	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Geophysical logging of penetration (0 to 15.2 m [50 ft] bgs; judgmental location). As warranted, complete contingency sampling as described in Appendix A.
216-A-45 Crib	DN #2-1, DN #3-1, DN #4-2, DN #4-3	Perform resistivity survey; collect soil samples (<4.6 m [15 ft] bgs; judgmental locations; judgmental depth intervals).
2607-E6 septic system	DN #0a-1	Perform GPR and/or EM surveys; collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals below discharge point). As warranted, complete contingency sampling as described in Appendix A.
UPR-200-E-10 (UPR–solid)	See UPR-200-E-11 waste site (investigations at the UPR-200-E-11 site encompass investigation at the UPR-200-E-10 site).	
UPR-200-E-12 (UPR–liquid)	See UPR-200-E-11 waste site (investigations at the UPR-200-E-11 site encompass investigation at the UPR-200-E-12 site).	
UPR-200-E-20 (UPR–solid)	See UPR-200-E-11 site (investigations at the UPR-200-E-11 site encompass investigation at the UPR-200-E-20 site).	

Table 4-3. 200-EA-1 OU Waste Sites with Data Gaps and Planned Field Investigation

Waste Site	Data Need Constituting a Data Gap[a]	Planned Field Investigation to Address Data Gap[b]
UPR-200-E-33 (UPR–liquid)	See the UPR-200-E-11 site (investigations at the UPR-200-E-11 site encompass investigation at the UPR-200-E-33 site).	
UPR-200-E-88 (UPR–liquid)	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Perform systematic radiological survey; collect soil samples (<4.6 m [15 ft] bgs; random locations; judgmental and standard depth intervals).
		Miscellaneous Group
200-E-BP burn pit	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Perform systematic radiological survey; perform GPR and/or EM surveys; collect soil samples (<4.6 m [15 ft] bgs; judgmental and random locations; judgmental and standard depth intervals).
200-E-53 (UPR–solid)	DN #1-1, DN #3-1, DN #4-2	Perform systematic radiological survey; collect soil samples (<4.6 m [15 ft] bgs; random locations on a systematic grid; judgmental and standard depth interval).
200-E-115 (UPR–solid)	DN #1-1, DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; random locations; standard depth intervals).
200-E-139 (UPR–solid)	DN #1-1, DN #3-1, DN #4-2	Collect soil samples (<4.6 m [15 ft] bgs; random locations on a systematic grid; standard depth intervals).
UPR-200-E-11 (UPR–liquid)	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Perform systematic radiological survey; collect soil samples (<4.6 m [15 ft] bgs; random locations; judgmental and standard depth intervals).
UPR-200-E-50 (UPR–solid)	See the 200-E-53 UPR waste site (investigations at 200-E-53 UPR site encompasses investigation at UPR-200-E-50 site).	
UPR-200-E-95 (UPR–solid)	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Perform systematic radiological survey; collect soil samples (<4.6 m [15 ft] bgs; random locations; judgmental and standard depth intervals).
UPR-200-E-112 (UPR–liquid)	DN #1-1, DN #2-1, DN #3-1, DN #4-2	Perform systematic radiological survey; collect soil samples (<4.6 m [15 ft] bgs; random locations; judgmental and standard depth intervals).

a. Table 4-2 defines the data needs.

b. The SAP (Appendix A, Section A3.2.3 and A3.2.4) defines standard soil sampling intervals, and SAP Tables A-12 through A-17 provide planned sampling depths and sample collection intervals.

c. Investigation at the 216-A-6 Crib encompasses the investigation at the UPR-200-E-21 and UPR-200-E-29 waste sites.

d. Investigation at the 216-A-41 Crib encompasses the investigation at the 200-E-276-PL pipeline waste site.

e. Investigations at the 216-A-42 retention basin encompasses the investigation at the 200-E-262-PL pipeline waste site.

f. Opportunistic characterization was completed in 2017 in accordance with DOE/RL-2017-35, *Characterization Sampling and Analysis Plan for the C9617 Borehole at the 216-A-29 Waste Site*, supporting DN #1-1 and DN #3-1.

bgs = below ground surface
DN = data need
EM = electromagnetometry
GPR = ground-penetrating radar
PUREX = Plutonium-Uranium Extraction (Plant)
SAP = sampling analysis plan
UPR = unplanned release
XRF = x-ray fluorescence

4.2.2 200-EA-1 Operable Unit Waste Sites with No Planned Field Investigations

Table 4-4 identifies the 21 waste sites where no field investigations are planned based on the following criteria:

- Sites where contamination is no longer present
- Sites where no data gaps exist based on previous characterization
- Sites where data gaps exist, but where investigations at other sites are being used to fill those data gaps
- Small UPR waste sites indicated for disposition with larger collocated waste sites
- Sites where some action is necessary for reasons other than past-practice releases to the environment (e.g., underground injection control [UIC] program decommissioning requirements; DOE facility management)
- Sites where DOE-RL and Ecology determined it is a more efficient use of resources to remove and dispose.

For several sites, DOE-RL and Ecology agreed that there is sufficient basis for action and identified a bias for removal and disposal in lieu of upfront characterization. The following describes the situations with a bias for removal and disposal (Table 4-4 identifies the site specific rationale):

- **Underground injection control (UIC) program sites:** UIC program sites must be decommissioned in accordance with WAC 173-218-120, "Decommissioning of a UIC Well," "Underground Injection Control Program." Decommissioning actions may include removing the structure within 0.91 m (3 ft) of ground surface, backfilling up to 0.91 m (3 ft) bgs with uncontaminated material that drains equal to or more slowly than native material, and backfilling to surface with native materials. The decommissioning end state must prevent contaminated liquid from migrating to groundwater.
- **Surface UPR waste sites:** Four 200-EA-1 OU waste sites are identified where there is sufficient basis for action and a bias for removal and disposal in lieu of upfront characterization. At these surface UPR waste sites, radiological detections were noted during surface surveillance and maintenance activities. Three of these sites were covered with 0.3 to 0.6 m (1 to 2 ft) of clean fill upon discovery. These UPR waste sites typically have an unknown source and are likely discrete "hot spots" resulting from surface deposition. Rather than designing and implementing a characterization effort around a hot spot, DOE-RL and Ecology agreed that it was more practical to excavate the area of detection first, followed by confirmation sampling in the waste site area. Confirmation sampling would indicate if additional soil excavation was necessary to achieve final cleanup levels.

Table 4-4. 200-EA-1 OU Waste Sites with No Planned Field Investigations

Waste Site	Rationale for No Planned Field Investigations
A Tank Farms Group	
200-E-27 dumping area	• Early action candidate site.* • Waste site consists of possible lead contamination in soil associated with lead cutting and storing. Visual inspection and sampling indicate contamination may still be present. • Lead cuttings (i.e., contaminant source) may not be homogeneously distributed across the site. • DOE-RL and Ecology determined it is a more efficient use of resources to remove and dispose.
200-E-125 (UPR–solid)	• **Surface UPR waste site**; early action candidate site.* • Waste site is a posted contamination area. No data exist regarding the nature of contamination. The reason for UPR waste site designation is unknown. Potentially impacted area is 4.6 m by 6.7 m (15 ft by 22 ft) and assumed to be 0.9 m (3 ft) deep. • DOE-RL and Ecology determined it is a more efficient use of resources to remove and dispose.
200-E-287 (UPR–solid)	• Waste site consists of radiologically contaminated tumbleweed accumulation. • Area will be managed through routine radiological surveillance and maintenance while there is the potential for continued contaminant deposition from future tumbleweed accumulation. Once accumulation has ceased, update scoping through evaluation of future surveillance and maintenance results to confirm absence of contamination and proceed to "no action" determination.
207-A-SOUTH Retention Basin	• Waste site has been addressed through previous characterization efforts and the recent TSD unit closure determinations (17-AMRP-0083; 17-NWP-057). • Evaluate and implement the MP-14 reclassification process.
UPR-200-E-143 (UPR–solid)	• Waste site is a surface contamination area that originated with the discovery of radiologically contaminated rabbit feces. Site size and shape has evolved over time due to new contamination identification and cleanup efforts. • Waste site is collocated with 200-E PD Ditch. • Radiological surveys (2016) indicate the waste site area is no longer contaminated. No further data needs identified during the DQO process to support a future "no action" determination.
B Tank Farms Group	
None.	
B Plant Group	
200-E-25 french drain 200-E-209-PL pipeline	• **UIC program site**; early action candidate site.* • No data exist for the french drain and associated pipeline (200-E-209-PL) other than process history indicating asbestos, a grease trap, and potential for organic chemicals. French drain is 0.6 m (2 ft) in diameter and 6.1 m (20 ft) deep; pipeline is 15.2 m (50 ft) long, 5.1 cm (2 in.) in diameter, and buried <0.9 m (3 ft) bgs. • Based on UIC designation, at least the top 0.9 m (3 ft) of the french drain will require excavation and subsequent stabilization (e.g., backfill). Sampling at the bottom of the first 0.9 m (3 ft) excavation would determine if any CERCLA COPCs are present that require further excavation. • DOE-RL and Ecology agreed that shallow trench excavation of the pipeline and the french drain (UIC) are the most effective use of resources to manage uncertainties associated with the presence of organics or other contaminants associated with the pipeline.

Table 4-4. 200-EA-1 OU Waste Sites with No Planned Field Investigations

Waste Site	Rationale for No Planned Field Investigations
200-E-123 (UPR–solid)	• **Surface UPR waste site**; early action candidate site.* • Waste site originated from a radiological detection; contaminant source is unknown but expected to be surface deposition. waste site area is about 4.6 m by 7.0 m (15 ft by 23 ft) and has been covered with 0.3 to 0.6 m (1 to 2 ft) of soil. • Given the CSM uncertainties, DOE-RL and Ecology agreed that surface soil excavation to at least 0.9 m (3 ft) bgs (based on assumed 0.6 m [2 ft] of cover material and 0.3 m [1 ft] of native soil) is the most cost effective response strategy. • DOE-RL and Ecology determined it is a more efficient use of resources to remove and dispose.
200-E-129 (UPR–solid)	• **Surface UPR waste site**; early action candidate site.* • Waste site originated from radiological detections; contaminant deposition unknown (i.e., surface particulate hot spots versus more homogenous surface spill). The reason for the UPR waste site designation unknown; potentially impacted area is 2.4 m by 4.6 m (8 ft by 15 ft) and is covered by 0.3 to 0.6 m (1 to 2 ft) of gravel. • DOE-RL and Ecology determined it is a more efficient use of resources to remove and dispose.
200-E-130 (UPR–solid)	• **Surface UPR waste site**; early action candidate site.* • Waste site originated from radiological detection; contaminant deposition unknown (i.e., surface particulate hot spots versus more homogenous surface spill). The reason for the UPR waste site designation unknown; potentially impacted area is 0.6 m by 15.2 m (2 ft by 50 ft) and is covered with 0.3 to 0.6 m (1 to 2 ft) of gravel. • DOE-RL and Ecology determined it is a more efficient use of resources to remove and dispose.
216-B-63 Ditch	• Waste site has been addressed through previous characterization efforts as part of the 200-CS-1 OU. The area was released from radiological posting status and no additional data needs were identified during the DQO process based on analysis and use of available information, data, and process knowledge. • Waste site is co-located and will be dispositioned with 216-B-2-1, 216-B-2-2, and 216-B-2-3 Ditches, which have planned field investigations (Table 4-3). Using the similar site approach, investigation data from the 216-B-2-1/2/3 Ditches will be used to confirm data sufficiency
Hot Semiworks Plant Group	
200-E-4 french drain 200-E-249-PL pipeline	• **UIC program site**; early action candidate site.* • Evidence from a 2005 boring (C4854) indicates that radiological and nonradiological contaminants are likely present in subsurface soil; french drain is 1.2 m (4 ft) in diameter and 2.4 m (8 ft) deep. Associated pipeline (200-E-249-PL is 7.6 m [25 ft] long, 3.8 cm [1.5 in] in diameter, and 1.8 m [6 ft] bgs). Associated valve box is 1.5 m (5 ft) wide, 2.4 m (8 ft) long, and 2.4 m (8 ft) deep. • Based on UIC designation, at least the top 0.9 m (3 ft) of the french drain will require excavation and subsequent stabilization (e.g., backfill). Sampling at the bottom of the first 0.9 m (3 ft) excavation would determine if any CERCLA COPCs are present that require further excavation (which is possible based on existing information). • DOE-RL and Ecology agreed that shallow trench excavation of the pipeline and the french drain (UIC) are the most effective use of resources to manage uncertainties associated with the presence radiological or chemical constituents associated with the pipeline. • Efforts could facilitate empirical data collection for the nearby 200-E-254-PL (assigned to the 200-IS-1 OU).

Table 4-4. 200-EA-1 OU Waste Sites with No Planned Field Investigations

Waste Site	Rationale for No Planned Field Investigations
200-E-251-PL pipeline	• Waste site is an underground collection of pipelines approximately 13.7 m (45 ft) long used to drain condensate from the 291C ventilation system to the 216-C-2 injection/reverse well. • Based on analysis and use of available information, data, and process knowledge, site will be dispositioned in conjunction with the 216-C-2 reverse well, 291-C process unit, and 291-C-1 Burial Ground (Table 4-3 describes the planned field investigations for the 216-C-2 and 291-C-1 waste sites).
200-E-252-PL pipeline	• Waste site is an underground pipeline approximately 30.5 m (100 ft) long used to carry condensate from the 291C stack to the 216-C-2 injection/reverse well as part of the 291C ventilation system. • Based on analysis and use of available information, data, and process knowledge, waste site will be dispositioned in conjunction with the 216-C-2 reverse well, 291-C process unit, and 291-C-1 Burial Ground (Table 4-3 describes the planned field investigations for the 216-C-2 and 291-C-1 waste sites).
209-E-WS-2 french drain	• **UIC program site**; early action candidate site.* • French drain is 1.2 m (4 ft) in diameter and 2.4 m (8 ft) deep. No characterization data are available for this site. • Based on UIC designation, at least the top 0.9 m (3 ft) of the french drain will require excavation and subsequent stabilization (e.g., backfill). Sampling at the bottom of the first 0.9 m (3 ft) excavation would determine if any CERCLA COPCs are present that require further excavation. • DOE-RL and Ecology determined it is a more efficient use of resources to remove and dispose. • Efforts could facilitate empirical data collection for the nearby 200-E-247-PL (assigned to the 200-IS-1 OU).
2607-E7A septic system	• Septic tank has been abandoned and backfilled with clean fill. • No data gaps identified for the tank during the DQO process. Data gaps associated with the drain field and leaching trench will be addressed with the 2607-E7B septic system as part of the 2607-E5 septic system. The 2607-E5 septic system has planned field investigations (Table 4-3).
2607-E7B septic system	• Septic tank has been abandoned and backfilled with clean fill. • No data gaps identified for the tank during the DQO process. Data gaps associated with the drain field and leaching trench will be addressed with 2607-E7A septic system as part of the 2607-E5 septic system. Field investigations are planned for the 2607-E5 septic system (Table 4-3).
291-C process unit	• Based on analysis and use of available information, data, and process knowledge, waste site will be dispositioned in conjunction with the 216-C-2 reverse well, and 291-C-1 Burial Ground (Table 4-3 describes the planned field investigations for the 216-C-2 and 291-C-1 waste sites).
HSVP valve pit	• Based on analysis and use of available information, data, and process knowledge, waste site will be dispositioned in conjunction with the 200-E-56 UPR and the 201-C process unit (Table 4-3 describes the planned field investigations for the 216-C-2 and 291-C-1 waste sites).
PUREX Plant Group	
None.	

Table 4-4. 200-EA-1 OU Waste Sites with No Planned Field Investigations

Waste Site	Rationale for No Planned Field Investigations
Miscellaneous Group	
200-E-109 (UPR–solid)	• Waste site consists of radiologically contaminated tumbleweed accumulation. • Area will be managed through routine radiological surveillance and maintenance while there is the potential for continued contaminant deposition from future tumbleweed accumulation. • Once accumulation has ceased, update scoping through evaluation of future surveillance and maintenance results to confirm absence of contamination and proceed to "no action" determination, otherwise coordinate remedy selection with 200-SW-2 OU waste site 200-E-12B.

Sources:

17-AMRP-0083, *207-A South Retention Basin Certification of Closure.*

17-NWP-057, *Determination on Closure Certification for Closure Unit Group 5, 207A South Retention Basin (207-A SRB) for the Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste (Site-Wide Permit), Part V, WA7890008967.*

DOE/RL-2005-63, *Feasibility Study for the 200-CS-1 Chemical Sewer Group Operable Unit.*

DOE/RL-2016-74, *207A South Retention Basin Closure Report.*

WAC 246-272A-0300 "On-site Sewage Systems – Abandonment."

* Section 5.1.1 describes the 200-EA-1 OU early action strategy.

bgs = below ground surface
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
COPC = contaminant of potential concern
CSM = conceptual site model
DOE-RL = U.S. Department of Energy, Richland Operations Office
DQO = data quality objective
Ecology = Washington State Department of Ecology
HSVP = Hot Semiworks Valve Pit
OU = operable unit
PUREX = plutonium-uranium extraction
TSD = treatment, storage, and disposal
UIC = underground injection control
UPR = unplanned release

5 RCRA Facility Investigation/Corrective Measures Study and Remedial Investigation/Feasibility Study Tasks

This chapter describes the tasks and activities to be completed during and after the combined RFI/CMS/RI/FS process. These descriptions incorporate the RFI/RI site characterization efforts necessary to fill the data needs presented in Chapter 4, as well as the data evaluation methods and remedial alternative development and evaluation needed for the CMS/FS. These tasks will culminate in an RFI/CMS/RI/FS report and a Proposed Corrective Action Decision (PCAD)/Proposed Plan (PP).

5.1 Task 1 – Project Planning

A series of collaborative workshops involving DOE-RL, Ecology, and the DOE-RL Plateau Remediation contractor responsible for integrating and executing 200-EA-1 OU tasks were held to review existing 200-EA-1 OU waste site information (presented in the 200-EA-1 scoping document [SGW-60540]), identify uncertainties (Appendix C), identify the activities required to address those uncertainties (Appendix A), and develop expectations for the 200-EA-1 OU work plan. The following sections describe future 200-EA-1 OU project planning efforts.

5.1.1 Data Usability Assessment of Existing Data

A data usability assessment (DUA) is planned for existing waste site data to support the RFI/RI and CMS/FS processes and the early action considerations. The data were identified and evaluated in ECF-200EA1-17-0046, *Assessment and Presentation of Available Waste Site Data for the 200-EA-1 Operable Unit*, and presented in the 200-EA-1 scoping document (SGW-60540). Once the DUA is complete, the data will be evaluated against PSQs #1 and #2 (defined in Chapter 4) to determine if a basis for action can be established.

5.1.2 Early Action Strategy

DOE-RL and Ecology may decide to pursue early actions to expedite cleanup during the RFI/CMS/RI/FS process. Depending on the urgency, DOE-RL and Ecology agreement, and the defined end state, early actions may be administered as follows:

- **Removal actions:** Conducted under CERCLA Section 104 authority and consistent with the Tri-Party Agreement Action Plan (Ecology et al., 1989b). Although not required, removal actions can be planned to attain final cleanup levels (if they have been defined) so no further remedial action is required at a waste site.
- **Remedial actions:**
  - **Interim response actions and interim measures:** Combined actions conducted consistent with the Tri-Party Agreement Action Plan (Ecology et al., 1989b) and in accordance with 40 CFR 300, Subpart E, "Hazardous Substance Response," and RCRA corrective actions. Interim actions should be planned for consistency with any potential final action and can be planned to achieve final cleanup levels for a portion of a waste site prior to agreement by the Tri-Parties regarding final remedial action.
  - **Early remedial actions:** Conducted under CERCLA Section 104 authority and consistent with the Tri-Party Agreement Action Plan (Ecology et al., 1989b). These can be planned as final remedies for specific waste sites or portions of OUs.

- **Maintenance actions:** Conducted under DOE-RL existing programs. If DOE-RL conducts maintenance actions, the related planning and reporting expectations would be defined to ensure effective integration with ongoing RFI/CMS/RI/FS activities.

Early actions may be considered for one or more of the following reasons (DOE/EH-0506, *Phased Response/Early Actions Under CERCLA*):

- Limit near-term contaminant exposure and migration as soon as feasible (e.g., recurrent surveillance and maintenance issues, or existing or potential near-term groundwater contamination sources).
- Address imminent exposure threat.
- Demonstrate early progress.
- Respond to stakeholder or other priorities.
- Reduce uncertainties and minimize data gaps to inform the RFI/CMS/RI/FS process.
- Facilitate related work completion (e.g., new construction, subsurface characterization, infrastructure demolition, waste management, and disposal).
- Reduce lifecycle project and/or program costs .

DOE-RL and Ecology will consider early actions at a given waste site when they agree that action is warranted and they are aligned on the preferred solution (e.g., excavation of a near-surface UPR). During early action planning, DOE-RL and Ecology will agree to clearly defined end states, which may include the following:

- Attaining final cleanup levels at a waste site (i.e., no additional cleanup required)
- Addressing specifically defined parts of the waste site (e.g., structural components, readily accessible areas of contamination) with characterization of as-left conditions to support subsequent cleanup efforts

Early actions and their end states are not precedent setting for other 200-EA-1 OU waste site cleanup expectations. Early action outcomes will be documented in the RFI/CMS/RI/FS report and the CAD/ROD. Table 4-4 in Chapter 4 identifies the 200-EA-1 OU early action candidate sites.

5.1.3 Operable Unit and Other Project Integration

This section describes how some of the 200-EA-1 OU RFI/CMS/RI/FS activities will be integrated with other activities for the groundwater and source OUs, described in Section 1.4 of Chapter 1. The lists presented in this section provide examples of areas for potential integration but are not intended to be comprehensive. The 200-EA-1 OU activities will also be integrated with other Central Plateau infrastructure (e.g., utilities) and operations (e.g., tank farms, waste treatment plant, and well monitoring).

To integrate with the two underlying groundwater OUs (200-BP-5 and 200-PO-1), the 200-EA-1 OU activities will include the following:

- Consider groundwater impacts when evaluating potential 200-EA-1 OU actions and decisions.
- Identify feasible and beneficial coordination activities (e.g., the 200-EA-1 OU plans a borehole in a similar location where a groundwater well is needed).

- Identify and provide analysis and data that may be relevant (e.g., information regarding 200-EA-1 OU continuing sources of groundwater contamination, to the appropriate groundwater OU), if applicable.
- Coordinate response action execution and long-term operations and maintenance, where feasible

To integrate with other Central Plateau source OUs, 200-EA-1 OU activities will include the following:

- Consider potential impacts to (or from) other source OU current or planned response actions when evaluating potential 200-EA-1 OU actions and decisions. Example 200-EA-1 OU waste site integration points include the following:
  - UPR-200-E-69 waste site and the 200-CB-1 OU
  - 200-E-4 french drain and the 200-IS-1 OU (200-E-254-PL)
  - 200-E-109 UPR waste site and the 200-SW-2 OU (200-E-12B)
  - 209-E-WS-2 french drain and the 200-IS-1 OU (200-E-247-PL)
- Review and incorporate lessons learned from other source OU characterization.
- Consider ongoing investigations at nearby source OUs where there is overlap of assigned waste sites (e.g., at the 200-DV-1 OU).
- Identify if 200-EA-1 OU remedial and removal activities can be effectively coordinated with other source OU activities.
- Consider if 200-EA-1 OU data or analyses may be relevant to other source OUs and if analyses relevant to the 200-EA-1 OU have been performed by other source OUs (e.g., leachability tests).
- Consider whether to augment 200-EA-1 OU data collection to better define the fate and transport modeling inputs and provide more robust waste site models in similar geophysical settings.
- Coordinate and integrate TSD unit closures during 200-EA-1 OU task implementation, as appropriate.
- Coordinate response action execution and long-term operations and maintenance, where feasible.

5.2 Task 2 – Community Relations

A public involvement plan (DOE et al., 2017, *Hanford Federal Facility Agreement and Consent Order Hanford Public Involvement Plan* [hereinafter referred to as the Hanford Public Involvement Plan) and the NCP (40 CFR 300) outline stakeholder and public involvement opportunities. Community involvement during the RFI/CMS/RI/FS activities will be consistent with the Hanford Public Involvement Plan and will comply with the NCP. The project will use existing public, stakeholder, and area tribes involvement mechanisms and approaches.

5.2.1 Tribal Consultation

Interactions between the area tribes and DOE-RL are facilitated through the DOE-RL Tribal program manager or the DOE-RL cultural resources program manager. DOE-RL interacts primarily with the Confederated Tribes and Bands of the Yakama Nation, the CTUIR, the Nez Perce Tribe, and the Wanapum Band of Indians. Tribal consultation is in accordance with DOE O 144.1, *Department of Energy American Indian Tribal Government Interactions and Policy*. DOE-RL consults and communicates regularly with Tribal program staff, as well as offers Tribal consultation to Tribal

governments and will consult with a tribal government upon its request. DOE-RL conducts regularly scheduled and ad hoc meetings with tribes based on Tribal interest and needed Tribal input and involvement. DOE-RL will continue to work with area tribes to ensure ongoing communication and involvement in the Central Plateau Inner Area decision-making process. EPA also has a government-to-government responsibility and will coordinate with DOE-RL on consultation with the Tribes.

This effort will include timely notice to area tribes on decisions that might affect their rights and/or resources in the early stages of the decision-making process.

5.2.2 Stakeholder Involvement

Stakeholders are individuals who are affected by, or have an interest in, Hanford Site issues. Hanford Site stakeholders include the Hanford Natural Resources Trustees; local governments; local and regional businesses; Hanford Site work force; local, regional, and national environmental groups; and local and regional public health organizations.

The HAB is a site-specific advisory board chartered under the *Federal Advisory Committee Act of 1972*. The HAB advises the Tri-Parties on cleanup issues. The HAB River and Plateau Committee addresses River Corridor and Central Plateau issues and meets approximately 10 times each year. On the basis of the timing of development of significant work plan components, periodic updates will be provided to the River and Plateau Committee.

The River and Plateau Committee provides an ongoing opportunity for informal stakeholder feedback on work plan components and evolving project activities. The committee decides if an issue should be brought to the full HAB, which then determines whether formal advice should be issued.

5.3 Task 3 – Field Investigations and Analytical Tasks

Field investigations and analytical tasks will be conducted for the 200-EA-1 OU RFI/CMS/RI/FS to address data needs and support the basis for action and response action decisions. Data needs are discussed in Chapter 4 and identified in Appendix C. Chapter 4 summarizes the field investigation activities planned for the 200-EA-1 OU, and the field sampling plan in the SAP (Appendix A) provides additional information. The SAP also describes the types of analyses to be performed and samples to be analyzed, and it provides the quality assurance project plan for characterization activities.

5.4 Task 4 – Sample Analysis and Validation

The SAP (Appendix A) identifies the sample locations, sampling strategies, target analytes, analytical methods, preliminary action levels, and analytical performance requirements for sample analysis. Data will be reviewed, verified, and validated in accordance with the quality assurance project plan in the SAP. Data usability determinations will be performed to ensure that data of known and acceptable quality are used in subsequent data analyses. Data usability determinations will be documented in DUA reports and made publicly available through the Administrative Record.

5.5 Task 5 – Data Evaluation

Data of known and acceptable quality (Section 5.4) will be evaluated and used in the risk assessment, fate and transport evaluations, the CMS/FS, and the RFI/CMS/RI/FS report. Waste site scoping summaries presented in the 200-EA-1 scoping document (SGW-60540) and the preliminary CSM (Section 3.7 in Chapter 3) will be refined and updated based on an evaluation of data collected in accordance with the SAP (Appendix A) and other project investigations, as applicable.

5.6 Task 6 – Assessment of Risk

The BRA will be conducted as part of the RFI/RI process to assess potential risks to human and ecological receptors from direct contact with soil and potential risks to groundwater from contaminants in the vadose zone. The BRA will determine if remedial action must be taken to reduce risks to acceptable levels. Section 1.3.2.2 in Chapter 1 establishes the BRA principles, and Section 3.8 in Chapter 3 describes the BRA methodology. Section 3.12 in Chapter 3 describes cleanup levels (PRGs), which will also be developed as part of this task.

5.7 Task 7 – Treatability Studies

This task includes efforts to prepare and conduct treatability studies, which may provide more detailed information on specific remedial technology performance. Treatability studies can reduce remedial technology costs and performance uncertainties, enable a technology to be scaled up for alternative development and evaluation purposes, and support remedial design of a selected alternative.

No treatability studies are anticipated for the 200-EA-1 OU; however, the need for treatability studies will be revisited as the RFI/RI proceeds. If treatability studies are deemed necessary, DOE-RL will initiate a change notice to the RFI/CMS/RI/FS work plan and conduct the studies as part of the RFI/RI to assist in remedial alternative evaluations during the CMS/FS. A separate treatability study report may be prepared if treatability studies are required.

5.8 Task 8 – Field Summary Reports

As the field investigations are completed, field summary reports will be prepared to summarize the activities performed and the information collected during field activities (e.g., collected sample number and type, investigation-derived waste management and disposition, geological logs, and characterization data obtained for each waste site or group of waste sites). The field summary reports will support RFI/CMS/RI/FS report preparation.

5.9 Task 9 – Remedial Alternatives Development and Screening

Remedial alternatives will be developed considering the results of previous tasks and considering the preliminary alternatives discussed during the scoping workshops (identified in Appendix C and described in Section 3.13 of Chapter 3). These alternatives will be screened for effectiveness, implementability, and cost (based on guidance provided in EPA/540/G-89/004, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final*) for each 200-EA-1 OU waste site or group of sites. Based on screening results, DOE-RL and Ecology will determine which alternatives should be retained for detailed analysis (Section 5.10).

5.10 Task 10 – Detailed Analysis of Alternatives

Remedial alternative actions that passed screening (Section 5.9) will be evaluated against the CERCLA criteria and the Washington State corrective action requirements shown in Table 5-1. As illustrated in the table, the CERCLA criteria and the Washington State corrective action requirements are functionally equivalent. The TSD units may be clean closed or closed as a landfill in accordance with WAC 173-303-610(2), "Closure and Post-Closure." Alternatively, where releases from TSD units have likely commingled with collocated R-CPP waste site releases, DOE-RL may petition the Ecology director to replace all or part of the closure requirements (except WAC 173-303-610(2)(a)) with alternative requirements in accordance with WAC 173-303-610(1)(e). Alternative requirements (which are identified in Table 5-1) will be recommended based on results from remedial technology investigation activities, as appropriate. Alternative requirements will be approved by the Ecology director by incorporating the closure plan containing the alternative requirements into the Permit (WA7890008967).

Due to the presence of multiple Central Plateau source OUs and waste sites (including those in the 200-EA-1 OU), a comprehensive Central Plateau groundwater cumulative impacts evaluation (CIE) will be conducted that integrates the current understanding of contributions from waste sites and potential sources to existing groundwater contamination.[1] The CIE will fulfill the requirements of WAC 173-340-747(8), "Deriving Soil Concentrations for Groundwater Protection," and will evaluate long-term groundwater impacts to enable informed decision making and provide context for alternatives analysis in the FSs for the 200-EA-1 OU and other source OUs. The crosswalk (as discussed in Section 3.8.3 of Chapter 3) will be developed or evaluated to identify any unique application aspects considering the 200-EA-1 OU waste sites. It could also serve as a planning tool to provide a reasonable expectation that remedial actions and waste disposal activities will not result in the need for future corrective or remedial action to protect HHE (DOE M 435.1-1, *Radioactive Waste Management Manual*). The CIE will be documented in a regulatory-approved approach document.

Once the remedial alternatives and TSD unit alternative closure requirements have been fully described and individually assessed against the applicable requirements and standards shown in Table 5-1, a comparative analysis will be conducted to evaluate the relative performance of the remedial alternatives and alternative closure requirements in relation to each specific evaluation requirement and standard. The RFI/CMS/RI/FS report will summarize the results of the detailed analysis, which will provide the basis for identifying the preferred remedial action/corrective action alternative and alternative closure requirements for each of the 200-EA-1 OU waste sites.

[1] The CIE will be defined as follows: "Effects on the environment that result from the proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions" (40 CFR 1508.7, "Terminology and Index," "Cumulative Impact").

Table 5-1. TSD Unit Alternative Closure Requirements and R-CPP Waste Site Remedial Alternative Requirements and Standards

CERCLA Criteria[a]	Washington State Corrective Action Requirements[b]	Washington State TSD Unit Alternative Closure Requirements[c]
Threshold criteria: • Overall protection of human health and the environment • Compliance with ARARs	Threshold requirements: • Protect human health and the environment • Comply with cleanup standards • Comply with applicable state and federal law • Provide for compliance monitoring	Closure performance standards (WAC 173-303-610(2)(a)): • Minimizes the need for further maintenance • Controls, minimizes, or eliminates to the extent necessary to protect human health and the environment, post-closure escape of dangerous waste, dangerous constituents, leachate, contaminated runoff, or dangerous waste decomposition products to the ground, surface water, groundwater, or the atmosphere • Returns the land to appearance and use of surrounding land areas to the degree possible given the nature of the previous dangerous waste activity
Primary balancing criteria: • Long-term effectiveness and permanence • Reductions in toxicity, mobility, or volume through treatment • Short-term effectiveness • Implementability • Cost Modifying criteria: • State/support agency acceptance • Community acceptance	Other requirements: • Use permanent solutions to the maximum extent practicable • Provide for a reasonable restoration timeframe • Consider public concerns	Alternative closure requirements (WAC 173-303-610(1)(e)): • The Ecology director may, in an enforceable document, replace all or part of the closure and post-closure requirements (except for those in WAC 173-303-610(2)(a)) with alternative requirements when the Ecology director determines: – A TSD unit is situated among other R-CPP units. – A release to soil has occurred. – Both the TSD unit and one or more R-CPP units are likely to have contributed to the release.

a. 40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan."

b. WAC 173-303-64620, "Dangerous Waste Regulations," "Requirements." These are the corrective action requirements.

c. WAC 173-303-610(2)(a) and (1)(e), "Dangerous Waste Regulations," "Closure and Post-Closure."

ARAR = applicable or relevant and appropriate requirement

CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*

Ecology = Washington State Department of Ecology

RCRA = *Resource Conservation and Recovery Act of 1976*

R-CPP = RCRA-CERCLA past practice

TSD = treatment, storage, and disposal

5.11 Task 11— RCRA Facility Investigation/Corrective Measures Study and Remedial Investigation/Feasibility Study Report

The RCRA RFI/CMS and CERCLA RI/FS will be combined into a single RFI/CMS/RI/FS report for the 200-EA-1 OU (Figure 5-1, step 2). The combined RFI/CMS/RI/FS report will provide details that support the TSD unit closure decisions and the permitting process, including alternative requirements (as described in Section 5.10). The RFI/CMS/RI/FS report will consider all information available at the time of report preparation, including pertinent information from activities conducted outside the work plan. The major elements and respective volumes of the RFI/CMS/RI/FS report include the following:

- **Volume I (RFI/RI):**
  - RAOs
  - Study area investigations and physical characteristics
  - Contamination nature and extent
  - Contaminant fate and transport
  - Human health (soil and groundwater protection) and ecological risk assessment (Section 5.6)
  - Treatability study results, if available (Section 5.7)
  - Early action summary
  - Basis for action determination
- **Volume II (CMS/FS):**
  - Refined RAOs
  - Treatability study results, if available (Section 5.7)
  - General response actions and remedial technology screening process
  - Individual and comparative alternative analysis (Section 5.10)

5.12 Task 12 – Post-RCRA Facility Investigation/Corrective Measures Study and Remedial Investigation/Feasibility Study Support

This section describes the post-RFI/CMS/RI/FS activities shown in Figure 5-1, which include PCAD/PP development, closure plan or closure/post-closure plan preparation or modification, draft Permit modification, CAD/ROD development, and Permit modification.

5.12.1 Proposed Corrective Action Decision/Proposed Plan, Closure Plan, and Draft Permit Modification

The PCAD/PP will use information from the RFI/CMS/RI/FS report to identify the preferred waste site response/corrective action for each waste site. It is the intent of Ecology that the TSD unit closure plans or closure/post-closure plans will also be prepared or modified using information from the RFI/CMS/RI/FS report (Figure 5-1, step 3). After the closure plan or closure/post-closure plan has been completed, DOE-RL will submit the closure plan or closure/post-closure plan to Ecology as a modification to the Permit. Ecology will process the draft Permit modification and define associated TSD unit closure requirements in accordance with WAC 173-303. If the Permit modification contains a request for alternative requirements, finalization of the Permit modification will also communicate the approval of the Ecology director approval of the alternative requirements for the specific TSD unit in accordance with WAC 173-303-610(1)(e).

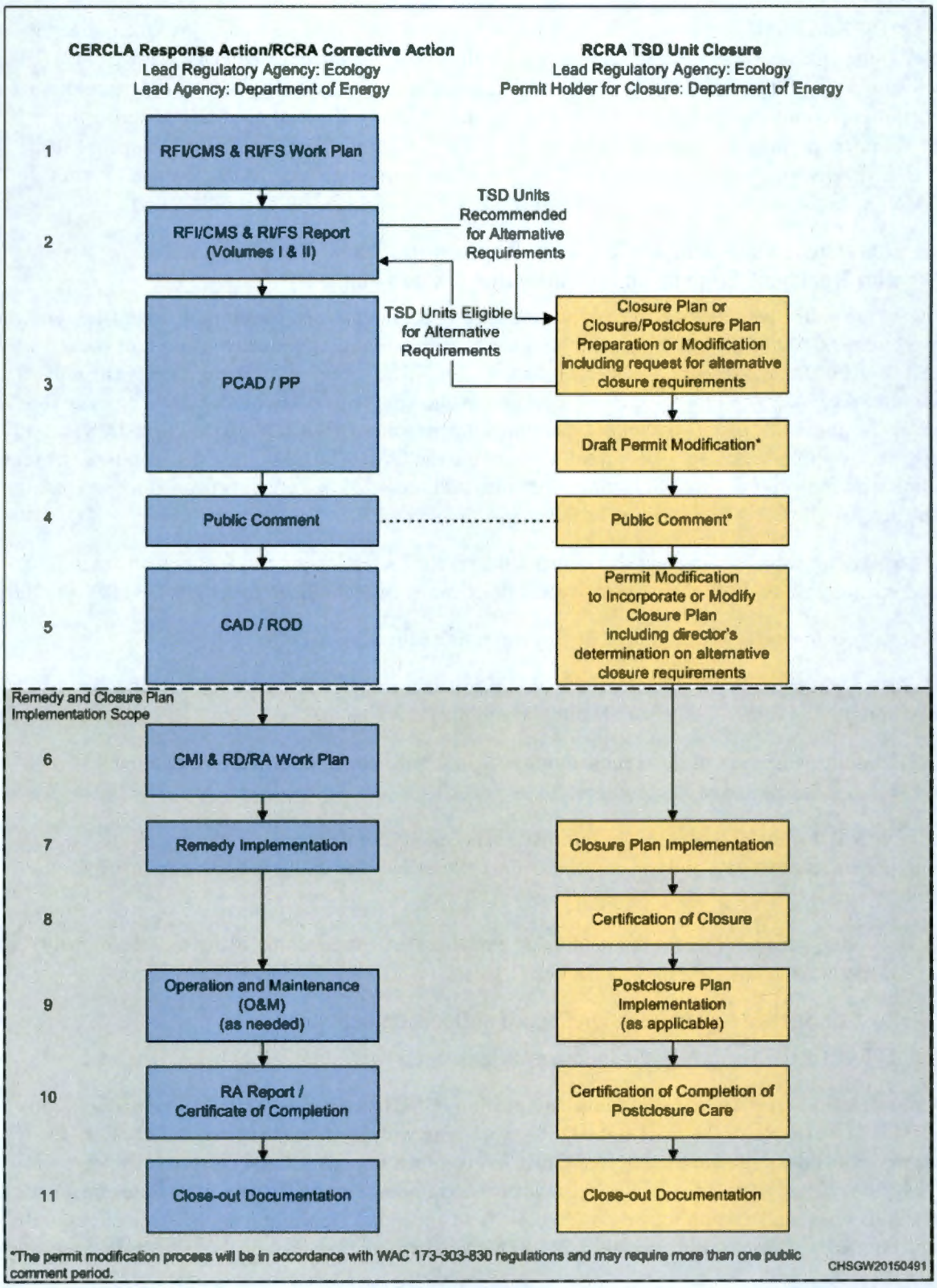

Figure 5-1. Coordinated CERCLA Response Action/RCRA Corrective Action and TSD Unit Closure Process

The PCAD/PP and draft Permit modification, when prepared, will be made available to the public in parallel so they may participate in the selection of both the past-practice remedial alternative and TSD unit closure action (Figure 5-1, step 4). Following the public review and comment period, responsiveness summaries presenting significant comments and any new relevant information received during the public comment period will be prepared for the PCAD/PP and draft Permit modification, respectively. The PCAD/PP responsiveness summary will be incorporated into the CAD/ROD. The draft Permit modification responsiveness summary will be included in the issuance of the modification.

5.12.2 Corrective Action Decision/Record of Decision and Permit Modification with Treatment, Storage, and Disposal Unit Closure Plan

Following the public comment period, supporting agency comments, and community acceptance criterion assessment, the CAD/ROD will document the selected response action/corrective action for each 200-EA-1 OU waste site (Figure 5-1, step 5). Ecology and EPA, working in cooperation with DOE-RL, will finalize the CAD/ROD for the cleanup decision. Although the CAD and ROD could be issued separately, a single CAD/ROD document is recommended to ensure that the selected decisions are compatible for implementation. Concurrent with issuing the CAD/ROD, Ecology will also issue a Permit modification to incorporate the TSD unit closure plan and post-closure care plan (as applicable) into the current Permit. The CAD/ROD will be as follows:

- A legally enforceable document that certifies the remedy selection process was performed in accordance with CERCLA and, to the extent practicable, in accordance with the NCP (40 CFR 300)[2]
- A legally enforceable document for RCRA corrective action
- A document that includes closure information that is incorporated into a Permit modification or revision of the Permit to satisfy TSD unit closure plan requirements
- A substantive summary of the technical rationale and background information contained in the CERCLA Administrative Record file[2]
- A technical document that provides information necessary for determining the conceptual engineering components and remedy costs, and that outlines the RAOs and cleanup levels for the selected remedy[2]
- A key communication tool for the public that explains the contamination issues that the remedy seeks to address and the rationale for its selection[2]

5.12.3 Post-Corrective Action Decision/Record of Decision Activities

Post-CAD/ROD activities include the following (Figure 5-1, steps 6 through 11):

- **Complete a corrective measures implementation (CMI) and remedial design/remedial action (RD/RA) work plan:** The CMI and RD/RA work plan will describe the activities necessary to implement and coordinate the selected CERCLA response actions, RCRA corrective actions, and TSD unit closure. It will also include the closure performance standards, associated closure details for the TSD units, and the applicable closure plan as an appendix. Depending on the selected response and corrective action complexity, the CMI/RD/RA work plan may include the remedial design report.

[2] EPA 540-R-98-031, *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents.*

The CMI/RD/RA work plan and associated SAP will identify remedy implementation and closure sampling, respectively.

- **Implement the remedy and TSD unit closure plan:** The CAD/ROD decisions and the TSD unit closure plans will be implemented. Closure plans implementation will be consistent with the schedule in the applicable closure plan.

- **Submit certification of closure:** After TSD unit closure requirements are performed, DOE-RL will submit to Ecology a certification of closure, signed by an independent, qualified, registered professional engineer in accordance with WAC 173-303-610(6).

- **Develop and implement an operations and maintenance plan (as needed) and implement the post-closure plan (as applicable):** Once the response action and corrective action are completed and an operations and maintenance plan to describe post-cleanup management and control of the sites is under development, the TSD unit post-closure plan will be implemented. If waste is left in place, the post-closure plan will be revised, as applicable. The post-closure plan may be a standalone document, or it can be incorporated into the operations and maintenance plan for implementation.

- **Complete a remedial action report, issue a certificate of completion, and submit a certification of completion of post-closure care:** After completing remediation and corrective actions, closeout activities will be performed and documented in the remedial action report, and Ecology will issue a certificate of completion to DOE-RL. Once post-closure care requirements are satisfied, DOE-RL will submit a certification of completion of post-closure care to Ecology in accordance with WAC 173-303-610(11).

- **Complete closeout documentation:** In accordance with RL-TPA-90-0001, *Tri-Party Agreement Handbook Management Procedures*, Guideline Number TPA-MP-14, "Maintenance of the Waste Information Data System (WIDS)," the Waste Information Data System waste unit information and Appendix C of the Tri-Party Agreement Action Plan (Ecology et al., 1989b) will be updated, as appropriate.

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6 Project Schedule

Figure 6-1 shows the high-level project schedule for the activities described in this work plan, including 200-EA-1 OU field activities (described in the SAP [Appendix A]), activity durations, and decision document preparation. The project schedule will be evaluated to identify efficiencies, will serve as the baseline for the work planning process, and will be used to measure work plan implementation progress. Project schedule revisions will be made in accordance with Section 11.3 of the Tri-Party Agreement Action Plan (Ecology et al., 1989b). It is the intent of DOE-RL to negotiate milestones once it obtains funding to execute the 200-EA-1 OU work plan.

A series of workshops with Ecology and EPA in 2018 initiated the comprehensive Central Plateau groundwater CIE (Section 5.6 in Chapter 5). The goal of these workshops is to gain general consensus regarding approaches and modeling tools for future groundwater impact evaluations. These approaches and modeling tools will be integral to the 200-EA-1 OU decision-making process.

The process used during 200-EA-1 OU work plan development (i.e., gaining early concurrence among the Tri-Parties regarding work plan approach, evaluation techniques, and conclusions) is intended to be used during RFI/RI, CMS/FS, and PCAD/PP development. In the June 2016 Hanford CERCLA Document Review and Comment Resolution Workshop, multi-agency participants recommended this process to ensure early alignment among the Tri-Parties on key decision document components. Continued early Tri-Party engagement during the RFI/RI data collection and evaluation phase is expected to foster a better understanding of 200-EA-1 OU waste sites and to better communicate how data gaps are filled. Continuing to use the process through RFI/RI, CMS/FS, and PCAD/PP development will ensure that the technical justification for decision making is in place prior to document development and is expected to result in more timely document reviews and approvals.

200-EA-1 OU Task Name	Duration (weeks)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Planning and Mobilization	20							
Conduct Field Work	190							
Prepare and issue RFI/RI Report, Draft A	153							
Prepare and issue CMS/FS Report, Draft A[a, b]	58							
Prepare and issue PCAD/PP, Draft A[c]	56							

a. Development and Tri-Party agreement of the CIE tool(s) are necessary to initiate the CMS/FS report
b. CMS/FS start is dependent upon agreement with the RFI/RI conclusions
c. PCAD/PP start is dependent upon agreement with the CMS/FS conclusions

CMS = Corrective Measures Study
FS = Feasibility Study
OU = Operable Unit
PCAD = Proposed Corrective Action Document
PP = Proposed Plan
RCRA = Resource Conservation and Recovery Act of 1976
RFI = RCRA Facility Investigation
RI = Remedial Investigation

Figure 6-1. Project Schedule for the 200-EA-1 OU

7 Project Management

This chapter discusses the project organization, project coordination, change control, and dispute resolution processes. Change control processes are used to document and achieve approval for changes that arise during execution of the RFI/CMS/RI/FS work plan. Problems are resolved at the lowest possible management level, with higher levels of project oversight engaged to resolve issues, as necessary.

7.1 Project Organization

DOE-RL is the lead federal agency responsible for Hanford Site investigation and cleanup. The DOE-RL contractor implements investigation and cleanup and is responsible for planning, coordinating, and executing RFI/CMS/RI/FS work plan activities for the Central Plateau OUs. The lead regulatory agency (Ecology) authorizes the OU work scope in accordance with the Tri-Party Agreement (Ecology et al., 1989a) and oversees the work for regulatory compliance with WAC 173-303, as applicable. Figure 7-1 illustrates the project organizational structure for 200-EA-1 OU investigation and cleanup.

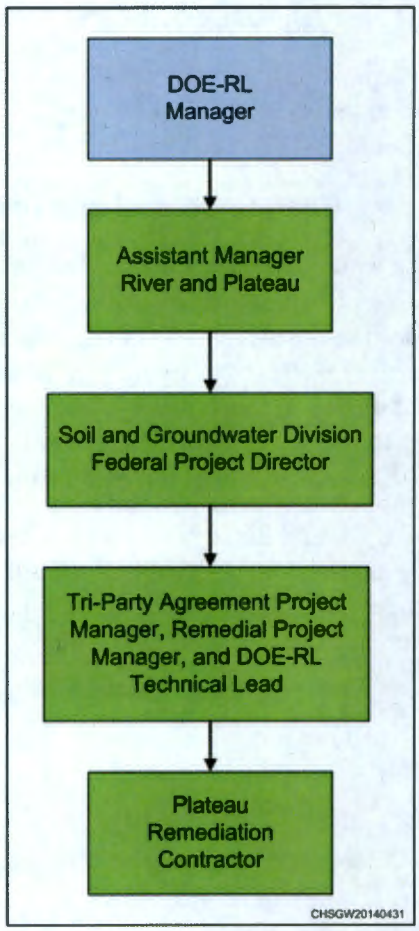

Figure 7-1. 200-EA-1 OU Project Organization

7.1.1 U.S. Department of Energy, Richland Operations Office Project Organization

DOE-RL is responsible for Central Plateau cleanup. The DOE-RL Soil and Groundwater Division is responsible for 200-EA-1 OU remedy implementation. The Soil and Groundwater Division Federal Project Director reports to the River and Plateau assistant manager. The DOE-RL contracting officer is responsible for authorizing the Central Plateau remediation contractor to perform the 200-EA-1 OU RFI/CMS/RI/FS work plan tasks (Figure 7-1).

The Federal Project Director is responsible for obtaining lead regulatory agency approval of the work plan and SAP, which authorize the RFI/CMS/RI/FS work plan tasks under the Tri-Party Agreement (Ecology et al., 1989a) and for obtaining EPA approval of the SAP. The Federal Project Director also assigns the 200-EA-1 OU DOE-RL technical lead, who performs the project manager role identified in Section 4.1 of the Tri-Party Agreement. The DOE-RL technical lead is responsible for managing the project, overseeing contractors performing day-to-day RFI/CMS/RI/FS work plan tasks, maintaining regulatory compliance necessary for milestone completion, and providing technical input to the DOE-RL Federal Project Director.

7.1.2 Regulatory Agency Oversight Organization

Ecology is the lead regulatory agency for the 200-EA-1 OU. Ecology has assigned a 200-EA-1 OU project manager who is responsible for overseeing various RFI/CMS/RI/FS work plan tasks, working with DOE-RL to resolve issues, and approving the documents in accordance with Section 5 of the Tri-Party Agreement Action Plan (Ecology et al., 1989b).

As a participating agency, EPA regulatory responsibilities include approving the SAP, providing assistance if requested by the lead regulatory agency (Ecology), approving the final remedy, approving completion of construction, and proposing sites for deletion from the NPL (40 CFR 300, Appendix B).

7.1.3 Contractor Organization

The DOE-RL contractor responsible for the Central Plateau integrates and executes the RFI/CMS/RI/FS work plan tasks.

7.2 Project Coordination, Decision Making, and Documentation

Coordination among the Tri-Parties and contractors is essential for successful RFI/CMS/RI/FS work plan execution. DOE-RL and Ecology project managers will manage decision making and documentation in accordance with Section 4.1 of the Tri-Party Agreement Action Plan (Ecology et al., 1989b).

7.3 Change Control and Dispute Resolution

The work plan represents the Tri Parties' data needs assessment at the end of the DQO process. As new information becomes available, DOE-RL and Ecology will revisit and discuss the waste site scoping efforts at the project level to determine if changes are needed to the work scope. These changes could require updates to the work plan or SAP (Appendix A), which will be made in accordance with Section 9.3 of the Tri-Party Agreement Action Plan (Ecology et al., 1989b). Changes that affect the Tri-Party Agreement (Ecology et al., 1989a) are documented using change control forms in accordance with Section 12 of the Tri-Party Agreement Action Plan.

DOE-RL and Ecology project managers intend to discuss issues on an informal basis early in the decision-making process before issues evolve into formal disputes. The formal dispute resolution process, which is handled in accordance with Articles VIII and XVI of the Tri-Party Agreement (Ecology et al., 1989a), will address issues that cannot be informally resolved.

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Appendix A

200-EA-1 Operable Unit Sampling and Analysis Plan

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Signature Sheet

Title: *Appendix A – Sampling and Analysis Plan of the 200-EA-1 Operable Unit Waste Site RCRA Facility Investigation/Corrective Measures Study and Remedial Investigation/ Feasibility Study Work Plan*

Print Name	Signature	Date
U.S. Department of Energy, Richland Operations Office		

Print Name	Signature	Date
Washington State Department of Ecology		

Print Name	Signature	Date
U.S. Environmental Protection Agency		

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Terms

AOI	area of interest
ASTM	American Society for Testing and Materials
bgs	below ground surface
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CHPRC	CH2M HILL Plateau Remediation Company
CMS	corrective measures study
COPC	contaminant of potential concern
DN	data need
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
DOT	U.S. Department of Transportation
DPT	direct-push technology
DQA	data quality assessment
DQO	data quality objective
DQI	data quality indicator
DUP	laboratory duplicate
DZ	deep zone
EB	equipment blank
ECO	environmental compliance officer
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FS	feasibility study
FSO	Field Sample Operations
FSP	field sampling plan
FTB	full trip blank
FWS	field work supervisor
FXR	field transfer blank
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document*

HEIS	Hanford Environmental Information System
HHE	human health and the environment
IATA	International Air Transportation Association
LCS	laboratory control sample
MB	method blank
MS	matrix spike
MSD	matrix spike duplicate
OU	operable unit
PSQ	principal study question
PUREX	Plutonium-Uranium Extraction (Plant)
QA	quality assurance
QAPjP	quality assurance project plan
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
redox	reduction-oxidation
RFI	RCRA facility investigation
RI/FS	remedial investigation/feasibility study
SAF	sample authorization form
SAP	sampling and analysis plan
SMR	Sample Management and Reporting
SPLIT	field split sample
SUR	surrogate
SZ	shallow zone
Tri-Party Agreement	Tri-Party Agreement
UPR	unplanned release
VOA	volatile organic analysis
VOC	volatile organic compound
XRF	x-ray fluorescence

A 200-EA-1 Operable Unit Sampling and Analysis Plan

This appendix provides the sampling and analysis plan (SAP) that identifies the characterization needed to satisfy the 200-EA-1 Operable Unit (OU) waste site data needs.

A1 Introduction

This SAP provides the quality assurance (QA) and field sampling requirements for characterizing waste sites in the 200-EA-1 OU, located within the Central Plateau Inner Area of the Hanford Site. This SAP is part of the remedial investigation/feasibility study (RI/FS) and *Resource Conservation and Recovery Act of 1976* (RCRA) facility investigation (RFI)/corrective measure study (CMS) work plan for the 200-EA-1 OU. Data collected during implementation of this SAP will be used in combination with existing site data to complete the baseline risk assessment as part of the RI/RFI and to support FS/CMS remedy evaluations.

A1.1 Project Scope

This SAP addresses characterization activities associated with 93 of 114 waste sites in the 200-EA-1 OU where field characterization activities are planned to address data gaps (Chapter 4 of the work plan). These sites are organized by groups, as listed in Table A-1. Data from these sites will support decision making during the RFI/CMS/RI/FS process. No field investigations are planned for 21 of the 114 waste sites (as presented in Section 4.2.2 of the work plan) for various reasons, ranging from contamination no longer being present, to sites where the U.S. Department of Energy, Richland Operations Office (DOE-RL) and the Washington State Department of Ecology (Ecology) determined it is a more efficient use of resources to remove and dispose impacted media. This SAP does include groundwater protection data needs but does not address characterization or monitoring requirements for the 200-PO-1 or 200-BP-5 Groundwater OUs beneath the 200-EA-1 Source OU.

A1.2 Background

The 200-EA-1 OU is located in the Central Plateau Inner Area at the Hanford Site. This OU primarily includes waste sites associated with liquid waste holding, conveyance, and disposal, as well as areas of unplanned releases (UPRs) of liquid or particulate contamination. The OU also includes other waste site types, such as small pipeline systems associated with other 200-EA-1 OU waste sites, and construction/demolition-type solid waste disposal and handling sites. Appendix B of this work plan shows the 200-EA-1 OU waste site locations, and SGW-60540, *200-EA-1 Operable Unit Scoping* (hereinafter referred to as the 200-EA-1 scoping document), provides additional waste site details.

The Inner Area vadose zone geologic framework underlying the 200-EA-1 OU waste sites generally consists of surficial eolian sand deposits underlain by Hanford formation sand and gravel. The Hanford formation comprises the majority of the vadose zone, although finer Cold Creek unit sediments are present in the deepest part of the vadose zone in some areas. Section 2.4.3.1 in Chapter 2 of this work plan provides additional geologic setting information.

Table A-1. 200-EA-1 OU Waste Sites Addressed by this SAP

200-EA-1 Operable Unit Group					
A Tank Farms	**B Tank Farms**	**B Plant**	**Hot Semiworks Plant**	**PUREX Plant**	**Miscellaneous**
200-E-262-PL	200-E-121	200-E-26	200-E-41	200-E PD	200-E BP
200-E-276-PL	200-E-292	200-E-117	200-E-56	200-E-13	200-E-53
207-A-NORTH	216-B-51	200-E-142	200-E-57	200-E-43	200-E-115
216-A-1	2607-E9	200-E-297	200-E-293	200-E-124	200-E-139
216-A-6	2607-EF	207-B	200-E-294	216-A-3	UPR-200-E-11
216-A-18	UPR-200-E-43	216-B-2-1	201-C	216-A-9	UPR-200-E-50
216-A-19	UPR-200-E-89	216-B-2-2	216-C-1	216-A-10	UPR-200-E-95
216-A-20	UPR-200-E-144	216-B-2-3	216-C-2	216-A-27	UPR-200-E-112
216-A-29		216-B-10A	216-C-3	216-A-36A	
216-A-30		216-B-10B	216-C-4	216-A-36B	
216-A-34		216-B-12	216-C-5	216-A-38-1	
216-A-37-1		216-B-55	216-C-6	216-A-45	
216-A-37-2		216-B-59	216-C-7	2607-E6	
216-A-40		216-B-59B	216-C-10	UPR-200-E-10	
216-A-41		216-B-62	2607-E5	UPR-200-E-12	
216-A-42		218-E-7	291-C-1	UPR-200-E-20	
2607-EA		2607-E3	UPR-200-E-37	UPR-200-E-33	
2607-E12		UPR-200-E-64	UPR-200-E-98	UPR-200-E-88	
UPR-200-E-21		UPR-200-E-69			
UPR-200-E-29					
UPR-200-E-66					
UPR-200-E-99					

PUREX = Plutonium-Uranium Extraction (Plant)

Previous Central Plateau investigations collected vadose zone contamination data at many 200-EA-1 OU waste sites. Section 3.2 in Chapter 3 of this work plan describes these investigations, and the 200-EA-1 scoping document (SGW-60540) identifies available site-specific data. Contaminated groundwater underlying 200-EA-1 OU waste sites is associated with multiple source OUs, including the 200-EA-1 OU, and is addressed by the 200-BP-5 and 200-PO-1 OUs. Section 3.2.2.2 in Chapter 3 of this work plan describes the ongoing groundwater monitoring activities, and Section 3.3 identifies the 200-EA-1 OU waste sites that may have impacted groundwater.

Based on documented liquid disposal volumes and data from previous investigations and monitoring, the 200-EA-1 OU waste sites were divided into the following categories pertaining to potential depth of vadose zone contamination:

- **Shallow vadose zone contamination:** Sites where potential site contamination is only expected to reside above 4.6 m (15 ft) below ground surface (bgs).
- **Partial-thickness vadose zone contamination**: Sites where potential site contamination is expected to be present deeper than 4.6 m (15 ft) bgs but does not likely extend to the water table (contamination may also be present shallower than 4.6 m [15 ft] bgs).
- **Full-thickness vadose zone contamination:** Sites where potential site contamination is expected to be present deeper than 4.6 m (15 ft) bgs and may potentially extend to the water table with possible historical or ongoing groundwater impacts (contamination may also be present shallower than 4.6 m [15 ft] bgs).

These categories are used to inform and align characterization strategies in the field sampling plan (FSP) (Section A3 of this appendix). Section 3.3 in Chapter 3 of this work plan provides additional information regarding 200-EA-1 OU waste site potential depths of vadose zone contamination.

A1.3 Data Quality Objective Process Summary

As part of the data quality objectives (DQO) process (described in Chapter 4 of this work plan), DOE-RL scoped each 200-EA-1 OU waste site using existing Hanford Site analytical and historical information. The 200-EA-1 scoping document (SGW-60540) presents this scoping information. Using the scoping information, DOE-RL and Ecology conducted initial evaluation workshops to identify uncertainties associated with the following statement:

> *Contaminant nature and extent must be sufficiently understood to determine if chemical or radiological contaminants of potential concern (COPCs) pose an unacceptable risk to human health and the environment (HHE) and to support potential groundwater impacts and response scenario evaluations in the FS/CMS.*

Appendix C (Tables C-2 through C-7) documents the preliminary evaluations and workshop outcomes for each waste site. The uncertainty management approach developed for each waste site (as summarized in Appendix C and detailed in this appendix) is sufficient to characterize the relevant media for each waste site. Sections A1.3.1 and A1.3.2 summarize the resulting principal study questions (PSQs) and data needs. Section 4.2 in Chapter 4 of this work plan provides additional PSQ and data needs information.

A1.3.1 Principal Study Questions

The 200-EA-1 OU PSQs are as follows:

- **PSQ #0a:** Did this septic system receive hazardous substance other than sanitary discharges that require additional investigations?
- **PSQ #0b:** Did the UPR-200-E-43 or UPR-200-E-99 waste sites receive radiological constituents that require additional investigations?
- **PSQ #1:** Do chemical or radiological COPCs in the vadose zone associated with 200-EA-1 OU waste sites pose an unacceptable risk to HHE under current or potential future land use?
- **PSQ #2:** Do chemical or radiological COPCs in the vadose zone associated with 200-EA-1 OU waste sites pose an unacceptable risk to groundwater under current or potential future land use in the next 1,000 years?
- **PSQ #3:** What is the lateral and vertical extent of chemical and radiological COPCs associated with 200-EA-1 OU waste sites that pose an unacceptable risk to HHE under current or potential future land use?
- **PSQ #4:** Will the identified remedial responses meet overall protection of HHE under current or potential future land use?

A1.3.2 Data Needs

The DQO process identified the following data needs for addressing the PSQs:

- **Data Need #0a-1:** Collect sufficient data to determine if chemical or radiological contaminants were discharged to the septic system.

- **Data Need #0b-1:** Collect sufficient data to determine if radiological contaminants are present.
- **Data Need #1-1:** Collect sufficient data to determine if chemical and/or radiological contaminants associated with 200-EA-1 OU waste sites exceed applicable risk-based values for human (outdoor worker) and ecological receptors in the vadose zone from 0 to 4.6 m (0 to 15 ft) bgs.
- **Data Need #2-1:** Collect sufficient chemical and radiological contaminant data to support fate and transport analysis for groundwater protection evaluations.
- **Data Need #2-2:** Collect sufficient lithology, hydraulic property, contaminant mobility, and geochemical information to support fate and transport analysis for groundwater protection evaluations, including Central Plateau groundwater protection preliminary remediation goal calculations.
- **Data Need #3-1:** Collect data to reduce uncertainty associated with the lateral and vertical extent of radiological and/or chemical contaminants posing an unacceptable risk to HHE for FS/CMS remedy evaluation.
- **Data Need #4-1:** Collect sufficient supplemental lithology, hydraulic property, contaminant mobility, and geochemical information to support fate and transport analysis for FS/CMS remedy evaluation, including Central Plateau groundwater protection preliminary remediation goal calculations.
- **Data Need #4-2:** Collect sufficient contaminant data to define how much time is required to meet cleanup levels for FS/CMS remedy evaluation.
- **Data Need #4-3:** Collect sufficient data to determine if radiological contaminants associated with 200-EA-1 OU waste sites exceed short term (acute) exposure for human receptors (construction worker) in the vadose zone >4.6 m (15 ft) bgs.

A1.4 Target Analytes

Target analytes selected for this SAP are based on the COPCs identified for the 200-EA-1 OU (Section 3.4 in Chapter 3 of this work plan). COPC identification built upon previous DQO efforts, existing site data, and 200-EA-1 OU waste site process knowledge. Table A-2 presents a list of target analytes for the 200-EA-1 OU. This comprehensive list does not apply to every waste site; the FSP (Section A3 of this appendix) identifies the subsets of the analyses that apply to each waste site.

Table A-2. Master Target Analyte List[a]

Radionuclides		
Americium-241	Hydrogen-3 (tritium)	Strontium-90
Carbon-14	Iodine-129	Technetium-99
Cesium-137	Neptunium-237	Uranium-233
Cobalt-60	Nickel-63	Uranium-234
Europium-152	Plutonium-238	Uranium-235
Europium-154	Plutonium-239	Uranium-238
Europium-155	Plutonium-240	

Table A-2. Master Target Analyte List[a]

Inorganics		
Ammonia	Cobalt	Nitrite
Antimony	Copper	Phosphate
Arsenic	Cyanide (free and total)	Selenium
Barium	Fluoride	Silver
Beryllium	Lead	Sulfate
Cadmium	Manganese	Uranium (total)
Chloride	Mercury	Vanadium
Chromium (total)	Nickel	Zinc
Chromium (VI)	Nitrate	
Organics		
Acenaphthene	Benzene	n-Butylbenzene
Acenaphthylene	Benzo(a)anthracene	Carbon tetrachloride
Acetone	Benzo(a)pyrene	Chlordane
Acetonitrile	Benzo(b)fluoranthene	Chrysene
alpha-BHC (alpha-HCH)	Benzo(ghi)perylene	Chlorobenzene
Aldrin	Benzo(k)fluoranthene	Chloroform
Anthracene	beta-BHC (beta-HCH)	Cyclohexane
Aroclor 1254[b]	n-Butanol (butyl alcohol)	Dibenz[a,h]anthracene
Aroclor 1260[b]	2-Butanone (methyl ethyl ketone)	Dibenzofuran
4,4'-Dichlorodiphenyldichloroethane	gamma-BHC (gamma-HCH, Lindane)	Phenanthrene
4,4'-Dichlorodiphenyltrichloroethane	n-Hexane	Pyrene
4,4'-Dichlorodiphenyldichloroethylene	2-Hexanone	Phenol
Dieldrin	Indeno[1,2,3-cd]pyrene	Tetrachloroethene (PCE)
1,1-Dichloroethane	4-Methyl-2-pentanone (hexone, methyl isobutyl ketone)	1,1,1-Trichloroethane
1,2-Dichloroethane	Methylene chloride (dichloromethane)	1,1,2-Trichloroethane
cis-1,2-Dichloroethylene	Napthalene	Toluene
trans-1,2-Dichloroethylene	Petroleum hydrocarbons (diesel to kerosene range)	Tributyl phosphate
Endrin	Total Polychlorinated biphenyls	Trichloroethene
Ethylbenzene		Vinyl chloride
Fluoranthene		Xylenes (total)
Fluorene		

a. This table is a comprehensive list including all contaminants of potential concern that may be present in the 200-EA-1 Operable Unit and is not intended to be applied globally to individual waste sites.

b. Polychlorinated biphenyl.

A1.5 Project Schedule

Chapter 6 of the work plan addresses project schedule elements for this SAP.

A2 Quality Assurance Project Plan

This quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection. It includes planning, implementing, and assessing sampling tasks; field measurements, laboratory analysis; and data review. This chapter describes the applicable environmental data collection requirements and controls based on the QA elements found in EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5); and DOE/RL-96-68, *Hanford Analytical Services*

Quality Assurance Requirements Document (HASQARD). DOECAP, 2013, *Department of Defense (DoD) Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories*, is also discussed. Sections 6.5 and 7.8 of Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan* (hereinafter referred to as the Tri-Party Agreement Action Plan), require that the QA/quality control (QC) and sampling and analysis activities specify the QA requirements for treatment, storage, and disposal units, as well as for past-practice processes. The QAPjP also describes applicable requirements and controls based on guidance provided in Ecology Publication No. 04-03-030, *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*; and EPA/240/R-02/009, *Guidance for Quality Assurance Project Plans* (EPA QA/G-5). The QAPjP supplements the contractor environmental QA program plan and includes the following sections, which describe the quality requirements and controls applicable to Hanford Site OU sampling activities:

- Section A2.1, Project Management
- Section A2.2, Data Generation and Acquisition
- Section A2.3; Assessment and Oversight
- Section A2.4, Data Review and Usability

A2.1 Project Management

The elements of project management include project history, project objectives, and participant responsibilities. This section addresses project goals, planned management approaches, and planned output documentation.

A2.1.1 Project/Task Organization

The prime contractor, or its approved subcontractor, is responsible for project planning and coordination, sample collection, and sample shipment. The project organization for sampling and characterization activities is described in the following subsections and is shown in Figure A-1. The 200-EA-1 OU project manager maintains a list of individuals or organizations as points of contact for each functional element shown in Figure A-1. For each functional prime contractor role, there is a corresponding oversight role within DOE-RL.

A2.1.1.1 Regulatory Agencies

As the lead regulatory agency, Ecology is responsible for regulatory oversight of cleanup projects and activities. Ecology has approval authority for the work being performed under this SAP. Ecology will work with DOE-RL to resolve concerns regarding the work described in this SAP in accordance with Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order* (hereinafter referred to as the Tri-Party Agreement). The U.S. Environmental Protection Agency (EPA) also has approval authority for this SAP.

A2.1.1.2 DOE-RL Manager

DOE-RL is responsible for Hanford Site cleanup. The DOE-RL manager is responsible for authorizing the contractor to perform activities at the Hanford Site under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA); RCRA; the *Atomic Energy Act of 1954*; and the Tri-Party Agreement (Ecology et al., 1989a). The DOE-RL manager is also responsible for obtaining Ecology and EPA approval of the SAP, authorizing field sampling activities, and functioning as the primary interface with the regulatory agencies.

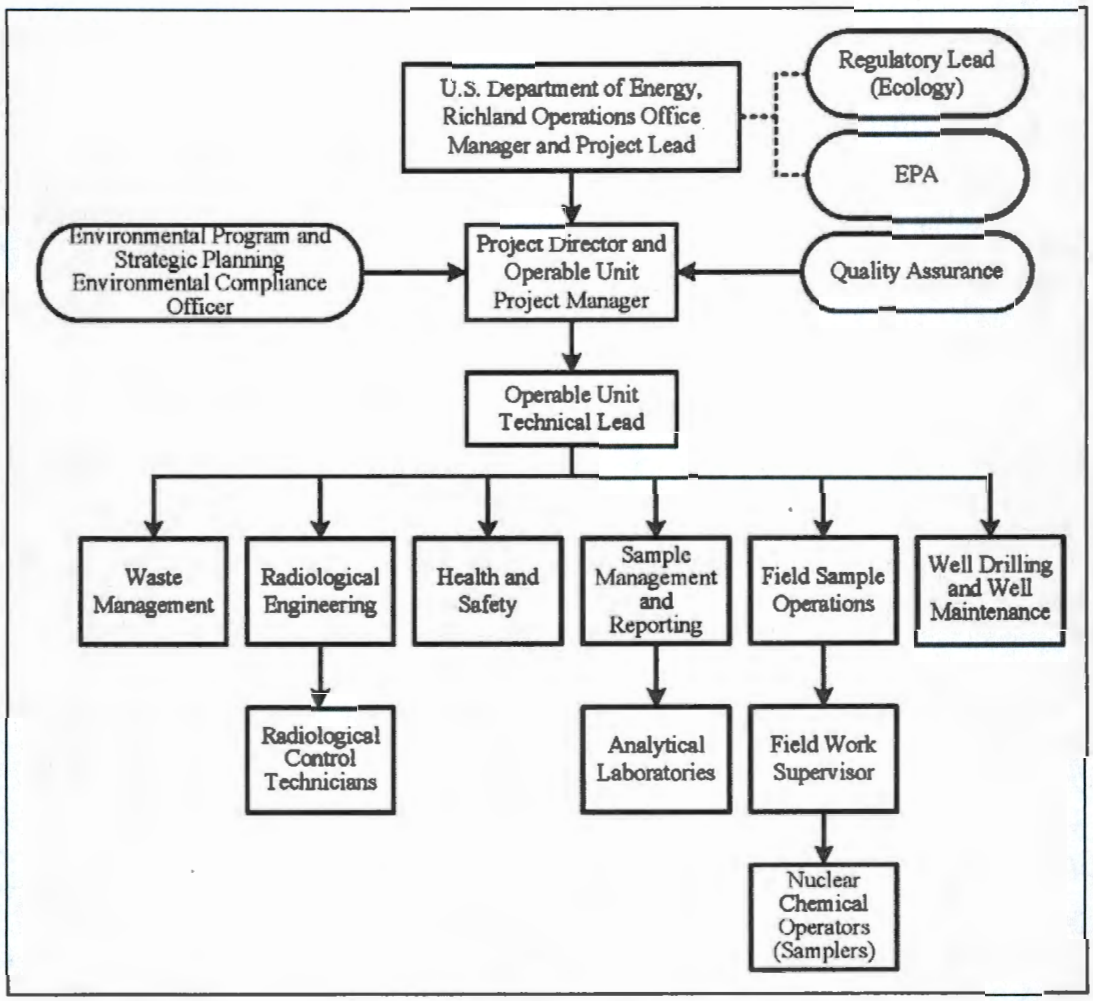

Figure A-1. Project Organization

A2.1.1.3 DOE-RL Project Lead

The DOE-RL project lead is responsible for providing day-to-day oversight of the contractor's performance of the work scope, working with the contractor to identify and work through issues, and providing technical input to DOE-RL management.

A2.1.1.4 Project Director

The project director provides oversight and coordinates with DOE-RL and prime contractor management in support of sampling and reporting activities. The project director also provides support to the OU project manager to ensure that work is performed safely and cost effectively.

A2.1.1.5 Operable Unit Project Manager

The OU project manager (or designee) is responsible and accountable for project-related activities, including coordinating with DOE-RL, the regulatory agencies, and contactor management in support of sampling activities to ensure that work is performed safely and cost effectively. In addition, the OU project manager (or designee) is also responsible for managing sampling documents and requirements, field activities, and subcontracted tasks; and for ensuring that the project file is properly maintained. The OU project manager is responsible for ensuring that project personnel are working to

the current version of the SAP. The OU project manager ensures that the sampling design requirements are converted into field instructions to provide specific direction for all field activities.

A2.1.1.6 Operable Unit Technical Lead

The OU technical lead is responsible for developing sampling designs, analytical requirements, and QC requirements. The technical lead ensures that sampling and analysis activities delegated by the OU project manager are carried out in accordance with the SAP. The OU technical lead works closely with the environmental compliance officer (ECO), the QA organization, the Health and Safety organization, the field work supervisor (FWS), and the Sample Management and Reporting (SMR) organization to plan and implement the work scope.

A2.1.1.7 Sample Management and Reporting

SMR oversees the offsite analytical laboratories, coordinates laboratory analytical work to ensure that laboratories conform to the requirements of the SAP, and verifies that laboratories are qualified for performing Hanford Site analytical work. SMR generates field sampling documents, labels, and instructions for field sampling personnel and develops the sample authorization form (SAF), which provides information and instruction to the analytical laboratories. SMR ensures that field sampling documents are revised to reflect approved changes. SMR receives analytical data from the laboratories, ensures that the data are appropriately reviewed, performs data entry into the Hanford Environmental Information System (HEIS) database, and arranges for data validation and recordkeeping. SMR is responsible for resolving sample documentation deficiencies or issues associated with Field Sample Operations (FSO), laboratories, or other entities. SMR is also responsible for informing the OU project manager of any issues reported by the analytical laboratories.

A2.1.1.8 Field Sample Operations

FSO is responsible for planning and coordinating field sampling resources and provides the FWS for sampling operations. The FWS directs the nuclear chemical operators (samplers), who collect samples in accordance with this SAP and corresponding standard methods and work packages. The FWS ensures that all field procedures are followed and that deviations from field sampling documents or issues encountered in the field are documented appropriately (e.g., in the field logbook). The FWS ensures that samplers are appropriately trained and available. Samplers collect samples in accordance with sampling documentation. Samplers also complete field logbooks, data forms, chain-of-custody forms, and shipping paperwork, and ensure delivery of the samples to the analytical laboratory.

In accordance with work management and work release requirements, pre-job briefings are conducted by FSO to evaluate activities and associated hazards by considering the following factors:

- Objective of the activities
- Individual tasks to be performed
- Hazards associated with the planned tasks
- Controls applied to mitigate hazards
- Environment in which the job will be performed
- Facility where the job will be performed
- Equipment and material required

Samplers collect required field samples, including replicates/duplicates; collect field parameters; and prepare QC samples in accordance with the SAP, corresponding standard methods, and field and sampling instructions.

A2.1.1.9 Quality Assurance

The QA point of contact provides independent oversight and is responsible for addressing QA issues on the project and overseeing implementation of project QA requirements. Responsibilities include reviewing project documents (including the QAPjP) and participating in QA assessments on sample collection and analysis activities, as appropriate.

A2.1.1.10 Environmental Compliance Officer

The ECO provides technical oversight, direction, and acceptance of project and subcontracted environmental work, and also develops appropriate mitigation measures with the goal of minimizing adverse environmental impacts. The ECO also reviews plans, protocols, and technical documents to ensure that environmental requirements have been addressed; identifies environmental issues that affect operations and develops cost-effective solutions; and responds to environmental/regulatory issues or concerns. The ECO also oversees project implementation for compliance with applicable internal and external environmental requirements. The OU project manager ensures that the single point of contact has been informed of events with the potential for release to the environment so the single point of contact can notify the lead regulatory agency, as appropriate. The ECO can be directed or delegated to inform the single point of contact of these events.

A2.1.1.11 Health and Safety

The Health and Safety organization is responsible for coordinating industrial safety and health support within the project as carried out through health and safety plans, job hazard analyses, and other pertinent safety documents required by federal regulations or internal prime contractor work requirements.

The Health and Safety organization also assists project personnel in complying with the applicable health and safety program. The Health and Safety organization coordinates with Radiological Engineering to determine personal protective equipment requirements.

A2.1.1.12 Radiological Engineering

Radiological Engineering is responsible for the following:

- Providing radiological engineering and project health physics support
- Conducting as low as reasonably achievable reviews, exposure and release modeling, and radiological controls optimization
- Identifying radiological hazards and ensuring that appropriate controls are implemented to maintain worker exposures to hazards at levels as low as reasonably achievable
- Interfacing with the project Health and Safety representative and other appropriate personnel, as needed, to plan and direct project radiological control technician support

A2.1.1.13 Waste Management

The Waste Management organization communicates policies and practices and ensures project compliance for storage, transportation, disposal, and waste tracking in a safe and cost-effective manner. Waste Management is responsible for identifying waste management sampling/characterization requirements to ensure regulatory compliance, interpreting data to determine waste designations and profiles, and preparing and maintaining other documents confirming compliance with waste acceptance criteria.

A2.1.1.14 Analytical Laboratories

The analytical laboratories analyze samples in accordance with established procedures and the requirements of this SAP, and provide necessary data packages containing analytical and QC results. Laboratories provide explanations of results to support data review and in response to resolution of analytical issues. Statements of work include quality requirements consistent with HASQARD (DOE/RL-98-68). The laboratories are evaluated under the U.S. Department of Energy (DOE) Consolidated Audit Program (or its successor program[s]) in accordance with the requirements of DOECAP (2013) and must be accredited by EPA and Ecology for the analyses performed for the DOE-RL prime contractor.

A2.1.1.15 Well Drilling and Well Maintenance

The well drilling and maintenance and the well coordination and planning managers are responsible for the following:

- Planning, coordinating, and executing drilling construction
- Performing well maintenance activities
- Coordinating with the OU technical lead regarding field constraints that could affect sampling design
- Coordinating well decommissioning in accordance with WAC 173-160-460, "Minimum Standards for Construction and Maintenance of Wells," "What is the decommissioning process for resource protection wells?"

A2.1.2 Quality Objectives and Criteria

The QA objective of this plan is to ensure that the generation of analytical data of known and appropriate quality is acceptable and useful for the evaluation requirements stated in the SAP. Data descriptors known as data quality indicators (DQIs) help determine the acceptability and utility of data to the user. For the purposes of this SAP, Table A-3 defines the principal DQIs (precision, accuracy, representativeness, comparability, completeness, bias, and sensitivity).

Data quality is defined by the degree of rigor in the acceptance criteria assigned to the DQIs. The applicable QC guidelines, DQI acceptance criteria, and levels of effort for assessing data quality are dictated by the intended use of the data and the requirements of the analytical method. In consultation with the laboratory, the OU project manager, and others (as appropriate), SMR identifies the appropriate analytical methods.

Table A-3. Data Quality Indicators

Data Quality Indicator (QC Element)[a]	Definition	Determination Methodologies	Corrective Actions
Precision (field duplicates, laboratory sample duplicates, and matrix spike duplicates)	Precision measures the agreement among a set of replicate measurements. Field precision is assessed through the collection and analysis of field duplicates. Analytical precision is estimated by duplicate/replicate analyses, usually on laboratory control samples, spiked samples, and/or field samples. The most commonly used estimates of precision are the relative standard deviation and, when only two samples are available, the relative percent difference.	Use the same analytical instrument to make repeated analyses on the same sample. Use the same method to make repeated measurements of the same sample within a single laboratory. Acquire replicate field samples for information on sample acquisition, handling, shipping, storage, preparation, and analytical processes and measurements.	If duplicate data do not meet objective: • Evaluate apparent cause (e.g., sample heterogeneity). • Request reanalysis or remeasurement. • Qualify the data before use.
Accuracy (laboratory control samples, matrix spikes, surrogates, carriers, and tracers)	Accuracy is the closeness of a measured result to an accepted reference value. Accuracy is usually measured as a percent recovery. QC analyses used to measure accuracy include standard recoveries, laboratory control samples, spiked samples, and surrogates.	Analyze a reference material or reanalyze a sample to which a material of known concentration or amount of pollutant has been added (a spiked sample).	If recovery does not meet objective: • Qualify the data before use. • Request reanalysis or remeasurement.
Representativeness (field duplicates)	Sample representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. It is dependent on the proper design of the sampling program and will be satisfied by ensuring that the approved plans were followed during sampling and analysis.	Evaluate whether measurements are made and physical samples collected in such a manner that the resulting data appropriately reflect the environment or condition being measured or studied.	If results are not representative of the system sampled: • Identify the reason for results not being representative. • Flag for further review. • Review data for usability. • If data are usable, qualify the data for limited use and define the portion of the system that the data represent. • If data are not usable, flag as appropriate. • Redefine sampling and measurement requirements and protocols. • Resample and reanalyze as appropriate.

Table A-3. Data Quality Indicators

Data Quality Indicator (QC Element)[a]	Definition	Determination Methodologies	Corrective Actions
Comparability (field duplicate, field splits, laboratory control samples, matrix spikes, and matrix spike duplicates)	Comparability expresses the degree of confidence with which one data set can be compared to another. It is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the approved plans are followed and that proper sampling and analysis techniques are applied.	Use identical or similar sample collection and handling methods, sample preparation and analytical methods, holding times, and quality assurance protocols.	If data are not comparable to other data sets: • Identify appropriate changes to data collection and/or analysis methods. • Identify quantifiable bias if applicable. • Qualify the data as appropriate. • Resample and/or reanalyze if needed. • Revise sampling/analysis protocols to ensure future comparability.
Completeness (no QC element; addressed in data quality assessment)	Completeness is a measure of the amount of valid data collected compared to the amount planned. Measurements are considered valid if they are unqualified or qualified as estimated data during validation. Field completeness is a measure of the number of samples collected versus the number of samples planned. Laboratory completeness is a measure of the number of valid measurements compared to the total number of measurements planned.	Compare the number of valid measurements completed (samples collected or samples analyzed) with those established by the project quality criteria (data quality objectives or performance/ acceptance criteria).	If data set does not meet the completeness objective: • Identify appropriate changes to data collection and/or analysis methods. • Identify quantifiable bias if applicable. • Resample and/or reanalyze if needed. • Revise sampling/analysis protocols to ensure future completeness.

Table A-3. Data Quality Indicators

Data Quality Indicator (QC Element)[a]	Definition	Determination Methodologies	Corrective Actions
Bias (equipment blanks, field transfer blanks, full trip blanks, laboratory control samples, matrix spikes, and method blanks)	Bias is the systematic or persistent distortion of a measurement process that causes error in one direction (e.g., the sample measurement is consistently lower than the sample's true value). Bias can be introduced during sampling, analysis, and data evaluation. Analytical bias refers to deviation in one direction (i.e., high, low, or unknown) of the measured value from a known spiked amount.	Sampling bias may be revealed by analysis of replicate samples. Analytical bias may be assessed by comparing a measured value in a sample of known concentration to an accepted reference value or by determining the recovery of a known amount of contaminant spiked into a sample (matrix spike).	For sampling bias: • Properly select and use sampling tools. • Institute correct sampling and subsampling practices to limit preferential selection or loss of sample media. • Use sample handling practices, including proper sample preservation, that limit the loss or gain of constituents to the sample media. • Analytical data known to be affected by either sampling or analytical bias are flagged to indicate possible bias. • Laboratories known to generate biased data for a specific analyte are asked to correct their methods to remove the bias as best as practicable. Otherwise, samples are sent to other laboratories for analysis.

Table A-3. Data Quality Indicators

Data Quality Indicator (QC Element)[a]	Definition	Determination Methodologies	Corrective Actions
Sensitivity (method detection limit, practical quantitation limit, and relative percent difference)	Sensitivity is an instrument's or method's minimum concentration that can be reliably measured (i.e., instrument detection limit or limit of quantitation).	Determine the minimum concentration or attribute to be measured by an instrument (instrument detection limit) or by a laboratory (limit of quantitation). The lower limit of quantitation[b] is the lowest level that can be routinely quantified and reported by a laboratory.	If detection limits do not meet objective: • Request reanalysis or remeasurement using methods or analytical conditions that will meet required detection or limit of quantitation. • Qualify/reject the data before use.

Source: SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*, as amended.

a. Acceptance criteria for QC elements are provided in Table A-8.

b. For purposes of this sampling and analysis plan, the lower limit of quantitation is interchangeable with the practical quantitation limit.

QC = quality control

A2.1.3 Methods-Based Analysis

Laboratory testing and reporting for the analytes described in Section A2.2.2 may include nontarget analytes that are part of the analytical method (i.e., methods-based reporting). Any nontarget analyte results reported by the laboratory as part of the method will be considered with those for the target analytes in the data evaluation. Analytical performance requirements will be applicable to all analytes resulting from the methods-based analysis process, including nondetects flagged as such by the laboratory.

A2.1.4 Analytical Priority

Analyte groups are listed in order of priority in Tables A-14 through A-19 (Section A3.3) and will be analyzed based on the available sample volume. If the sample volume is insufficient to analyze for all analytes listed for a given waste site, analysis will be performed according to analyte priority and available sample volume. Attempts will be made to collect at least every other sample of the lesser priority analytes that are important for supporting waste site decisions. Lowest priority analytes not critical for supporting waste site decisions will be analyzed only if sufficient sample volumes are collected.

In general, gamma energy analysis is placed as the highest priority because the analysis is nondestructive to the sample matrix (i.e., the sample material may be reused for other subsequent analyses) and provides data on key radionuclide risk drivers. Other radionuclide analyses are typically of the next highest priority, followed by cation, anion, organic, and physical properties analyses. This general priority order may be modified for individual waste sites (as listed in Section A3.3) in consideration of site-specific factors. Supplemental testing for attenuation and transport properties (described in Section A2.2.2) will be performed as warranted, only if sufficient sample material is available after other analyses.

A2.1.5 Special Training/Certification

Workers receive a level of training commensurate with their responsibility for collecting and transporting samples and that is compliant with applicable DOE orders and government regulations. The FWS, in coordination with line management, will ensure that special training requirements (e.g., radiological worker or hazardous waste worker) are met for field personnel.

Training has been instituted by the contractor management team to meet training and qualification programs that satisfy multiple training drivers imposed by applicable DOE, *Code of Federal Regulations*, and *Washington Administrative Code* requirements.

Training records are maintained for each employee in an electronic training record database. The contractor's training organization maintains the training records system. Line management confirms that an employee's training is appropriate and up to date prior to performing any field work.

A2.1.6 Documents and Records

The OU project manager (or designee) is responsible for ensuring that the current version of the SAP is being used and for providing any updates to field personnel. Version control is maintained by the administrative document control process. Changes to the SAP affecting sampling documents are handled consistent with HASQARD requirements (DOE/RL-96-68) and the Tri-Party Agreement Action Plan (Ecology et al., 1989b). Table A-4 defines the types of changes that may impact sampling and the associated approvals, notifications, and documentation requirements. The OU project manager is responsible for tracking all changes and obtaining appropriate reviews by contractor staff. The OU project manager will discuss the changes and provide appropriate documentation notifications to DOE-RL.

Table A-4. Change Control for Sampling Projects

Type of Change[a]	Type of Change[b]	Action	Documentation
Minor change: Change has no impact on the sample or field analytical result, and little or no impact on performance or cost. Further, the change does not affect obtaining the data gaps specified in the SAP.	**Minor field change:** Changes that have no adverse effect on the technical adequacy of the job or the work schedule.	The field personnel recognizing the need for a field change will consult with the OU project manager (or designee) prior to implementing the field change.	Minor field changes will be documented in the field logbook. The logbook entry will include the field change, the reason for the field change, and the names and titles of those approving the field change.
Significant change: Change has a considerable effect on performance or cost but still allow for meeting the data gaps specified in the SAP.	**Minor change:** Changes to approved plans that do not affect the overall intent of the plan or schedule.	The OU project manager will inform the DOE-RL project manager and the regulatory lead of the change and seek concurrence at a unit managers' meeting or comparable forum. The lead regulatory agency project manager and EPA project manager determine when there is no need to revise the document.	Documentation of this change approval would be in the unit managers' meeting minutes or comparable record (e.g., a change notice[c]).
Fundamental change: Change has significant effect on the sample or the field analytical result, performance, or cost, and the change does not meet the requirements specified for meeting the data gaps in the sampling document.	**Revision necessary:** Lead regulatory agency project manager determines changes to approved plans require revision to document.	If it is anticipated that a fundamental change will require the approval of the lead regulatory agency, the applicable DOE-RL project manager will be notified by the OU project manager and will be involved in the decision prior to implementation of a fundamental change. The lead regulatory agency project manager and EPA determine if the change requires a revision to the document.	Formal revision of the sampling document.

a. Consistent with DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document.*

b. Consistent with Sections 9.3 and 12.4 of Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan* (Tri-Party Agreement Action Plan).

c. Section 9.3 of the Tri-Party Agreement Action Plan (Ecology et al., 1989b) defines the minimum elements of a change notice.

DOE-RL = U.S. Department of Energy, Richland Operations Office
EPA = U.S. Environmental Protection Agency
OU = operable unit
SAP = sampling and analysis plan

The FWS, SMR, and any field crew supervisor are responsible for ensuring that field instructions are maintained and aligned with any revisions or approved changes to the SAP. SMR will ensure that any deviations from the SAP are reflected in revised field sampling documents for the samplers and the analytical laboratory. The FWS or appropriate field crew supervisor will ensure that deviations from the SAP or problems encountered in the field are documented appropriately (e.g., in the field logbook) in accordance with internal corrective action protocols.

Logbooks and data forms are required for field activities. The logbook must be identified with a unique project name and number. Individuals responsible for the logbooks shall be identified in the front of the logbook, and only authorized individuals may make entries into the logbooks. Logbooks and forms will be controlled in accordance with internal work requirements and processes.

The OU project manager, FWS, or designee is responsible for communicating field corrective action requirements and for ensuring that immediate corrective actions are applied to field activities. The OU project manager is also responsible for ensuring that project files are appropriately established and maintained. The project files will contain project records or references to their storage locations. Project files may include the following information:

- Operational records and logbooks
- Data forms
- Global positioning system data in accordance with Appendix G of the Tri-Party Agreement Action Plan (Ecology et al., 1989b)
- Inspection or assessment reports and corrective action reports
- Photographs
- Field summary reports
- Interim progress reports
- Final reports
- Forms required by WAC 173-160 and the master drilling contract

The following records are managed and maintained by SMR personnel:

- Completed field sampling logbooks
- Field drilling and analytical data
- Completed chain-of-custody forms
- Sample receipt records
- Laboratory data packages
- Analytical data verification and validation reports
- Analytical data "case file purges" (i.e., raw data purged from laboratory files) provided by the offsite analytical laboratories

For a period of 5 years, the laboratory is responsible for maintaining, and having available upon request, the following:

- Analytical logbooks
- Raw data and QC sample records
- Standard reference material and/or proficiency test sample data
- Sample chain-of-custody and sample storage temperature logs

- Instrument calibration information
- Training records for employees (regarding analytical methods)
- Laboratory state accreditation records
- Laboratory audit records

Convenience copies of laboratory analytical results are maintained in the HEIS database. Records may be stored in either electronic (e.g., in the managed records area of the Integrated Document Management System) or hardcopy format (e.g., DOE Records Holding Area). Documentation and records, regardless of medium or format, are controlled in accordance with internal work requirements and processes that ensure accuracy and retrievability of stored records. Records required by the Tri-Party Agreement (Ecology et al., 1989a) will be managed in accordance with Tri-Party Agreement requirements.

A2.2 Data Generation and Acquisition

This section addresses data generation and acquisition to ensure that the project's methods for sample measurement and analysis, data collection or generation, data handling, and QC activities are appropriate and documented. Requirements for instrument calibration and maintenance, supply inspections, and data management are also addressed. The FSP (Section A3 of this appendix) describes the field sampling methods, including corrective actions for sampling activities.

A2.2.1 Analytical Methods Requirements

Tables A-5 and A-6 provide information regarding standard analytical method requirements for samples collected. The analytical methods are controlled in accordance with the laboratory's QA plan and the requirements of this QAPjP. In consultation with the laboratory and the OU project manager, SMR can approve changes to analytical methods, provided the new method is based upon a nationally recognized standard method (e.g., EPA or ASTM International [formerly known as the American Society for Testing and Materials or ASTM]) and if the new method delivers analytical data comparable to those provided by the listed method. The new method shall achieve project DQOs as well or better than the replaced method.

If the laboratory proposes the use of a nonstandard or unapproved method, then the laboratory must provide justification for the use of that method, along with method validation data, to confirm that the method is adequate for the intended data use. This includes information such as determining detection limits, acceptance limits, corrective actions, quantitation limits, typical recoveries, and analytical precision and bias.

Laboratories providing analytical services in support of this SAP will have a corrective action program in place that addresses analytical system failures and documents the effectiveness of any corrective actions. Issues that may affect analytical results will be resolved by SMR in coordination with the OU project manager.

The preliminary action levels provided in Tables A-5 and A-6 are risk-based values used to ensure that adequate analytical requirements are identified. Risk-based concentrations often have a different basis (as stated in the footnotes to these tables) and should not be compared to cleanup levels. For example, the concentrations based on the (EPA) outdoor worker scenario are based on a 1 in 1,000,000 cancer risk or a hazard quotient of 0.1, while the concentrations based on the comparable industrial scenario (WAC 173-340, "Model Toxics Control Act—Cleanup," Method C) are based on a 1 in 100,000 cancer risk or a hazard quotient of 1.

Table A-5. Analytical Performance Requirements for Radionuclides in Soil

Analyte Name	CAS Number	Preliminary Action Levels[a] (pCi/g)			Hanford Site Background[d] (pCi/g)	Analytical Method[e]	Highest Allowable MDC[f] (pCi/g)
		Outdoor Worker RBL[b]	Ecological Protection[c]	Groundwater Protection			
Americium-241	14596-10-2	61	3,890	—	—	Americium isotopic – AEA	1
Carbon-14	14762-75-5	57,013	32	—	—	C-14 – LSC	5
Cesium-137	10045-97-3	1.1	21	—	1.05	GEA	0.1
Cobalt-60	10198-40-0	0.57	692	—	0.00842	GEA	0.1
Europium-152	14683-23-9	0.68	1,520	—	—	GEA	0.1
Europium-154	15585-10-1	0.82	1,290	—	0.0334	GEA	0.1
Europium-155	14391-16-3	60	15,800	—	0.0539	GEA	0.1
Iodine-129	15046-84-1	157	—	—	—	GEA	2
Neptunium-237	13994-20-2	2.4	3,860	—	—	Np-237 – AEA	1
Nickel-63	13981-37-8	59,952	—	—	—	Ni-63 – LSC	10
Plutonium-238	13981-16-3	344	5,270	—	0.00378	Pu isotopic – AEA	1
Plutonium-239/240	PU-239/240[g]	297	6,110	—	0.0248	Pu isotopic – AEA	1
Strontium-90	10098-97-2	119	22.5	—	0.178	Total radioactive strontium – GPC	2
Technetium-99	14133-76-7	11,705	4,490	—	—	Tc-99 – LSC or GPC	5
Tritium	10028-17-8	1,259	420	—	—	Tritium – LSC	30
Uranium-233/234[h]	U-233/234[g]	220	5,130	—	1.1	U isotopic – AEA or ICP/MS	1
Uranium-235	15117-96-1	3.6	2,770	—	0.109	U isotopic – AEA or ICP/MS	1
Uranium-238	U-238[g]	17	1,580	—	1.06	U isotopic – AEA or ICP/MS	1

Table A-5. Analytical Performance Requirements for Radionuclides in Soil

Analyte Name	CAS Number	Preliminary Action Levels[a] (pCi/g)			Hanford Site Background[d] (pCi/g)	Analytical Method[e]	Highest Allowable MDC[f] (pCi/g)
		Outdoor Worker RBL[b]	Ecological Protection[c]	Groundwater Protection			

a. The preliminary action level is the risk-based value used to determine appropriate analytical requirements (e.g., detection limits). Remedial action levels will be proposed in the feasibility study, finalized in the Record of Decision, and will guide site remediation.

b. The outdoor worker RBL is used to determine analytical performance requirements is based on an excess lifetime cancer risk of 1 in 100,000 (ECF-HANFORD-16-0133, *Calculation of Soil Radiological Preliminary Remedial Goals for the Outdoor Worker Scenario.*)

c. From CHPRC-00784, *Tier 1 Risk-Based Soil Concentrations Protective of Ecological Receptors at the Hanford Site*. Value listed is the lower of the generic soil screening level (Table 6-1) and Tier 1 risk-based concentration (Table 6-12).

d. DOE/RL-96-12, *Hanford Site Background: Part 2, Soil Background for Radionuclides.*

e. Equivalent methods may be substituted, as described in Section A2.2.

f. Highest allowable MDC values are specified in contracts with analytical laboratories. Actual MDC values vary by laboratory and may be lower. Where project-specific action levels are greater than contract-specified highest allowable MDC values, the contract-specified highest allowable MDC value is given. Where project-specific action levels are less than contract-specified highest allowable MDC values, a highest allowable MDC value that is lower than the action level is given, provided that the lower highest allowable MDC is technically achievable under routine operating conditions by laboratories under contract to CH2M HILL Plateau Remediation Company.

g. Not a CAS number; the entry is provided to facilitate data management and retrieval in the Hanford Environmental Information System database.

h. If ICP/MS is used, individual isotopes will be quantified.

AEA = alpha energy analysis
CAS = Chemical Abstracts Service
GEA = gamma energy analysis
GPC = gas proportional counting
ICP/MS = inductively coupled plasma/mass spectrometry
LSC = liquid scintillation counting
MDC = minimum detectable concentration
RBL = risk-based level

Table A-6. Analytical Performance Requirements for Nonradionuclides in Soil

Analyte Name	CAS Number	Preliminary Action Levels[a] (mg/kg)				Hanford Site Background[f] (mg/kg)	Analytical Method[g]	Highest Allowable PQL[h] (mg/kg)
		Direct Contact, WAC 173-340 Method C Industrial RBL[b]	Outdoor Worker RBL[c]	Ecological Protection[d]	Groundwater Protection[e]			
Metals								
Antimony	7440-36-0	1,400	52	0.27	5.4	0.13	SW-846, Method 6010 or 6020	0.5
Arsenic	7440-38-2	20	20[i]	10	0.034	6.47[o]	SW-846, Method 6010 or 6020	1
Barium	7440-39-3	700,000	25,900	102	1,650	132	SW-846, Method 6010 or 6020	5
Beryllium	7440-41-7	7,000	259	10	63	1.51	SW-846, Method 6010 or 6020	0.5
Cadmium	7440-43-9	3,500	111	0.36	0.69	0.563	SW-846, Method 6010 or 6020	0.5
Chromium (total)	7440-47-3	5,250,000	195,000	0.4	2,000	18.5	SW-846, Method 6010 or 6020	1
Chromium (VI)	18540-29-9	240	389	104	0.192	—	EPA Method 7196 – colorimetric	0.5
Cobalt	7440-48-4	1,050	39	13	4.3	15.7	SW-846, Method 6010 or 6020	5
Copper	7440-50-8	140,000	5,190	16	284	22	SW-846, Method 6010 or 6020	2.5
Lead	7439-92-1	1,000[i]	1,000[i]	11	3,000	10.2	SW-846, Method 6010 or 6020	5
Manganese	7439-96-5	490,000	17,985	220	501	512	SW-846, Method 6010 or 6020	5
Mercury	7439-97-6	560	39	0.03	2.1	0.013	SW-846, Method 7471	0.2
Nickel	7440-02-0	70,000	2,593	16.3	130	19.1	SW-846, Method 6010 or 6020	4
Selenium	7782-49-2	17,500	649	0.3	5.2	0.78	SW-846, Method 6010 or 6020	0.5
Silver	7440-22-4	17,500	649	2	14	0.167	SW-846, Method 6010 or 6020	1
Uranium	7440-61-1	10,500	389	4	3.2	3.21	SW-846, Method 6010 or 6020	0.2
Vanadium	7440-62-2	17,500	649	2	1,600	85.1	SW-846, Method 6010 or 6020	5
Zinc	7440-66-6	1,050,000	38,930	46	5,970	67.8	SW-846, Method 6010 or 6020	5

Table A-6. Analytical Performance Requirements for Nonradionuclides in Soil

Analyte Name	CAS Number	Preliminary Action Levels[a] (mg/kg)				Hanford Site Background[f] (mg/kg)	Analytical Method[g]	Highest Allowable PQL[h] (mg/kg)
		Direct Contact, WAC 173-340 Method C Industrial RBL[b]	Outdoor Worker RBL[c]	Ecological Protection[d]	Groundwater Protection[e]			
Other Inorganic Analytes								
Ammonia	7664-41-7	—	—	—	—	9.23	EPA Method 350.1	0.5
Chloride	16887-00-6	—	—	—	1,000	100	EPA Method 300.0 – IC	55[j]
Cyanide (total)	57-12-5	2,100	18	20,693	0.97	—	EPA Method 9012	1
Fluoride	16984-48-8	210,000	7,787	556	2,884	2.81	EPA Method 300.0 or SW-846, Method 9056	25[j]
Nitrate	14797-55-8	24,900,000	921,422	12[k]	180	52	EPA Method 300.0 or SW-846 Method 9056	12.5[j]
Nitrite	14797-65-0	1,050,000	42,827	12[k]	13	—	EPA Method 300.0 or SW-846, Method 9056	12.5[j]
Phosphate	14265-44-2	—	—	—	—	0.785	EPA Method 300.0 or SW-846, Method 9056	5
Sulfate	14808-79-8	—	—	—	1,000	237	EPA Method 300.0 or SW-846, Method 9056	27.5[j]
Volatile Organic Compounds								
Acetone	67-64-1	3,150,000	74,600	—	29	—	SW-846, Method 8260	0.02
Acetonitrile	75-05-8	—	385	—	—	—	SW-846, Method 8260	0.1
Benzene	71-43-2	2,390	3.0	7	0.005	—	SW-846, Method 8260	0.005
1-Butanol	71-36-3	350,000	13,000	2,626	3.31	—	SW-846, Method 8260	0.25
2-Butanone	78-93-3	2,100,000	21,800	312	20	—	SW-846, Method 8260	0.02
n-Butylbenzene	104-51-8	175,000	6,490	193	—	—	SW-846, Method 8260	0.005
Carbon tetrachloride	56-23-5	1,880	3.1	82	0.0058	—	SW-846, Method 8260	0.005
Chlorobenzene	108-90-7	70,000	75.3	40	0.87	—	SW-846, Method 8260	0.005
Chloroform	67-66-3	4,230	1.3	83	0.0075	—	SW-846, Method 8260	0.005

Table A-6. Analytical Performance Requirements for Nonradionuclides in Soil

Analyte Name	CAS Number	Preliminary Action Levels[a] (mg/kg)				Hanford Site Background[f] (mg/kg)	Analytical Method[g]	Highest Allowable PQL[h] (mg/kg)
		Direct Contact, WAC 173-340 Method C Industrial RBL[b]	Outdoor Worker RBL[c]	Ecological Protection[d]	Groundwater Protection[e]			
Cyclohexane	110-82-7	—	2,780	—	—	—	SW-846, Method 8260	0.1
1,1-Dichloroethane	75-34-3	23,000	15	83	0.042	—	SW-846, Method 8260	0.01
1,2-Dichloroethane	107-06-2	1,440	1.8	84	0.0023	—	SW-846, Method 8260	0.005[i]
cis-1,2-Dichloroethylene	156-59-2	7,000	260	83	0.08	—	SW-846, Method 8260	0.005
trans-1,2-Dichloroethylene	156-60-5	70,000	2,600	83	0.54	—	SW-846, Method 8260	0.005
Ethylbenzene	100-41-4	11,900	12	159	0.034	—	SW-846, Method 8260	0.005
Hexane	110-54-3	—	344	—	96.2	—	SW-846, Method 8260	0.01
2-Hexanone	591-78-6	17,500	135	186	0.17	—	SW-846, Method 8260	0.02
4-Methyl-2-pentanone	108-10-1	—	13,900	193	2.7	—	SW-846, Method 8260	0.02
Methylene chloride	75-09-2	21,000	344	59	0.022	—	SW-846, Method 8260	0.005
Tetrachloroethene	127-18-4	21,000	38	14	0.053	—	SW-846, Method 8260	0.005
1,1,1-Trichloroethane	71-55-6	7,000,000	3,820	82	1.6	—	SW-846, Method 8260	0.005
1,1,2-Trichloroethane	79-00-5	2,300	0.47	83	0.0043	—	SW-846, Method 8260	0.005[i]
Toluene	108-88-3	280,000	3,408	195	4.7	—	SW-846, Method 8260	0.005
Trichloroethene	79-01-6	1,750	5.4	7	0.0036	—	SW-846, Method 8260	0.005[i]
Vinyl chloride	75-01-4	18	1.8	—	0.0004	—	SW-846, Method 8260	0.01[i]
Xylenes (total)	1330-20-7	700,000	122	149	15	—	SW-846, Method 8260	0.01
Semivolatile Organic Compounds (Including Polycyclic Aromatic Hydrocarbons)								
Acenaphthene	83-32-9	210,000	5,020	20	98	—	SW-846, Method 8270 (SIM)	0.05
Acenaphthylene	208-96-8	—	—	7.4	—	—	SW-846, Method 8270 (SIM)	0.05
Anthracene	120-12-7	1,050,000	25,100	29	2,275	—	SW-846, Method 8270 (SIM)	0.05
Aroclor-1254[m]	11097-69-1	66	1.0	0.27	0.11	—	SW-846, Method 8082	0.033

Table A-6. Analytical Performance Requirements for Nonradionuclides in Soil

Analyte Name	CAS Number	Preliminary Action Levels[a] (mg/kg)				Hanford Site Background[f] (mg/kg)	Analytical Method[g]	Highest Allowable PQL[h] (mg/kg)
		Direct Contact, WAC 173-340 Method C Industrial RBL[b]	Outdoor Worker RBL[c]	Ecological Protection[d]	Groundwater Protection[e]			
Aroclor-1260[m]	11096-82-5	66	1.1	0.27	0.72	—	SW-846, Method 8082	0.033
Benzo(a)anthracene	56-55-3	1,313	3.2	1.1	0.86	—	SW-846, Method 8270 (SIM)	0.015
Benzo(a)pyrene	50-32-8	131	0.32	1.1	0.23	—	SW-846, Method 8270 (SIM)	0.015
Benzo(b)fluoranthene	205-99-2	1,313	3.2	1.1	2.9	—	SW-846, Method 8270 (SIM)	0.015
Benzo(ghi)perylene	191-24-2	—	—	1.1	—	—	SW-846, Method 8270 (SIM)	0.03
Benzo(k)fluoranthene	207-08-9	13,125	3.2	0.17	2.9	—	SW-846, Method 8270 (SIM)	0.015
Chrysene	218-01-9	131,250	32	1.1	9.5	—	SW-846, Method 8270 (SIM)	0.04
Dibenz[a,h]anthracene	53-70-3	131	3.2	1.1	0.43	—	SW-846, Method 8270 (SIM)	0.03
Dibenzofuran	132-64-9	3,500	115	—	3.0	—	SW-846, Method 8270	0.33
Fluoranthene	206-44-0	140,000	3,350	1.1	631	—	SW-846, Method 8270 (SIM)	0.04
Fluorene	86-73-7	140,000	3,350	1	51	—	SW-846, Method 8270 (SIM)	0.03
Indeno[1,2,3-cd]pyrene	193-39-5	1,313	3.2	1.1	8.3	—	SW-846, Method 8270 (SIM)	0.03
Naphthalene	91-20-3	70,000	7.4	29	4.5	—	SW-846, Method 8270 (SIM)	0.04
Phenanthrene	85-01-8	—	—	5	—	—	SW-846, Method 8270 (SIM)	0.01
Phenol	108-95-2	1,050,000	8,440	0.2	11	—	SW-846, Method 8270	0.33
Pyrene	129-00-0	105,000	2,510	1.1	655	—	SW-846, Method 8270 (SIM)	0.04
Total petroleum hydrocarbons – diesel to oil range (kerosene)	TPH-diesel TPH-kerosene	2,000	—	200 (diesel) 35,638 (kerosene)	2,000	—	NWTPH-DX[n]	25
Total polychlorinated biphenyls[m]	1336-36-3	66	1.0	0.27	—	—	SW-846, Method 8082	N/A
Tributyl phosphate	126-73-8	14,583	284	—	0.50	—	SW-846, Method 8270	0.33

Table A-6. Analytical Performance Requirements for Nonradionuclides in Soil

Analyte Name	CAS Number	Preliminary Action Levels[a] (mg/kg)				Hanford Site Background[f] (mg/kg)	Analytical Method[g]	Highest Allowable PQL[h] (mg/kg)
		Direct Contact, WAC 173-340 Method C Industrial RBL[b]	Outdoor Worker RBL[c]	Ecological Protection[d]	Groundwater Protection[e]			
Pesticides								
Aldrin	309-00-2	7.7	0.17	0.01	0.0025	—	SW-846, Method 8081	0.0017
Alpha-BHC	319-84-6	21	0.41	—	0.0005	—	SW-846, Method 8081	0.0017[i]
Beta-BHC	319-85-7	73	1.4	0.02	0.0023	—	SW-846, Method 8081	0.0017
Chlordane	57-74-9	375	8.0	0.1	0.26	—	SW-846, Method 8081	0.017
4,4'-DDD	72-54-8	547	11	0.01	0.34	—	SW-846, Method 8081	0.0033
4,4'-DDE	72-55-9	386	10	0.01	0.45	—	SW-846, Method 8081	0.0033[i]
4,4'-DDT	50-29-3	386	9.5	0.01	3.5	—	SW-846, Method 8081	0.0033
Dieldrin	60-57-1	8.2	0.16	0.001	0.0028	—	SW-846, Method 8081	0.0017[i]
Endrin	72-20-8	1,050	27.4	0.06	0.44	—	SW-846, Method 8081	0.0017
Gamma-BHC	58-89-9	119	2.8	—	0.0025	—	SW-846, Method 8081	0.0017
Soil Properties								
pH	N/A	N/A	N/A	N/A	N/A	N/A	SW-846, Method 9045	N/A
Bulk density	N/A	N/A	N/A	N/A	N/A	N/A	ASTM D7263-09 or ASTM D854-14	N/A
Moisture content	N/A	N/A	N/A	N/A	N/A	N/A	ASTM D2216-10	N/A
Specific conductance	N/A	N/A	N/A	N/A	N/A	N/A	ASTM D1125-14 or EPA Method 9050A	N/A
Total inorganic carbon	N/A	N/A	N/A	N/A	N/A	N/A	SW-846, Method 9060	N/A
Total organic carbon	N/A	N/A	N/A	N/A	N/A	N/A	SW-846, Method 9060	N/A
Particle-size distribution	N/A	N/A	N/A	N/A	N/A	N/A	ASTM D6913/D6913M-17 or ASTM D4464-15	N/A

Table A-6. Analytical Performance Requirements for Nonradionuclides in Soil

Analyte Name	CAS Number	Preliminary Action Levels[a] (mg/kg)				Hanford Site Background[f] (mg/kg)	Analytical Method[g]	Highest Allowable PQL[h] (mg/kg)
		Direct Contact, WAC 173-340 Method C Industrial RBL[b]	Outdoor Worker RBL[c]	Ecological Protection[d]	Groundwater Protection[e]			
Unsaturated/saturated hydraulic conductivity (permeability) and moisture retention properties	N/A	N/A	N/A	N/A	N/A	N/A	ASTM D6836-02(2008)e2; ASTM D5856-15; ASTM D5084-16a; Hopmans et al., 2002	N/A

Source: WAC 173-340, "Model Toxics Control Act—Cleanup."

a. The preliminary action level is the risk-based value used to determine appropriate analytical requirements (e.g., detection limits). Remedial action levels will be proposed in the feasibility study, finalized in the Record of Decision, and will guide site remediation.

b. The direct contact risk-based level is based on an excess lifetime cancer risk of 1 in 100,000 or hazard quotient of 1.0 (ECF-HANFORD-10-0453, *Calculation of Standard Method C Direct Contact Soil Cleanup Levels for Industrial Land Use for the 100 Areas and 300 Area Remedial Investigation/Feasibility Study Reports*).

c. The outdoor worker RBL used to determine analytical performance requirements is based on an excess lifetime cancer risk of 1 in 1,000,000 or hazard quotient of 0.1 (ECF-HANFORD-16-0134, *Calculation of Soil Nonradiological Preliminary Remediation Goals for the Outdoor Worker Scenario*).

d. The ecological protection levels are from CHPRC-00784, *Tier 1 Risk-Based Soil Concentrations Protective of Ecological Receptors at the Hanford Site*; CHPRC-01311, *Tier 2 Risk-Based Soil Concentrations Protective of Ecological Receptors at the Hanford Site*; ECF-HANFORD-11-0158, *Tier 2 Terrestrial Plant and Invertebrate Preliminary Remediation Goals (PRGs) for Nonradionuclides for Use at the Hanford Site.* Value listed is the lower of the generic soil screening level (Table 6-1 of CHPRC-00784), Tier 1 risk-based concentration (Table 6-9 of CHPRC-00784), or Tier 2 preliminary remediation goals (Table 2-1 of CHPRC-01311 or Table 6-3 of ECF-HANFORD-11-0158). Three constituents (antimony, mercury, and nitrite) have action levels lower than the PQL. The PQL is sufficient for antimony based on a Tier 1 ecological protection value of 0.6 mg/kg (CHPRC-00784). The PQL is sufficient for mercury based on the Tier 2 plant PRG of 0.3 mg/kg (ECF-HANFORD-11-0158). The PQL is sufficient for nitrite based on the Tier 2 PRG lowest observed adverse effect level of 27 mg/kg (CHPRC-01311).

e. From ECF-HANFORD-10-0442, *Calculation of Nonradiological Soil Concentrations Protective of Groundwater Using the Fixed Parameter 3-Phase Equilibrium Partitioning Equation for the 100 Areas and 300 Area.*

f. DOE/RL-92-24, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes*; ECF-HANFORD-11-0038, *Soil Background for Interim Use at the Hanford Site.*

g. For EPA Method 300.0, see EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples*. For EPA Method 350.1, see EPA-600/4-79-020, *Methods for Chemical Analysis of Water and Wastes*. For four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*, as amended. Equivalent methods may be substituted, as described in Section A2.2.

h. Highest allowable PQL values are specified in contracts with analytical laboratories. Actual PQL values vary by laboratory and may be lower. Where project-specific action levels are greater than contract-specified highest allowable PQL values, the contract-specified highest allowable PQL value is given. Where project-specific action levels are less than contract-specified highest allowable PQL values, a highest allowable PQL value that is lower than the action level is given, provided that the lower highest allowable PQL is technically achievable under routine operating conditions by laboratories under contract to CH2M HILL Plateau Remediation Company. Method detection limits are three to five times lower than quantitation limits.

Table A-6. Analytical Performance Requirements for Nonradionuclides in Soil

Analyte Name	CAS Number	Preliminary Action Levels[a] (mg/kg)				Hanford Site Background[f] (mg/kg)	Analytical Method[g]	Highest Allowable PQL[h] (mg/kg)
		Direct Contact, WAC 173-340 Method C Industrial RBL[b]	Outdoor Worker RBL[c]	Ecological Protection[d]	Groundwater Protection[e]			

i. From WAC 173-340-900, "Tables," Tables 745-1 (Method A).

j. Dilutions for certain general chemistry ion chromatography constituents may be necessary, potentially raising PQLs achieved above the listed limit.

k. The values for nitrate and nitrite are calculated for nitrogen in nitrate plus nitrite.

l. The lowest screening level is greater than the method detection limit but is slightly less than the PQL. If the analyte is found to be a contaminant of concern based on the 200-EA-1 Operable Unit baseline risk assessment, an evaluation will be performed (if necessary) to determine if it is technically possible for the PQL for those contaminants to be lowered.

m. Total polychlorinated biphenyls are obtained by summing individual Aroclor results.

n. From Ecology Publication ECY 97-602, *Analytical Methods for Petroleum Hydrocarbons*. The Washington State Department of Ecology methods use a modification to EPA Method 8015.

o. Ecology, 2013, "Issues Associated with Establishing Soil Cleanup Levels for Arsenic," (memorandum to J. Hedges and J. Price, Nuclear Waste Program, from D. Bradley), Toxics Cleanup Program, Washington State Department of Ecology, Olympia, Washington, June 11, indicates that the Method A soil cleanup level of 20 mg/kg can be used to define natural background levels when developing soil cleanup levels for the Hanford Site.

ASTM = ASTM International
CAS = Chemical Abstracts Service
EPA = U.S. Environmental Protection Agency
N/A = not applicable
NWTPH = Northwest total petroleum hydrocarbons
PQL = practical quantitation limit
PRG = preliminary remediation goal
RBL = risk-based level
SIM = selected ion monitoring

A2.2.2 Laboratory Testing for Attenuation and Transport Process Evaluation

Supplemental laboratory testing for attenuation and transport processes may be performed on a limited number of samples in consideration of the results of other analyses, other available data, and site-specific and regional data needs. As part of defining data needs for detailed fate and transport modeling, a set of tiered analyses have been defined to ensure that collection of sophisticated geochemical data is targeted to resolve specific data needs. The tiers are as follows:

- **Tier I (nature and extent):** Measurement of physical and chemical parameters to characterize sediment and pore water chemistry and define the nature and extent of contamination.
  - Also evaluates attenuation capacity[1] due to presence of iron and manganese.
  - Details are presented in Table A-7.
- **Tier II (contaminant mobility):** Laboratory testing for contaminant mobility (leaching) will be performed with consideration of the geochemical and contaminant analysis of sediment and pore water.
  - Perform on multiple sediment samples to quantify transport parameters.
  - Include (1) sediment sequential extraction (phase identification), (2) batch leaching (static conditions for estimating distribution coefficient), and (3) flow-through column leaching tests (for estimating kinetic sorption).
  - Identify surface sorption phases and mineral associations.
  - Determine the reduction-oxidation (redox) state of contaminant/speciation.
  - Details are presented in Table A-8.
- **Tier III (selective analysis):** Perform specialized analyses on select samples to fill any data/information gaps.
  - Determine hydraulic properties (moisture retention relationship functions) for selected samples in a comprehensive manner.
  - Conduct isotopic analysis of oxygen and hydrogen to develop vertical profile for evaluation of source terms and for mixing calculations.
  - Conduct microbial studies to understand biogeochemical processes to quantify attenuation rates.
  - Details are presented in Table A-9.

[1] Attenuation capacity relates to the adsorption of contaminant, decreasing the dissolved concentration. Iron and manganese oxides have high capacities to adsorb contaminants and, as such, can play an important role in attenuating the dissolved concentration.

Table A-7. Tier I General Sample Characterization

Data Type	Analytical Method(s) Used to Measure/Attain Required Data	Data Need Addressed[a]
COPC concentration (from selected depths)	Chemical-specific WE and AE methods	DN #1-1, DN #2-1, DN #3-1, DN #4-2, DN #4-3
Organic contaminant identification (if needed)	The need for additional analyses and analytical methods will be defined pending review of organic contaminant data and consideration of disposed organics	DN #1-1 , DN #2-1, DN #3-1, DN #4-2, DN #4-3
Anions (bromide, chloride, fluoride, nitrate, nitrite, phosphate, and sulfate)	EPA Method 300.0/EPA Method 9056A (Revision 1, February 2007)	DN #1-1, DN #2-1, DN #3-1, DN #4-2, DN #4-3
Cations (aluminum, barium, calcium, iron, potassium, magnesium, manganese, sodium, silicon, and total chromium)	EPA Method 6010D[e]/6020B[f], ICP/OES, ICP/MS, WE, and AE	DN #1-1, DN #2-1, DN #3-1, DN #4-2, DN #4-3
Cation-exchange capacity	EPA Method 9080	DN #1-1, DN #2-1, DN #3-1, DN #4-2, DN #4-3
Specific conductance	ASTM D1125-14 or EPA Method 9050A; WE	DN #2-1, DN #2-2, DN #4-1
pH	EPA Method 9045C, WE	DN #2-1, DN #2-2, DN #4-1
Total organic carbon	EPA Method 9060A, WE, and sediment[b] (total carbon minus total inorganic carbon)	DN #2-1, DN #2-2, DN #4-1
Total inorganic carbon	EPA Method 9060A, WE, and sediment[b]	DN #2-1, DN #2-2, DN #4-1
Quantify changes in available iron(II)/iron(III) and manganese in borehole sediment	Sequential ferrous/ferric iron extractions, including analysis for iron and manganese in extractions (see Section 4.2.8 in Chapter 4); WE	DN #2-1, DN #2-2, DN #4-1
Correlation of contaminant extractability with extracted soil minerals	Sequential extractions with analysis for contaminants and key associations (aluminum, barium, ferric and ferrous iron, calcium, magnesium, manganese, sulfate, sodium, potassium, phosphate, and silicon)	DN #2-1, DN #2-2, DN #4-1
Moisture content	ASTM D2216-10	DN #2-1, DN #2-2, DN #4-1
Bulk density and porosity	ASTM D7263-09, ASTM D854-14	DN #2-1, DN #2-2, DN #4-1
Particle-size distribution (grain size)	ASTM D6913-04(2009)e1, ASTM D4464-15	DN #2-1, DN #2-2, DN #4-1
Lithology, texture, petrologic composition	Geologist inspection of borehole samples	DN #2-1, DN #2-2, DN #4-1

a. Section A1.3.2 defines the DNs.

b. Total organic carbon and total inorganic carbon will be analyzed directly on sediment samples as an information-only analysis using manufacturer procedures.

AE = acid extract
ASTM = ASTM International
COPC = contaminant of potential concern
DN = data need
EPA = U.S. Environmental Protection Agency
ICP/MS = inductively coupled plasma/mass spectrometry
ICP/OES = inductively coupled plasma/optical emission spectrometry
WE = water extract

Table A-8. Tier II Contaminant Attenuation and Transport Characterization

Data Type	Analytical Method(s) Used to Measure/ Attain Required Data[a]	Data Need Addressed[b]
Sequential extraction to identify COPC association with sediment	Sequential treatment with increasingly harsh extraction solutions to evaluate mineral phase association of COPCs	DN #2-1, DN #2-2, DN #4-1, DN #4-3
Batch leaching kinetics and partitioning behavior of contaminants	Batch leaching tests and selected partitioning experiments based on results	DN #2-1, DN #2-2, DN #4-1, DN #4-3
Leaching kinetics of contaminants	Soil column leaching tests	DN #2-1, DN #2-2, DN #4-1, DN #4-3
Sediment surface chemistry to identify associations of contaminants with specific elements	X-ray diffraction and a sequential suite of electron microscopy analyses to map and then verify associations of contaminants with elements indicative of precipitate forms (iron, phosphorus, calcium, silica, barium, and manganese)	DN #2-1, DN #2-2, DN #4-1, DN #4-3
Reaction mechanisms and rates based on identified geochemical conditions	Geochemical assessment with confirmatory batch and soil column experiments to evaluate mechanisms associated with identified surface phases	DN #2-1, DN #2-2, DN #4-1, DN #4-3
Sediment particle surface area	Specific surface area	DN #2-2, DN #4-1, DN #4-3
Reductive capacity of sediments in relation to redox-sensitive contaminants	Soil column reductive capacity tests for selected contaminants	DN #2-1, DN #2-2, DN #4-1, DN #4-3
Contaminant redox speciation	Uranium redox speciation Chromium redox speciation Technetium-99 speciation Iodine-129 speciation	DN #2-1, DN #2-2, DN #4-1, DN #4-3

a. These analyses will be conducted for selected samples to augment the fate and transport data available for the Central Plateau. Determination of whether to conduct these analyses will be made after examining the sediment texture distribution within the sample intervals (based on inspecting the sediment visible at the ends of the liners).

b. Section A1.3.2 defines the DNs.

COPC = contaminant of potential concern
DN = data need
redox = reduction-oxidation

Table A-9. Tier III Selective Sample Characterization

Data Type	Analytical Method(s) Used to Measure/ Attain Required Data	Data Need Addressed*
Unsaturated/saturated hydraulic conductivity (permeability) and moisture retention properties	Multi-step method to determine parameters for soil-moisture characteristic curves ASTM D6836-02(2008)e2, ASTM D5856-15, ASTM D5084-16a, Hopmans et al., 2002	DN #2-2, DN #4-1, DN #4-3
Environmental isotopes as tracers to identify source terms	δ^2H [deuterium] and $\delta^{18}O$ [18-oxygen] isotopic analysis	DN #2-2, DN #4-1, DN #4-3
Microbial tests and indicators of microbial ecology related to contaminant transformation and biogeochemical interactions	qPCR, 16S sequencing/fingerprinting, physiological assays, and total biomass	DN #2-2, DN #4-1, DN #4-3
Microbial tests and indicators of activity associated with contaminant transformation and biogeochemical interactions	The need for analysis and analytical methods will be determined pending review of microbial population data; denitrification enzyme activity (Tiedje, 1994) Selected activity assessments based on qPCR results	DN #2-2, DN #4-1, DN #4-3
Subsurface microbiology transformations	Microbial transformation testing for identified geochemical conditions and organic carbon evaluation	DN #2-2, DN #4-1, DN #4-3

Sources:

Hopmans et al., 2002, *Methods of Soil Analysis Part 4 Physical Methods*, Chapter 3.6.2, "Inverse Methods."

Tiedje, 1994, "Denitrifiers," in *Methods of Soil Analysis Part 2—Microbiological and Biochemical Properties.*

* Section A1.3.2 defines the DNs.

δ = isotopic ratio (delta) of heavy to light isotope
ASTM = ASTM International
DN = data need
qPCR = quantitative polymerase chain reaction

The following are minimum expectations for characterizing geochemical conditions to support fate and transport modeling that might be expanded upon as result of Tier 1 findings. Because there is uncertainty in the subsurface contaminant distribution, multiple lateral locations may be needed at some sites, in particular where intermediate and deep boreholes are used. Details of the decision logic related to sample location selection are provided below:

- **Lateral:**
  - **Shallow:** One of the penetrations known or expected to be in the area of contamination.
  - **Intermediate:** One or more of the penetrations known or expected to be in the area of contamination. The OU technical lead will assess the need for multiple lateral locations based on the volume of waste released and the potential for lateral spreading. If appropriate and available, electrical resistivity tomography data will also be used as input to this selection based on waste stream.
  - **Deep:** All penetrations.

- **Vertical:** Use sample intervals/frequency for shallow, intermediate, and deep penetrations as defined in Sections A3.2.3 and A3.2.4 of this SAP. Zones of contamination and changes in lithology should be primary targets. Where available, electrical resistivity tomography data will be used as input to this selection.

Sample analyses will be conducted using the following logic:

- The base analyses for soil samples are the Tier 1 list. Analyses from the Tier 1 list will define current subsurface contamination characteristics and the basic physical and geochemical parameters necessary to assess whether the Tier 2 and Tier 3 parameters from DOE/RL-2011-50, *Regulatory Basis and Implementation of a Graded Approach to Evaluation of Groundwater Protection* (hereinafter referred to as the graded approach document), or other Central Plateau OUs apply (i.e., whether site-specific conditions are different than those for which the existing parameters and data can be defensibly applied, as determined by the OU technical lead).

- The OU technical lead will determine the number and type of additional tests (selected from the Tier 2 and Tier 3 lists) based on the initial assessment of Tier 1 results as follows:

  - If Tier 1 results indicate specific Tier 2 parameters are needed, then the OU technical lead will first look to existing parameters and data from the graded approach document (DOE/RL-2011-50) or other Central Plateau OUs to fulfill the data needs for site-specific fate and transport evaluations. If existing data are deemed insufficient due to the site-specific conditions, then a site-specific data gap exists and the applicable Tier 2 analyses will be performed. The OU technical lead will select the specific Tier 2 analyses to fill the identified data gaps.

  - If Tier 2 results indicate specific Tier 3 parameters are needed, then the OU technical lead will first look to existing parameters and data from the graded approach document (DOE/RL-2011-50) or other Central Plateau OUs to fulfill the data needs. If existing data are deemed insufficient due to the site-specific conditions, then a site-specific data gap exists and the applicable Tier 3 analyses will be performed. The OU technical lead will select the specific Tier 3 analyses to fill the identified data gaps.

A2.2.2.1 Sequential Extraction Tests

Sequential extraction tests may be used to support data needs to characterize the attenuation processes of vadose zone soil. Sequential extraction may be used to determine the percentage of contaminants and key associated compounds present in the extractable phases of carbonate coatings, carbonate solid-bearing compounds, amorphous hydrous oxides, crystalline iron(III) oxides, and strong acid leachable compounds. This test will involve a series of six sequential liquid extractions and one additional parallel extraction. The sequential extractions are as follows:

- Aqueous extraction by the addition of synthetic groundwater. Synthetic groundwater is created in the laboratory and simulates vadose zone pore water composition near applicable waste sites.

- Adsorbed contaminant extraction by 0.0144M $NaHCO_3$ + 0.0028M Na_2CO_3 (pH 9.3, 1 hour).

- Weak acetic acid extraction (i.e., rind carbonate extraction) consisting of 1 M/L sodium acetate with a pH of ~5, agitated for 1 hour at a solid to solution ratio of 1 g/2 mL. The sample extraction tubes are then centrifuged, and the solution is then decanted and filtered with 0.45 μm filters and preserved for analysis. The sample is weighed to determine the remaining residual solution prior to starting the next

sequential extraction. The target phase for this extraction is the adsorbed contaminant and the contaminant associated with carbonate minerals.

- Strong acetic acid extraction using concentrated glacial acetic acid (pH 2.3, 5 days). The same centrifuge and decanting procedure as for weak acetic acid extraction is used. The target phase for the strong acetic acid is the strongly bound uranium and other contaminants associated with carbonates.
- Oxalate extraction for oxides uses a solution consisting of 0.1 M/L ammonium oxalate, 0.1 mol/L oxalic acid for 1 hour, after which time the samples are centrifuged, decanted, filtered, and weighed. The target phases for the oxalate solution are the amorphous iron, aluminum, manganese, and silicon oxides.
- Nitric acid for hard-to-extract uranium phases (8 M/L HNO_3) at 95°C (203°F) for 2 hours in a sealed Teflon® bottle. Samples are weighed after this step so the final volume can be determined. The target phases for the nitric acid include clays, crystalline oxides, and iron, aluminum, and manganese uranium oxides.
- Analysis for all leachate samples will include selected contaminants for specific waste sites, as well as aluminum, barium, ferric and ferrous iron, calcium, magnesium, manganese, sulfate, phosphate, sodium, potassium, and silicon.
- The mM carbonate solution at pH 9.3 (0.0144M $NaHCO_3$ + 0.0028M Na_2CO_3) will be reacted with sediment for 1,000 hours in a parallel extraction for measurement of long-term labile contaminants because some fraction of the contaminant mass can slowly diffuse out of sediment microfractures (Kohler et al., 2004, "Methods for Estimating Adsorbed Uranium(VI) and Distribution Coefficients of Contaminated Sediments").

A2.2.2.2 Reductive Capacity Tests

Reductive capacity tests may be performed for samples and redox-sensitive contaminants where other tests (e.g., sequential extractions, ferrous iron content, uranium, and chromium speciation) indicate the potential for significant reductive activity, as determined by the OU technical lead. A subsample of the <2 mm fraction of the sediments will be loaded into a stainless-steel column with Teflon end frits. The experimental procedure will consist of anaerobic conditioning and a contaminant-reduction experiment. The anaerobic conditioning will be conducted for the partially saturated sediment column by applying six cycles of vacuum and then nitrogen gas over the course of 1 hour, after which time the columns will be flushed with 400 pore volumes of helium to remove any trapped air in sediment dead end pores.

After anaerobic conditioning, the column will be saturated with one pore volume of liquid, and the inlet and outlets will be sealed with valves. The contaminant reduction experiment will consist of manual injection of ~0.06 pore volumes of anoxic, contaminant-free Hanford Site artificial groundwater at the column inlet and collection of effluent samples at the column outlet. Effluent samples will be analyzed for contaminant concentrations. This contaminant-reduction experimental procedure will enable measurement of the pore water contaminant concentration over time at a high soil-to-water ratio where the soil columns can be considered as a batch (nonflowing) configuration for the test. The sampling procedure will be applied 7 to 14 times to track changes in the tested contaminant concentration, for time periods of up to 1,200 hours.

Teflon® is a registered trademark of E.I. du Pont de Nemours and Company, Wilmington, Delaware.

A2.2.2.3 Microbial Ecology Tests

Microbial ecology tests may be used to identify biological attenuation processes in vadose zone soil for representative locations and depths. If needed, two categories of analyses will be applied to evaluate the microbial ecology of the samples. The first category is based on applying an extract of the sample to different types of microbial culturing media. Microbial growth for these culturing media are measured and used to interpret the phenotypes of microbes present in the sample. The second category is based on extracting genetic material from the sample, identifying the genetic sequences present, and comparing these sequences to established databases to identify the microbes present at the genus or species level. Genetic material will also be probed for specific functional genes that are important in driving biogeochemical processes. This identification can be used to interpret the types of microbes present and provide information on the types of biogeochemical reactions these microbes may catalyze. This information will be used in conjunction with geochemical data to evaluate potential attenuation mechanisms catalyzed by these reactions, potentially including degradation (e.g., denitrification or cyanide degradation) or reductive transformation (e.g., reduction of uranium, hexavalent chromium, iodine-129, or technetium-99 through direct microbial reactions or indirectly by microbially reduced iron) or biogeochemical sequestration (e.g., formation of organic contaminant complexes as a form of bioaccumulation).

Methods for enumeration of total microbial numbers, bacterial density, and total heterotrophs are based on methods provided in APHA/AWWA/WEF, 2012, *Standard Methods For the Examination of Water and Wastewater*, based on Methods SM9216A, SM9221C, and SM9215A. Modifications for methods include verification of electron acceptor use with methods from the literature (e.g., Collos et al., 1999, "An optical method for the rapid measurement of micromolar concentrations of nitrate in marine phytoplankton cultures"; Gould et al., 2003, *An MPN Method for the Enumeration of Iron-Reducing Bacteria*). Tests to quantify functional genes are based on gene amplification using a kit available from Bio-Rad Laboratories of Berkeley, California. Specific primers used to target functional genes are based on methods obtained from the peer-reviewed literature. The quality approach used for gene quantification will be based on EPA 815-B-04-001, *Quality Assurance/Quality Control Guidance for Laboratories Performing PCR Analyses on Environmental Samples*.

A2.2.2.4 Microbial Activity Test

Based on the results from sequential extraction and the quantitative polymerase chain reaction and most probable number analyses, additional experiments may be performed to understand the rates of contaminant biotransformation. Examples include determining enzymes for denitrification using nitrate and nitrite and determining production of nitric oxide or nitrogen gas (Mahne and Tiedje, 1995, "Criteria and Methodology for Identifying Respiratory Denitrifiers"). These analyses will be performed using serum bottles and monitoring the headspace using gas chromatography/mass spectroscopy. Potential for transformation of contaminants such as uranium, technetium-99, and iodine-129 will also be performed using microcosms to determine the capacity of the microbial community present to biotransform contaminants of interest in the waste areas. This information will augment microbial ecology information and will be used in the same way to evaluate potential attenuation mechanisms catalyzed by these microbes. The activity information provides additional evidence that specific types of enzymes can be active in the samples and transform or degrade contaminants (e.g., as specified by OSWER Directive 9283.1-36, *Use of Monitored Natural Attenuation for Inorganic Contaminants at Superfund Sites,* in relation to denitrification enzymes).

A2.2.2.5 Batch Leach Testing

Batch leach testing may be used to characterize the desorption or dissolution kinetics of contaminants. The batch experiments will use ~50 g of sediment and 200 mL of air-saturated artificial pore water. The low sediment-to-water ratio (compared to field at ~5 to 10 g/mL) should result in contaminant desorption to pore water and dissolution of some surface phases. Samples will be taken at specific times to evaluate a wide range of time scales that are relevant to field-scale contaminant transport. The samples will be filtered (0.45 μm) and analyzed for selected contaminants. Pre- and post-batch leaching analyses will be conducted to determine the sediment concentrations.

Batch adsorption/desorption experiments may be performed using a spike with a known mass of contaminant. Experiments will be conducted in 50 mL tubes at a solid-to-solution ratio of 2:3. The actual sediment weight of each tube will be recorded. To initiate the adsorption portion of the experiment, spiked solutions will be added to tubes containing measured aliquots of sediment. Sampling and analysis of the supernatant will be used to determine the extent the contaminant partitions onto the sediment.

A2.2.2.6 Flow-Through Soil Column Leach Tests

Flow-through column leach tests may be conducted to quantify the rate at which contaminants that can be mobilized from the soil. Tests performed will use intact core liners and/or repacked sediment (<2 mm) and will be configured similarly to those described in PNNL-23666, *Conceptual Model of Uranium in the Vadose Zone for Acidic and Alkaline Wastes Discharged at the Hanford Site Central Plateau*, but will be tailored to the specific processes and biogeochemistry of interest.

- **Intact cores:** Any samples to be used for intact core column leach tests should be disturbed as little as possible, with no voids or preferential pathways. The weight of the water-saturated, sediment-filled apparatus and the weight of the dry sediment (dried and weighed at the end of the experiment) within the columns, along with the known volume of the columns, are used to calculate the column pore volume and sediment bulk density of each column, respectively. The columns will be leached with the simulated vadose zone pore water containing a bromide tracer.

- **Repacked sediment (<2 mm):** Flow-through column leach tests may be conducted using repacked sediment (<2 mm) in stainless-steel columns to compare contaminant release rates. This method characterizes additional slow release from millimeter- to centimeter-scale, low-conductivity zones that would be present in the intact cores but not in the repacked sediment. The columns will be filled in increments and tamped as they are filled in order to minimize void space and channelized flow within the columns. The columns will be packed to a bulk density of ~1.65 g/cm^3 (and/or similar to that calculated from any adjacent intact core liners, recognizing the difference in grain-size distribution). The weight of the water-saturated, sediment-filled apparatus and the weight of the dry sediment (placed in the <4 mm particle-size columns), along with the known volume of the columns, are used to calculate the pore volumes and sediment bulk densities of each column.

Column leach tests are performed by slowly injecting air-saturated, simulated vadose zone pore water in an upflow direction in order to remove as much trapped air as possible, thus creating near-water-saturation conditions. Experiments will be run for at least 50 pore volumes and include stop-flow events.

The field texture column tests will measure the saturated hydraulic conductivity of the sample. Effluent samples will be analyzed for target contaminants (e.g., hexavalent chromium [and selected samples for total chromium], uranium, technetium-99, iodine-129, cyanide, and nitrate), pH, and bromide. Pre- and post-test sediment and pore water analyses will be conducted using the methods listed in Tables A-5 and A-6.

A comparison of field and repacked sediment may be used to evaluate the influence of slow release of contaminants from low-permeability zones in the field sediment (i.e., millimeter- to centimeter-scale heterogeneities). Stop-flow events will be conducted multiple times during column studies to evaluate contaminant release rates.

Partitioning experiments may be performed using contaminants spiked in a solution transported by one-dimensional, vertical, bottom-up flow through sediment. The breakthrough of effluent contaminant concentration will be compared to the influent contaminant concentration and the breakthrough of a nonsorbing, nonreactive tracer (bromide ion). The data can be analyzed by one-dimensional flow analysis to estimate an adsorption distribution coefficient. Once the contaminant has achieved a full breakthrough, the influent solution will switch to contaminant-free solution. The elution of contaminant and decrease of contaminant concentrations in the effluent will be tracked, and the data can be analyzed by one-dimensional flow analysis to estimate a desorption distribution coefficient.

A2.2.2.7 Attenuation Mechanism Evaluation

Data obtained from attenuation and transport process testing will be analyzed (e.g., using geochemical simulations) to identify candidate attenuation mechanisms. Batch and soil column transformation and redox speciation tests will be conducted as appropriate to enhance evaluation of the identified mechanisms for select contaminants. This additional information can be used to determine the rate and extent of transformation, as follows:

- Batch and soil column transformation tests may be conducted to demonstrate the observed microbial or abiotic transformation processes under Hanford Site conditions if needed to augment the existing data, geochemical simulations, and literature information. Tests will be conducted using the nominal approaches described above, with selected contaminants spiked at known concentrations and tracked to determine concentration changes over time due to transformation. These tests may expand upon those by using a range of spiked contaminant concentrations, experiment duration, experimental conditions (e.g., solution composition), and sampling times selected by the OU technical lead to enhance understanding of contaminant transformation.

- The oxidation state of uranium minerals in sediments may be identified by x-ray absorption near-edge structure analysis. The molecular structure around the uranium molecules may be evaluated with extended x-ray absorption fine structure. Methods to evaluate the oxidation state of technetium-99 are currently being studied through DOE Office of Energy Management programs. Information from these programs will be used to define the most appropriate redox assessment of technetium-99 in the samples. Iodine speciation will be determined with an adapted inductively coupled plasma/mass spectrometry method using an ion chromatography column for separation of iodine species prior to inductively coupled plasma/mass spectrometry analysis. Chromium, uranium, and iodine redox speciation will be determined as described in Table A-8.

A2.2.2.8 Iron/Manganese Phase Extractions

Attenuation mechanisms and rates may be moderated by the valence states of iron. Therefore, iron extractions may be used to quantify changes in the available iron(II) (ferrous) and iron(III) (ferric) and in borehole sediment. This information is used to evaluate the potential for reduction of uranium, chromium, iodine, and technetium-99 through processes catalyzed by ferrous iron species. The iron extractions are conducted in an anaerobic chamber and consist of (a) 1 M $CaCl_2$, (b) 0.5 M HCl, (c) 0.25 M NH_2OH, 0.25 M HCl, (d) dithionite-citrate-bicarbonate, and (e) 5 M HCl. The quantity of aqueous iron(II) from each extraction was measured using the FerroZine method (Gibbs, 1976, "Characterization and Application of FerroZine Iron Reagent as a Ferrous Iron Indicator") and iron(II) plus iron(III) after

reduction. Ferrous iron is divided into four subfractions and determined from the extraction results in the following manner: ion-exchangeable iron(II) (a), $FeCO_3$ and FeS (b – a), residual iron(II) (e – b), and total Fe(II) (e) (Heron et al., 1994, "Speciation of Fe(II) and Fe(III) in Contaminated Aquifer Sediments Using Chemical Extraction Techniques"). Similarly, the ferric iron was divided into three subfractions defined by poorly crystalline and amorphous iron(III) oxides (c) (Chao and Zhou, 1983, "Extraction Techniques for Selective Dissolution of Amorphous Iron Oxides from Soils and Sediments"), crystalline iron(III) oxides (d – c), and total iron(III) (e). Extraction solutions will also be analyzed for manganese.

A2.2.2.9 Sediment Specific Surface Area

Sediment particle surface area may be analyzed using methods based on the N2-Brunauer-Emmett-Teller method (Brunauer et al., 1938, "Adsorption of Gases in Multimolecular Layers"). This analysis provides precise specific surface area evaluation of materials by nitrogen multi-layer adsorption measured as a function of relative pressure. The technique encompasses external area and pore area evaluations to determine the total specific surface area (in m^2/g), yielding information relevant to the effects of surface porosity and particle size.

A2.2.3 Field Analytical Methods Requirements

Field screening and survey data will be measured in accordance with HASQARD requirements (DOE/RL-96-68). Field analytical methods are performed in accordance with manufacturers' manuals.

A2.2.4 Quality Control

The QC requirements specified in the SAP must be followed in the field and analytical laboratory to ensure that reliable data are obtained. Field QC samples will be collected to evaluate the potential for cross-contamination and to provide information pertinent to sampling variability. Laboratory QC samples estimate the precision, bias, and matrix effects of the analytical data. Tables A-10 and A-11 summarize the field and laboratory QC samples and the acceptance criteria for laboratory. Data will be appropriately qualified and flagged in the HEIS database.

Additional QC measures include laboratory audits and participation in nationally based performance evaluation studies. The contract laboratories participate in national studies such as the EPA-sanctioned Water Pollution and Water Supply Performance Evaluation studies.

Table A-10. QC Sample Requirements[a]

Sample Type	Purpose	Frequency
Field QC		
Field duplicate	Estimate precision, including sampling and analytical variability.	One per batch of 20 or fewer samples collected.
Field split	Estimate precision, including sampling, analytical, and interlaboratory variability.	As needed. When needed, the minimum is one for every analytical method, per medium sampled.
Equipment blank	Verify adequacy of sampling equipment decontamination.	As needed.[b] If only disposable equipment is used, then an equipment blank is not required. Otherwise, one per 20 samples, per medium sampled.
Full trip blank	Assess contamination from containers or transportation.	One per 20 samples per medium sampled.

Table A-10. QC Sample Requirements[a]

Sample Type	Purpose	Frequency
Field transfer blank	Assess contamination from sampling site.	One each day volatile organic compounds are sampled. Not required if no samples are collected for volatile organic compound analysis.
Laboratory QC[c]		
Method blank	Assess response of an entire laboratory analytical system.	At least one per analytical batch[c] or as identified by the method guidance.
Matrix spike	Identify analytical (preparation and analysis) accuracy; possible matrix effect on the analytical method used.	When required by the method guidance, at least one per analytical batch[c] or as identified by the method guidance.
Matrix spike duplicate	Estimate analytical accuracy and precision.	When required by the method guidance, at least one per analytical batch[c] or as identified by the method guidance.
Laboratory control sample	Assess method accuracy.	At least one per analytical batch[c] or as identified by the method guidance.
Laboratory sample duplicates	Laboratory reproducibility and precision.	At least one per batch[c] or as identified by the method guidance.
Surrogates	Recovery/yield.	Added to each sample and QC sample.[d]
Carrier/tracer	Recovery/yield.	Added to each sample and QC sample.[d]

a. The information in this table does not represent U.S. Environmental Protection Agency requirements and is intended solely as guidance.

b. An equipment blank shall be collected for all nondedicated equipment until it can be shown that less frequent collection of equipment blanks is adequate to monitor the decontamination procedure for the nondedicated equipment.

c. Batching across projects is allowed for similar matrices (e.g., soil). The maximum batch size is 20 samples.

d. Unless not required by or a different frequency is defined in laboratory analysis methods.

QC = quality control

Table A-11. Laboratory QC and Acceptance Criteria[a]

Analysis	QC Element	Acceptance Criteria	Corrective Action
Radiochemical Analyses			
Gamma spectroscopy[b]	MB	<MDC <5% sample activity concentration	Flag with "B"
	LCS	80–120% recovery	Flag with "o"[c]
	DUP	≤30% RPD[d]	Review data[e]
	EB, FTB	< MDC <5% sample activity concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote f	Review data[e]
Alpha energy analysis[b]	MB	<MDC <5% sample activity concentration	Flag with "B"
	LCS	80–120% recovery	Flag with "o"[c]
	DUP	≤30% RPD[d]	Review data[e]
	EB, FTB	< MDC <5% sample activity concentration	Flag with "Q"

Table A-11. Laboratory QC and Acceptance Criteria[a]

Analysis	QC Element	Acceptance Criteria	Corrective Action
	Field duplicate/SPLIT	See footnote f	Review data[e]
	Tracer	30-105% recovery	Review data[e]
Liquid scintillation counting[b]	MB	<MDC <5% sample activity concentration	Flag with "B"
	LCS	80–120% recovery	Flag with "o"[c]
	MS	75-125% recovery	Review data[e]
	DUP	≤30% RPD[d]	Review data[e]
	Carrier	40-110%	Review data[e]
	Tracer	30-105% recovery	Review data[e]
	EB, FTB	< MDC <5% sample activity concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote f	Review data[e]
Strontium-90	MB	< MDC <5% sample activity concentration	Flag with "B"
	LCS	80–120% recovery	Flag with "o"[c]
	DUP	≤30% RPD[d]	Review data[e]
	EB, FTB	< MDC <5% sample activity concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote f	Review data[e]
	Carrier	40-110% recovery	Review data[e]
	Tracer	30-105% recovery	Review data[e]
General Chemical Analyses			
Cyanide	MB	<MDL <5% sample concentration	Flag with "C"
	LCS	80–120% recovery	Flag with "o"[c]
	MS/MSD	75–125% recovery	Flag with "N"
	DUP[g]/MSD[g]	≤35% RPD[d]	Review data[d]
	EB, FTB	< MDL <5% sample concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote f	Review data[c,e]
Anions by ion chromatography[h]	MB	<MDL <5% sample concentration	Flag with "C"
	LCS	80–120% recovery	Flag with "o"[c]
	MS/MSD	75–125% recovery	Flag with "N"
	DUP[g]/MSD[g]	≤35% RPD[d]	Review data[e]
	EB, FTB	< MDL <5% sample concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote f	Review data[e]
Ammonia	MB	< MDL <5% sample concentration	Flag with "C"
	LCS	80–120% recovery	Flag with "o"[c]

Table A-11. Laboratory QC and Acceptance Criteria[a]

Analysis	QC Element	Acceptance Criteria	Corrective Action
	MS/MSD	75–125% recovery	Flag with "N"
	DUP[g]/MSD[g]	≤35% RPD[d]	Review data[e]
	EB, FTB	< MDL <5% sample concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote f	Review data[e]
Metals			
Metals (ICP/AES and ICP/MS)[g]	MB	< MDL <5% sample concentration	Flag with "C"
	LCS	80–120% recovery	Flag with "o"[c]
	MS/MSD	75–125% recovery	Flag with "N"
	DUP[g]/MSD[g]	≤35% RPD[d]	Review data[e]
	EB, FTB	< MDL <5% sample concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote f	Review data[e]
Chromium(VI)	MB	<MDL <5% sample concentration	Flag with "C"
	LCS	80–120% recovery	Flag with "o"[c]
	MS/MSD	75–125% recovery	Flag with "N"
	DUP[g]/MSD[g]	≤35% RPD[d]	Review data[e]
	EB, FTB	< MDL <5% sample concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote f	Review data[e]
Mercury	MB	<MDL <5% sample concentration	Flag with "C"
	LCS	80–120% recovery	Flag with "o"[c]
	MS/MSD	75–125% recovery	Flag with "N"
	DUP[g]/MSD[g]	≤35% RPD[d]	Review data[e]
	EB, FTB	< MDL <5% sample concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote f	Review data[e]
Volatile Organic Compounds			
Volatiles by GC/MS[h]	MB	<MDL[i] <5% sample concentration	Flag with "B"
	LCS	70-130% recovery	Flag with "o"[c]
	MS/MSD	70-130% recovery	Flag with "T"
	DUP[g]/MSD[f, g]	≤20% RPD[d]	Review data[e]
	SUR	% recovery statistically derived[j]	Review data[e]
	EB, FTB, FXR	< MDL[i] <5% sample concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote f	Review data[e]

Table A-11. Laboratory QC and Acceptance Criteria[a]

Analysis	QC Element	Acceptance Criteria	Corrective Action
Semivolatile Organic Compounds			
Semivolatiles by GC/MS[h]	MB	<MDL[i] <5% sample concentration	Flag with "B"
	LCS	70-130% recovery	Flag with "o"[c]
	MS/MSD	% recovery statistically derived[j]	Flag with "T"
	DUP[g]/MSD[g]	<30% RPD[d]	Review data[e]
	SUR	% recovery statistically derived[j]	Review data[e]
	EB, FTB	< MDL[i] <5% sample concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote f	Review data[e]
Pesticides by GC[h]	MB	<MDL <5% sample concentration	Flag with "B"
	LCS	70-130% recovery	Flag with "o"[c]
	MS/MSD	% recovery statistically derived[j]	Flag with "N"
	DUP[g]/MSD[g]	<30% RPD[d]	Review data[e]
	SUR	% recovery statistically derived[i]	Review data[e]
	EB, FTB	< 2 times MDL <5% sample concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote f	Review data[e]
PCBs by GC[h]	MB	<MDL <5% sample concentration	Flag with "B"
	LCS	70-130% recovery	Flag with "o"[c]
	MS/MSD	% recovery statistically derived[j]	Flag with "N"
	DUP[g]/MSD[g]	<30% RPD[d]	Review data[e]
	SUR	% recovery statistically derived[j]	Review data[e]
	EB, FTB	< MDL <5% sample concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote f	Review data[e]
Total petroleum hydrocarbons	MB	<MDL <5% sample concentration	Flagged with "B"
	LCS	70-130% recovery	Flag with "o"[c]
	MS/MSD	70-130% recovery	Flag with "N"
	DUP[g]/MSD[g]	≤ 30% RPD[d]	Review data[e]
	SUR	60-140% recovery	Review data[e]
	EB, FTB	< MDL <5% sample concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote f	Review data[e]

Table A-11. Laboratory QC and Acceptance Criteria[a]

Analysis	QC Element	Acceptance Criteria	Corrective Action

Sources:

DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document.*

SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*, as amended.

a. Information in this table does not represent U.S. Environmental Protection Agency requirements and is intended solely as guidance. It only applies to laboratory analyses of analytes. QC associated with physical properties is maintained by analytical laboratories.

b. See Table A-5 for constituent list.

c. Apply with concurrence from the Sample Management and Reporting organization.

d. Applies when at least one result is greater than the laboratory practical quantitation limit (chemical analyses) or >5 times the MDC (radiochemical analyses).

e. After review, corrective actions are determined on a case-by-case basis. Corrective actions may include a laboratory recheck or flagging the data as suspect ("Y" flag) or rejected ("R" flag).

f. A field duplicate RPD for soils is not recommended because of possible soil matrix heterogeneity effects.

g. Either a sample duplicate or an MSD is to be analyzed to determine measurement precision.

h. See Table A-6 for constituent list.

i. For common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the acceptance criteria is <5 times the MDL.

j. Determined by the laboratory based on historical data or statistically derived control limits. Limits are reported with the data. Where specific acceptance criteria are listed, those acceptance criteria may be used in place of statistically derived acceptance criteria.

Data flags:

B, C = possible laboratory contamination; analyte was detected in the associated MB
N = result may be biased; associated MS result was outside the acceptance limits (except GC/MS)
o = result may be biased: associated laboratory control sample result was outside the acceptance limits
Q = problem with associated field QC blank; results were out of limits
R = result is rejected
T = result may be biased; associated MS result was outside the acceptance limits (GC/MS only)
Y = result is suspect

DUP = laboratory sample duplicate
EB = equipment blank
FTB = full trip blank
FXR = field transfer blank
GC = gas chromatography
GC/MS = gas chromatography/mass spectrometry
ICP/AES = inductively coupled plasma/atomic emission spectrometry
ICP/MS = inductively coupled plasma/ mass spectrometry
LCS = laboratory control sample
MB = method blank
MDC = minimum detectable concentration
MDL = method detection limit
MS = matrix spike
MSD = matrix spike duplicate
PCB = polychlorinated biphenyl
QC = quality control
RPD = relative percent difference
SPLIT = field split
SUR = surrogate

A2.2.4.1 Field Quality Control Samples

Field QC samples will be collected to evaluate the potential for cross-contamination and provide information pertinent to field sampling variability and laboratory performance to help ensure that reliable data are obtained. Field QC samples include field duplicates, field split (SPLIT) samples, and three types of field blanks (equipment blanks [EBs], field transfer blanks [FXRs], and full trip [FTBs]). Field blanks

are typically prepared using high-purity reagent water[2] or silica sand. The QC sample definitions and their required frequency for collection are described below:

- **Field duplicates:** Independent samples collected as close as possible to the same time and same location as the scheduled sample and intended to be identical. Field duplicates are placed in separate sample containers and analyzed independently. Field duplicates are used to determine precision for both sampling and laboratory measurements.

  Soil duplicates will be collected and homogenized before dividing into two separate samples in the field. Volatile organic compound (VOC) analysis soil duplicates are not to be homogenized or split and will be collected as collocated samples. Duplicates will be stored and transported together and analyzed for the same constituents by the same laboratory. The duplicates will be used to determine precision for both sampling heterogeneity and laboratory manipulation.

- **Field splits (SPLITs):** Two samples collected as close as possible to the same time and same location and intended to be identical. SPLITs will be stored in separate containers and analyzed by different laboratories for the same analytes. SPLITs are interlaboratory comparison samples used to evaluate comparability between laboratories.

- **Equipment blanks (EBs):** High-purity water or silica sand passed through or poured over decontaminated sampling equipment identical to the sample set collected and placed in sample containers, as identified on the SAF. EB sample bottles are placed in the storage containers with samples from the associated sampling event and are analyzed for the same constituents as samples from the sampling event. EBs are used to evaluate decontamination process effectiveness; these samples are not required for disposable sampling equipment.

- **Field transfer blanks (FXRs):** Preserved volatile organic analysis (VOA) sample vials filled with high-purity water at the sample collection site where VOC samples are collected. FXR samples are prepared during sampling to evaluate potential contamination attributed to field conditions. After collection, FXR sample vials are sealed and placed into the same storage containers with samples collected the same day for the associated sampling event. FXR samples are analyzed for VOCs only.

- **Full trip blanks (FTBs):** Bottles prepared by the sampling team before travel to the sampling site. The preserved bottle set is either for VOA only or identical to the set to be collected in the field. The bottles are filled with high-purity water or silica sand and then sealed and transported (unopened) to the field in the same storage containers used for samples collected that day. The FTBs are typically analyzed for the same constituents as the samples from the associated sampling event. FTB sample results are used to evaluate potential contamination from sample bottles, preservatives, handling, storage, and transport.

A2.2.4.2 Laboratory Quality Control Samples

Internal QA/QC programs are maintained by laboratories used by the project. Laboratory QA includes a comprehensive QC program that uses laboratory control samples (LCSs), laboratory sample duplicates (DUPs), matrix spikes (MSs), matrix spike duplicates (MSDs), method blanks (MBs), surrogates (SURs), tracers, and carriers. These QC analyses are required by EPA methods (e.g., those in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*, as amended), and will be run at the frequency specified in the respective references, unless superseded by

[2] Reagent water is high-purity water generally defined as water that has been distilled, deionized, or any combination of distillation, deionization, reverse osmosis, activated carbon filtration, ion exchange, particulate filtration, or other polishing techniques (DOE/RL-96-68).

agreement. QC checks outside of control limits are documented in analytical laboratory reports during data quality assessments (DQAs), if performed. For organic analyses, QC acceptance criteria are typically statistically derived from historical data at the laboratories in accordance with SW-846.

- **Laboratory control sample (LCS):** A control matrix (e.g., reagent water) spiked with analytes representing the target analytes or certified reference material used to evaluate laboratory accuracy.
- **Laboratory sample duplicate (DUP):** An intralaboratory replicate sample used to evaluate the precision of a method in a given sample matrix.
- **Matrix spike (MS):** An aliquot of a sample spiked with a known concentration of the target analyte(s). The MS is used to assess the bias of a method in a given sample matrix. Spiking occurs prior to sample preparation and analysis.
- **Matrix spike duplicate (MSD):** A replicate spiked aliquot of a sample subjected to the entire sample preparation and analytical process. MSD results are used to determine the bias and precision of a method in a given sample matrix.
- **Method blank (MB):** An analyte-free matrix to which the same reagents are added in the same volumes or proportions as used in the sample processing. The MB is carried through the sample preparation and analytical procedure and is used to quantify contamination resulting from the analytical process.
- **Surrogate (SUR):** A compound added to every sample in the analysis batch (field samples and QC samples) prior to preparation. SURs are typically similar in chemical composition to the analyte being determined but are not normally encountered. SURs are expected to respond to the preparation and measurement systems similar to the analytes of interest. Because SURs are added to every standard, sample, and QC sample, they are used to evaluate overall method performance in a given matrix. SURs are used only in organic analyses.
- **Tracer:** A known quantity of radioactive isotope different from that of the isotope of interest but expected to behave similarly and is added to an aliquot of sample. Sample results are generally corrected based on tracer recovery.
- **Carrier:** Typically nonradioactive (e.g., natural strontium) substances added in known quantities to samples to determine the overall chemical yield for the analytical preparation steps. As with a tracer, carrier recovery is a measure of the amount of analyte lost in performing the method.

Laboratories are required to analyze samples within the holding times specified in Table A-12. In some instances, constituents in the samples not analyzed within the holding times may be compromised by volatilization, decomposition, or other chemical changes. If holding times are exceeded, the effects of the holding-time exceedance on the results will be evaluated on a case-by-case basis. Data from samples analyzed outside of the holding times are flagged in the HEIS database with an "H." The laboratory is required to notify the client in writing as soon as possible if they are unable, for any reason, to meet the prescribed holding times.

Table A-12. Soil Sample Holding-Time Guidelines

Analytes[a]	Preservation[b]	Holding Time[c]
Radionuclides		
Radionuclides by gamma spectroscopy	None	6 months
Radionuclides by alpha energy analysis	None	6 months
Radionuclides by liquid scintillation counting		
Strontium-90	None	6 months
Chemicals		
Cyanide	Store ≤6°C	14 days
Anions by ion chromatography	Store ≤6°C	28 days before extraction 28 days/48 hours[d] after extraction
Ammonia	None	28 days after extraction
Metals by ICP/AES and ICP/MS	None	6 months
Chromium(VI)	Store ≤6°C	30 days before extraction 24 hours after extraction
Mercury	None	28 days
Volatiles by GC/MS	Methanol; store ≤6°C	14 days
Semivolatiles by GC/MS	Store ≤6°C	14 days before extraction 40 days after extraction
Pesticides by GC	Store ≤6°C	14 days before extraction 40 days after extraction
Polychlorinated biphenyls by GC	Store ≤6°C	1 year before extraction 40 days after extraction
Polycyclic aromatic hydrocarbons by GC/MS (SIM)	Store ≤6°C	14 days before extraction 40 days after extraction
Total petroleum hydrocarbons – diesel to oil range (kerosene)	Store ≤6°C	14 days before extraction 40 days after extraction

a. See Section A1.4 for constituent lists.

b. For preservation identified as "store ≤6°C," the sample should be protected against freezing unless it is known that freezing will not impact the sample integrity

c. Hold times for Soil and Sediment Analyses are specified in Table B-5 of CHPRC-00189, *CH2M Hill Plateau Remediation Company Environmental Quality Assurance Program Plan.*

d. The EPA Method 300.0 nitrate, nitrite, and phosphate holding time is 48 hours after sample extraction preparation. The holding time of 28 days applies to all other anions quantified by EPA Method 300.0.

EPA = U.S. Environmental Protection Agency
GC = gas chromatography
GC/MS = gas chromatography/mass spectrometry
ICP/AES = inductively coupled plasma/atomic emission spectrometry
ICP/MS = inductively coupled plasma/mass spectrometry
SIM = selected ion monitoring

A2.2.5 Measurement Equipment

Each user of measuring equipment is responsible for ensuring that the equipment is functioning as expected, properly handled, and properly calibrated at required frequencies in accordance with methods governing control of the equipment. Onsite environmental instrument testing, inspection, calibration, and maintenance will be recorded in accordance with approved methods. Field screening instruments will be used, maintained, and calibrated in accordance with the manufacturer's specifications and other approved methods.

A2.2.6 Instrument and Equipment Testing, Inspection, and Maintenance

Collection, measurement, and testing equipment should meet applicable standards (e.g., ASTM International) or be acceptable and valid in accordance with instrument-specific methods, requirements, and specifications. Software applications will be acceptance tested prior to use in the field.

Measurement and testing equipment used in the field or laboratory will be subject to preventive maintenance measures to minimize downtime. Laboratories must maintain and calibrate their equipment. Maintenance requirements (e.g., documentation of routine maintenance) will be included in the individual laboratory and onsite organization's QA plan or operating protocols, as appropriate. Laboratory instruments maintenance will be performed in accordance with the laboratory procedures.

A2.2.7 Instrument/Equipment Calibration and Frequency

Section A3.6 discusses field equipment calibration. Analytical laboratory instruments are calibrated in accordance with the laboratory's QA plan and applicable Hanford Site requirements.

A2.2.8 Inspection/Acceptance of Supplies and Consumables

Consumables, supplies, and reagents will be reviewed in accordance with internal work requirements and processes described in the Hanford Site contractor and subcontract laboratory's acquisition system and will be appropriate for their use. Responsibilities and interfaces necessary to ensure that items procured/acquired for the contractor meet the specific technical and quality requirements must be in place. The procurement system ensures that purchased items comply with applicable procurement specifications. Supplies and consumables are checked and accepted prior to use.

A2.2.9 Nondirect Measurements

Data obtained from sources such as computer databases, programs, literature files, and historical databases will be technically reviewed to the same extent as data generated as part of any sampling and analysis QA/QC effort. Data used in evaluations will be identified by source.

A2.2.10 Data Management

SMR, in coordination with the OU project manager, is responsible for ensuring that analytical data are appropriately reviewed, managed, and stored in accordance with applicable programmatic requirements governing data management methods.

Electronic data access, when appropriate, will be through a Hanford Site database (e.g., HEIS). Where electronic data are not available, hardcopies will be provided in accordance with Section 9.6 of the Tri-Party Agreement Action Plan (Ecology et al., 1989b).

Laboratory errors are reported to SMR through an established process. For reported laboratory errors, a sample issue resolution form will be initiated in accordance with applicable methods. This process is used to document analytical errors and to establish resolution with the OU project manager. The sample issue resolution forms become a permanent part of the analytical data package for future reference and for records management purposes

A2.3 Assessment and Oversight

Assessment and oversight activities address the effectiveness of project implementation and associated QA/QC activities. The purpose of assessment is to ensure that the QAPjP is implemented as prescribed.

A2.3.1 Assessments and Response Actions

Random surveillances and assessments to verify compliance with the requirements outlined in this SAP, project field instructions, the QAPjP, methods, and regulatory requirements will be directed by the OU project manager. Deficiencies identified by these assessments will be reported in accordance with existing programmatic requirements. The project line management chain coordinates corrective actions/deficiency resolutions in accordance with the QA program, corrective action management program, and associated methods implementing these programs. When appropriate, corrective actions will be taken by the OU project manager (or designee).

A data usability assessment will be performed for the identified SAP activities. The data usability assessment results will be provided to the OU project manager. No other planned assessments have been identified. If circumstances arise in the field dictating the need for additional assessments, the additional assessments will be performed.

Oversight activities in the analytical laboratories, including corrective action management, are conducted in accordance with the laboratory's QA plan. SMR oversees offsite analytical laboratories and verifies that the laboratories are qualified to perform Hanford Site analytical work.

A2.3.2 Reports to Management

Program and project management (as appropriate) will be made aware of deficiencies identified by self-assessments, corrective actions from ECOs, and findings from QA assessments and surveillances. Issues reported by the laboratories are communicated to SMR, which then initiates a sample issue resolution form. This process is used to document analytical or sample issues and to establish resolution with the OU project manager.

These assessments are internal and are not subject to environmental regulations. If an assessment finding results in sampling issues that affect a regulatory requirement, DOE-RL will be informed and the matter will be discussed with the regulatory agencies.

A2.4 Data Review and Usability

This section addresses QA activities that occur after data collection. Implementation of these activities determines whether data conform to the specified criteria, thus satisfying project objectives.

A2.4.1 Data Review and Verification

Data review and verification are performed to confirm that documentation associated with the sampling and analysis processes are complete. This review includes linking sample numbers to specific sampling locations, as well as reviewing sample collection dates and sample preparation and analysis dates to assess whether holding times (if any) have been met. The QC data review is also used to determine whether analyses have met the data quality requirements specified in the SAP.

The criteria for verification include, but are not limited to, review for contractual compliance (samples were analyzed as requested), use of the correct analytical method, transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight, and correct application of conversion factors. Field QA/QC results will be reviewed to ensure usability.

Any errors identified by the laboratories are reported to the SMR project coordinator, who will initiate a sample issue resolution form. This process is used to document analytical errors and establish resolution with the OU technical lead.

Relative to analytical data in sample media, physical data and/or field screening results are of lesser importance in making inferences regarding risk. Physical data and field QA/QC results will be reviewed to ensure the usability of physical property data and/or field screening results.

The OU technical lead will perform data reviews to help determine if observed changes reflect potential data errors, which may result in submitting a request for data review for questionable data. The laboratory may be asked to check calculations or reanalyze the sample. The results of the request for data review process are used to flag the data appropriately in the HEIS database and/or to add comments.

A2.4.2 Data Validation

Data validation is an independent assessment to ensure the reliability of the data. Analytical data validation provides a level of assurance that an analyte is present or absent. Validation may also include verification of instrument calibrations, evaluation of analytical results based on method blanks, recovery of various internal standards, correctness of uncertainty calculations, correctness of identification and quantification of analytes, and the effect of quality deficiencies on data reliability. The contractor follows the data validation process described in EPA-540-R-013-001, *National Functional Guidelines for Inorganic Superfund Data Review*; and EPA-540-R-014-002, *National Functional Guidelines for Superfund Organic Methods Data Review*, adjusted for use with SW-846, HASQARD (DOE/RL-96-68), and radiochemistry methods. The criteria for data validation are based on a graded approach, using five levels of validation: Levels A through E. Level A is the lowest level and is the same as verification. Level E is a 100% review of all data (e.g., calibration data and calculations of representative samples from the data set). Data validation will be performed to Level C, which is a review of the QC data. Level C validation consists of a review of the QC data and specifically requires verification of deliverables; requested versus reported analytes; and qualification of the results based on evaluation of analytical holding times, method blank results, MS/MSD results, surrogate recoveries, and duplicate sample results. Level C data validation is generally equivalent to Level 2A in EPA 540-R-08-005, *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use*. Level C data validation will be performed on at least 5% of the data by matrix and analyte group under the direction of SMR. Analyte group refers to categories such as radionuclides, volatile chemicals, semivolatiles, metals, and anions. The goal is to include each of the various analyte groups and matrices during the data validation process. The DOE-RL project lead or OU project manager may specify a higher percentage of data to be validated or that data validation be performed at higher levels.

A2.4.3 Reconciliation with User Requirements

The purpose of reconciliation with user requirements is to determine if quantitative data are of the correct type and are of adequate quality and quantity to meet the project data needs. The data quality assessment (DQA process) is the scientific and statistical evaluation of previously verified and validated data to determine if information obtained from environmental data operations are of the right type, quality, and quantity to support their intended use (usability). The DQA process uses the entirety of the collected data to determine usability for decision making. If a statistical sampling design was utilized during field sampling activities, then the DQA will be performed following guidance in EPA/240/B-06/003, *Data Quality Assessment Statistical Methods for Practitioners* (EPA QA/G-9S). When judgmental (focused) sampling designs are implemented in the field, DQIs such as precision, accuracy, representativeness, comparability, completeness, and sensitivity for the specific data sets (individual data packages) will be evaluated in accordance with EPA/240/R-02/004, *Guidance on Environmental Data Verification and Data Validation* (EPA QA/G-8). Data verification and data validation are integral to the statistical DQA data evaluation process and the DQI evaluation process. Results of the DQA or DQI processes will be used by the OU technical lead to interpret the data and determine if the data quality objectives for this activity have been met.

A3 Field Sampling Plan

The FSP identifies project sampling and analysis activities, using the sampling design developed through the DQO process. The FSP includes defining sample locations, sampling methods, field documentation, field equipment calibration requirements, and data collection technology information.

A3.1 Sampling Objectives

Field sampling will be performed at individual waste sites or groups of waste sites to address the data gaps identified through the DQO process summarized in Section A1.3 and described in Chapter 4 of the work plan. Due to differences in the nature of waste sites and availability of existing data, the data gaps do not apply uniformly to all waste sites. Section A3.3 discusses the site-specific sampling designs.

A3.2 Sampling Strategies

The purpose of field sampling is to collect representative site data to address the identified data gaps. Optimal sampling strategies involve a combination of targeting locations where contamination is likely to occur and in consideration of data collection capabilities and constraints and statistically based random sampling to support risk assessment. Sampling strategies took into consideration the previous data collected (200-EA-1 scoping document [SGW-60540]), potential contamination depth based on pore volume calculations (ECF-200EA1-17-0066, *Pore Volume Calculation – 200-EA-1 OU Liquid Waste Disposal Sites*), the DQO process (Appendix C of this work plan), and known conditions in the groundwater. This section describes general strategies for data collection based on expected contamination depths. Site-specific sampling designs discussed in Section A3.3 apply combinations of strategies that consider waste site types, physical details, the nature of expected contamination, existing data, and other site-specific considerations identified through the DQO process.

A3.2.1 Systematic Surface Contaminant Detection Surveys

Surface contaminant detection surveys will be performed using field x-ray fluorescence (XRF) and ionizing radiation detection instrument measurements on a systematic grid or at systematic walking intervals to investigate the presence or absence of surface contamination, identify the lateral extent of surface contamination, and identify locations for focused soil sample collection. Systematic surveys

provide an effective means of collecting data over large areas while providing high data density. Radiological and XRF field instruments can reliably measure contamination at the surface, so they are only used where surface contamination is expected and measurements would not be affected by stabilization or cover. Stabilization material may be removed to provide access to a surface of interest.

A3.2.2 Surface Geophysical Surveys to Detect Subsurface Conditions

Surface geophysical surveys can be used to identify subsurface conditions of interest when a difference is present in the properties of the material in relation to the surrounding conditions. These measurements can indicate the presence of subsurface features and obstructions that are important to siting subsequent subsurface characterization efforts or can provide indirect measurement of the distribution of some contaminants in the vadose zone. These techniques will be used to help focus subsequent soil sampling and analysis activities. Two surface geophysical surveys categories will be used in the 200-EA-1 OU:

- Surface-based resistivity methods will be used to measure resistivity gradients at select waste sites. These gradients can provide estimates of ionic contaminant (e.g., nitrate) distribution in the subsurface and identify areas of apparent high concentrations for further study. The methodology may also detect changes in geologic features. Resistivity methods are sensitive to soil moisture and the presence and depth of detectable gradients. The analysis and interpretation of the data are performed on the basis of direct currents and are dependent on a variation between the area being investigated and the surrounding material. Subtle differences may not provide conclusive results and may require secondary methods for confirmation. Resistivity data collected at the surface will be correlated to the known conditions in the surrounding material by using geologic borehole, other geophysical methods, and contaminant information. Results will be included in the remedial investigation report but will primarily be used to guide further investigations at select waste sites.

- Surface-based ground-penetrating radar and electromagnetometry/induction can identify subsurface structural anomalies (e.g., pipelines and buried debris). The survey data can be used to inform judgmental sampling locations. The analysis and interpretation of the data are based on the return frequency detection. As with resistivity data, results will be correlated to known conditions in the surrounding material by using geologic borehole, other geophysical methods, and contaminant information. Results will be included in the remedial investigation report but will primarily be used to guide further investigations at select waste sites. Ground-penetrating radar and/or electromagnetometry surveys may also be used as part of field planning to identify subsurface interferences.

A3.2.3 Shallow Zone Soil Sampling

Surface and subsurface soil samples will be collected for observation and measurement/analysis by field and laboratory techniques. The shallow zone (SZ) (<4.6 m [15 ft] bgs) soil sample locations were selected using judgmental and statistical approaches. The purpose of SZ soil sampling and analysis is to collect site-specific data that will be used to assess the potential exposure to human and ecological receptors under the identified future exposure scenarios. Tables A-14 through A-19 (in Section A3.3) identify the target sampling depths as either judgmental or standard SZ depth intervals. The judgmental SZ depth intervals are generally biased toward locations where contamination is more likely to be identified (based on process history, existing data, and site surveys). The standard SZ depth intervals are generally based on collecting material from the following zones:

- 0.6 to 1.2 m (2 to 4 ft) bgs
- 1.2 to 1.8 m (4 to 6 ft) bgs

- 1.8 to 2.4 m (6 to 8 ft) bgs
- 2.4 to 3.0 m (8 to 10 ft) bgs
- 3.0 to 3.7 m (10 to 12 ft) bgs
- 4.0 to 4.6 m (13 to 15 ft) bgs

A subset of these intervals may be targeted based on individual waste site dimensions and process history. Where SZ sampling is used to characterize soil associated with a specific feature (e.g., a discharge lateral or buried debris), samples will be biased toward the feature depth instead of the standard depth intervals.

A3.2.4 Deep Zone Sampling

Deep zone (DZ) (>4.6 m [15 ft] bgs) soil sample locations were selected using judgmental approaches, generally biasing toward locations where contamination is most likely to be identified based on process history, existing data, and site surveys. The DZ sampling and analysis will generally be used to assess the potential risk to groundwater posed by the observed contamination conditions. Target maximum depths for DZ soil sampling were based on consideration of existing site data, structural feature dimensions (including depth), and potential contamination depth based on pore volume calculations (as calculated in ECF-200EA1-17-0066, *Pore Volume Calculation – 200-EA-1 OU Liquid Waste Disposal Sites*).

The DZ is further subdivided into the intermediate and lower DZ, which are described as follows.

- **Intermediate DZ (4.6 to 15.2 m [15 to 50 ft] bgs):** Subsurface soil samples in the intermediate DZ will be collected for observation and measurement/analysis by field and laboratory techniques. The 15.2 m (50 ft) depth was selected because it is sufficient to bound the lower vertical extent of contamination based on the design of the subsurface engineered disposal features within the OU. The intermediate DZ soil sample locations were selected using judgmental and statistical approaches. Sampling and analysis will generally be used to assess the potential risk to groundwater posed by the observed contamination conditions. Tables A-14 through A-19 (in Section A3.3) identify the target sampling depths as either judgmental or standard intermediate DZ depth intervals.

  The judgmental intermediate DZ depth intervals are generally biased toward locations where contamination is more likely to be identified (based on process history, existing data, and site surveys). The standard intermediate DZ depth intervals are generally based on collecting material from the following zones:

  - 5.3 to 6.1 m (17.5 to 20 ft) bgs
  - 6.9 to 7.6 m (22.5 to 25 ft) bgs
  - 8.4 to 9.1 m (27.5 to 30 ft) bgs
  - 9.9 to 10.7 m (32.5 to 35 ft) bgs
  - 11.4 to 12.2 m (37.5 to 40 ft) bgs
  - 13.0 to 13.7 m (42.5 to 45 ft) bgs
  - 14.5 to 15.2 m (47.5 to 50 ft) bgs

  A subset of these intervals may be targeted based on individual waste site dimensions and process history. Where intermediate DZ sampling is used to characterize soil associated with a specific feature (e.g., a discharge lateral or buried debris), samples will be biased toward the feature depth instead of the standard intervals.

- **Lower DZ (>15.2 m [50 ft] bgs):** Subsurface soil samples in the lower DZ will be collected at discretionarily selected depths. These judgmental lower DZ depth intervals will be selected based on consideration of elevated field screening measurements, observed changes in lithology, observed staining or other discoloration, and observed presence of a higher relative proportion of fine-grained material. Approximately eight judgmental sample depths will be selected for each lower DZ location. If available field data do not suggest a basis for sample depth selection, samples will be collected from roughly equal intervals in the lower DZ, to the extent possible.

A3.2.5 Limitations on Soil Sampling

Sampling with direct-push technology (DPT) or borehole drilling methods may not recover sufficient sample material for analysis from all intervals. If no material is recovered from a given interval, it will be noted in the logbook and no further action is required for that interval. If insufficient sample material is recovered for all analyses, samples will be analyzed according to the priority identified in Tables A-14 through A-19 (in Section A3.3). If insufficient sample material is recovered for multiple sequential intervals, analytical prioritization will attempt to address the entirety of identified methods across these intervals. Laboratory coordination for analyses based on smaller sample volumes will be considered on a case-by-case basis, as allowed by quality criteria.

Many sampling locations were selected to target locations of maximum expected contamination. It is possible that radiological contamination in some depth intervals cannot reasonably be brought to the surface due to personnel exposure and shipping/receiving limitations. Samples will not be collected if expected target interval radiological conditions will not allow sample collection. Field execution planning for this SAP, including radiological work planning, will attempt to minimize target intervals affected by radiological constraints.

Surface and subsurface soil samples collected outside a contaminated waste site footprint may be inconclusive in their ability to describe the vertical distribution of contamination and the observed range of contaminant concentration in soil. No contaminant detection, or no elevated contaminant concentrations outside the area of anticipated contamination extent, may not be conclusive of absence. During the data analysis phase of the RFI/remedial investigation, all data will be evaluated to determine the presence or absence of contamination, or the range of contaminant concentrations present.

A3.2.6 Concrete Sampling

A limited number of 200-EA-1 OU waste sites include concrete structures (e.g., retention basins and residual foundations). If it is necessary to evaluate residual contamination in concrete, corings will be collected and sent intact to analytical laboratories for homogenization and subsequent analysis. These analytical results and subsequent evaluations will be used to inform site decision making. After sampling completion, coring holes will be filled to prevent preferential flow pathways for precipitation or habitation by insects or animals.

A3.2.7 Downhole Geophysical Logging

Downhole geophysical logging methods (e.g., digitally available spectral gamma logging, passive neutron logging, or neutron moisture logging as a percentage) will provide subsurface contaminant measurements and selected physical conditions for all boreholes. These measurements can provide enhanced description of subsurface distribution of naturally occurring and manmade radioisotopes, as well as relative soil moisture conditions. Depending on site conditions and instrument operating conditions, downhole measurements may produce substantially more sensitive results than sample collection and analysis. The measurements will be integrated with other subsurface measurements and observations to support the understanding of site contaminant distribution conditions.

A3.2.8 Transects for Systematic Sampling

Sampling of waste sites collocated with railroad sites will follow a transect approach similar to the approach used for the 200-WA-1 OU. Sampling will consist of a transect across the tracks within the waste site boundary. At each transect, one sample from the center line and one from each side of the track will be analyzed for contamination. Transects can be located randomly to provide even waste site coverage or biased to investigate specific areas of concern. The sampling design presented in Tables A-14 through A-19 (in Section A3.3) specify whether a given transect is random or targeted.

A3.3 Sampling Locations

The following sections summarize target locations for surface-based surveys and subsurface soil sampling. These sampling designs are based on collaboration with Ecology during the DQO process and in consideration of identified data gaps and known sampling constraints.

A3.3.1 Surface Survey Locations

Table A-13 provides the survey requirements for identified data gaps. Surveys in addition to those identified may be performed as part of field work planning.

Table A-13. Field Survey Objectives Summary

Waste Site	Location/Survey Category	Survey Objectives
A Tank Farms Group		
207-A-NORTH	Appendix B, Figure B-1 Systematic radiological survey	Provide systematic beta/gamma radiation measurement maps for the basin.
216-A-6 UPR-200-E-21 UPR-200-E-29	Figure A-2 Resistivity	Estimate lateral extent of subsurface contamination; identify location(s) of highest relative contamination for subsequent subsurface soil sampling and analysis.
216-A-18	Figure A-5 Systematic radiological survey and resistivity	Estimate lateral extent of subsurface contamination.
216-A-19 216-A-20 216-A-34	Figure A-5 GPR and/or electromagnetometry and resistivity	Confirm presence or absence and location of discharge pipeline; estimate lateral extent of subsurface contamination; support identification of soil sampling locations and avoid subsurface interferences.
216-A-30	Figure A-7 Resistivity	Estimate lateral extent of subsurface contamination; identify location(s) of highest relative contamination for subsequent subsurface soil sampling and analysis.
216-A-37-2	Figure A-7 Resistivity	Estimate lateral extent of subsurface contamination; identify location(s) of highest relative contamination for subsequent subsurface soil sampling and analysis.
216-A-40	Figure A-8 GPR and/or electromagnetometry	Confirm extent and depth to the top of subsurface debris; confirm location of the pump caisson for subsequent subsurface soil sampling and analysis and to avoid interferences.
216-A-42 200-E-262-PL	Figure A-2 GPR and/or electromagnetometry	Confirm locations of pipelines around the basin to avoid interferences.
2607-EA	Figure A-8 GPR and/or electromagnetometry	Confirm location of cesspit for subsequent subsurface soil sampling and analysis and to avoid interferences.

Table A-13. Field Survey Objectives Summary

Waste Site	Location/Survey Category	Survey Objectives
2607-E12	Figure A-4 GPR and/or electromagnetometry	Identify the location of discharge laterals at the head end of the western drain field; confirm the location of the primary laterals at the head end of the eastern drain field (secondary laterals also expected) for subsequent subsurface soil sampling and analysis and to avoid interferences.
UPR-200-E-99	Figure A-3 Systematic radiological survey	Provide systematic beta/gamma radiological measurements for the waste site footprint for subsequent soil sampling and analysis.
B Tank Farms Group		
200-E-121	Figure A-9 Systematic radiological survey	Provide systematic beta/gamma radiological measurements for the waste site footprint for subsequent soil sampling and analysis.
200-E-292	Figure A-10 GPR and/or electromagnetometry	Identify potential debris.
2607-E9	Figure A-13 GPR and/or electromagnetometry	Identify the location of discharge laterals at the head end of the drain field for subsequent subsurface soil sampling and analysis and to avoid interferences.
2607-EF	Figure A-13 GPR and/or electromagnetometry	Identify the location of the drain field or other discharge terminus; if present, identify the location of discharge laterals at the head end of the drain field for subsequent subsurface soil sampling and analysis and to avoid interferences.
UPR-200-E-43	Appendix B, Figure B-1 Systematic radiological survey	Provide systematic beta/gamma radiological measurements for the waste site footprint for confirmation of expected conditions.
UPR-200-E-89	Figure A-11 Systematic radiological survey	Provide systematic beta/gamma radiological measurements for the waste site footprint for subsequent soil sampling and analysis.
UPR-200-E-144	Figure A-12 Systematic radiological survey	Provide systematic beta/gamma radiological measurements for the waste site footprint for subsequent soil sampling and analysis.
B Plant Group		
200-E-117	Figure A-15 GPR and/or electromagnetometry	Investigate potential for an underground tank or subsurface pipelines in a 9.1 m (30 ft) radius around the surface risers, as achievable around surface-level infrastructure for subsequent subsurface soil sampling and analysis and to avoid interferences.
200-E-297	Figure A-16 GPR and/or electromagnetometry, systematic radiological survey, and systematic XRF survey	Identify locations and approximate depth of debris; provide systematic beta/gamma radiological and XRF measurements for the waste site footprint for subsequent subsurface soil sampling and analysis and to avoid interferences.
207-B	Figure A-17 Systematic radiological survey	Provide systematic beta/gamma radiological measurements for the waste site footprint for subsequent soil sampling and analysis.

Table A-13. Field Survey Objectives Summary

Waste Site	Location/Survey Category	Survey Objectives
216-B-12	Figure A-22 Resistivity	Estimate lateral extent of subsurface contamination; identify location(s) of highest relative contamination for subsequent soil sampling and analysis.
216-B-59 216-B-59B	Figure A-23 Systematic radiological or systematic XRF survey	Provide systematic XRF measurements for the waste site footprint for subsequent subsurface soil sampling and analysis and to avoid interferences.
218-E-7	Figure A-15 GPR and/or electromagnetometry	Confirm locations of burial vaults and presence/absence of any other detectable subsurface anomalies in a 4.6 m (15 ft) radius around each vault for subsequent subsurface soil sampling and analysis and to avoid interferences.
2607-E3	Figure A-22 GPR and/or electromagnetometry	Identify the location of discharge laterals at the head end of the drain field for subsequent subsurface soil sampling and analysis and to avoid interferences.
UPR-200-E-64	Figure A-18 Systematic radiological survey	Provide systematic beta/gamma radiological measurements for the waste site footprint for subsequent soil sampling and analysis.
UPR-200-E-69	Figure A-19 Systematic radiological survey	Provide systematic beta/gamma radiological measurements for the waste site footprint for subsequent soil sampling and analysis.
Hot Semiworks Plant Group		
200-E-41	Figure A-27 Systematic radiological survey	Provide systematic beta/gamma radiological measurements for a 4.6 m (15 ft) wide corridor surrounding the surface ash layer for subsequent soil sampling and analysis.
200-E-56	Figure A-25 GPR and/or electromagnetometry	Confirm location of subsurface pipelines in a 4.6 m (15 ft) radius around the waste site location for subsequent subsurface soil sampling and analysis and to avoid interferences.
200-E-57	Figure A-25 GPR and/or electromagnetometry	Confirm location of subsurface pipelines in a 4.6 m (15 ft) radius around the waste site location, attempting to identify the endpoints of the abandoned pipeline section for subsequent subsurface soil sampling and analysis and to avoid interferences.
200-E-293	Figure A-24 Systematic radiological survey (after removal of soil cover)	Provide systematic beta/gamma radiological measurements for the residual slab for subsequent soil sampling and analysis.
200-E-294	Figure A-24 Systematic radiological survey (after removal of soil cover)	Provide systematic beta/gamma radiological measurements for the residual slab for subsequent soil sampling and analysis.
216-C-1	Figure A-25 Resistivity	Estimate lateral extent of subsurface contamination and to avoid interferences.
216-C-2	Figure A-25 GPR and/or electromagnetometry and resistivity	Confirm location of the injection well and influent pipelines; estimate lateral extent of subsurface contamination for subsequent subsurface soil sampling and analysis and to avoid interferences.

Table A-13. Field Survey Objectives Summary

Waste Site	Location/Survey Category	Survey Objectives
216-C-6	Figure A-25 GPR and/or electromagnetometry	Confirm crib boundaries and the location of the influent pipeline; identify any discharge laterals within the crib footprint for subsequent subsurface soil sampling and analysis and to avoid interferences.
216-C-7	Figure A-24 GPR and/or electromagnetometry	Confirm crib boundaries and the location of the influent pipeline; identify any discharge laterals within the crib footprint for subsequent subsurface soil sampling and analysis and to avoid interferences.
216-C-10	Figure A-25 Resistivity	Estimate lateral extent of subsurface contamination; identify location(s) of highest relative contamination for subsequent subsurface soil sampling and analysis and to avoid interferences.
2607-E5	Figure A-24 GPR and/or electromagnetometry	Identify the location of discharge laterals at the head end of the drain field; identify the location of the terminus of the discharge pipeline in the leaching trench for subsequent subsurface soil sampling and analysis and to avoid interferences.
291-C-1	Figure A-25 GPR and/or electromagnetometry	Confirm stack foundation and burial trench locations for subsequent subsurface soil sampling and analysis and to avoid interferences.
PUREX Plant Group		
200-E-13	Figure A-29 GPR and/or electromagnetometry, and systematic XRF survey	Identify locations and approximate depth of debris; provide systematic XRF measurements for the waste site footprint for subsequent subsurface soil sampling and analysis and to avoid interferences.
216-A-3	Figure A-30 GPR and/or electromagnetometry and resistivity	Identify the locations of discharge laterals within the crib footprint; estimate lateral extent of subsurface contamination; identify location(s) of highest relative contamination for subsequent subsurface soil sampling and analysis and to avoid interferences.
216-A-9	Figure A-30 Resistivity	Estimate lateral extent of subsurface contamination; identify location(s) of highest relative contamination for subsequent subsurface soil sampling and analysis and to avoid interferences.
216-A-10	Figure A-33 Resistivity and systematic radiological survey	Estimate lateral extent of subsurface contamination; identify location(s) of highest relative contamination; provide systematic beta/gamma radiological measurements for the waste site footprint for subsequent subsurface soil sampling and analysis and to avoid interferences.
216-A-27	Figure A-34 Resistivity	Estimate lateral extent of subsurface contamination; identify location(s) of highest relative contamination for subsequent subsurface soil sampling and analysis and to avoid interferences.
216-A-45	Figure A-33 Resistivity	Estimate lateral extent of subsurface contamination; identify location(s) of highest relative contamination for subsequent subsurface soil sampling and analysis and to avoid interferences.

Table A-13. Field Survey Objectives Summary

Waste Site	Location/Survey Category	Survey Objectives
2607-E6	Figure A-32 GPR and/or electromagnetometry	Identify the distribution box and discharge lateral locations at the head ends of both drain fields for subsequent subsurface soil sampling and analysis and to avoid interferences.
UPR-200-E-88	Figure A-32 Systematic radiological survey	Provide systematic beta/gamma radiological measurements for the waste site footprint for subsequent soil sampling and analysis.
Miscellaneous Group		
200-E BP	Figure A-35 GPR and/or electromagnetometry and systematic radiological survey	Identify locations and approximate depth of debris; provide beta/gamma radiological measurements for the waste site footprint for subsequent subsurface soil sampling and analysis and to avoid interferences.
200-E-53; UPR-200-E-50	Figure A-37 Systematic radiological survey	Provide systematic beta/gamma radiological measurements for the waste site footprint for subsequent soil sampling and analysis.
UPR-200-E-11 UPR-200-E-10 UPR-200-E-12 UPR-200-E-20 UPR-200-E-33	Appendix B, Figure B-1 Systematic radiological survey	Provide systematic beta/gamma radiological measurements for the waste site footprint for subsequent soil sampling and analysis.
UPR-200-E-95	Figure A-19 Systematic radiological survey	Provide systematic beta/gamma radiological measurements for the waste site footprint for subsequent soil sampling and analysis.
UPR-200-E-112	Appendix B, Figure B-1 Systematic radiological survey	Provide systematic beta/gamma radiological measurements for the waste site footprint for subsequent soil sampling and analysis.

GPR = ground-penetrating radar
PUREX = plutonium uranium extraction
UPR = unplanned release
XRF = x-ray fluorescence

A3.3.2 Soil Sampling Locations

Tables A-14 through A-19 and Figures A-2 through A-35 identify soil sample locations organized by 200-EA-1 OU group. The tables describe sampling targets as either an area of interest[3] (AOI) or sample location. The locations and depths identified in these sampling designs are targets, and all reasonable efforts will be made to collect soil samples from the locations and depths described. Where sampling is limited by the potential for excessive radiological or chemical hazards, physical safety, administrative restrictions, or other operational planning considerations, the locations or depth intervals may be adjusted or eliminated in consideration of sampling objectives. In these instances, change control will be managed in accordance with Section A2.1.6. If sample collection is limited by insufficient sample material for a given depth, this will be described in the field logbook and further corrective action is not required. Where sample collection is limited by unexpected field conditions (e.g., contamination levels above

[3] The area of interest provides the spatial area where random sample locations will be selected.

planned exposure limits or borehole refusal), change control will be managed in accordance with Section A2.1.6 in consideration of field conditions and sampling objectives.

A3.4 Sampling Methods

This section describes the sampling methods that will be used in combination with the sampling strategies (Section A3.2) to accomplish the sampling objectives (Section A3.1). Sampling activities broadly include vadose zone soil sampling, field surveys, field screening measurements, and geophysical logging. Depending on the site-specific conditions, data needs, and target sampling depth, the following methods for vadose zone soil sampling will be used (methods are presented in general order of preference):

- Surface soil samples will be collected using hand tools.
- Shallow subsurface samples may be collected using test pits or trenching.
- All other subsurface soil samples will be collected with DPT or borehole drilling methods using the continuous coring method, as conditions allow.
- In cases where continuous coring may not be possible, samples may be collected using split-spoon samplers, split-spoon-like devices driven by DPT, or core barrels advanced with conventional drilling technology.

These methods are most often used in chemical and radiological contaminant data collection; however, some methods may also be used to collect lithology, hydraulic property, contaminant mobility, and geochemical information. In all cases requiring vadose zone soil sampling, excavation permits will be obtained prior to any digging, and precautions will be taken to minimize dispersing contamination and risks from exposure.

To ensure the usability of samples and data, sampling associated with this SAP will be performed in accordance with established sampling practices, procedures, and requirements pertaining to sample collection, sampling equipment, and sample handling. The OU project manager and other contractor managers are responsible for ensuring that all field procedures are followed and that field sampling personnel are adequately trained to perform sampling activities under this SAP.

Field sampling shall comply with HASQARD requirements (DOE/RL-96-68) for sample collection, collection equipment, and sample handling.

For certain types of samples, preservation is required (Table A-12). Where applicable, preservatives are added to the collection bottles before their use in the field. The container types, preservatives, and volumes will be identified on the SAF and chain-of-custody form. This SAP defines a "sample" as a set of filled sample bottles for the purpose of beginning holding-time restrictions.

Holding time is the maximum period allowed between sample collection and laboratory analysis (Table A-12). Exceeding required holding times could result in changes in constituent concentrations due to volatilization, decomposition, or other contaminant alterations. Required holding times depend on the constituent and are listed in analytical method compilations such as APHA/AWWA/WEF, 2012, *Standard Methods for the Examination of Water and Wastewater*; and SW-846. Recommended holding times are also provided in HASQARD (DOE/RL-96-68).

Table A-14. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the A Tank Farms Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[e]
Potential Shallow Vadose Zone Contamination			
UPR-200-E-99 (UPR-solid) Figure A-3	Contingency samples to be collected if radiological contamination is detected during the radiological survey: • AOI #1: Collect two random samples within the AOI.[g]	At each location, collect standard SZ depth intervals from the bottom of the stabilization material to 4.6 m (15 ft).	GEA, AEA, strontium-90, metals, mercury, anions
Potential Partial- and Full-Thickness Vadose Zone Contamination			
216-A-1 Crib Figure A-4	AOI #1: Random location near the center of the crib.[f]	Location #1: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; standard intermediate DZ depth intervals from 4.6 to 15.2 m (15 to 50 ft) bgs.	GEA, AEA, strontium-90, carbon-14, iodine-129, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, cyanide, ammonia, VOA, SVOA, PAHs, PCBs, TPH
	AOI #2: Random location near the inlet to the crib (western side).[f]	Location #2: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
216-A-6 Crib UPR-200-E-21 (UPR-liquid) UPR-200-E-29 (UPR-liquid) Figure A-2	Location #4: Near the center of the crib, biased by resistivity results.	Location #4: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; judgmental intermediate and lower DZ depth intervals from 4.6 m (15 ft) bgs to the groundwater table.	GEA, AEA, strontium-90, carbon-14, iodine-129, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, cyanide, ammonia, VOA, SVOA, PAHs, PCBs, TPH
	AOI #5: Random location on the northern side of the crib.[g] AOI #6: Random location on the southern side of the crib.[g]	AOIs #5 and #6: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; judgmental intermediate and lower DZ depth intervals from 4.6 m (15 ft) bgs sampling to the groundwater table.	
	AOI #7: Random location on the southwest of the crib.[g] AOI #8: Random location on the northeast of the crib.[g]	AOIs #7 and #8: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	

Table A-14. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the A Tank Farms Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[e]
216-A-18 Trench Figure A-5	AOI #1: Random location outside of the trench footprint.[f]	AOI #1: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; one judgmental sample at 6.1 m (20 ft) bgs.	GEA, AEA, strontium-90, carbon-14, iodine-129, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, cyanide, ammonia, VOA, SVOA, PAHs, PCBs, TPH
	AOI #2: Random location within the trench footprint.[f]	AOI #2: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; standard intermediate DZ depth intervals from 4.6 to 15.2 m (15 to 50 ft) bgs; judgmental lower DZ depth intervals from 15.2 m (50 ft) to the groundwater table.	
216-A-19 Trench Figure A-5	Location #3: To be sited based on resistivity results.	Location #3: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; standard intermediate DZ depth intervals from 4.6 to 15.2 m (15 to 50 ft) bgs.	GEA, AEA, strontium-90, carbon-14, iodine-129, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, cyanide, ammonia, VOA, SVOA, PAHs, PCBs, TPH
	AOI #4: Random location to the north of boring C3245 location.[f]	AOI #4 and Location #5: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
	Location #5: Random location.		
216-A-20 Trench Figure A-5	Location #6: To be sited based on resistivity results.	Location #6: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; standard intermediate DZ depth intervals from 4.6 to 15.2 m (15 to 50 ft) bgs.	GEA, AEA, strontium-90, carbon-14, iodine-129, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, cyanide, ammonia, VOA, SVOA, PAHs, PCBs, TPH
	AOIs #7 and #8: Random location within the overflow area.[f]	AOIs #7 and #8: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
216-A-29 Ditch Figure A-6	AOI #1: Random location near the head (southwestern) end of the waste site.[f]	AOIs #1 and #2: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; standard intermediate DZ depth intervals from 4.6 to 15.2 m (15 to 50 ft) bgs.	GEA, pH, anions, cyanide, ammonia, AEA, tritium, VOA, SVOA, PAHs, PCBs, pesticides,[h] TPH, metals, mercury, hexavalent chromium, technetium-99, nickel-63, strontium-90
	AOI #2: Random location near the downstream (northeastern) end of the waste site.[f]		

Table A-14. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the A Tank Farms Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[e]
216-A-30 Crib Figure A-7	Location #E1: To be sited in the middle of the crib, biased by resistivity survey results.	Location #1: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; judgmental intermediate and lower DZ depth intervals from 4.6 m (15 ft) bgs sampling to the groundwater table.	GEA, AEA, strontium-90, carbon-14, iodine-129, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, cyanide, ammonia, VOA, SVOA, PAHs, PCBs, TPH
	AOI #2: Random location near the crib distribution box.[f]	AOI #2 and Location #3: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; judgmental intermediate and lower DZ depth intervals from 4.6 m (15 ft) bgs sampling to 61.0 m (200 ft) bgs	
	Location #3: Inside the eastern end of the crib (biased by resistivity survey results).		
	AOI #4: Random location near boring C5941.[f]	AOI #4: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
216-A-34 Ditch Figure A-5	AOI #9: Random location near the former discharge from 200-E-166-PL/head end of 216-A-34.[f]	Location #9: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; standard intermediate DZ depth intervals from 4.6 to 15.2 m (15 to 50 ft) bgs.	GEA, AEA, strontium-90, carbon-14, iodine-129, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, cyanide, ammonia, VOA, SVOA, PAHs, PCBs, TPH
	AOI #10: Random location near the former trench junction.[f]	AOI #10: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
216-A-37-1 Crib Figure A-7	AOI #5: Random location near boring C4106.[f]	AOIs #5, #6, and #7: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; judgmental intermediate and lower DZ depth intervals from 4.6 m (15 ft) bgs sampling to the groundwater table.	GEA, pH, anions, cyanide, ammonia, AEA, tritium, VOA, SVOA, PAHs, PCBs, pesticides,[h] TPH, metals, mercury, hexavalent chromium, technetium-99, nickel-63, strontium-90
	AOI #6: Random location near the midpoint of the crib.[f]		
	AOI #7: Random location near the northwestern end of the crib.[g]		
	AOI #8: Random location between AOIs #5 and #6.[g]	AOIs #8 and #9: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
	AOI #9: Random location between AOIs #6 and #7.[g]		

Table A-14. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the A Tank Farms Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[e]
216-A-37-2 Crib Figure A-7	Location #10: To be sited near the middle of the crib, biased by resistivity survey results.	Location #10: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; judgmental intermediate and lower DZ depth intervals from 4.6 m (15 ft) bgs sampling to the groundwater table.	GEA, pH, anions, cyanide, ammonia, AEA, tritium, VOA, SVOA, PAHs, PCBs, pesticides,[h] TPH, metals, mercury, hexavalent chromium, technetium-99, nickel-63, strontium-90
	Location #11: To be sited at the eastern end of the crib, biased by resistivity survey results.	Location #11: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; judgmental intermediate and lower DZ depth intervals from 4.6 m (15 ft) bgs sampling to 61.0 m (200 ft) bgs.	
	Locations #12 and #13: Random locations.	Locations #12 and #13: standard SZ depth intervals from 0 to 4.6 S (0 to 15 ft) bgs.	
216-A-40 Retention Basin Figure A-8	AOI #1: Random location near the middle of the site.[f]	AOI #1: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; standard intermediate DZ depth intervals from 4.6 to 15.2 m (4.6 to 50 ft) bgs.	GEA, AEA, strontium-90, carbon-14, iodine-129, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, cyanide, ammonia, VOA, SVOA, PAHs, PCBs, TPH
	AOI #2: Random location near the northern end of the site (former unlined area).[f]	AOI #2: standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; one judgmental sample at 6.1 m (20 ft) bgs.	
	Location #3: Under the southern end of the site/buried debris area (angled penetration expected).	Location #3: One judgmental sample at 6.1 m (20 ft) bgs.	
	AOI #4: Random location near the pump caisson.[f]	AOIs #4 and #5: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; one judgmental sample at 6.1 m (20 ft) bgs.	
	AOI #5: Random location near the diversion box.[f]		
216-A-41 Crib 200-E-276-PL (pipeline) Figure A-8	AOI #6: Random location near the middle of the crib.[f]	AOI #6: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; one judgmental sample at 6.1 m (20 ft) bgs.	GEA, AEA, strontium-90, carbon-14, iodine-129, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, cyanide, ammonia, VOA, SVOA, PAHs, PCBs, TPH
	AOI #7: Random location near the inlet to the crib (southeast side).[f]	AOI #7: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	

Table A-14. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the A Tank Farms Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[e]
UPR-200-E-66 (UPR-solid) Figure A-2	AOI #1: Random location near the 216A42D diversion box, after removal of the box.[f]	AOIs #1 to #3: Collect standard SZ depth intervals from directly below stabilization material to 4.6 m (15 ft) bgs.	GEA, AEA, strontium-90, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, cyanide, ammonia, SVOA, PAHs, PCBs, TPH
	AOI #2: Random location to the southwest of the 216A42D diversion box, after removal of the box.[f]		
	AOI #3: Random location to the northeast of the 216A42D diversion box, after removal of the box.[f]		
216-A-42 Retention Basin 200-E-262-PL (pipeline) Figure A-2	AOI #9: Random location near the 216A42D diversion box, after removal of the box.[f]	AOI #9: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; standard intermediate DZ depth intervals from 4.6 to 15.2 m (15 to 50 ft) bgs.	GEA, AEA, strontium-90, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, cyanide, ammonia, SVOA, PAHs, PCBs, TPH For concrete cores, GEA and AEA only
	AOI #10: Remove cover blocks and sample random location near the 200-E-263-PL connection with the basin.[f]	AOI #10: Collect concrete coring; standard SZ depth intervals from 3.0 to 4.6 m (10 to 15 ft) bgs; standard intermediate DZ depth intervals from 4.6 to 15.2 m (15 to 50 ft) bgs.	
	AOI #11: Random location near the 200-E-262-PL connections on the southwestern side of the basin.[f]	AOI #11: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; standard intermediate DZ depth intervals from 4.6 to 15.2 m (15 to 50 ft) bgs.	
	AOI #12: Remove cover blocks and sample random location within the 216-A-42 basin.[f]	AOI #12: Collect concrete coring; standard SZ depth intervals from 3.0 to 4.6 m (10 to 15 ft) bgs; standard intermediate DZ depth intervals from 4.6 to 15.2 m (15 to 50 ft) bgs.	

Table A-14. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the A Tank Farms Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[e]
2607-E12 septic system Figure A-4	AOI #3: Random location near seepage pit.[f]	AOIs #3 to #5: Collect judgmental samples at base of structure (~2.1 m [~7 ft] bgs) and from 0.9 m (3 ft) further below.	GEA, SVOA, PAHs, TPH, PCBs, pesticides, metals, mercury, anions
	AOI #4: At western drain field, randomly select one location within a trench along first lateral and across sublaterals.[f]		
	AOI #5: At eastern drain field, randomly select one location within a trench across main line at the first laterals.[f]		
	Contingency sampling: In the event that nonsanitary discharges are indicated at any of the discharge features, then randomly select two locations at each discharge feature where nonsanitary discharges were indicated.	Contingency sampling: For each location, collect standard SZ depth intervals from the bottom to the structure (~2.1 m [~7 ft] bgs) to 4.6 m (15 ft) bgs.	
2607-EA septic system Figure A-8	Location# 8: At the cesspit/dry well.	Location #8: Standard SZ depth intervals from the bottom of the structure (~2.1 m [~7 ft] bgs) to 4.6 m (15 ft) bgs.	GEA, SVOA, PAHs, TPH, PCBs, pesticides, metals, mercury, anions
	Contingency sampling: In the event that nonsanitary discharges are indicated at the cesspit, then randomly select two locations within 6.1 m (20 ft) of the cesspit.	Contingency sampling: For each location, collect standard SZ depth intervals from 0 to 4.6 m (15 ft) bgs.	

a. Section A3.2.3 provides the standard SZ depth intervals. Site-specific sample designs may restrict sample collection to a subset of these intervals.

b. Section A3.2.4 provides the standard intermediate DZ depth intervals. Site-specific sample designs may restrict sample collection to a subset of these intervals.

c. For judgmental sampling in the DZ, eight samples will be collected at discretionarily selected locations as described in Section A3.2.4.

d. Analytical methods are listed in descending order of priority. If insufficient sample volume is available for all planned analyses, analysis will be requested based on priority and available volume. Attempts will be made to collect at least every other sample of lower priority analytical groups.

e. Supplemental analyses and testing for soil properties and attenuation/transport evaluations are not listed. See Sections 2.2.2, 3.4.8, and 3.4.9 in the work plan for additional details and guidance.

f. Location shown on the figure represents the center point of the AOI. Sampling locations for the AOI will be randomly selected within 6.1 m (20 ft) of this location.

g. Location shown on the figure represents the general location of the AOI. Sampling locations for the AOI will be randomly selected within the area described.

h. Pesticide analysis will be requested only for samples collected from 0 to 4.6 m (0 to 15 ft) bgs.

Table A-14. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the A Tank Farms Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[e]

AEA = alpha energy analysis
AOI = area of interest
bgs = below ground surface
DZ = deep zone
GEA = gamma energy analysis
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
SZ = shallow zone
SVOA = semivolatile organic analysis
TPH = total petroleum hydrocarbons
UPR = unplanned release
VOA = volatile organic analysis

Table A-15. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the B Tank Farms Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b]	Sample Analyses[c,d]
Potential Shallow Vadose Zone Contamination			
200-E-121 (UPR-solid) Figure A-9	Locations #1 to #10: Randomly determined locations on a systematic grid within the area on the east side of Baltimore Avenue.	Locations #1 to #10: Collect one judgmental sample between 0 to 1.5 m (0 to 5 ft) bgs, biased by radiological field screening.	GEA, AEA, strontium-90, metals, mercury, anions
	Location #11: Randomly determined locations on a systematic grid within the area on the east side of Baltimore Avenue.	Location #11: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
	Locations #12 to #22: Randomly determined locations on a systematic grid within the area on the west side of Baltimore Avenue.	Locations #12 to #22: Collect one judgmental sample between 0 to 1.5 m (0 to 5 ft) bgs, biased by radiological field screening.	
	Location #23: Randomly determined locations on a systematic grid within the area on the west side of Baltimore Avenue.	Location #23: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
200-E-292 dumping area Figure A-10	Location #1: Randomly determined locations on a systematic grid in debris pit.	Location #1: Standard SZ depth intervals from 0 to 4.6 m (0 toS15 ft) bgs.	GEA, metals, mercury, hexavalent chromium, SVOA, PAHs, TPH, PCBs, VOA, pesticides, anions
	Locations #2 through #10: Randomly determined locations on a systematic grid in debris pit.	Locations #2 to #10: Collect one judgmental sample from native material directly below any debris located	
	Location #11: Randomly determined locations on a systematic grid in debris pit.	Location #11: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
UPR-200-E-89 (UPR-solid) Figure A-11	Location #1: Randomly determined locations on a systematic grid within the site boundaries.	Location #1: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	GEA, AEA, strontium-90, metals, mercury, anions
	Locations #2 through #10: Randomly determined locations on a systematic grid within the site boundaries.	Locations #2 through #10: Collect one judgmental sample between 0 to 1.5 m (0 to 5 ft) bgs, biased by radiological field screening.	
	Location #11: Randomly determined locations on a systematic grid within the site boundaries.	Location #11: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	

Table A-15. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the B Tank Farms Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b]	Sample Analyses[c,d]
UPR-200-E-144 (UPR-solid) Figure A-12	Location #1: Randomly determined locations on a systematic grid on soil pile.	Location #1: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	GEA, AEA, strontium-90, metals, mercury, anions
	Locations #2 through #11: Randomly determined locations on a systematic grid on soil pile.	Locations #2 through #10: Collect one judgmental sample between 0 to 1.5 m (0 to 5 ft) bgs, biased by radiological field screening.	
	Location #12: Randomly determined locations on a systematic grid on soil pile.	Location #12: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
Potential Partial-Thickness Vadose Zone Contamination			
216-B-51 french drain Figure A-13	AOI #1: Random location near the french drain.[e]	AOI #1: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; standard intermediate DZ depth intervals from 4.6 to 15.2 m (15 to 50 ft) bgs.	GEA, AEA, strontium-90, , iodine-129, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, cyanide, ammonia, VOA, SVOA, PAHs, PCBs, TPH
	AOI #2: Random location near the inlet.[e]	AOI #2: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; standard intermediate DZ depth intervals from 4.6 to 15.2 m (15 to 50 ft) bgs.	
2607-E9 septic system Figure A-13	AOI #3: Randomly select two locations within a trench near the first lateral and the main line.[e]	AOI #3: Standard SZ depth intervals from the discharge point to 4.6 m (15 ft) bgs.	GEA, SVOA, PAHs, TPH, PCBs, pesticides, metals, mercury, anions
	Contingency sampling: In the event that nonsanitary discharges are indicated at the drain field, then randomly select two locations within the drain field.	Contingency sampling: For each location, collect standard SZ depth intervals from 0 to 4.6 m (15 ft) bgs.	
2607-EF septic system Figure A-13	AOI #4: Randomly select one location within a trench along location of first lateral from main line (if no drain field is located, define AOI as the terminal end of the discharge pipe from the septic tank).[e]	AOI #4: Standard SZ depth intervals from the discharge point to 4.6 m (15 ft) bgs.	GEA, SVOA, PAHs, TPH, PCBs, pesticides, metals, mercury, anions
	Contingency sampling: In the event that nonsanitary discharges are indicated at the drain field, then randomly select two locations within the drain field.	Contingency sampling: For each location, collect standard SZ depth intervals from 0 to 4.6 m (15 ft) bgs.	

Table A-15. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the B Tank Farms Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b]	Sample Analyses[c,d]

a. Section A3.2.3 provides the standard SZ depth intervals. Site-specific sample designs may restrict sample collection to a subset of these intervals.

b. Section A3.2.4 provides the standard intermediate DZ depth intervals. Site-specific sample designs may restrict sample collection to a subset of these intervals.

c. Analytical methods are listed in descending order of priority. If insufficient sample volume is available for all planned analyses, analysis will be requested based on priority and available volume. Attempts will be made to collect at least every other sample of lower priority analytical groups.

d. Supplemental analyses and testing for soil properties and attenuation/transport evaluations are not listed. See Sections 3.4.8 and 3.4.9 in the work plan for additional details and guidance.

e. Location shown on the figure represents the center point of the AOI. Sampling locations for the AOI will be randomly selected within 6.1 m (20 ft) of this location.

AEA = alpha energy analysis
AOI = area of interest
bgs = below ground surface
DZ = deep zone
GEA = gamma energy analysis
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
SVOA = semivolatile organic analyte
SZ = shallow zone
TPH = total petroleum hydrocarbons
UPR = unplanned release
VOA = volatile organic analyte

Table A-16. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the B Plant Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[d,e]
Potential Shallow Vadose Zone Contamination			
200-E-26 (UPR-liquid) Figure A-14	Location #1: Randomly determined locations on a systematic grid within the site boundaries.	Location #1: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	SVOA, PAHs, TPH, PCBs, VOAs
	Locations #2 through #9: Randomly determined locations on a systematic grid within the site boundaries.	Locations #2 through #9: Collect judgmental samples at 0.9 m (3 ft) bgs and 4.6 m (15 ft) bgs.	
	Location #10: Randomly determined locations on a systematic grid within the site boundaries.	Location #10: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
200-E-117 (UPR-solid) Figure A-15	AOI #1: Random location near riser or side of any apparent subsurface feature identified by geophysical surveys.[f]	AOIs #1 and #2: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	GEA, AEA, pH, SVOA, PAHs, TPH, metals, mercury, anions
	AOI #2: Random location near second riser or opposite side of any apparent subsurface feature identified by geophysical surveys.[f]		
	Location #3: To be sited based on resistivity or other geophysical survey results.	Location #3: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; judgmental intermediate and lower DZ depth intervals from 4.6 m (15 ft) bgs to the groundwater table.	
200-E-297 dumping ground Figure A-16	Locations #1 through #10: Randomly selected on a systematic grid within the area of potential anomalies (indications of surface contamination and/or subsurface debris) identified by field surveys (locations to be identified following surveys). For any transite encountered, remove and dispose prior to waste site sampling.	Locations #1 through #10: Collect one judgmental sample from native material directly below any debris located or at 0.9 m (3 ft) bgs if no debris is identified.	GEA, metals, mercury, hexavalent chromium, SVOA, PAHs, TPH, PCBs, VOA, pesticides, anions
	Locations #11 and #12: Randomly selected on a systematic grid within the area of potential anomalies (indications of surface contamination and/or subsurface debris) identified by field surveys (locations to be identified following surveys). For any transite encountered, remove and dispose prior to waste site sampling.	Locations #11 and #12: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	

Table A-16. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the B Plant Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[d,e]
207-B Retention Basin Figure A-17	AOI #1: Random location outside basin by eastern outflow.[f]	AOI #1: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	GEA, AEA, strontium-90, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, SVOA, and PAHs For concrete cores, GEA and AEA only
	AOI #2: Random location near the southwest corner of the northern basin (near inflow).[f]	AOIs #2 through #4 and Location #5: Collect concrete coring; standard SZ depth intervals from beneath concrete to 4.6 m (15 ft) bgs.	
	AOI #3: Random location near the northwest corner of the southern basin (near inflow).[f]		
	AOI #4: Random location near crack or seam in northern basin, preferring northeast corner area.[f]		
	Location #5: Random location near crack or seam in southern basin.[f]		
	AOI #6: Random location in the northeast stabilized area outside basin.[f]	AOI #6: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
UPR-200-E-64 (UPR-solid) Figure A-18	Locations #1 and #2: Randomly determined locations on a systematic grid in site area east of 200-E-217-PL (excluding 216-B-64 concrete roof).	Locations #1 and #2: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	GEA, AEA, strontium-90, metals, mercury, anions
	Locations #3 through #5: Randomly determined locations on a systematic grid in site area east of 200-E-217-PL (excluding 216-B-64 concrete roof).	Locations #3 through #5: Collect one judgmental sample biased by field radiological measurements or directly below stabilization material.	
	Locations #6 and #7: Randomly determined locations on a systematic grid in site area east of 200-E-217-PL (excluding 216-B-64 concrete roof).	Locations #6 and #7: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
	Locations #8 through #11: Randomly determined locations on a systematic grid in site area east of 200-E-217-PL (excluding 216-B-64 concrete roof).	Locations #8 through #15: Collect one judgmental sample biased by field radiological measurements or directly below stabilization material.	
	Locations #12 through #15: Randomly determined locations on a systematic grid in the site area west of 200-E-217-PL.		

Table A-16. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the B Plant Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[d,e]
	Locations #16 and #17: Randomly determined locations on a systematic grid in the site area west of 200-E-217-PL.	Locations #16 and #17: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
	Locations #18 through #22: Randomly determined locations on a systematic grid in the site area west of 200-E-217-PL.	Locations #18 through #25: Collect one judgmental sample biased by field radiological measurements or directly below stabilization material.	
	Locations #23 through #25: Randomly determined locations on a systematic grid in the northern site area along 200-E-160-PL.		
	Locations #26 through #27: Randomly determined locations on a systematic grid in the northern site area along 200-E-160-PL.	Locations #26 and #27: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
	Locations #28 through 34: Randomly determined locations on a systematic grid in the northern site area along 200-E-160-PL.	Locations #28 through #34: Collect one judgmental sample biased by field radiological measurements or directly below stabilization material.	
	Location #35: Place one sample location at swap riser.	Location #35: Collect one judgmental sample biased by radiological measurements or directly below stabilization material.	
UPR-200-E-69 (UPR-liquid) Figure A-19	Transect #1 through #3: Randomly sample three transects across the rail line for a total of nine sample locations.	Locations #1 and #9: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	GEA, AEA, strontium-90, metals, mercury, anions
		Locations #2 through #8: Collect one judgmental sample from soil directly below any stabilization material.	
	AOIs #10 and #11: Collect samples at two AOIs at areas of highest activity based on rad surface survey.[f]	AOIs #10 and #11: Collect one judgmental sample from soil directly below any stabilization material.	
	Transect #4: Sample one biased transect situated at the tunnel entrance for a total of three sample locations.	Locations #12 and #13: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
		Location #14: Collect one judgmental sample from soil directly below any stabilization material.	

Table A-16. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the B Plant Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[d,e]
Potential Partial- and Full-Thickness Vadose Zone Contamination			
200-E-142 depression Figure A-15	Trench #4: Along slab.	Trench #4: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs at two randomly selected locations within the trench footprint; judgmental SZ depth intervals from visually stained soil or concrete up to 1.5 m (5 ft) bgs.	Metals, mercury, SVOA, PAHs, TPH, VOA, pH
	Locations #3 through #10: Up to eight discrete samples from beneath concrete slab edge at the former washing station location; and from the concrete slab at the former washing station location.	Locations #3 through #10: Collect one judgmental sample at each location between 0 to 1.5 m (0 to 5 ft) bgs, where soils are visually stained.	
216-B-2-1 Ditch Figures A-20 and A-21	Location #1A: At ~243.8 m (800 ft) from the head end of the ditch.	Location #1A: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; judgmental intermediate and lower DZ depth intervals from 4.6 m (15 ft) bgs to the groundwater table.	GEA, AEA, strontium-90, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, ammonia, cyanide, SVOA, PAHs, PCBs, VOA, pesticides[g]
	AOI #2: Random location near the head end of the ditch.[f]	AOIs #2, #3, and #1B: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; standard intermediate DZ depth intervals from 4.6 to 15.2 m (15 to 50 ft) bgs.	
	AOI #3: Random location near the midpoint of the ditch.[f]		
	AOI #1B: Random location near the downstream end of the ditch.[f]		
216-B-2-2 Ditch Figure A-20	AOI #4: Random location near the downstream end of the waste site.[f]	AOI #4: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; standard intermediate DZ depth intervals from 4.6 to 15.2 m (15 to 50 ft) bgs.	GEA, AEA, strontium-90, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, ammonia, cyanide, SVOA, PAHs, PCBs, VOA, pesticides[g]
	AOI #5: Random location near the upstream end of the waste site.[f]	AOI #5: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
216-B-2-3 Ditch Figure A-20	AOI #6: random location near the head end of the waste site.[f]	AOI #6: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; standard intermediate DZ depth intervals from 4.6 to 15.2 m (15 to 50 ft) bgs.	GEA, AEA, strontium-90, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, ammonia, cyanide, SVOA, PAHs, PCBs, VOA, pesticides[g]
	AOI #7: Random location near the downstream end of the waste site.[f]	AOI #7: Standard SZ depth intervals from 0 to 4.6 m (10 to 15 ft) bgs.	

Table A-16. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the B Plant Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[d,e]
216-B-10A Crib Figure A-15	AOI #5: Random location near the middle of the crib.[f]	AOI #5: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; judgmental intermediate and lower DZ depth intervals from 4.6 (15 ft) to the groundwater table.	GEA, AEA, carbon-14, iodine-129, nickel-63, strontium-90, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, ammonia, cyanide, VOA, SVOA, PAHs, TPH
	Locations #6: Random location.	Location #6: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
216-B-10B Crib Figure A-15	AOI #7: Random location near the middle of the crib.[f]	AOI #7: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; standard intermediate DZ depth intervals from 4.6 to 15.2 m (15 to 50 ft) bgs.	GEA, AEA, carbon-14, iodine-129, nickel-63, strontium-90, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, ammonia, cyanide, VOA, SVOA, PAHs, TPH
	Location #8: Random location.	Location #8: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
216-B-12 Crib Figure A-22	Location #1: To be sited based on resistivity results.	Location #1: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; judgmental intermediate and lower DZ depth intervals from 4.6 m (15 ft) bgs to the groundwater table.	GEA, AEA, carbon-14, iodine-129, nickel-63, strontium-90, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, ammonia, cyanide, VOA, SVOA, PAHs, TPH, and PCBs
	AOI #2: Random location near boring C3246.[f]	AOIs #2 through #4: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; judgmental intermediate and lower DZ depth intervals from 4.6 to 30.5 m (15 to 100 ft) bgs.	
	AOI #3: Random location in the southern end of the crib.[h]		
	AOI #4: Random location in the northern portion of the crib.[h]		

Table A-16. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the B Plant Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[d,e]
216-B-55 Crib Figure A-22	AOI #5: Random location near boring C5929.[f]	AOI #5: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; judgmental intermediate and lower DZ depth intervals from 4.6 m (15 ft) bgs to the groundwater table.	GEA, AEA, strontium-90, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, SVOA, and PAHs
	AOI #6: Random location at northwestern end of the crib.[h]	AOIs #6 through #8: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; one judgmental sample at 6.1 m (20 ft) bgs.	
	AOI #7: Random location near mid-point of the crib.[f]		
	AOI #8: Random location near southeastern end of the crib.[h]		
216-B-59 Trench 216-B-59B Retention Basin Figure A-23	AOI #1: Random location near the middle of the southeastern berm.[f]	AOIs #1 and #2: Collect one judgmental sample at 1.5 m (5 ft) below the top of the berm, one judgmental sample biased towards elevated field radiological or XRF measurements (or at 4.6 m [15 ft] bgs if no elevated measurements are observed), and one judgmental sample at 6.1 m (20 ft) bgs.	GEA, AEA, strontium-90, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, SVOA, and PAHs
	AOI #2: Random location in the southwestern portion of the northwestern berm.[f]		
	AOI #3: Random location in overflow area.[f]	AOIs #3 through #6: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
	AOI #4: Random location near the pump pit.[f]		
	AOI #5: Random location by the diverter box.[f]		
	AOI #6: Random location by the valve pit.[f]		

Table A-16. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the B Plant Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[d,e]
216-B-62 Crib Figure A-22	AOI #9: Random location at the head end of the crib, between wells 299-E28-75 and 299-E28-84.[f]	AOI #9: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; judgmental intermediate and lower DZ depth intervals from 4.6 m (15 ft) bgs to the groundwater table.	GEA, AEA, carbon-14, iodine-129, nickel-63, strontium-90, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, ammonia, cyanide, VOA, SVOA, PAHs, TPH
	AOI #10: Random location outside of the crib, by well 299-E28-18.[f]	AOIs #10 and #11: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; judgmental intermediate and lower DZ depth intervals from 4.6 to 45.7 m (15 to 150 ft) bgs.	
	AOI #11: Random location at the northern end of crib, between wells 299-E28-87 and 299-E28-91.[f]		
	AOI #12: Random location northwest of AOI #9.[f]	AOIs #12 and #13: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
	AOI #13: Random location near the middle of the crib.[f]		
218-E-7 burial vault Figure A-15	Location #9: Adjacent to the eastern vault.	Locations #9 and #10: Collect up three samples biased by observed elevated gamma activity between 0 to 3 m (0 to 10 ft) bgs and one sample at 4.6 m (15 ft) bgs.	GEA, AEA, carbon-14, iodine-129, nickel-63, strontium-90, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, ammonia, cyanide, VOA, SVOA, PAHs, TPH
	Location #10: Adjacent to the center vault.		
	Location #11: Adjacent to the western vault.	Location #11: Collect three samples biased by observed elevated gamma activity between 0 to 3 m (0 to 10 ft) bgs and one sample at 7.6 m (25 ft) bgs.	
	Locations #12 and #13: Random locations.	Locations #12 and #13: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
2607-E3 septic system Figure A-22	AOI #14: randomly select one location within a trench along main line across first three laterals.[h]	AOI #14: Standard SZ depth intervals from the discharge point to 4.6 m (15 ft) bgs.	GEA, SVOA, PAHs, TPH, PCBs, pesticides, metals, mercury, anions
	Contingency sampling: In the event that nonsanitary discharges are indicated at the drain field, then randomly select two locations within the drain field.	Contingency sampling: For each location, collect standard SZ depth intervals from 0 to 4.6 m (15 ft) bgs.	

Table A-16. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the B Plant Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[d,e]

a. Section A3.2.3 provides the standard SZ depth intervals. Site-specific sample designs may restrict sample collection to a subset of these intervals.

b. Section A3.2.4 provides the standard intermediate DZ depth intervals. Site-specific sample designs may restrict sample collection to a subset of these intervals.

c. For judgmental sampling in the DZ, eight samples will be collected at discretionarily selected locations as described in Section A3.2.4.

d. Analytical methods are listed in descending order of priority. If insufficient sample volume is available for all planned analyses, analysis will be requested based on priority and available volume. Attempts will be made to collect at least every other sample of lower priority analytical groups.

e. Supplemental analyses and testing for soil properties and attenuation/transport evaluations are not listed. See Sections 3.4.8 and 3.4.9 in the work plan for additional details and guidance.

f. Location shown on the figure represents the center point of the AOI. Sampling locations for the AOI will be randomly selected within 6.1 m (20 ft) of this location.

g. Pesticide analysis will be requested only for samples collected from 0 to 4.6 m (0 to 15 ft) bgs.

h. Location shown on the figure represents the general location of the AOI. Sampling locations for the AOI will be randomly selected within the area described.

AEA = alpha energy analysis
AOI = area of interest
bgs = below ground surface
DZ = deep zone
GEA = gamma energy analysis
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
SZ = shallow zone
SVOA = semivolatile organic analysis
TPH = total petroleum hydrocarbons
UPR = unplanned release
VOA = volatile organic analysis
XRF = x-ray fluorescence

Table A-17. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the Hot Semiworks Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[d,e]
Potential Shallow Vadose Zone Contamination			
200-E-293 foundation Figure A-24	AOIs #1 and #2: Random locations near the highest observed radiological activity levels.	AOIs #1 and #2: Collect concrete coring, standard SZ depth intervals from below slab to 4.6 m (0 to 15 ft) bgs,	GEA, AEA
200-E-294 foundation Figure A-24	Locations #3 through #5: To be sited at the highest observed radiological activity levels.	Locations #3 to #5: Collect concrete coring.	GEA, AEA
	AOI #6: Random location near the junction between the critical assembly room and the mix room.	AOIs #6 and #7: Collect concrete coring, standard SZ depth intervals from below slab to 4.6 m (0 to 15 ft) bgs.	
	AOI #7: Random location near the identified hot spot on the floor of the critical assembly room.		
291-C-1 Burial Ground Figure A-25	AOI #1: Random location at the western edge of the foundation.[f]	AOIs #1 through 4: Collect sample at interface of fly ash and underlying soil and at standard SZ depth intervals to 4.6 m (15 ft) and standard intermediate DZ intervals to 7.6 m (25 ft) bgs excluding any ash encountered.	GEA, AEA, carbon-14, iodine-129, technetium-99, tritium, metals, mercury, anions, SVOA, PAHs, TPH
	AOI #2: Random location at the northeastern edge of the burial trench.[g]		
	AOI #3: Random location at the western central edge of the burial trench.[g]		
	AOI #4: Random at the southeastern edge of the burial trench.[g]		

Table A-17. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the Hot Semiworks Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[d,e]
UPR-200-E-37 (UPR-solid) Figure A-26	Location #1: Randomly determined location on a systematic grid within waste site boundary.	Location #1: Collect one sample at site surface, up to 0.2 m (0.5 ft) bgs, excluding any ash encountered.	GEA, AEA, strontium-90, metals, mercury, anions
	Location #2: Randomly determined location on a systematic grid within waste site boundary.	Location #2: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs excluding any ash encountered.	
	Locations #3 through #15: Randomly determined locations on a systematic grid within waste site boundary.	Locations #3 through #15: Collect one sample at site surface, up to 0.2 m (0.5 ft) bgs excluding any ash encountered.	
	Location #16: Randomly determined location on a systematic grid within waste site boundary.	Location #16: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs excluding any ash encountered.	
	Location #17: Randomly determined location on a systematic grid within waste site boundary.	Location #17: Collect one sample at site surface, up to 0.2 m (0.5 ft) bgs excluding any ash encountered.	
UPR-200-E-98 (UPR-solid) Figure A-25	Locations #5 and #6: Random locations.	Locations #5 and #6: Standard SZ depth intervals from the interface of the ash and native soil to 4.6 m (15 ft) bgs excluding any ash encountered.	GEA, AEA, strontium-90, metals, mercury, anions

Table A-17. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the Hot Semiworks Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[d,e]
Potential Partial- and Full-Thickness Vadose Zone Contamination			
200-E-41 (UPR-solid) Figure A-27	Locations #1 and #2: Randomly determined locations on a systematic grid within site boundary and outside of the footprint of other waste sites.	Locations #1 and #2: Collect sample at interface of fly ash and underlying material and at standard SZ depth intervals from the interface to 4.6 m (15 ft) bgs excluding any ash encountered.	GEA, AEA, strontium-90, metals, mercury, anions
	Locations #3 through #11: Randomly determined locations on a systematic grid within site boundary and outside of the footprint of other waste sites.	Locations #3 through #11: Collect one sample from soil below the ash interface.	
	Location #12: Randomly determined locations on a systematic grid within site boundary and outside of the footprint of other waste sites.	Location #12: Collect sample at interface of fly ash and underlying material and at standard SZ depth intervals from the interface to 4.6 m (15 ft) bgs excluding any ash encountered.	
	Locations #13 and #14: Two locations identified based on radiological survey around the boundary of the ash layer.	Locations #13 and #14: Collect one judgmental sample from surface material excluding any ash encountered.	
200-E-56 (UPR-liquid) Figure A-25	AOI #7: Random location near location of leakage.[f]	AOI #7: Standard SZ and intermediate DZ depth intervals from 0 to 4.6 m (2 to 15 ft) starting at the ash layer to 15.2 m (50 ft) bgs.	GEA, AEA, carbon-14, iodine-129, nickel-63, strontium-90, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, ammonia, cyanide, VOA, SVOA, PAHs, TPH, PCBs
	AOI #8: Random location near contaminated soil emplacement.[f]	AOI #8: Standard SZ and intermediate DZ depth intervals from beneath the ash layer to 15.2 m (0 to 50 ft) bgs; judgmental lower DZ depth intervals from 15.2 m (50 ft) to the groundwater table	
200-E-57 (UPR-liquid) Figure A-25	AOI #9: Random location near western end of the abandoned pipe segment.[f]	AOIs #9 through #11: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	GEA, AEA, carbon-14, iodine-129, nickel-63, strontium-90, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, ammonia, cyanide, VOA, SVOA, PAHs, TPH, PCBs
	AOI #10: Random location near the mid-point of the abandoned pipe segment.[f]		
	AOI #11: Random location near eastern end of the abandoned pipe segment.[f]		

Table A-17. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the Hot Semiworks Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[d,e]
201-C process unit Figure A-25	AOI #12: Random location under the eastern hot cells (angled penetration expected).[f]	AOI #12: Collect three judgmental samples under hot cells/foundation.	GEA, AEA, carbon-14, iodine-129, nickel-63, strontium-90, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, ammonia, cyanide, VOA, SVOA, PAHs, TPH
	Locations #13 through #16: Random locations around the perimeter of 201-C.	Locations #13 through #16: Standard SZ depth intervals from the interface of ash and underlying material to 4.6 m (15 ft) bgs excluding any ash encountered.	
216-C-1 Crib Figure A-25	Location #17: Outside of the crib footprint, sited based on resistivity results.	Locations #17: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; judgmental intermediate and lower DZ depth intervals from 4.6 m (15 ft) bgs to the groundwater table.	GEA, AEA, carbon-14, iodine-129, nickel-63, strontium-90, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, ammonia, cyanide, VOA, SVOA, PAHs, TPH, PCBs
	AOI #18: Random location outside of the crib footprint, opposite of AOI #17.[f]	Location #18: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
	AOI #19: Random location under the middle of the crib (angled penetration expected).[f]	Location #19: Collect one judgmental sample under the crib.	
	Location #20: Random location.	Location #20: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
216-C-2 injection/reverse well Figure A-25	AOI #21: Random location adjacent to the reverse well.[f]	AOI #21: Judgmental intermediate and lower DZ depth intervals from 4.6 m (15 ft) bgs to the groundwater table.	GEA, AEA, carbon-14, iodine-129, technetium-99, tritium, pH, metals, mercury, anions, SVOA, PAHs, TPH
	Locations #22 and #23: Random locations.	Locations #22 and #23: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
216-C-3 Crib Figure A-28	AOI #1: Random location near the middle of the crib.[f]	AOI #1: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; judgmental intermediate and lower DZ depth intervals from 4.6 m (15 ft) bgs to the groundwater table.	GEA, AEA, carbon-14, iodine-129, nickel-63, strontium-90, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, ammonia, cyanide, VOA, SVOA, PAHs, TPH, PCBs
	AOI #2: Random location outside of the northern edge of the crib.[f]	AOIs #2 through #4: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
	AOI #3: Random location outside of the southern edge of the crib.[f]		
	AOI #4: Random location at the western end of the crib.[g]		

Table A-17. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the Hot Semiworks Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[d,e]
216-C-4 Crib Figure A-28	AOI #5: Random location near the middle of the crib.[f]	Location #5: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; standard intermediate DZ depth intervals from 4.6 to 15.2 m (15 to 50 ft) bgs.	GEA, AEA, carbon-14, iodine-129, nickel-63, strontium-90, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, ammonia, cyanide, VOA, SVOA, PAHs, TPH, PCBs
	AOI #6: Random location outside the northern edge of the crib.[f]	Locations #6 and #7: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; one judgmental sample at 6.1 m (20 ft) bgs.	
	AOI #7: Random location outside the western edge of the crib.[f]		
216-C-5 Crib Figure A-28	AOI #8: Random location near the eastern end of the crib.[g]	AOI #8: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; standard intermediate DZ depth intervals from 4.6 to 15.2 m (15 to 50 ft) bgs.	GEA, AEA, carbon-14, iodine-129, nickel-63, strontium-90, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, ammonia, cyanide, VOA, SVOA, PAHs, TPH, PCBs
	AOI #9: Random location outside of the southern edge of the crib.[f]	AOIs #9 and #10: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; one judgmental sample at 6.1 m (20 ft) bgs.	
	AOI #10: Random location in the western end of the crib.[g]		
216-C-6 Crib Figure A-25	AOI #24: Random location outside of the northern edge of the crib, near the 200-E-171-PL pipeline.[f]	AOIs #24 through #27: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; one judgmental sample at 6.1 m (20 ft) bgs.	GEA, AEA, carbon-14, iodine-129, nickel-63, strontium-90, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, ammonia, cyanide, VOA, SVOA, PAHs, TPH, PCBs
	AOI #25: Random location outside the southern edge of the crib.[f]		
	AOI #26: Random location in the western half of the crib.[g]		
	AOI #27: Random location in the eastern half of the crib.[g]		
	AOI #28: Random location near the middle of the crib.[f]	AOI #28: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; judgmental intermediate and lower DZ depth intervals from 4.6 m (15 ft) bgs to the groundwater table.	

Table A-17. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the Hot Semiworks Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[d,e]
216-C-7 Crib Figure A-24	AOI #8: Random location near the middle of the crib.[f]	AOI #8: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; one judgmental sample at 6.1 m (20 ft) bgs.	GEA, AEA, carbon-14, iodine-129, nickel-63, strontium-90, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, ammonia, cyanide, VOA, SVOA, PAHs, TPH, and PCBs
	AOI #9: Random location outside of the northern edge of the crib, near the 200-E-172-PL pipeline.[f]	AOIs #9 through #12: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
	AOI #10: Random location outside of the southern edge of the crib.[g]		
	AOI #11: Random location in the northwestern portion of the crib (near a lateral).[g]		
	AOI #12: Random location in the southeastern portion of the crib (near a lateral).[g]		
216-C-10 Crib Figure A-25	AOI #28: Random location outside of the northern side of the crib.[f]	AOIs #28 through #30: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	GEA, AEA, carbon-14, iodine-129, nickel-63, strontium-90, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, ammonia, cyanide, VOA, SVOA, PAHs, TPH
	AOI #29: Random location within the crib near the western end.[g]		
	AOI #30: Random location within the crib near the eastern end.[g]		
	Location #31: To be sited based on resistivity results.	Location #31: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; judgmental intermediate and lower DZ depth intervals from 4.6 m (15 ft) bgs to the groundwater table.	
2607-E5 septic system Figure A-24	AOI #13: At southern drain field, randomly select one location within a trench along location of first lateral from main.[g]	AOIs #13 and #14: Standard SZ depth intervals from the discharge points to 4.6 m (15 ft) bgs.	GEA, SVOA, PAHs, TPH, PCBs, pesticides, metals, mercury, anions
	AOI #14: Random location near the northern leaching trench, at terminus of discharge line.[f]		
	Contingency sampling: In the event that nonsanitary discharges are indicated at either of the discharge features, then randomly select two locations at each discharge feature where nonsanitary discharges were indicated.	Contingency sampling: For each location, collect standard SZ depth intervals from 0 to 4.6 m (15 ft) bgs.	

Table A-17. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the Hot Semiworks Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[d,e]

a. Section A3.2.3 provides the standard SZ depth intervals. Site-specific sample designs may restrict sample collection to a subset of these intervals.

b. Section A3.2.4 provides the standard intermediate DZ depth intervals. Site-specific sample designs may restrict sample collection to a subset of these intervals.

c. For judgmental sampling in the DZ, eight samples will be collected at discretionarily selected locations as described in Section A3.2.4.

d. Analytical methods are listed in descending order of priority. If insufficient sample volume is available for all planned analyses, analysis will be requested based on priority and available volume. Attempts will be made to collect at least every other sample of lower priority analytical groups.

e. Supplemental analyses and testing for soil properties and attenuation/transport evaluations are not listed. See Sections 3.4.8 and 3.4.9 in the work plan for additional details and guidance.

f. Location shown on the figure represents the center point of the AOI. Sampling locations for the AOI will be randomly selected within 6.1 m (20 ft) of this location.

g. Location shown on the figure represents the general location of the AOI. Sampling locations for the AOI will be randomly selected within the area described.

AEA	=	alpha energy analysis	PCB	=	polychlorinated biphenyl
AOI	=	area of interest	SZ	=	shallow zone
bgs	=	below ground surface	SVOA	=	semivolatile organic analysis
DZ	=	deep zone	TPH	=	total petroleum hydrocarbons
GEA	=	gamma energy analysis	UPR	=	unplanned release
PAH	=	polycyclic aromatic hydrocarbon	VOA	=	volatile organic analysis

Table A-18. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the PUREX Plant Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[d,e]
Potential Shallow Vadose Zone Contamination			
200-E-13 dumping area Figure A-29	Locations #1 through #12: Randomly selected on a systematic grid within the area of potential anomalies (indications of surface contamination and/or subsurface debris) identified by field surveys (area to be identified following surveys).	Location #1: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	GEA, metals, mercury, hexavalent chromium, SVOA, PAHs, TPH, PCBs, VOA, pesticides, anions
		Locations #2 through #11: Collect one judgmental sample from soil directly below any debris located, or at 1.5 m (5 ft) bgs if no debris is located.	
		Location #12: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
200-E-124 (UPR-liquid) Figure A-30	If an evaluation to determine the cost of RTD for this waste site indicates that characterization is preferred, then: Transects #1 through #3: Randomly sample three transects across the rail line for a total of nine sample locations.	Transects #1 through #3: Collect one judgmental sample from soil directly below any stabilization material. For two randomly selected locations out of the nine, collect standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	GEA, AEA, strontium-90, metals, mercury, anions
	Transect #4: Locate one biased transect at the location of the former door with cranes.	Transect #4: Collect one set of judgmental samples (left/middle/right) from soil directly below any stabilization material.	
Potential Partial- and Full-Thickness Vadose Zone Contamination			
200-E PD Ditch Figure A-31	AOI #1: Random location near the western end of the ditch.[g]	AOIs #1 through #5: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; standard intermediate DZ depth intervals from 4.6 to 15.2 m (15 to 50 ft) bgs.	GEA, pH, anions, metals, mercury, hexavalent chromium, SVOA, PAHs, TPH, PCBs, pesticides[h]
	AOI #2: Random location near the mid-point of the east-west portion of the ditch.[g]		
	AOI #3: Random location near the eastern end of the east-west portion of the ditch.[g]		
	AOI #4: Random location near the southwestern end of the backfilled portion of the ditch.[g]		
	AOI #5: Random location near the northeastern end of the backfilled portion of the ditch.[g]		

Table A-18. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the PUREX Plant Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[d,e]
200-E-43 storage area Figure A-32	Locations #1 through #4: Random locations.	Locations #1 through #4: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	GEA, AEA, strontium-90, metals, mercury, anions
216-A-3 Crib Figure A-30	Location #1: To be sited based on resistivity results.	Location #1: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; judgmental intermediate and lower DZ depth intervals from 4.6 m (15 ft) bgs to the groundwater table.	GEA, AEA, strontium-90, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, cyanide, ammonia, VOA, SVOA, PAH, PCBs, TPH
	AOI #2: Random location in the northwestern quadrant of the crib.[g]	AOIs #2 through #5: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; one judgmental sample at 6.1 m (20 ft) bgs.	
	AOI #3: Random location in the northeastern quadrant of the crib lateral.[g]		
	AOI #4: Random location in the southwestern quadrant of the crib.[g]		
	AOI #5: Random location in the southeastern quadrant of the crib.[g]		
216-A-9 Crib Figure A-30	Location #6: To be sited based on resistivity results.	Location #6: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; judgmental intermediate and lower DZ depth intervals from 4.6 m (15 ft) bgs to the groundwater table.	GEA, AEA, strontium-90, carbon-14, iodine-129, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, cyanide, ammonia, VOA, SVOA, PAHs, PCBs, TPH
	AOI #7: Random location in the northwestern end of the crib.[g]	AOIs #7 through #10: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
	AOI #8: Random location northwest of the midpoint of the crib.[g]		
	AOI #9: Random location southeast of the midpoint of the crib.[g]		
	AOI #10: Random location in the southeastern end of the crib.[g]		

Table A-18. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the PUREX Plant Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[d,e]
216-A-10 Crib Figure A-33	Location #1: To be sited based on resistivity results.	Location #1: Judgmental intermediate and lower DZ depth intervals from 9.1 m (30 ft) bgs to the groundwater table.	GEA, AEA, strontium-90, carbon-14, iodine-129, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, cyanide, ammonia, VOA, SVOA, PAHs, TPH
	AOI #2: Random location in the northern portion of the crib.[g]	AOI #2: Judgmental intermediate and lower DZ depth intervals from 9.1 to 30.5 m (30 to 100 ft) bgs.	
216-A-27 Crib Figure A-34	Location #1: To be sited based on resistivity results.	Location #1 and AOI #2: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; judgmental intermediate and lower DZ depth intervals from 4.6 m (15 ft) bgs to the groundwater table.	GEA, AEA, strontium-90, carbon-14, iodine-129, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, cyanide, ammonia, VOA, SVOA, PAHs, PCBs, TPH
	AOI #2: Random location in the north-central area of the crib.[g]		
	AOI #3: Random location in the western end of the crib.[g]	AOIs #3 through #6: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	
	AOI #4: Random location near the middle of the crib.[g]		
	AOI #5: Random location in the eastern end of the crib.[g]		
	AOI #6: Random location in the southeastern end of the crib.[g]		
216-A-36A Crib Figure A-34	AOI #7: Random location near the riser.[f]	AOIs #7 and #8: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs starting directly below any stabilization material; standard intermediate DZ depth intervals from 4.6 to 15.2 m (15 to 50 ft) bgs.	GEA, AEA, strontium-90, carbon-14, iodine-129, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, cyanide, ammonia, VOA, SVOA, PAHs, PCBs, TPH
	AOI #8: Random location in the middle of northern end of the crib.[g]		
	AOI #9: Random location near the inlet.[f]	AOI #9: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs; judgmental intermediate and lower DZ depth intervals from 4.6 m (15 ft) bgs to groundwater.	

Table A-18. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the PUREX Plant Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[d,e]
216-A-36B Crib Figure A-34	AOI #10: Random location near central riser.[f]	AOIs #10 through #11 and Locations #12 and #13: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs starting directly below any stabilization material; standard intermediate DZ depth intervals from 4.6 to 15.2 m (15 to 50 ft) bgs.	GEA, AEA, strontium-90, carbon-14, iodine-129, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, cyanide, ammonia, VOA, SVOA, PAHs, PCBs, TPH
	AOI #11: Random location near southern riser.[f]		
	Location #12: Random location.[f]		
	Location #13: Random location.[f]		
216-A-38-1 Crib Figure A-33	Location #3: At the inlet to the crib.	Location #3: Gamma logging only to 15.2 m (50 ft) bgs.	Contingency analyses: GEA, AEA, strontium-90, carbon-14, iodine-129, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, cyanide, ammonia, VOA, SVOA, PAHs, TPH
	Contingency locations if elevated radiological readings are identified at Location #3; Locations #4 through #6: Random locations.	Locations #4 through #6: Standard SZ and intermediate DZ depth intervals from 10.7 to 15.2 m (35 to 50 ft) bgs.	
216-A-45 Crib Figure A-33	Locations #7 and #8: To be sited based on resistivity results.	Locations #7 and #8: Judgmental intermediate and lower DZ depth intervals from 13.8 m (45 ft) bgs to the groundwater table.	GEA, AEA, strontium-90, carbon-14, iodine-129, nickel-63, technetium-99, tritium, pH, metals, mercury, hexavalent chromium, anions, cyanide, ammonia, VOA, SVOA, PAHs, TPH
2607-E6 septic system Figure A-32	AOI #5: Random location adjacent to distribution box.[f]	AOIs #5 through #7: Standard SZ depth intervals from the discharge points to 4.6 m (15 ft) bgs.	GEA, SVOA, PAHs, TPH, PCBs, pesticides, metals, mercury, anions
	AOI #6: At western drain field, randomly select one location within a trench across main line at the first laterals.[g]		
	AOI #7: At eastern drain field, randomly select one location within a trench across main line at the first laterals.[g]		
	Contingency sampling: In the event that nonsanitary discharges are indicated at either of the drain fields, then randomly select two locations at each drain field where nonsanitary discharges were indicated.	Contingency sampling: For each location, collect standard SZ depth intervals from 0 to 4.6 m (15 ft) bgs.	

Table A-18. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the PUREX Plant Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a,b,c]	Sample Analyses[d,e]
UPR-200-E-88 (UPR-liquid) Figure A-32	Transects #1 through #3: Randomly sample three transects across the rail line for a total of nine sample locations.	Locations #1, #4, and #7 (west side of each transect): Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs. All other locations: collect one judgmental sample from soil directly below any stabilization material.	GEA, AEA, strontium-90, metals, mercury, anions

a. Section A3.2.3 provides the standard SZ depth intervals. Site-specific sample designs may restrict sample collection to a subset of these intervals.

b. Section A3.2.4 provides the standard intermediate DZ depth intervals. Site-specific sample designs may restrict sample collection to a subset of these intervals.

c. For judgmental sampling in the DZ, eight samples will be collected at discretionarily selected locations as described in Section A3.2.4.

d. Analytical methods are listed in descending order of priority. If insufficient sample volume is available for all planned analyses, analysis will be requested based on priority and available volume. Attempts will be made to collect at least every other sample of lower priority analytical groups.

e. Supplemental analyses and testing for soil properties and attenuation/transport evaluations are not listed. See Sections 3.4.8 and 3.4.9 in the work plan for additional details and guidance.

f. Location shown on the figure represents the center point of the AOI. Sampling locations for the AOI will be randomly selected within 6.1 m (20 ft) of this location.

g. Location shown on the figure represents the general location of the AOI. Sampling locations for the AOI will be randomly selected within the area described.

h. Pesticide analysis will be requested only for samples collected from 0 to 4.6 m (0 to 15 ft) bgs.

AEA = alpha energy analysis
AOI = area of interest
bgs = below ground surface
DZ = deep zone
GEA = gamma energy analysis
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
RTD = removal, treatment, and disposal
SZ = shallow zone
SVOA = semivolatile organic analysis
TPH = total petroleum hydrocarbons
UPR = unplanned release
VOA = volatile organic analysis

Table A-19. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the Miscellaneous Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a]	Sample Analyses[b]
Potential Shallow Vadose Zone Contamination			
200-E BP burn pit Figure A-35	Locations #1 through #8: To be identified based on geophysical investigation results.	Locations #1 through #8: Collect one judgmental sample from soil beneath solid waste and/or burn ash at <3 m (10 ft) bgs and two judgmental samples from 3 to 4.6 m (10 to 15 ft) bgs.	GEA, SVOA, PAHs, TPH, PCBs, VOA, pesticides, metals, mercury, anions
	Locations #9 and #10: Random locations.	Locations #9 and #10: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs, but excluding any ash.	
200-E-115 (UPR-solid) Figure A-3	Locations #2 and #3: To be sited randomly within site boundary.	Locations #2 and #3: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	GEA, AEA, strontium-90, metals, mercury, anions
200-E-139 (UPR-solid) Figure A-36	Locations #1 through #10: Randomly determined locations on a systematic grid within the waste site boundary.	Locations #1 through #10: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs.	GEA, AEA, strontium-90, metals, mercury, anions
200-E-53 (UPR-solid) UPR-200-E-50 (UPR-solid) Figure A-37	Location #1: Randomly determined locations on a systematic grid within the waste site boundary.	Location #1: Standard SZ depth intervals from directly below stabilization fill to 4.6 m (15 ft) bgs.	GEA, AEA, strontium-90, metals, mercury, anions
	Locations #2 through #11: Randomly determined locations on a systematic grid within the waste site boundary.	Locations #2 through #11: Collect one judgmental sample from soil directly below stabilization fill.	
	Location #12: Randomly determined locations on a systematic grid within the waste site boundary.	Location #12: Standard SZ depth intervals from directly below stabilization fill to 4.6 m (15 ft) bgs.	

Table A-19. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the Miscellaneous Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a]	Sample Analyses[b]
UPR-200-E-11 (UPR-liquid) UPR-200-E-10 (UPR-solid) UPR-200-E-12 (UPR-liquid) UPR-200-E-20 (UPR-solid) UPR-200-E-33 (UPR-liquid) Appendix B, Figure B-1	Following radiological surface scans to eliminate nonimpacted areas of the waste site from further evaluation, define transects for all potentially impacted sections(radiological constituents detected or gravel cover noted).	For each planned transect, Locations #1 and #9: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs. Locations #2 through #8: Collect one judgmental sample from soil directly below any stabilization material.	GEA, AEA, strontium-90, metals, mercury, anions
UPR-200-E-95 (UPR-solid) Figure A-19	Randomly sample three transects across the rail line for a total of nine sample locations.	Locations #1 and #9: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs. Locations #2 through #8: Collect one judgmental sample from soil directly below any stabilization material.	GEA, AEA, strontium-90, metals, mercury, anions

Table A-19. Soil Sampling Locations for 200-EA-1 OU Waste Sites in the Miscellaneous Group

Waste Site	Areas of Interest or Sampling Locations	Target Sampling Depths[a]	Sample Analyses[b]
UPR-200-E-112 (UPR-liquid) Appendix B, Figure B-1	Following radiological surface scans to eliminate nonimpacted areas of the waste site from further evaluation, define transects for all potentially impacted sections (radiological constituents detected or gravel cover noted), excluding the portion covered by sampling for UPR-200-E-69.	For each planned transect, Locations #1 and #9: Standard SZ depth intervals from 0 to 4.6 m (0 to 15 ft) bgs. Locations #2 through #8: Collect one judgmental sample from soil directly below any stabilization material.	GEA, AEA, strontium-90, metals, mercury, anions

a. Section A3.2.3 provides the standard SZ depth intervals. Site-specific sample designs may restrict sample collection to a subset of these intervals.

b. Analytical methods are listed in descending order of priority. If insufficient sample volume is available for all planned analyses, analysis will be requested based on priority and available volume. Attempts will be made to collect at least every other sample of lower priority analytical groups.

AEA = alpha energy analysis
bgs = below ground surface
GEA = gamma energy analysis
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
SZ = shallow zone
SVOA = semivolatile organic analysis
TPH = total petroleum hydrocarbons
UPR = unplanned release
VOA = volatile organic analysis

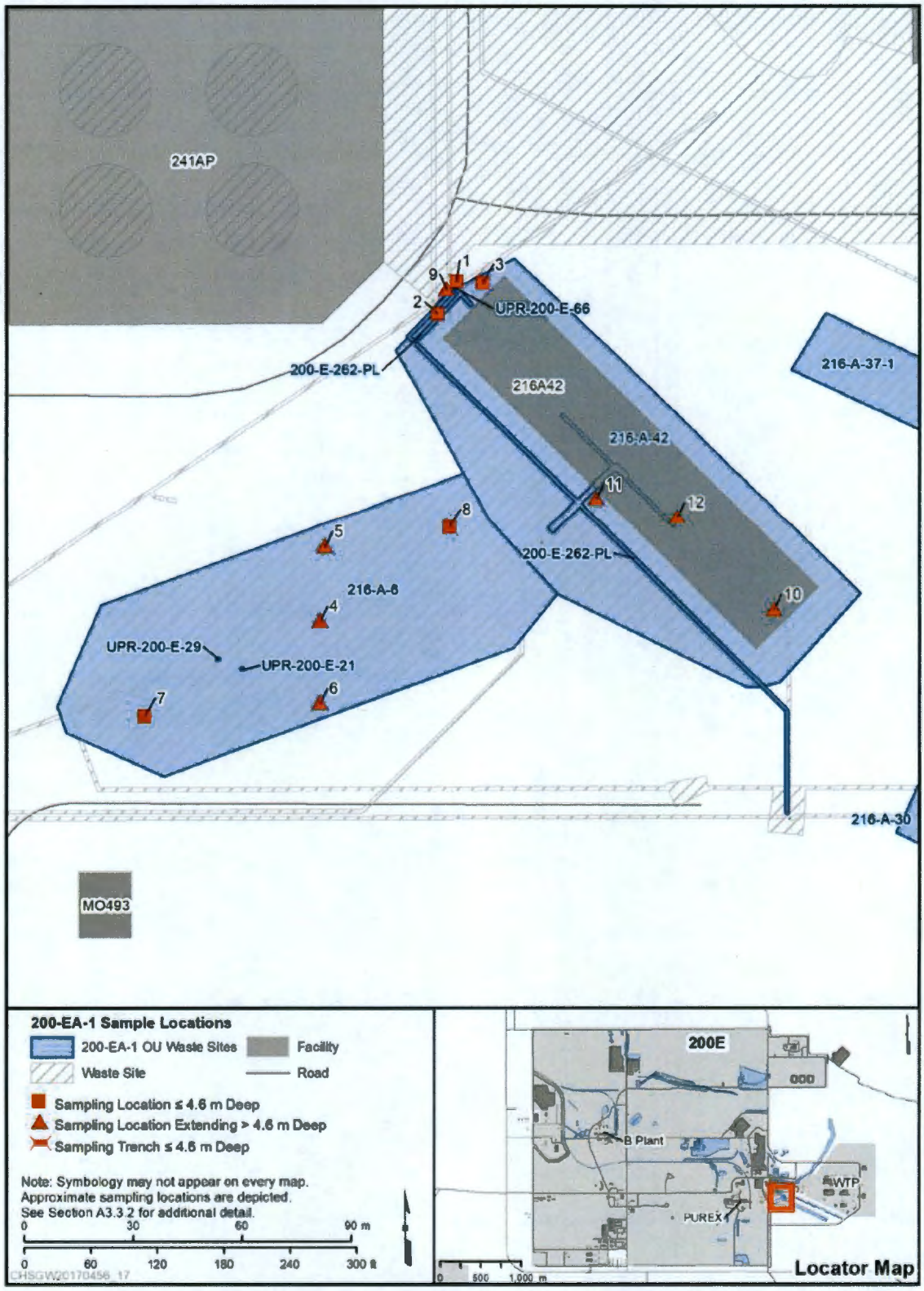

Figure A-2. 200-E-262-PL, 216-A-6, 216-A-42, UPR-200-E-21, UPR-200-E-29, and UPR-200-E-66 Sample Locations (A Tank Farms Group)

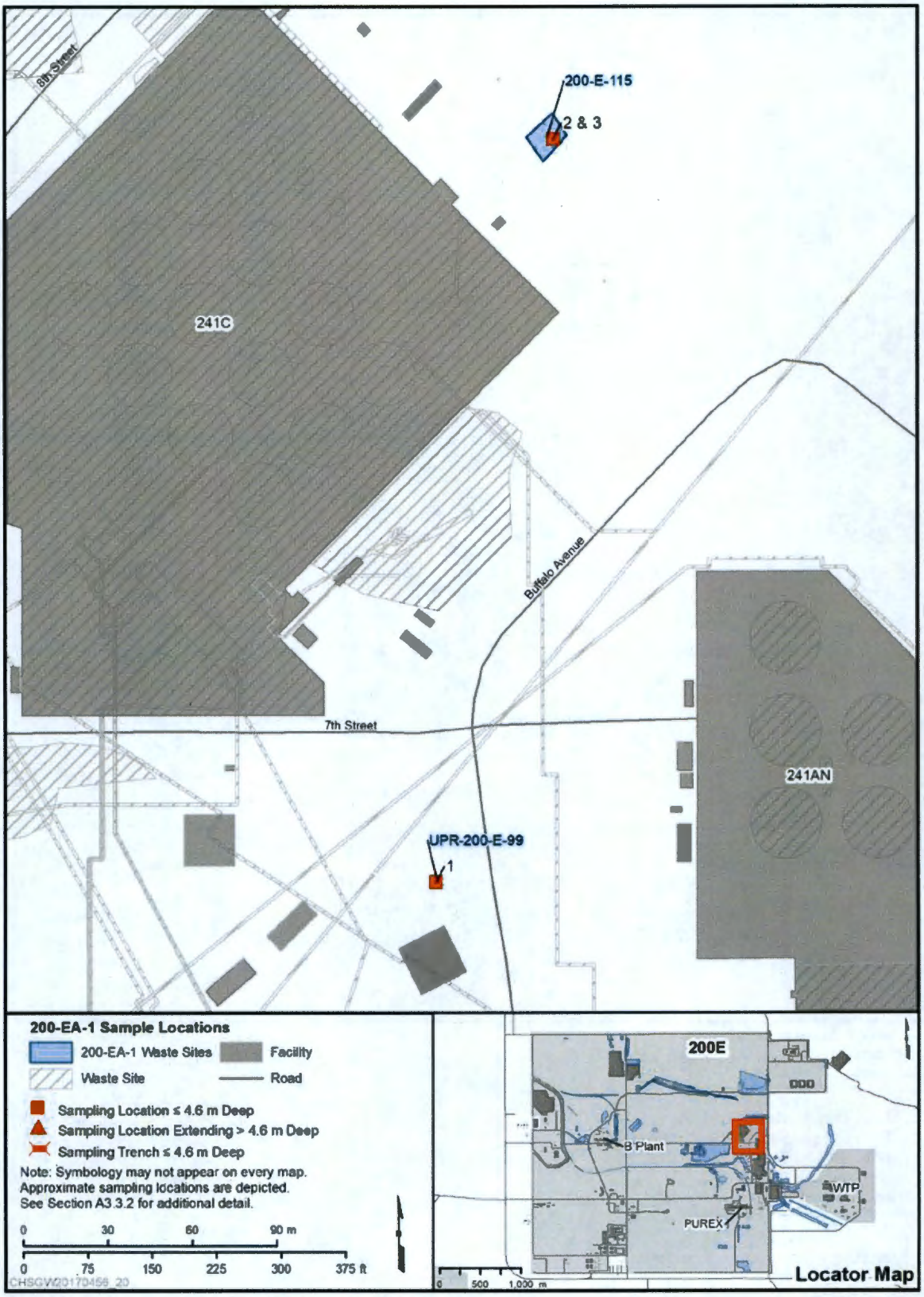

Figure A-3. UPR-200-E-99 and 200-E-115 Sample Locations (A Tank Farms and Miscellaneous Groups)

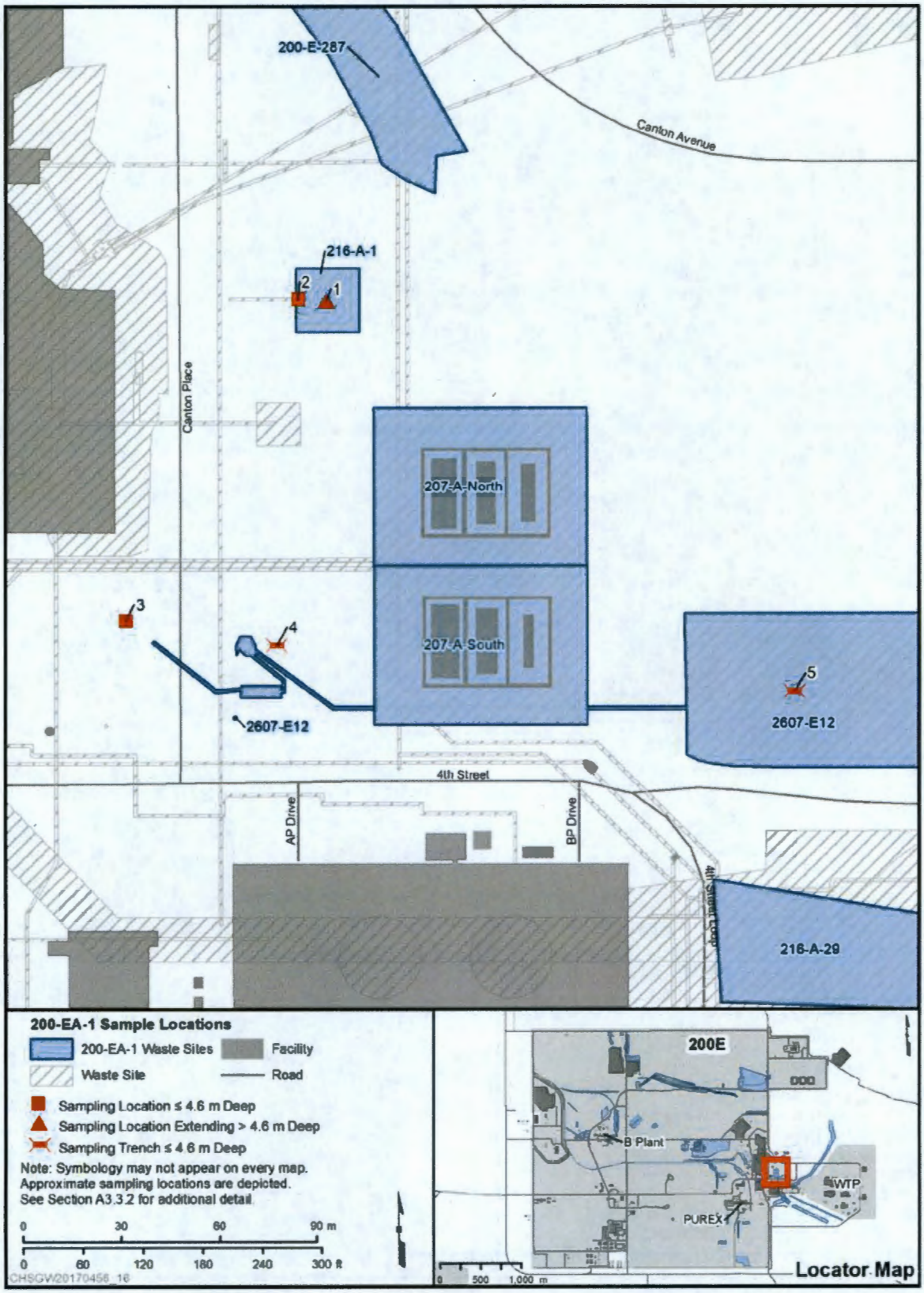

Figure A-4. 216-A-1 and 2607-E12 Sample Locations (A Tank Farms Group)

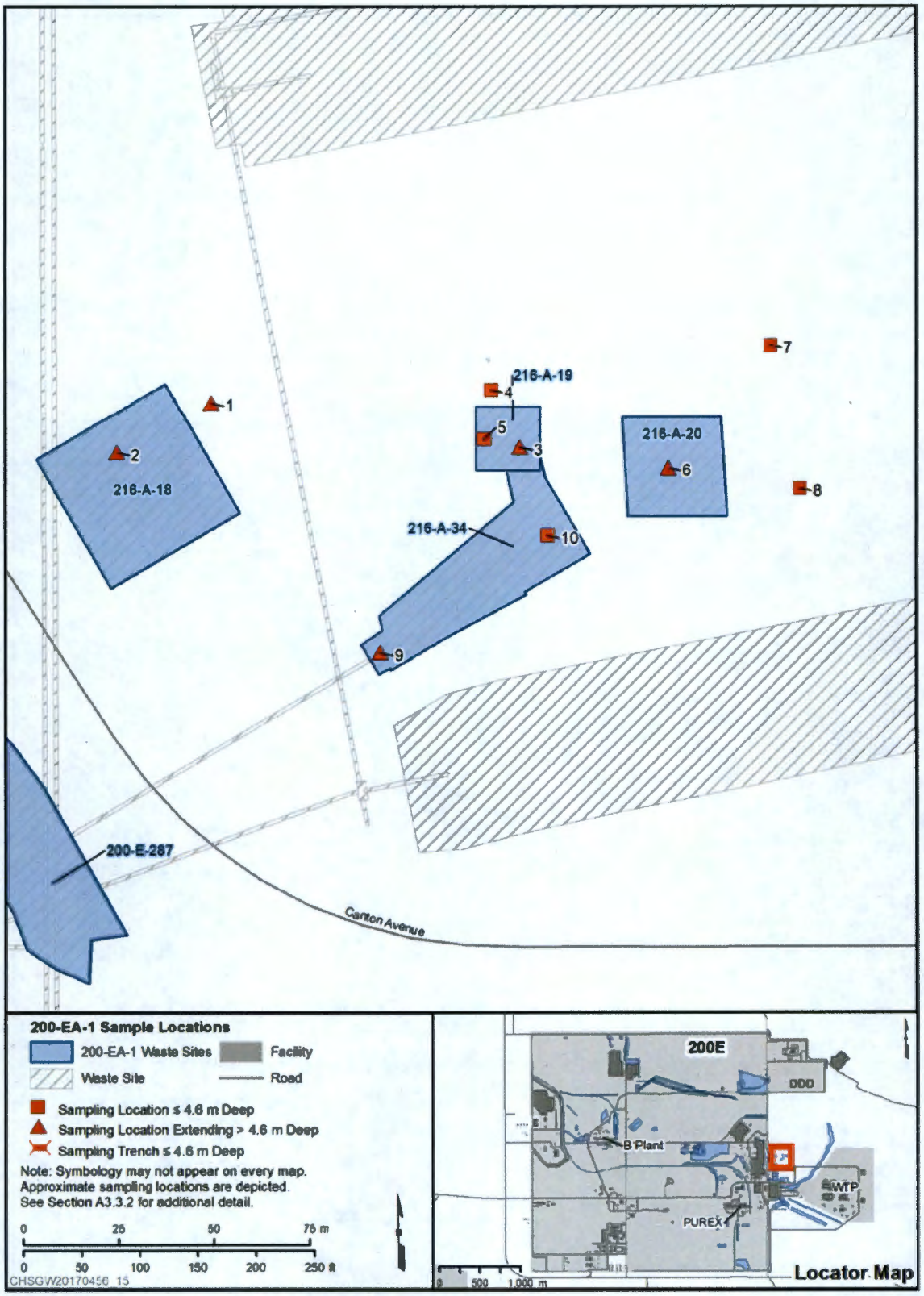

Figure A-5. 216-A-18, 216-A-19, 216-A-20, and 216-A-34 Sample Locations (A Tank Farms Group)

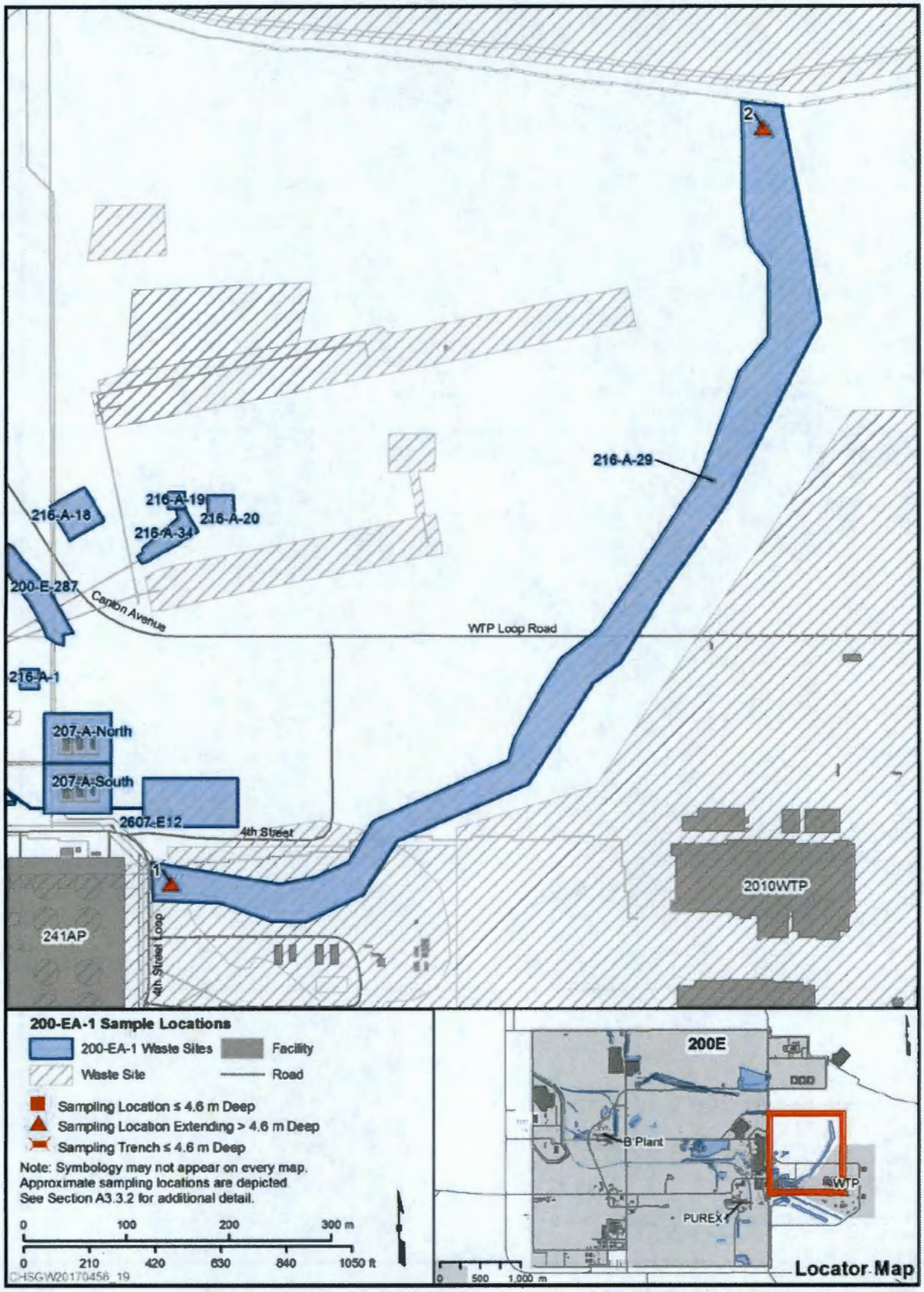

Figure A-6. 216-A-29 Sample Locations (A Tank Farms Group)

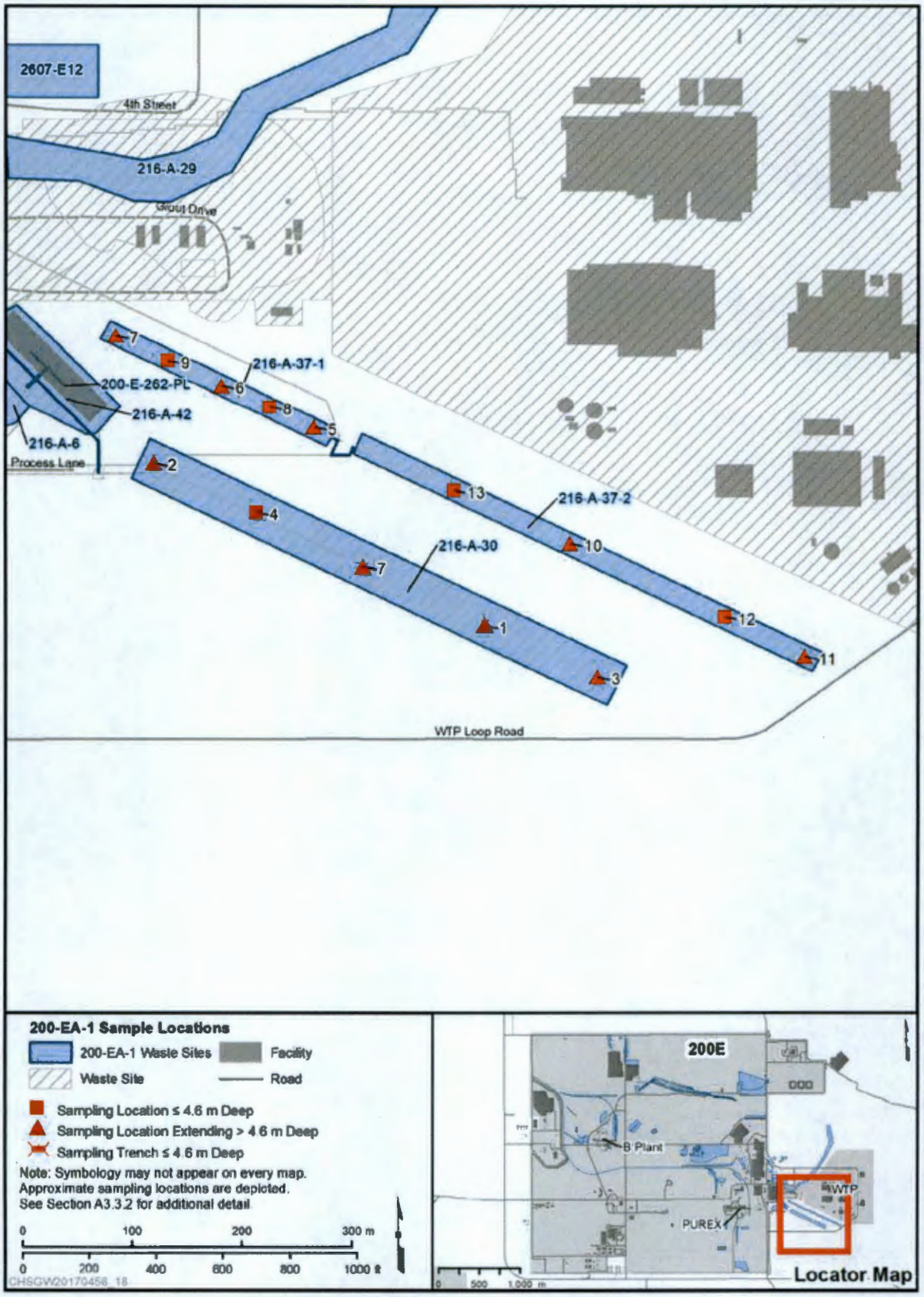

Figure A-7. 216-A-30, 216-A-37-1, and 216-A-37-2 Sample Locations (A Tank Farms Group)

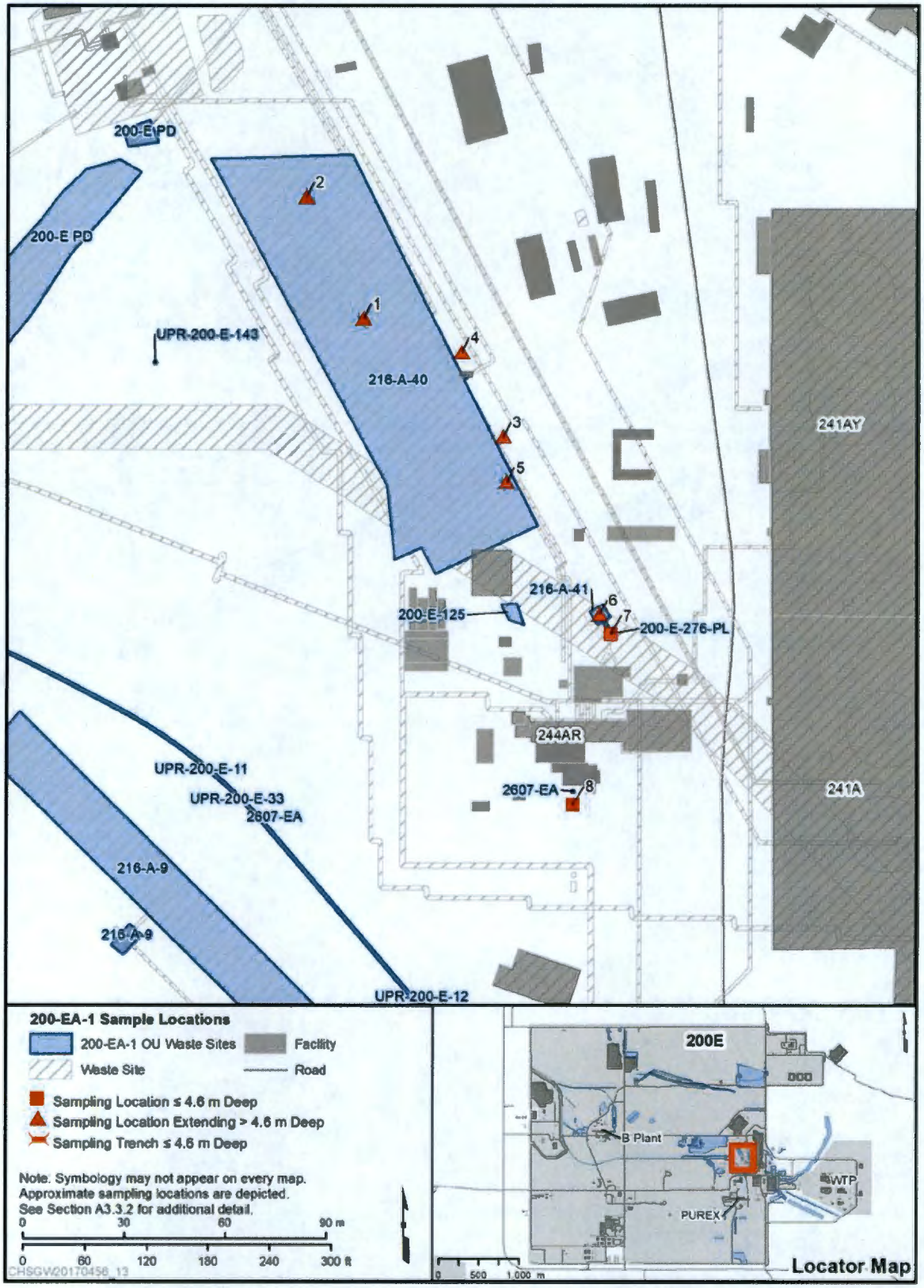

Figure A-8. 200-E-276-PL, 216-A-40, 216-A-41, and 2607-EA Sample Locations (A Tank Farms Group)

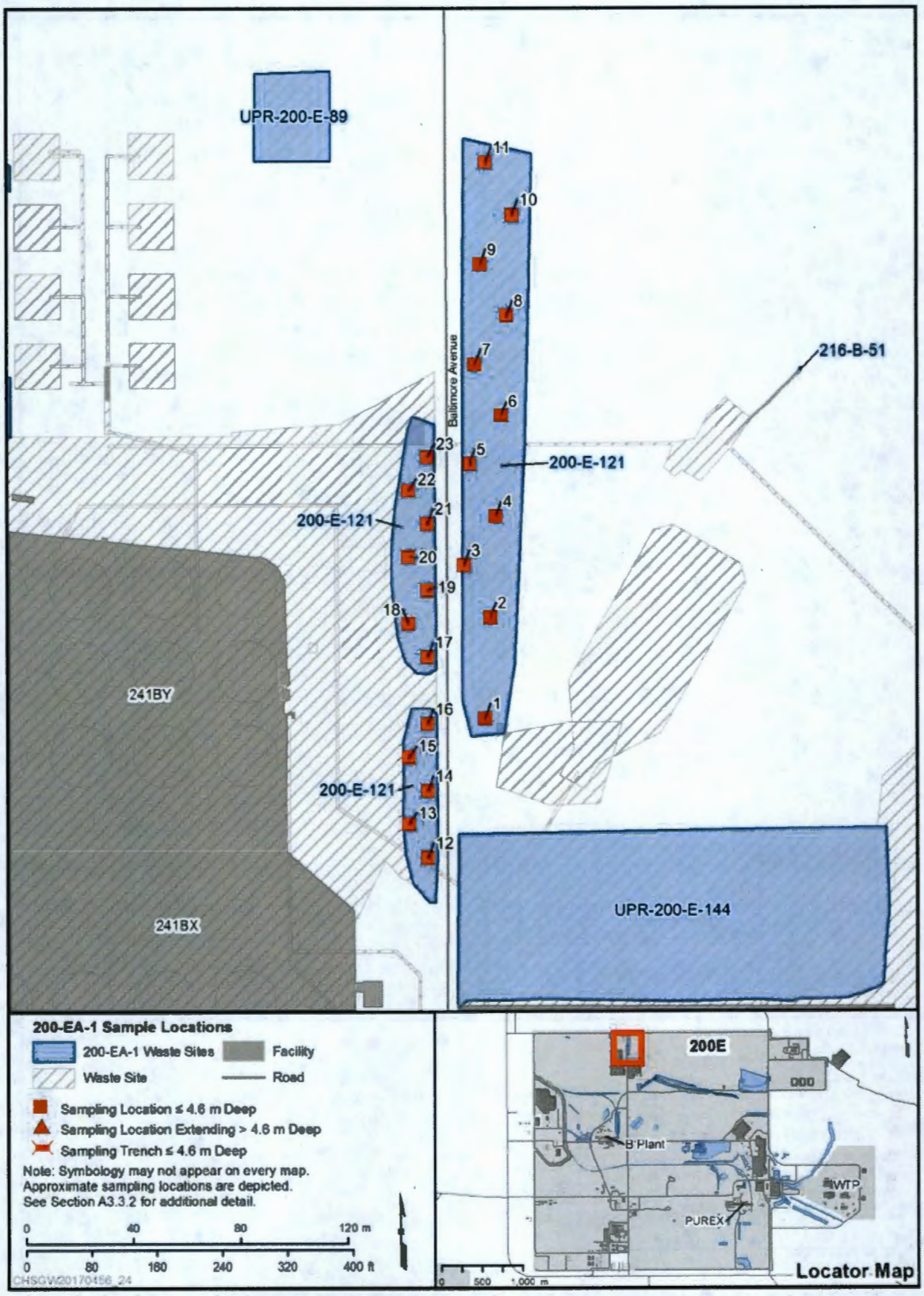

Figure A-9. 200-E-121 Sample Locations (B Tank Farms Group)

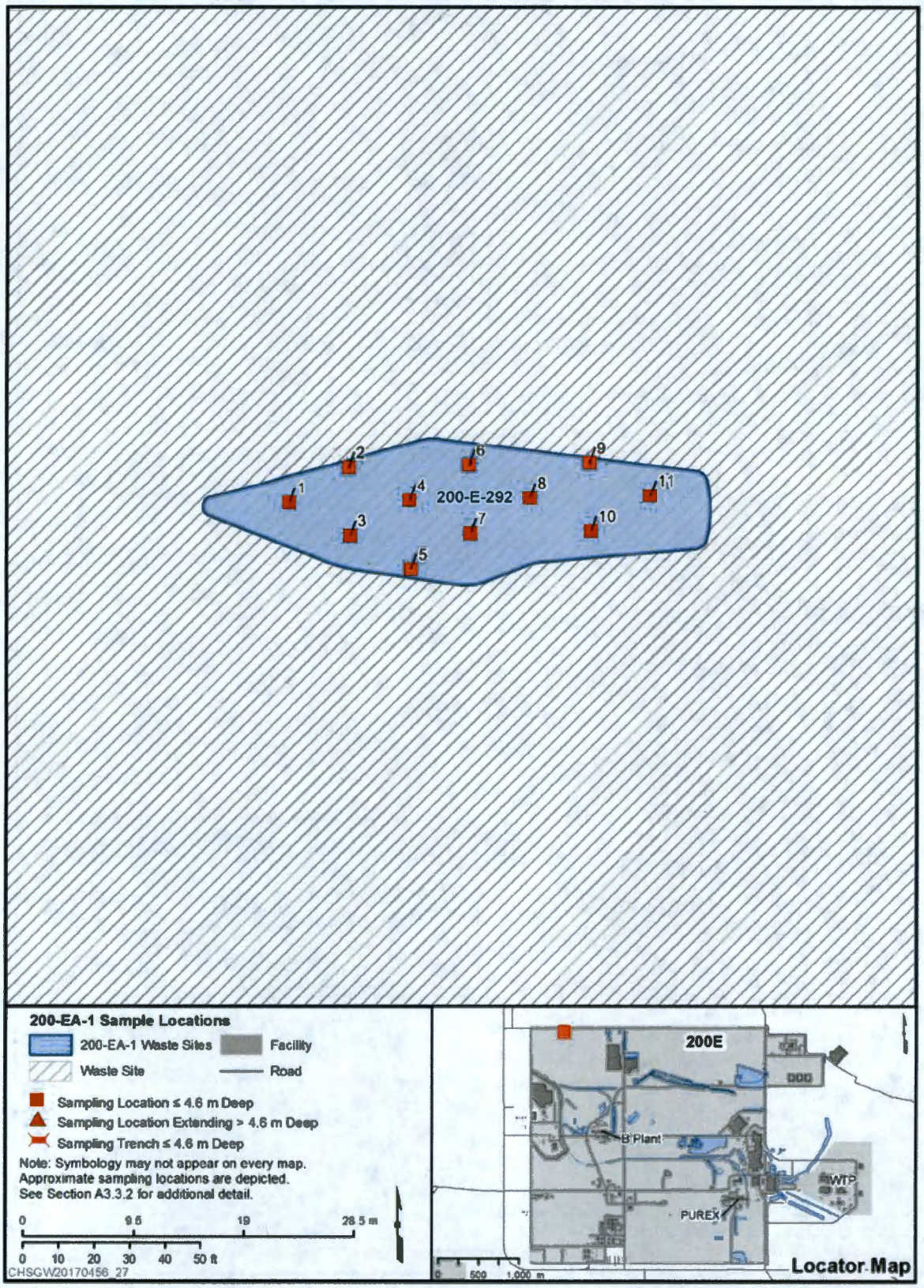

Figure A-10. 200-E-292 Sample Locations (B Tank Farms Group)

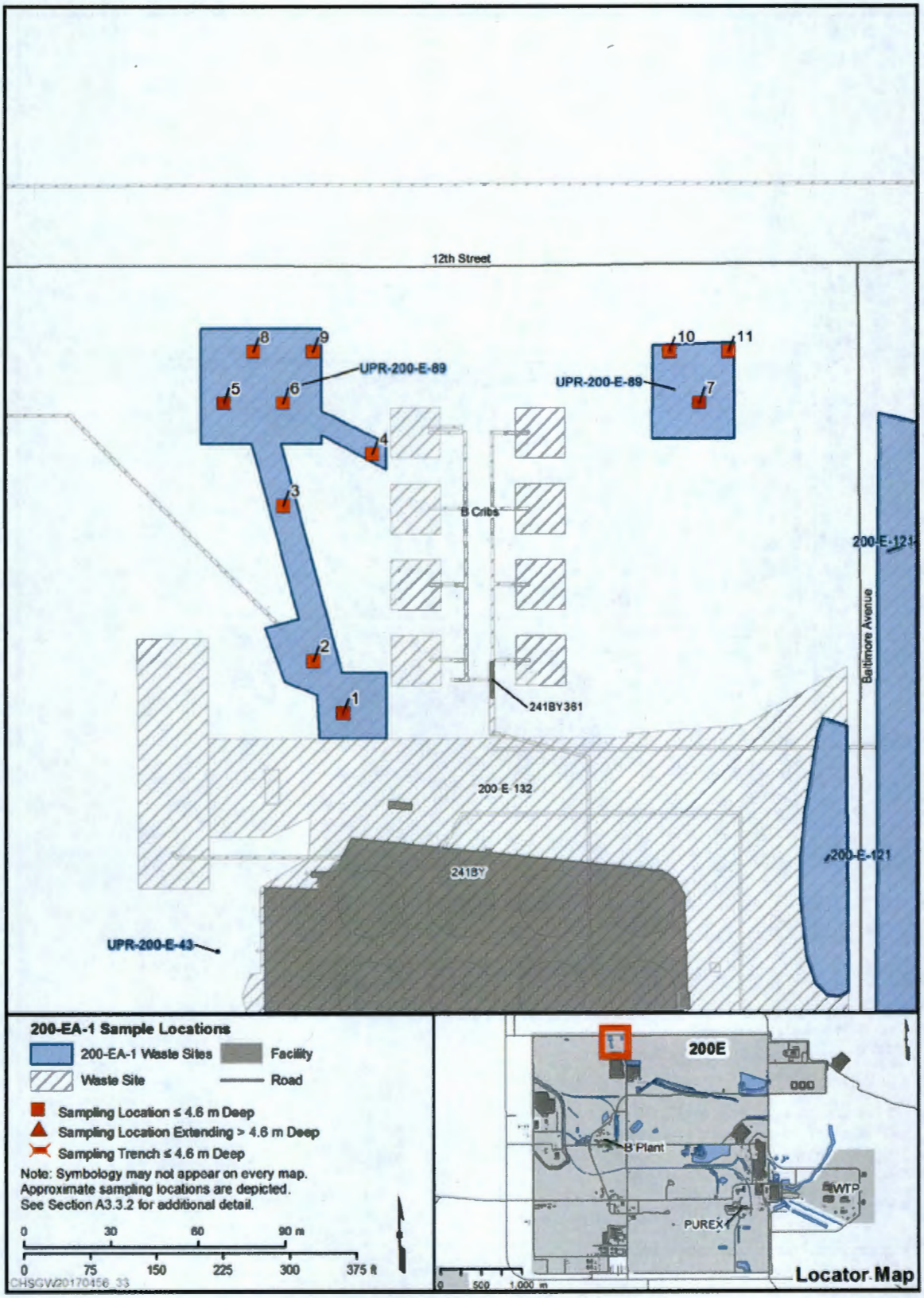

Figure A-11. UPR-200-E-89 Sample Locations (B Tank Farms Group)

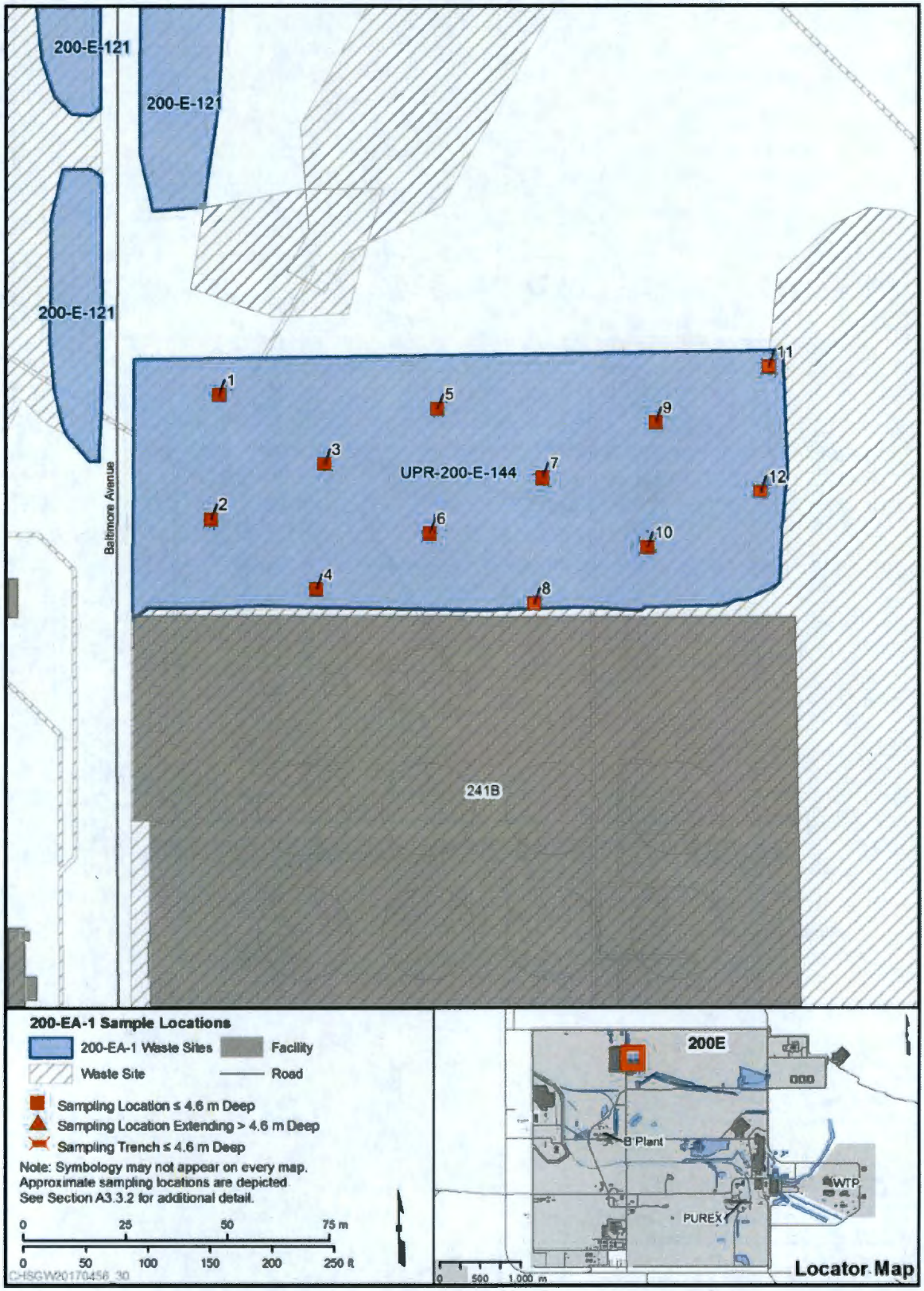

Figure A-12. UPR-200-E-144 Sample Locations (B Tank Farms Group)

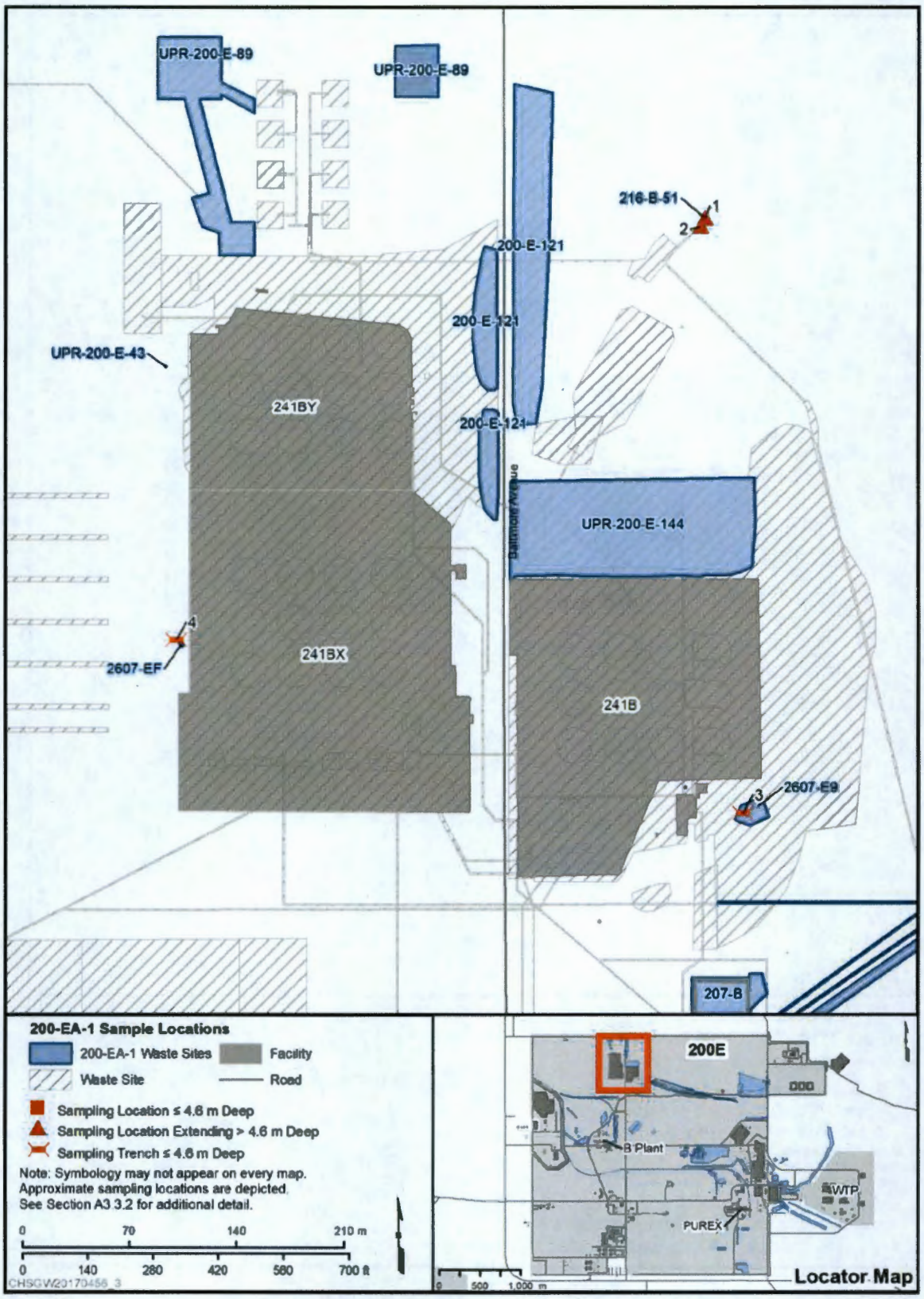

Figure A-13. 216-B-51, 2607-E9, and 2607-EF Sample Locations (B Tank Farms Group)

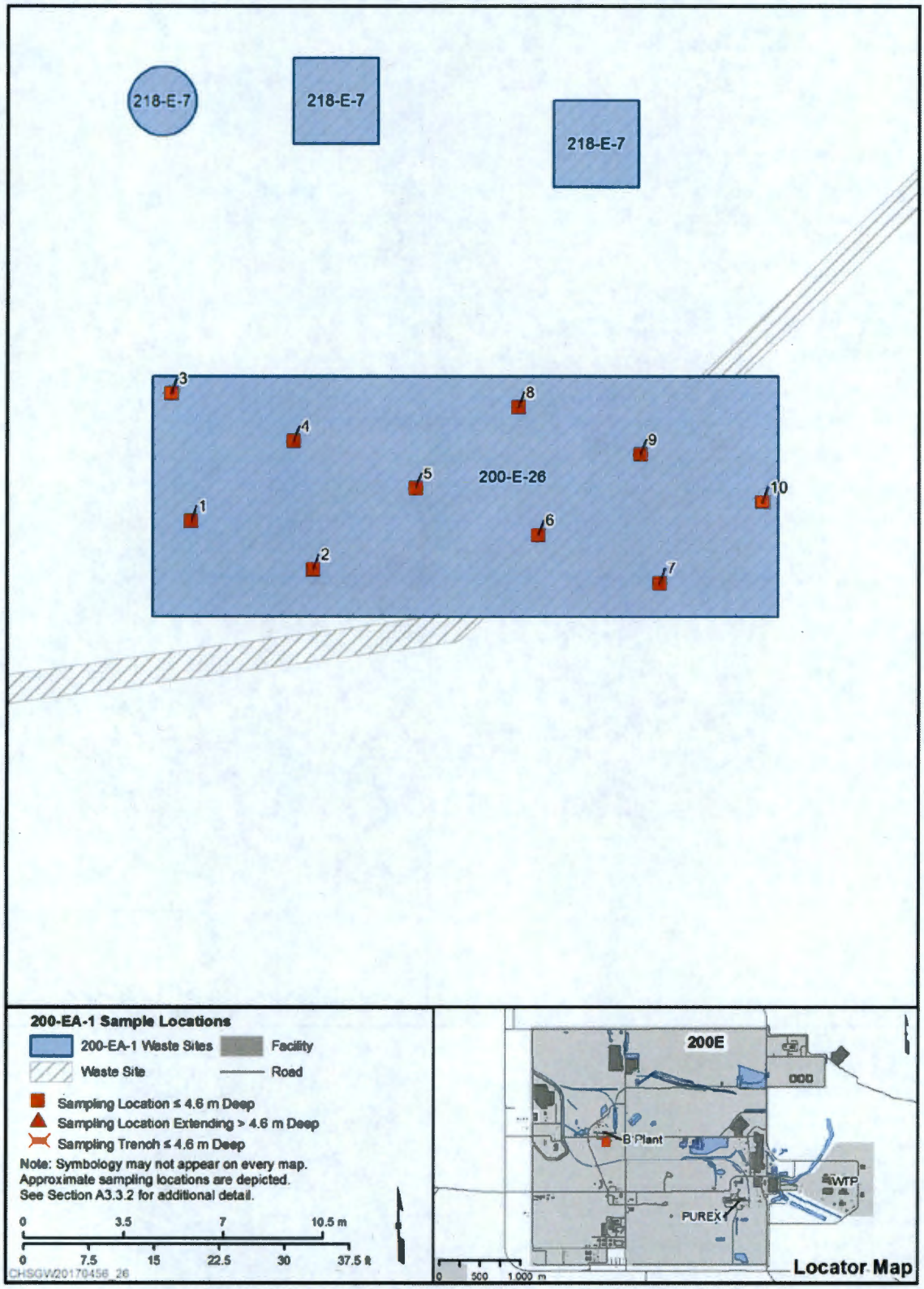

Figure A-14. 200-E-26 Sample Locations (B Plant Group)

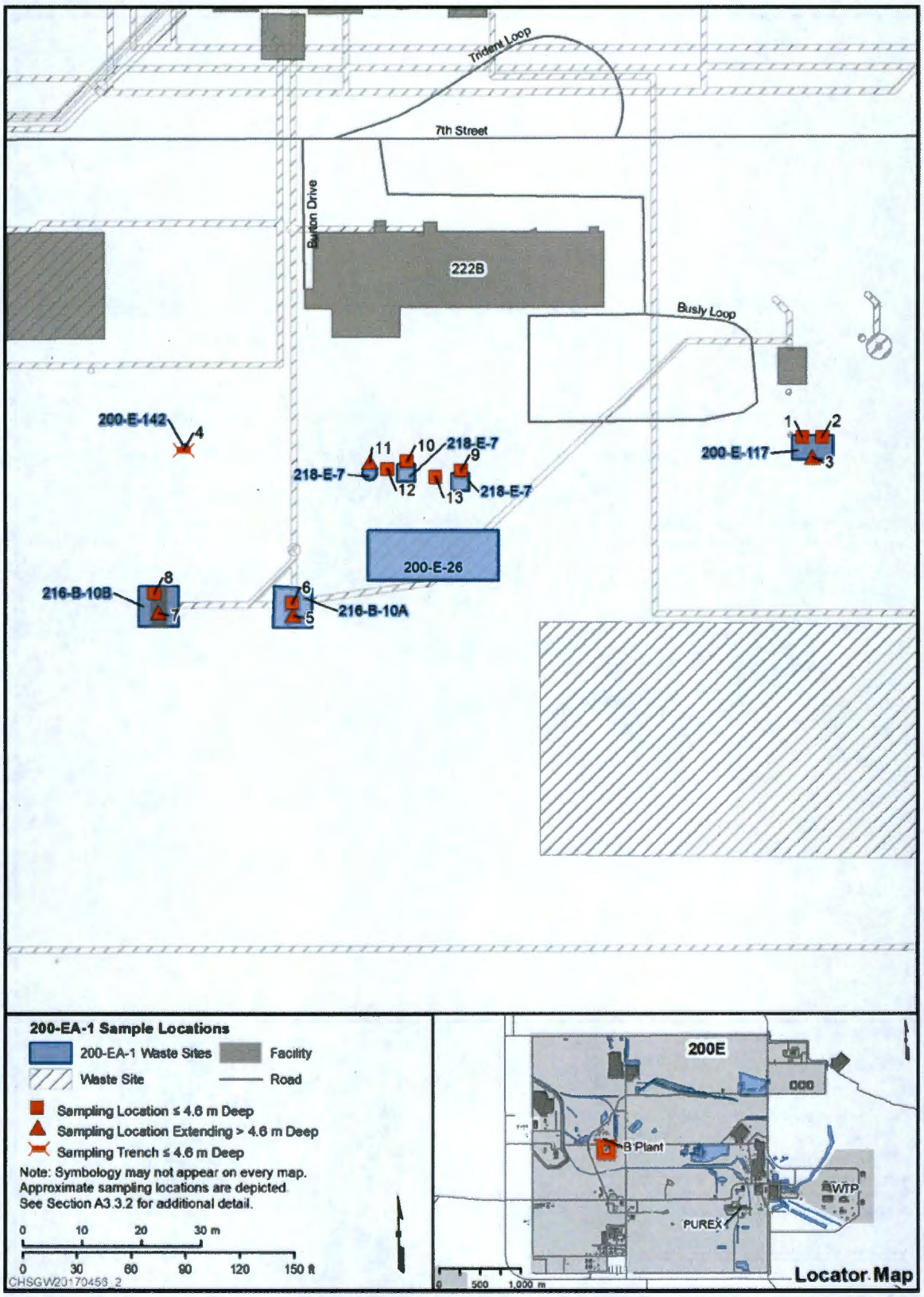

Figure A-15. 200-E-117, 200-E-142, 216-B-10A, 216-B-10B, and 218-E-7 Sample Locations

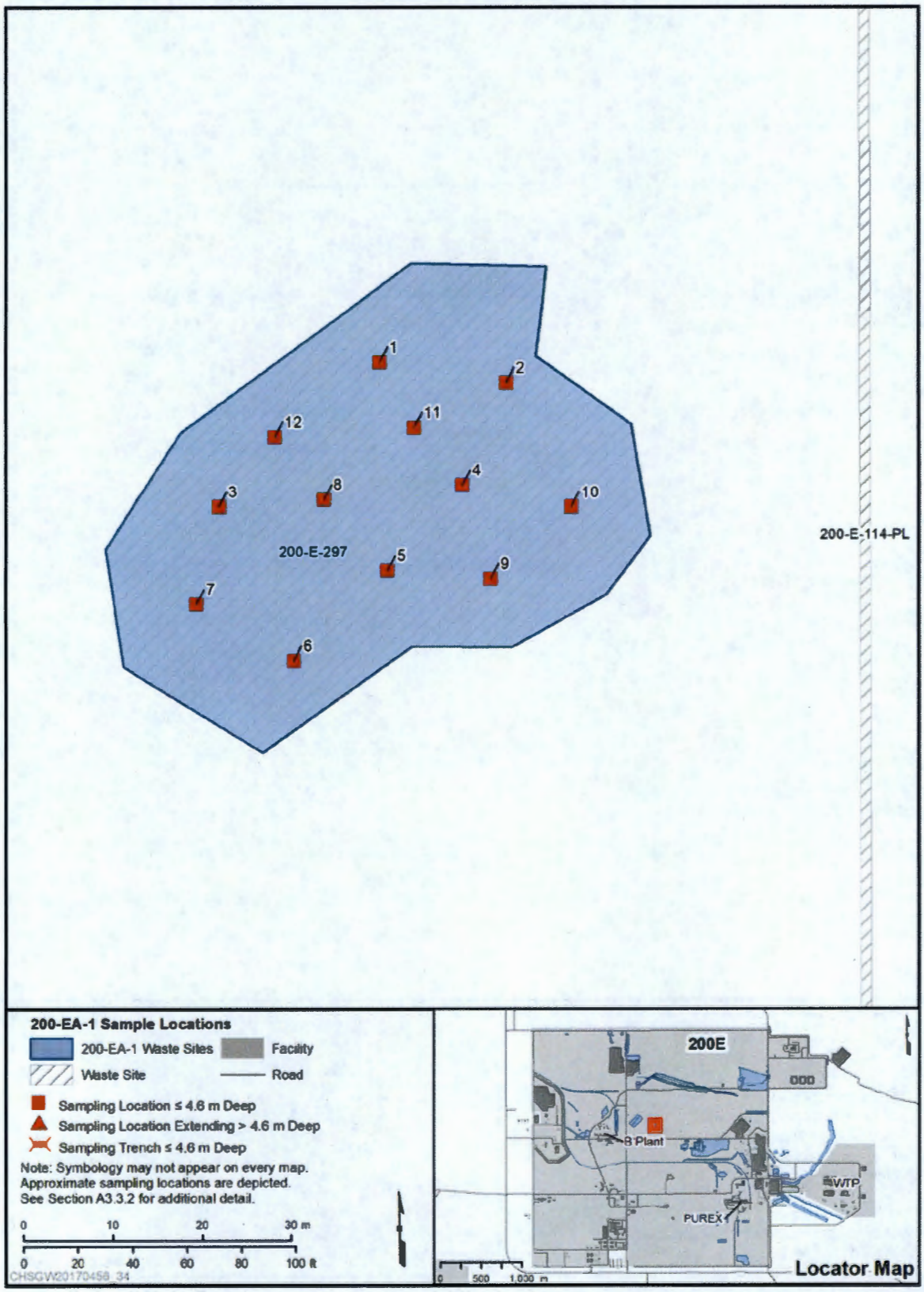

Figure A-16. 200-E-297 Sample Locations (B Plant Group)

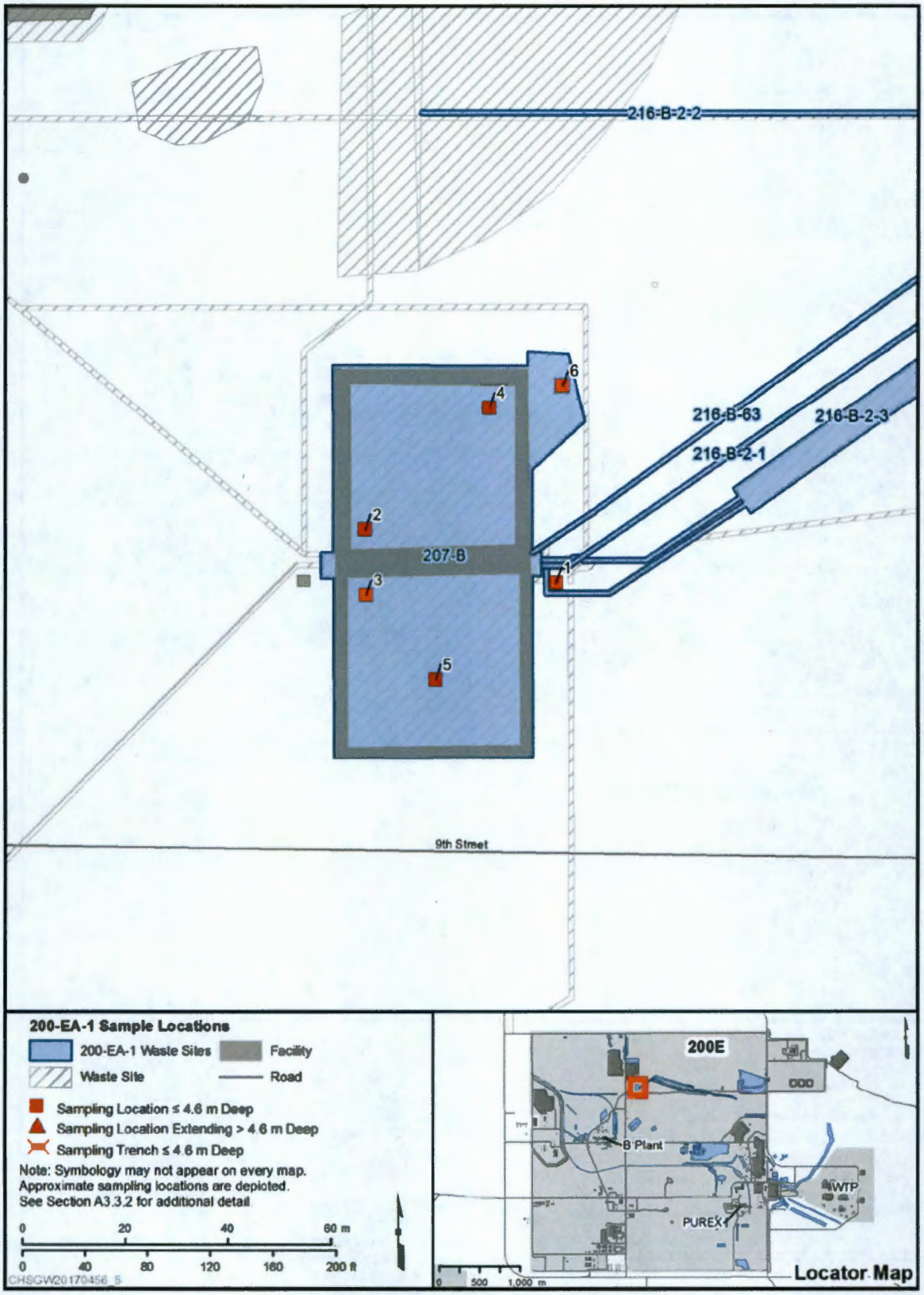

Figure A-17. 207-B Sample Locations (B Plant Group)

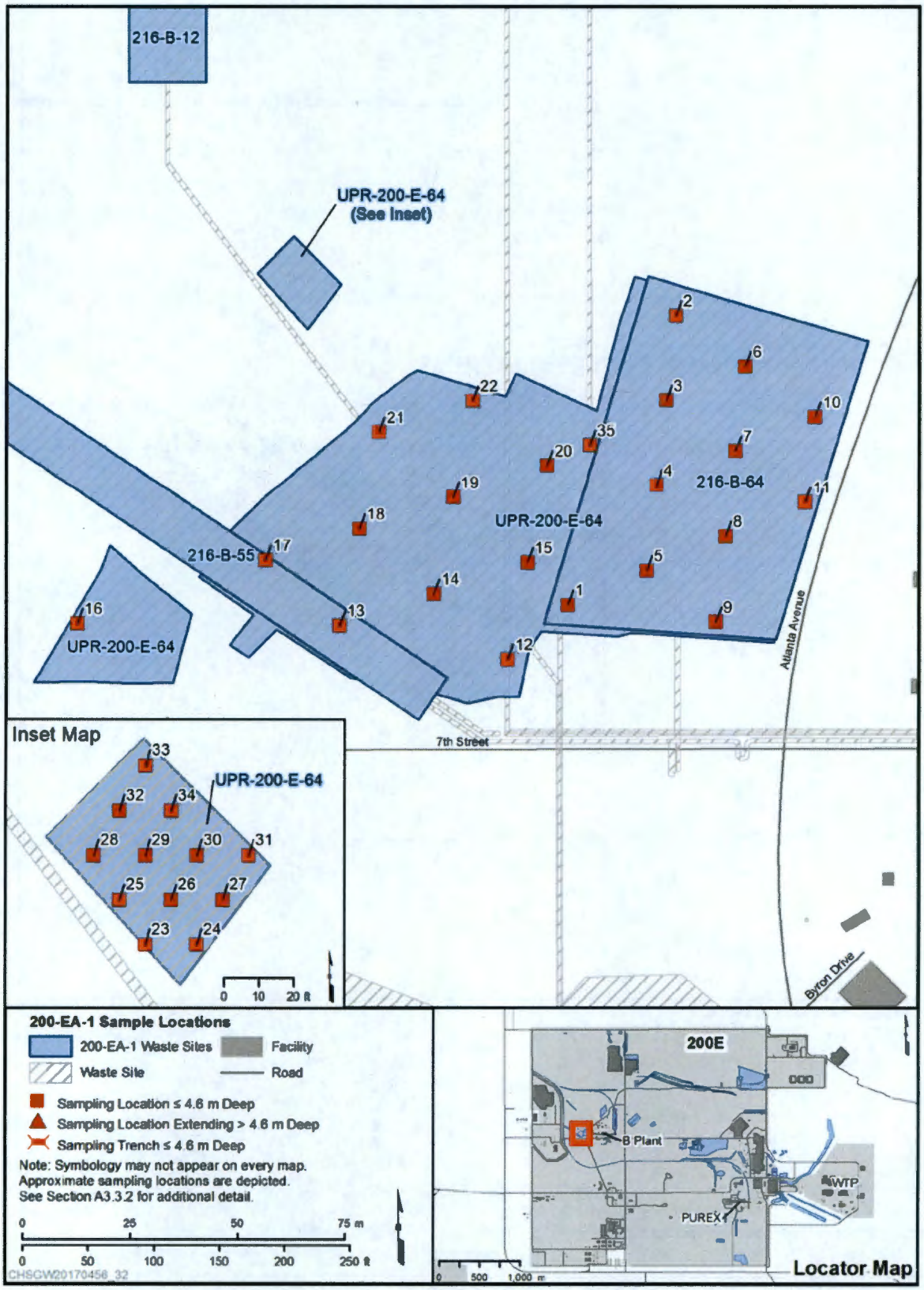

Figure A-18. UPR-200-E-64 Sample Locations (B Plant Group)

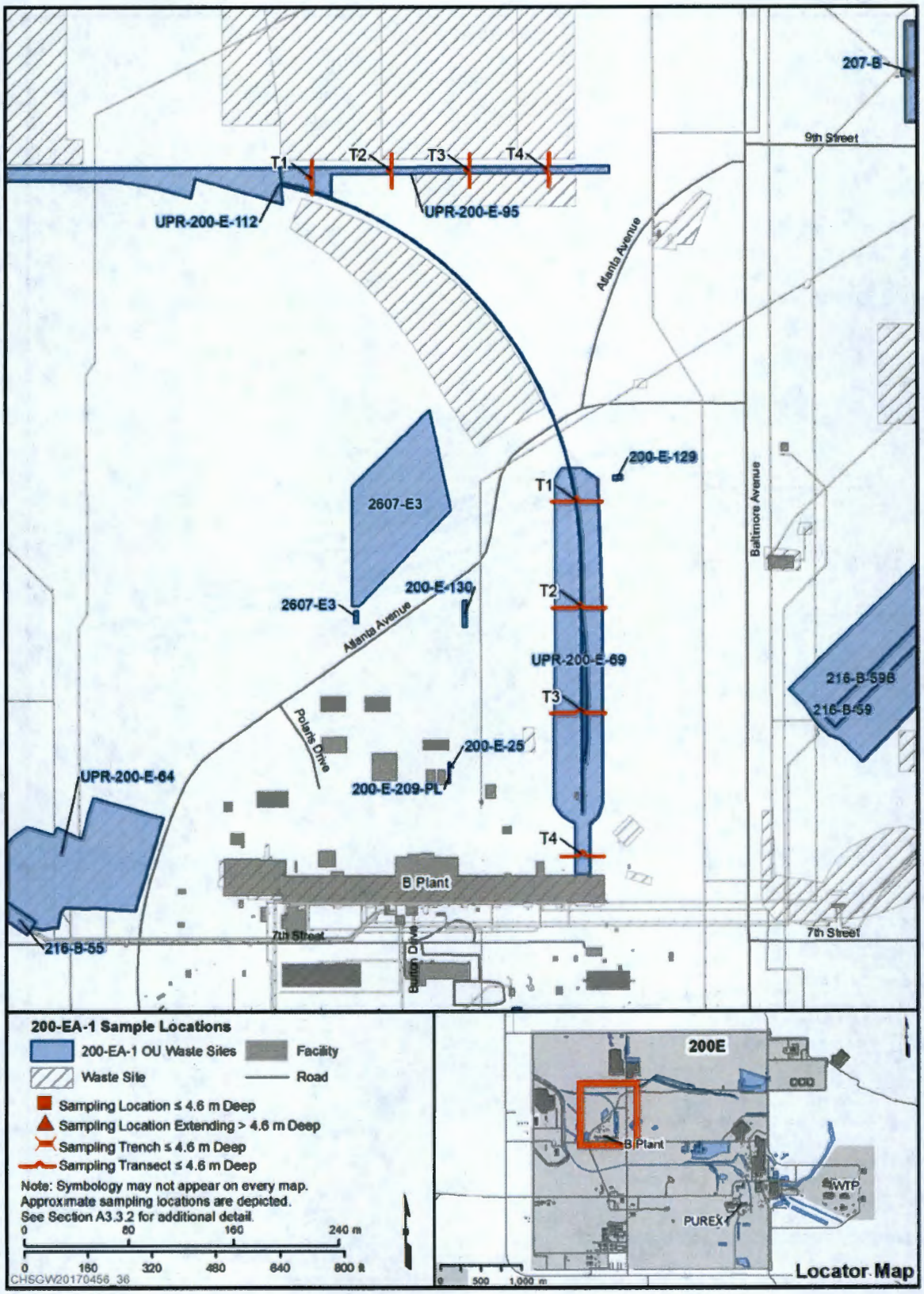

Figure A-19. UPR-200-E-69 and UPR-200-E-95 Sample Locations (B Plant Group)

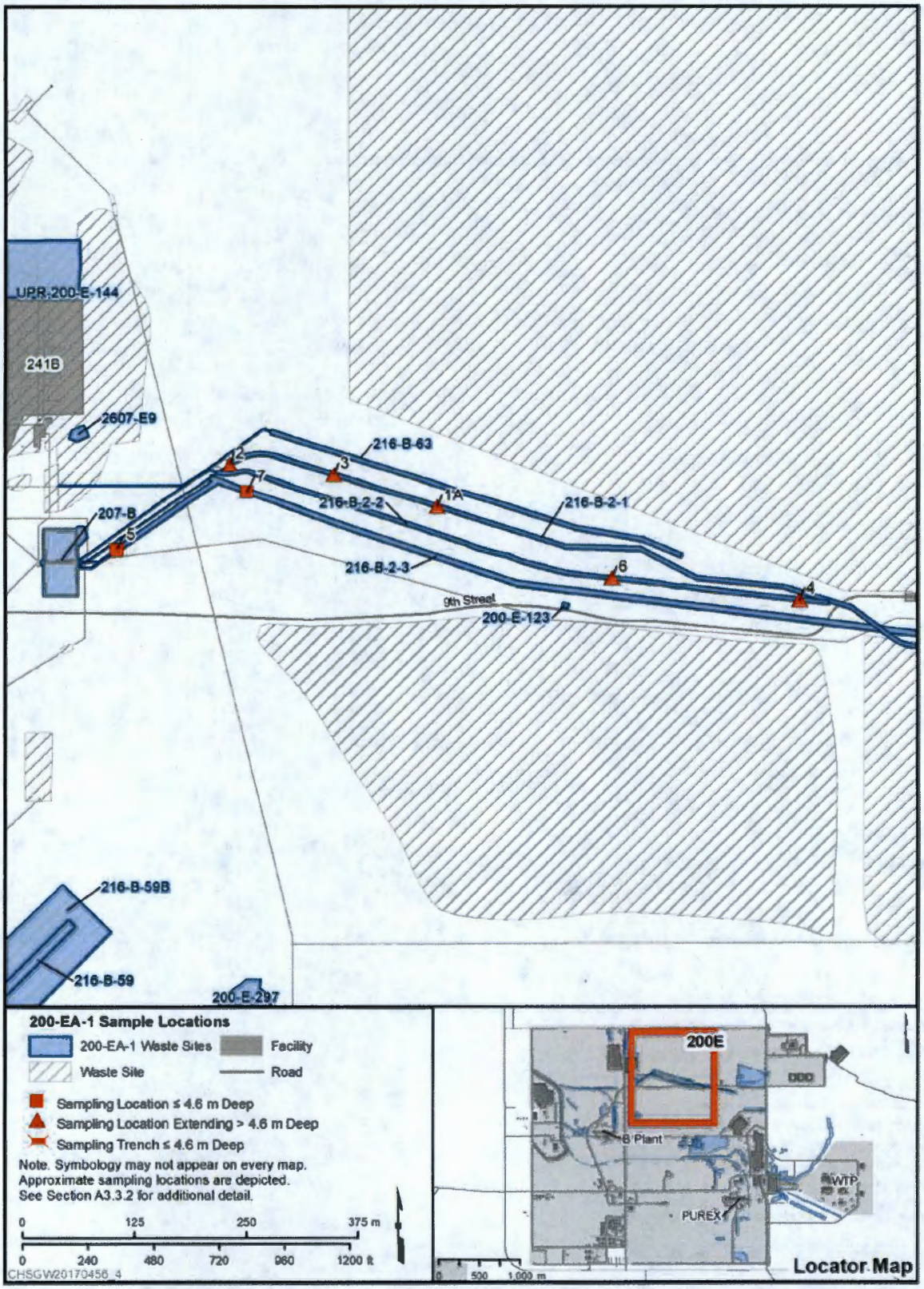

Figure A-20. 216-B-2-1, 216-B-2-2, and 216-B-2-3 Sample Locations (B Plant Group)

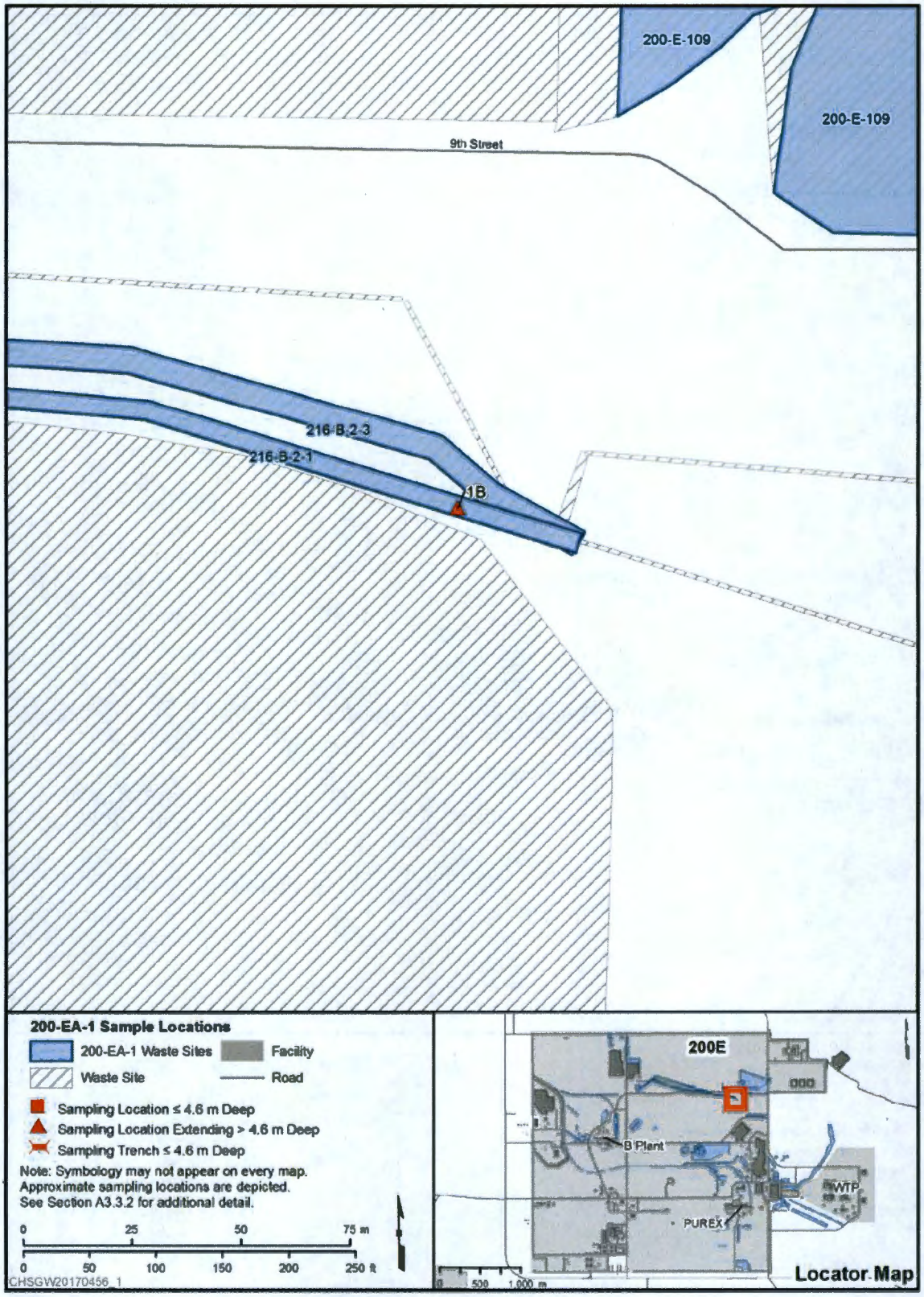

Figure A-21. 216-B-2-1 Eastern Sample Locations (B Plant Group)

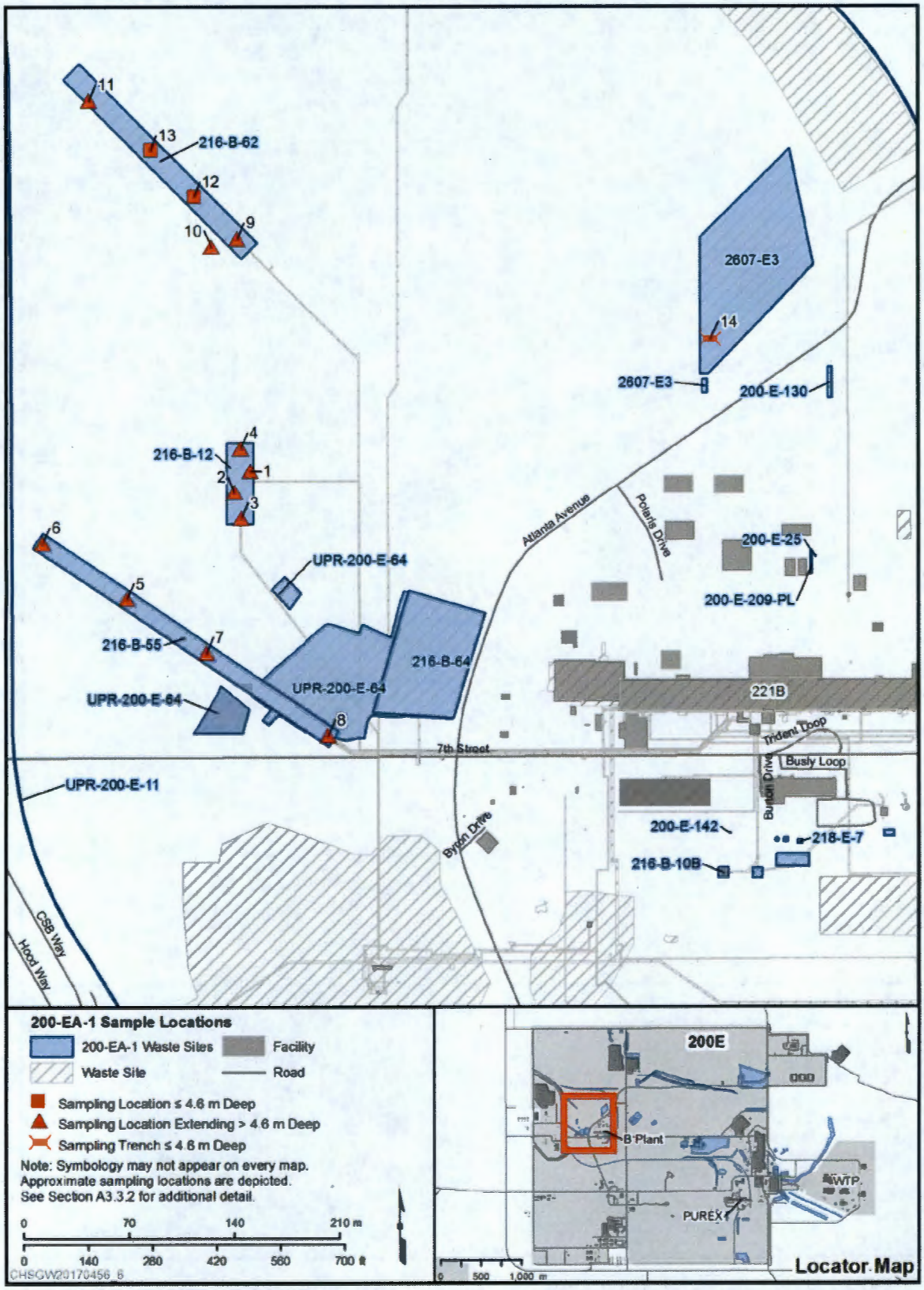

Figure A-22. 216-B-12, 216-B-55, 216-B-62, and 2607-E3 Sample Locations (B Plant Group)

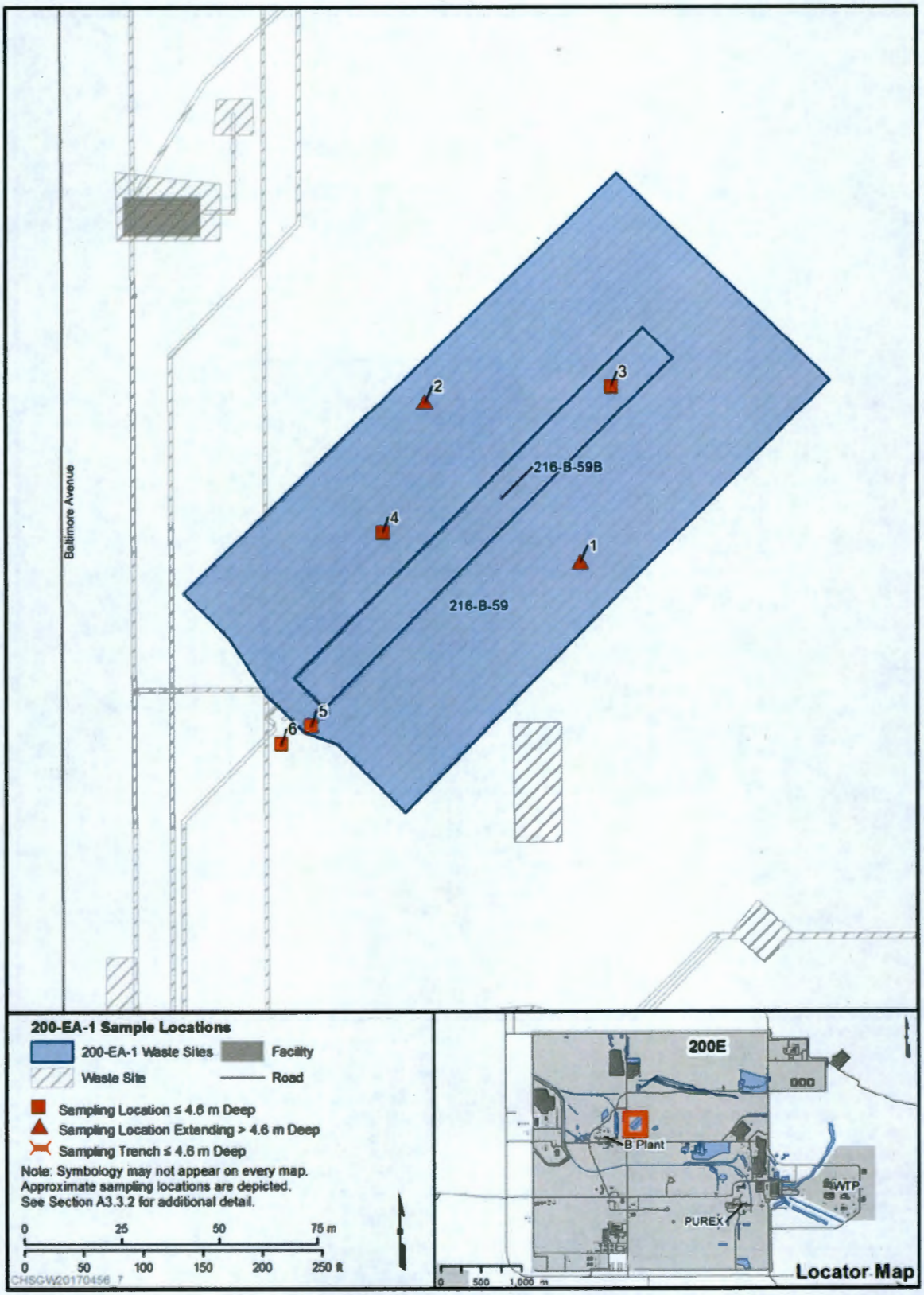

Figure A-23. 216-B-59 and 216-B-59B Sample Locations (B Plant Group)

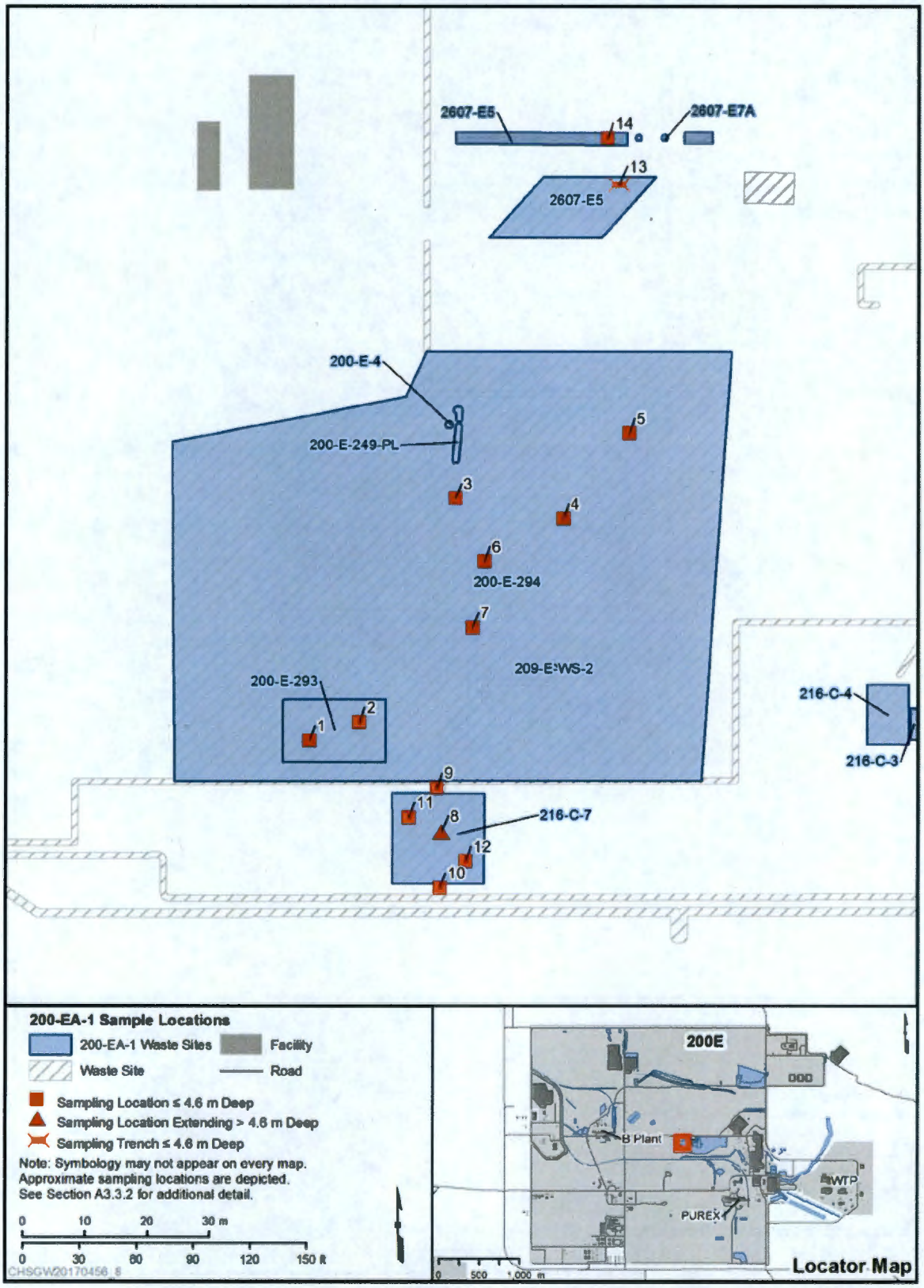

Figure A-24. 200-E-293, 200-E-294, 216-C-7, and 2607-E5 Sample Locations

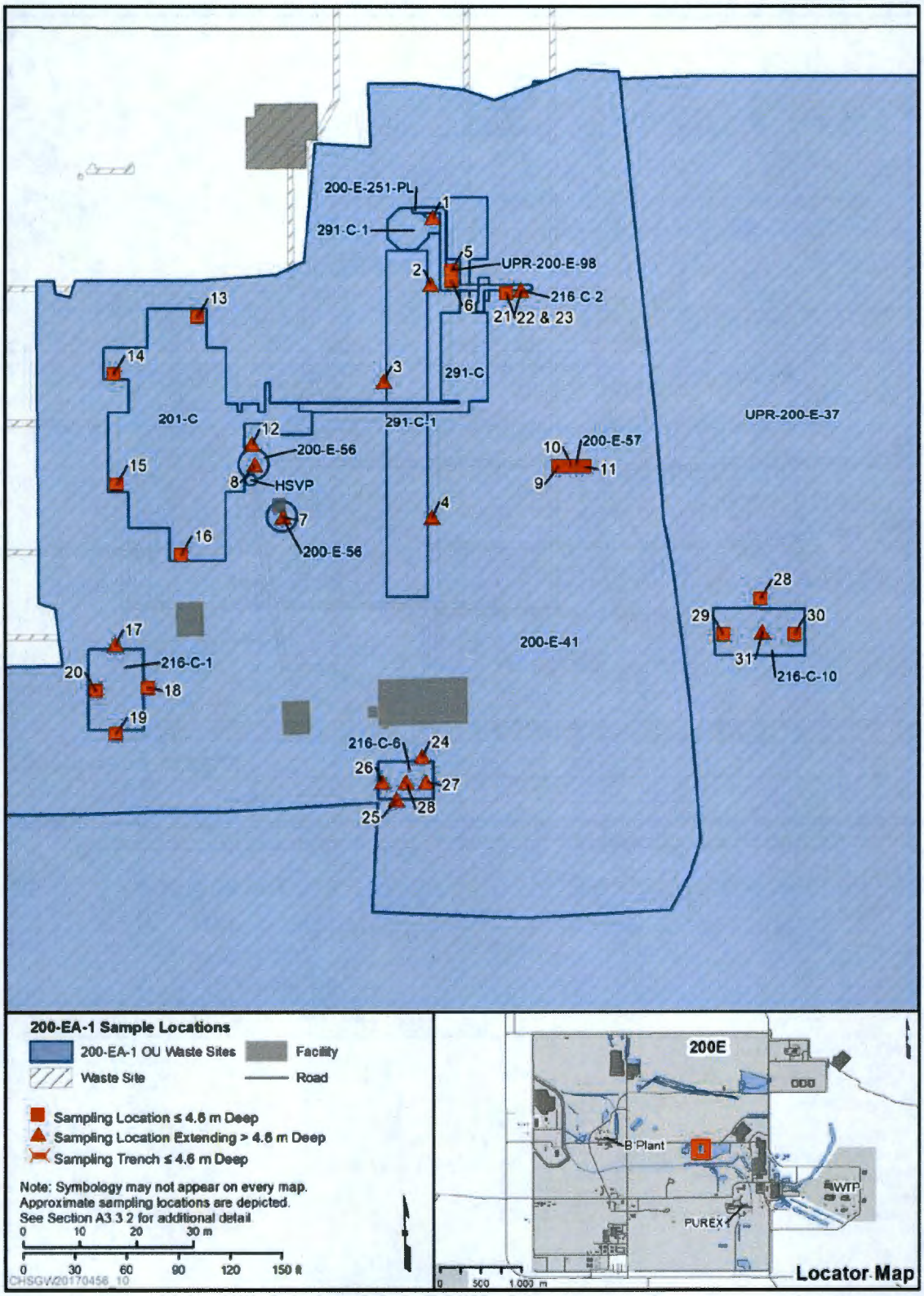

Figure A-25. 200-E-56, 200-E-57, 201-C, 216-C-1, 216-C-2, 216-C-6, 216-C-10, 291-C-1, and UPR-200-E-98 Sample Locations (Hot Semiworks Group)

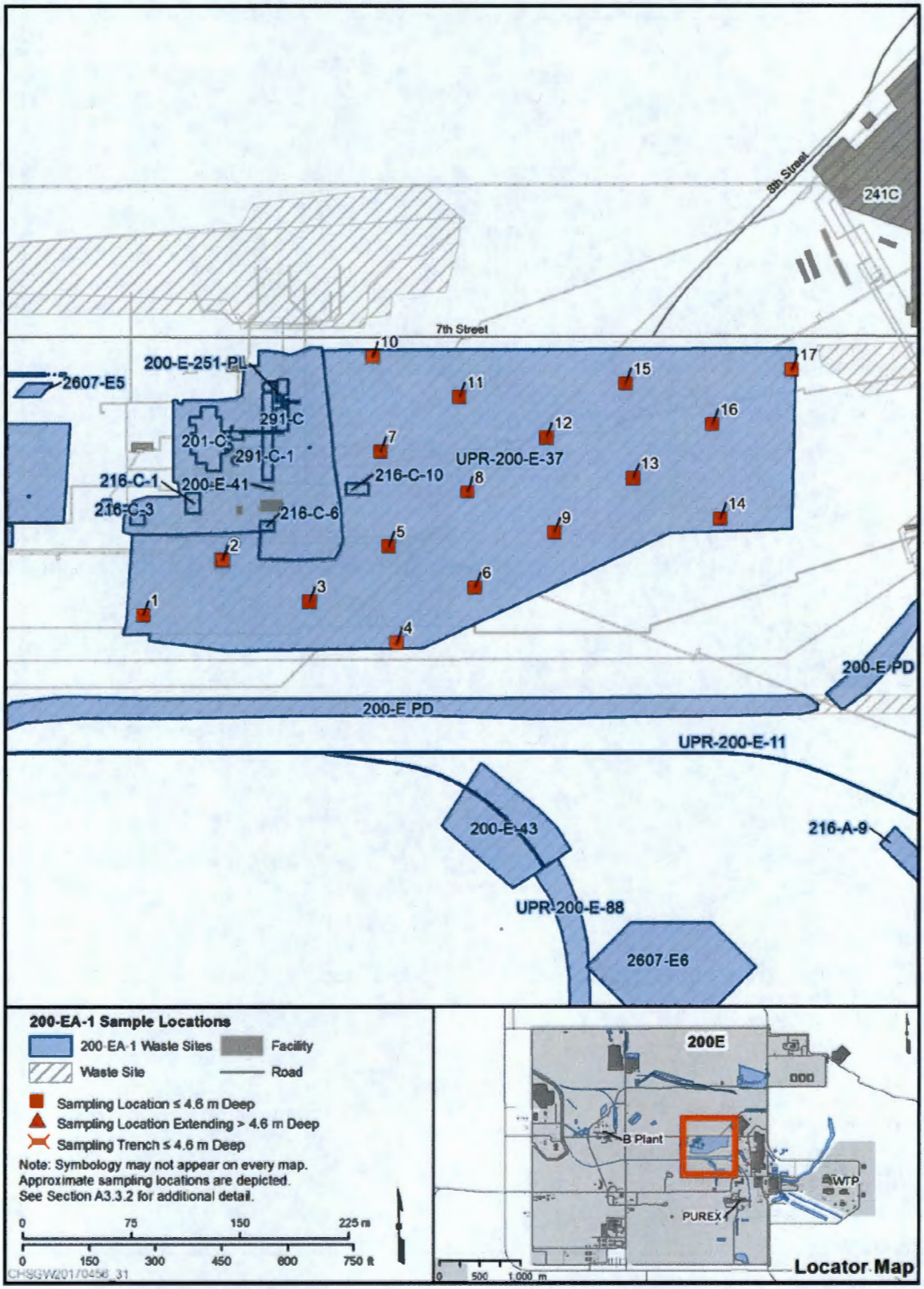

Figure A-26. UPR-200-E-37 Sample Locations (Hot Semiworks Group)

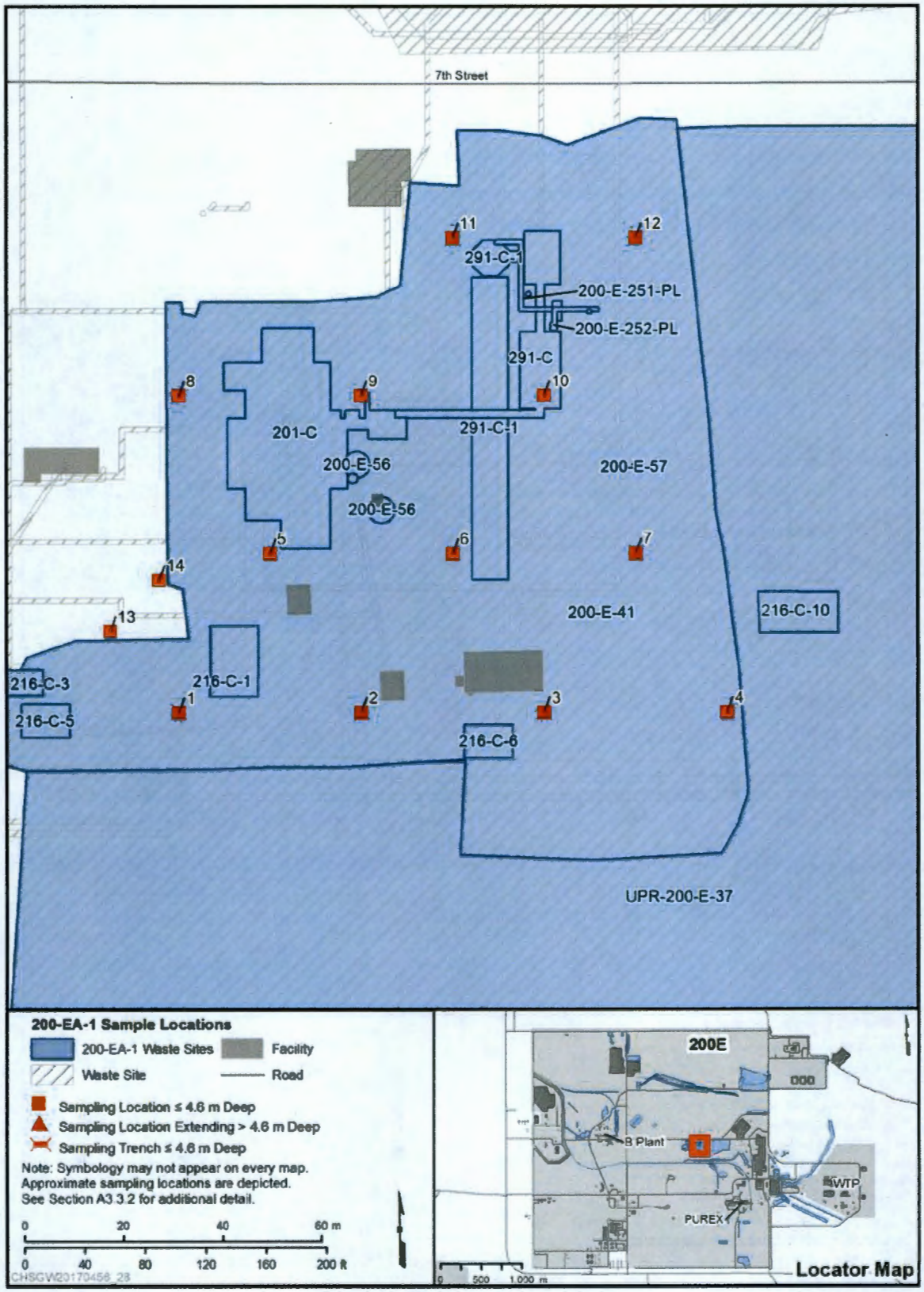

Figure A-27. 200-E-41 Sample Locations (Hot Semiworks Group)

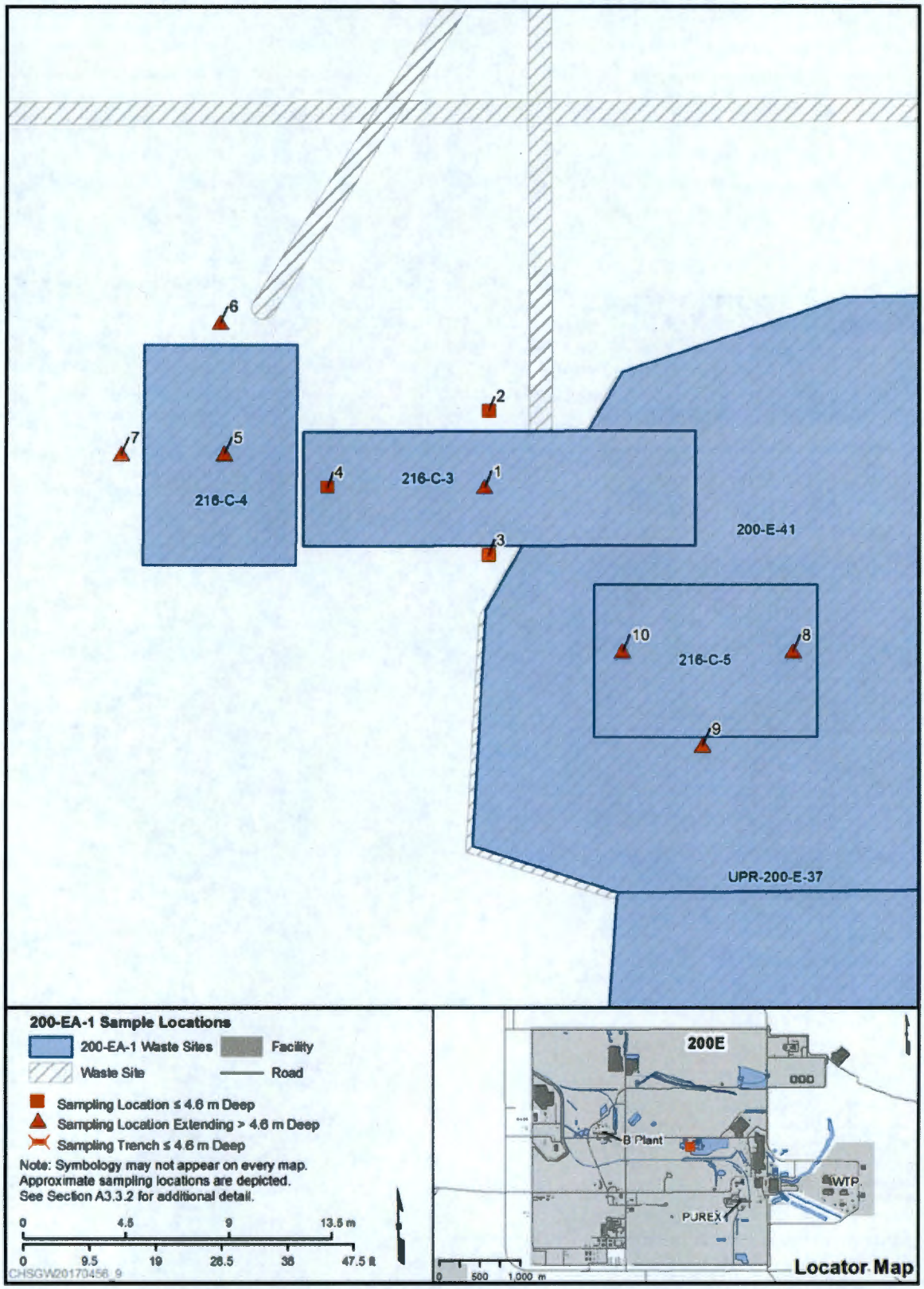

Figure A-28. 216-C-3, 216-C-4, and 216-C-5 Sample Locations (Hot Semiworks Group

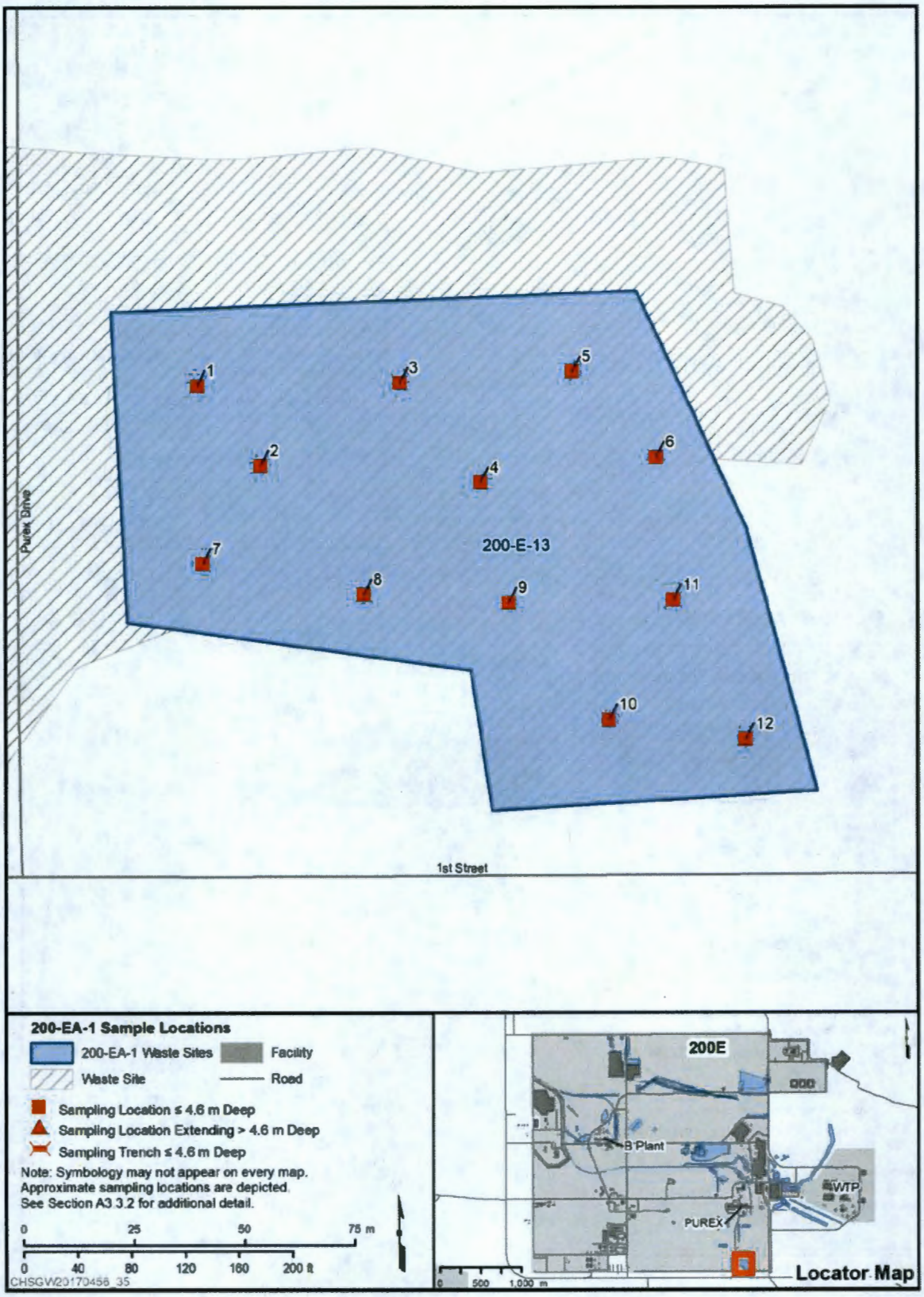

Figure A-29. 200-E-13 Sample Locations (PUREX Plant Group)

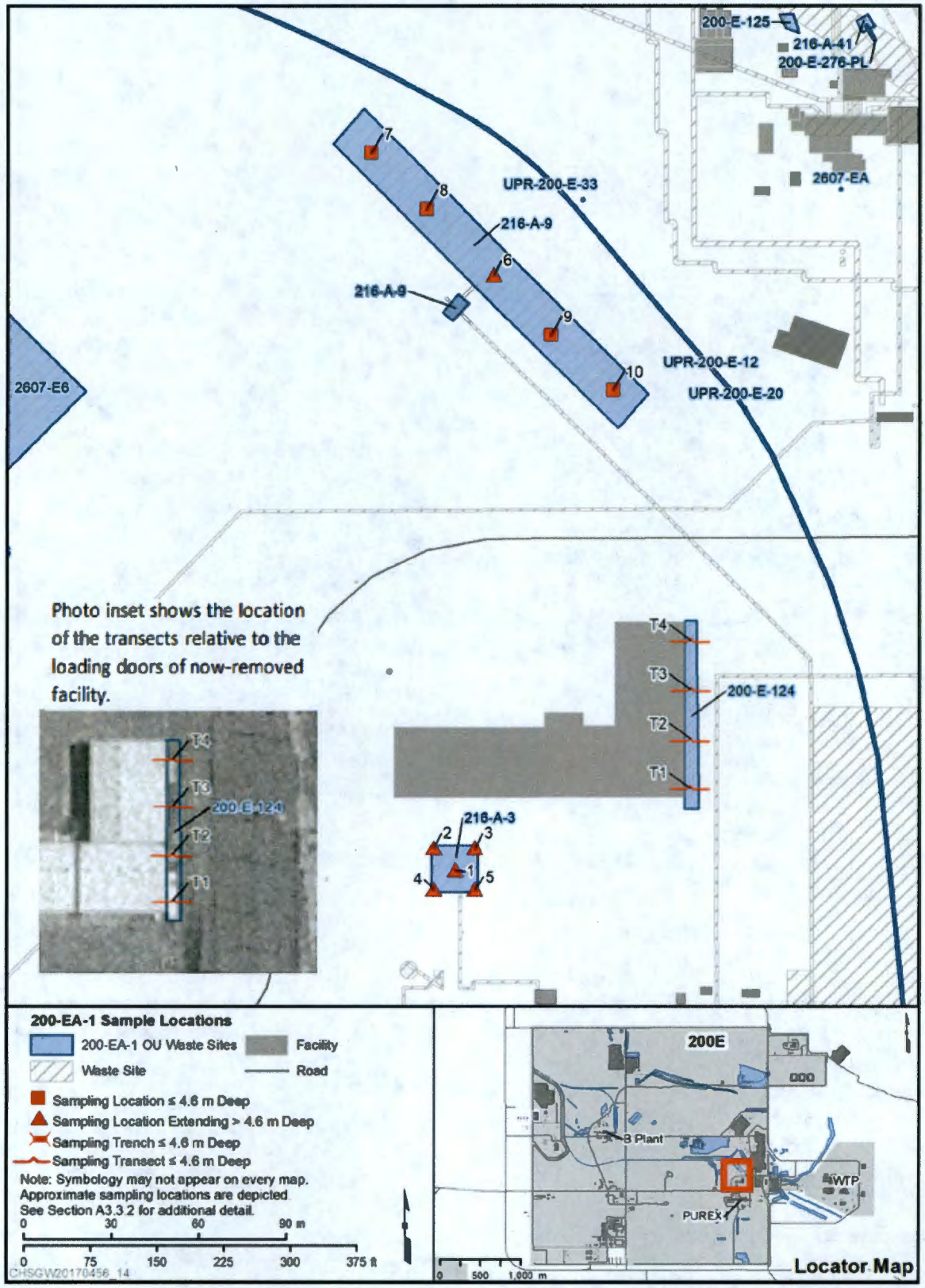

Figure A-30. 200-E-124, 216-A-3, and 216-A-9 Sample Locations (PUREX Plant Group)

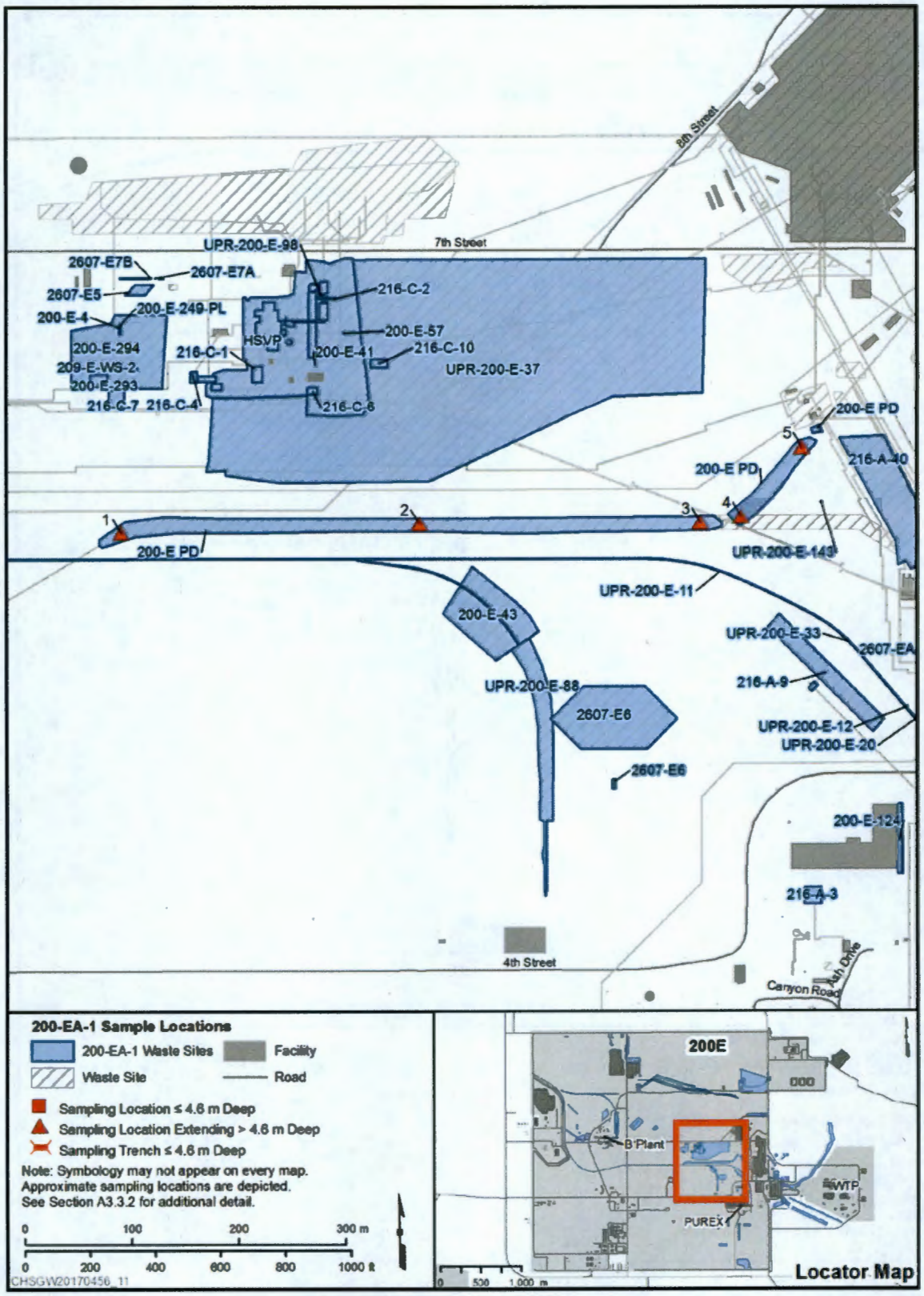

Figure A-31. 200-E PD Sample Locations (PUREX Plant Group)

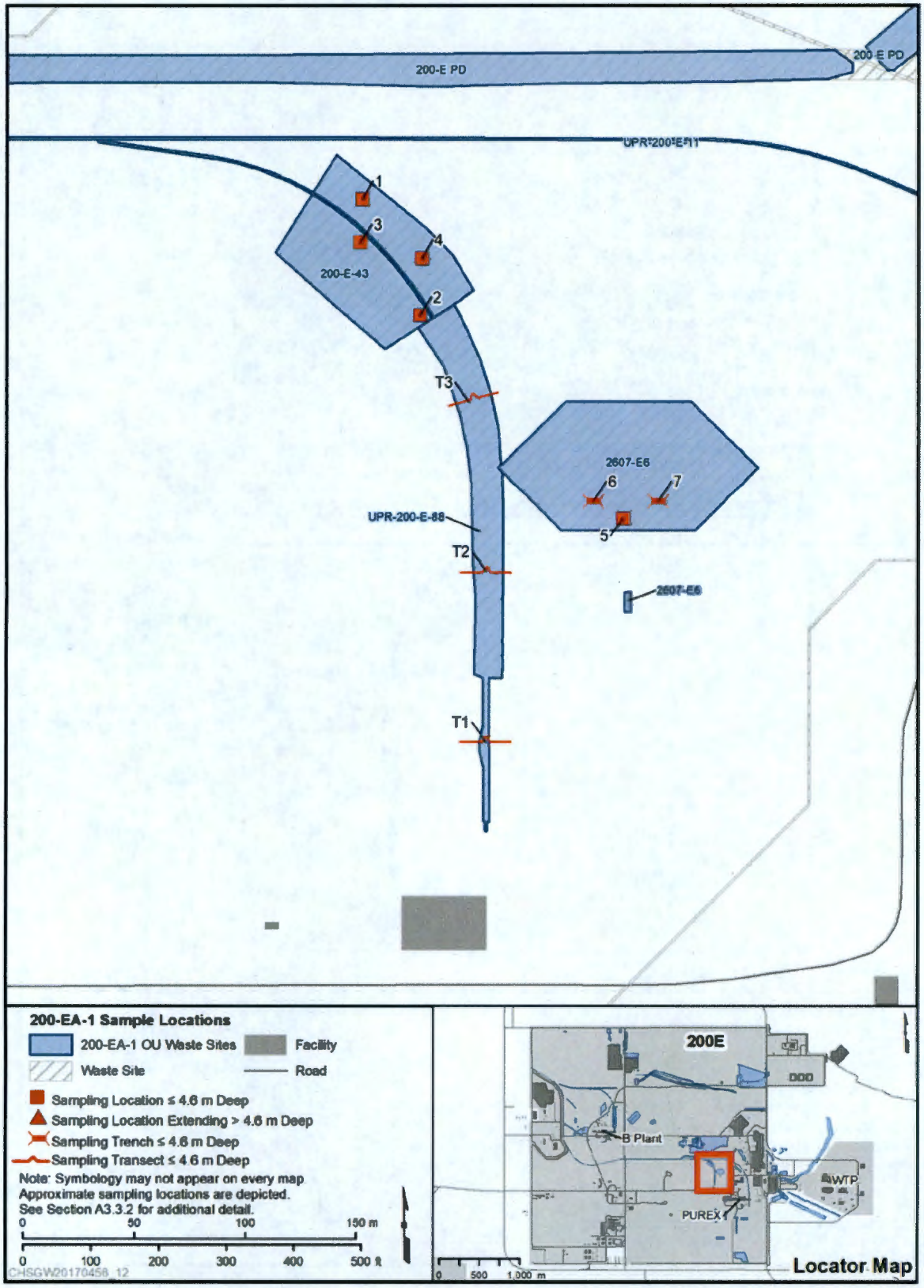

Figure A-32. 200-E-43, 2607-E6, and UPR-200-E-88 Sample Locations (PUREX Plant Group)

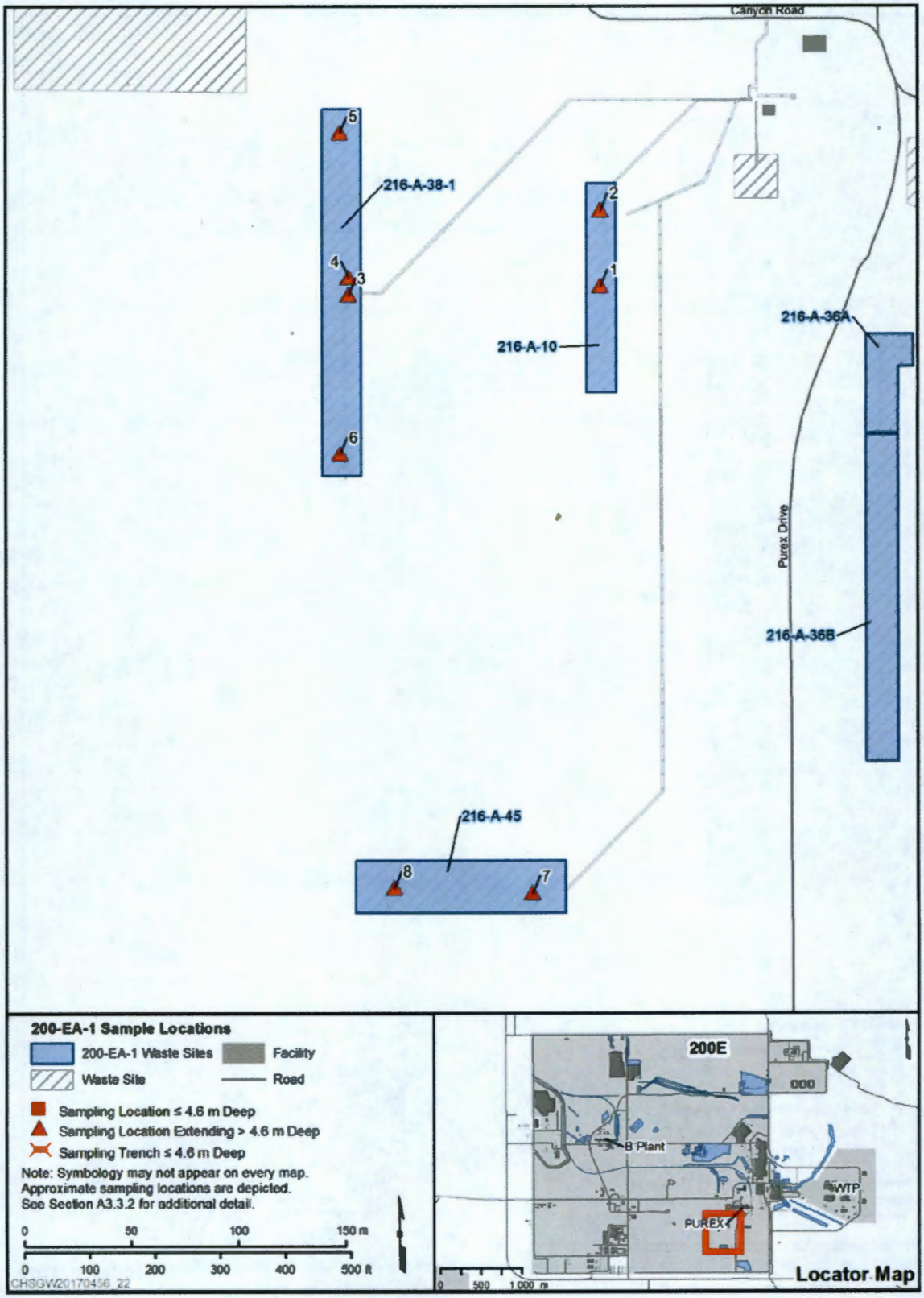

Figure A-33. 216-A-10, 216-A-38-1, and 216-A-45 Sample Locations (PUREX Plant Group)

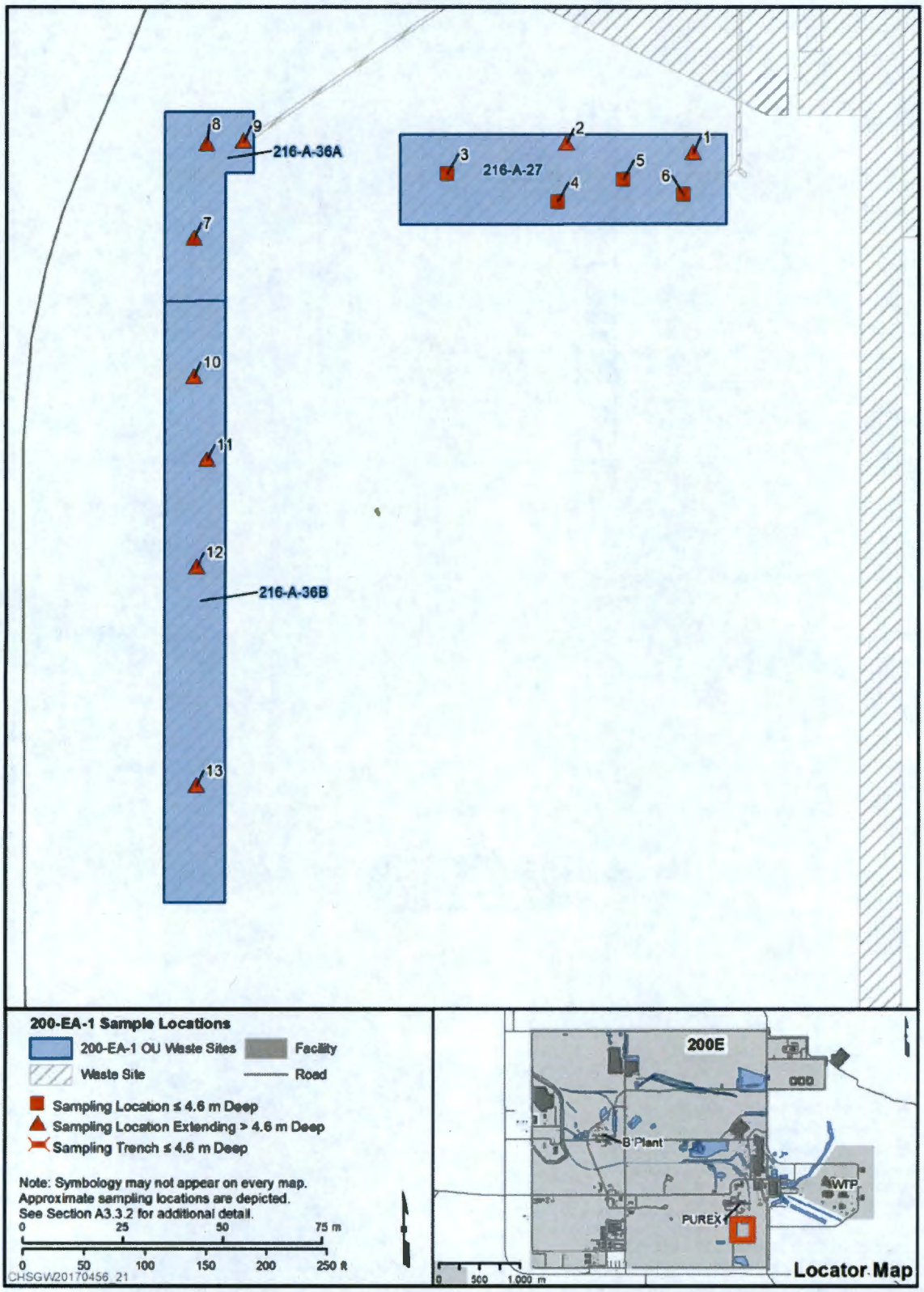

Figure A-34. 216-A-27, 216-A-36A, and 216-A-36B Sample Locations (PUREX Plant Group)

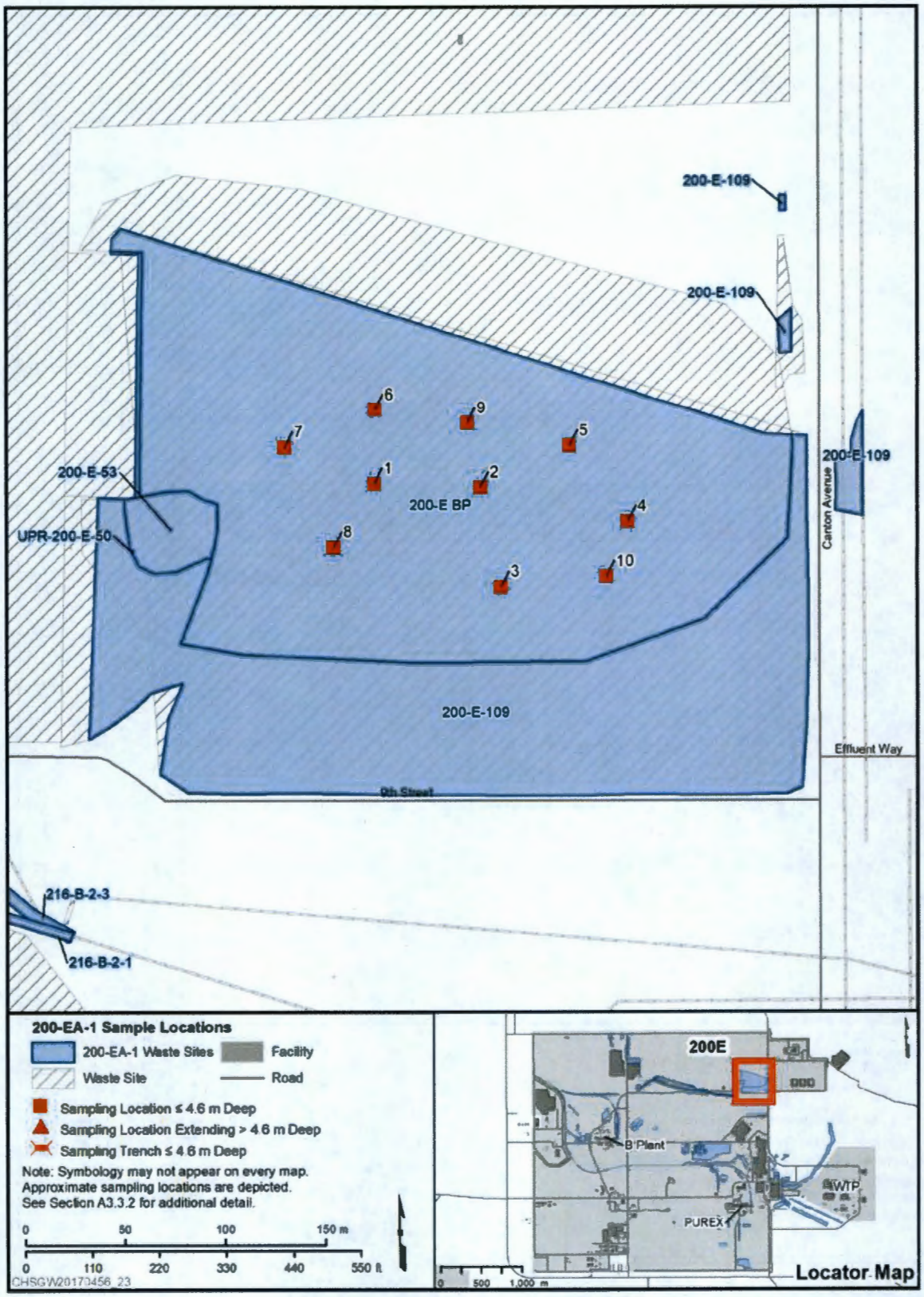

Figure A-35. 200-E BP Sample Locations (Miscellaneous Group)

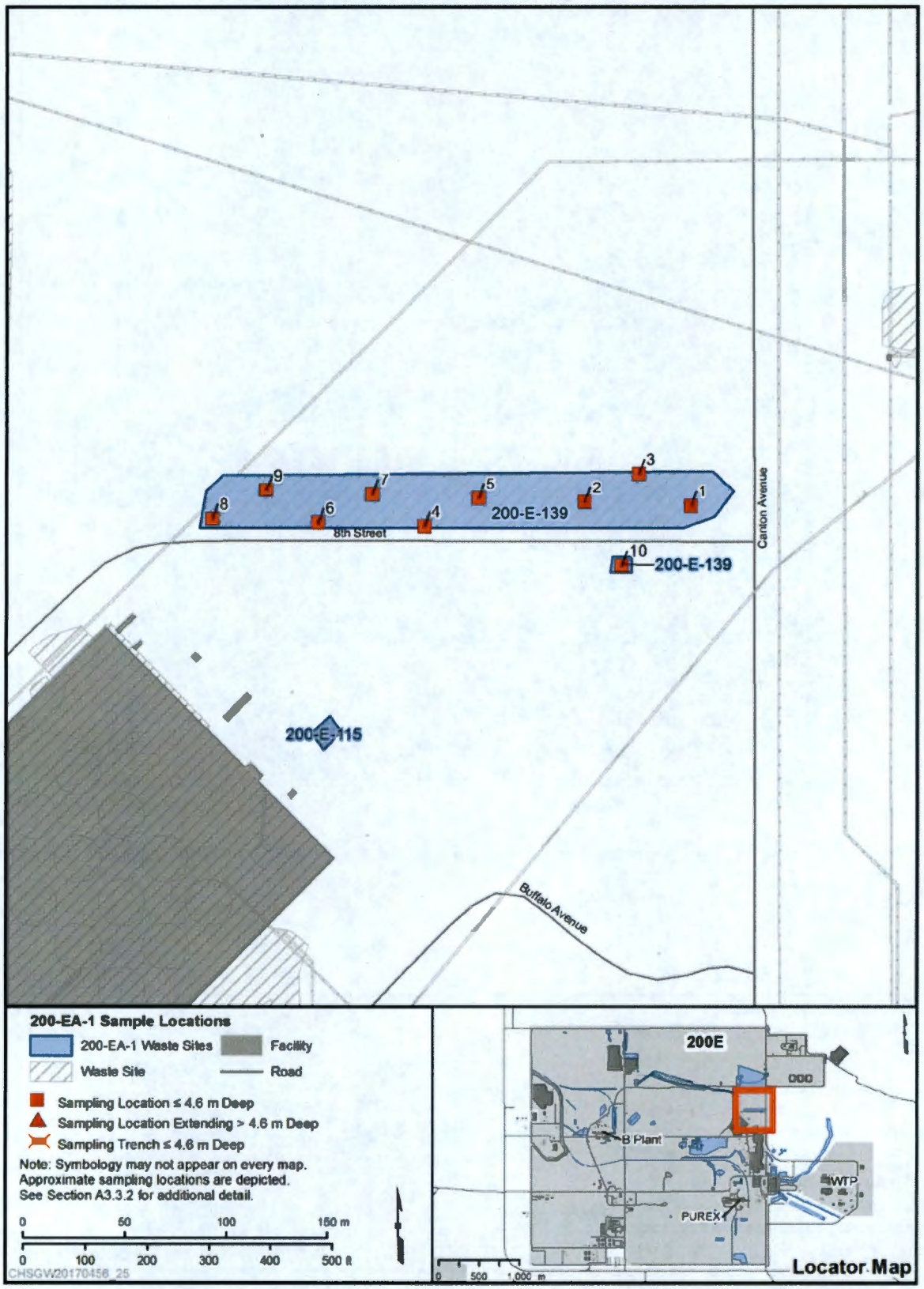

Figure A-36. 200-E-139 Sample Locations (Miscellaneous Group)

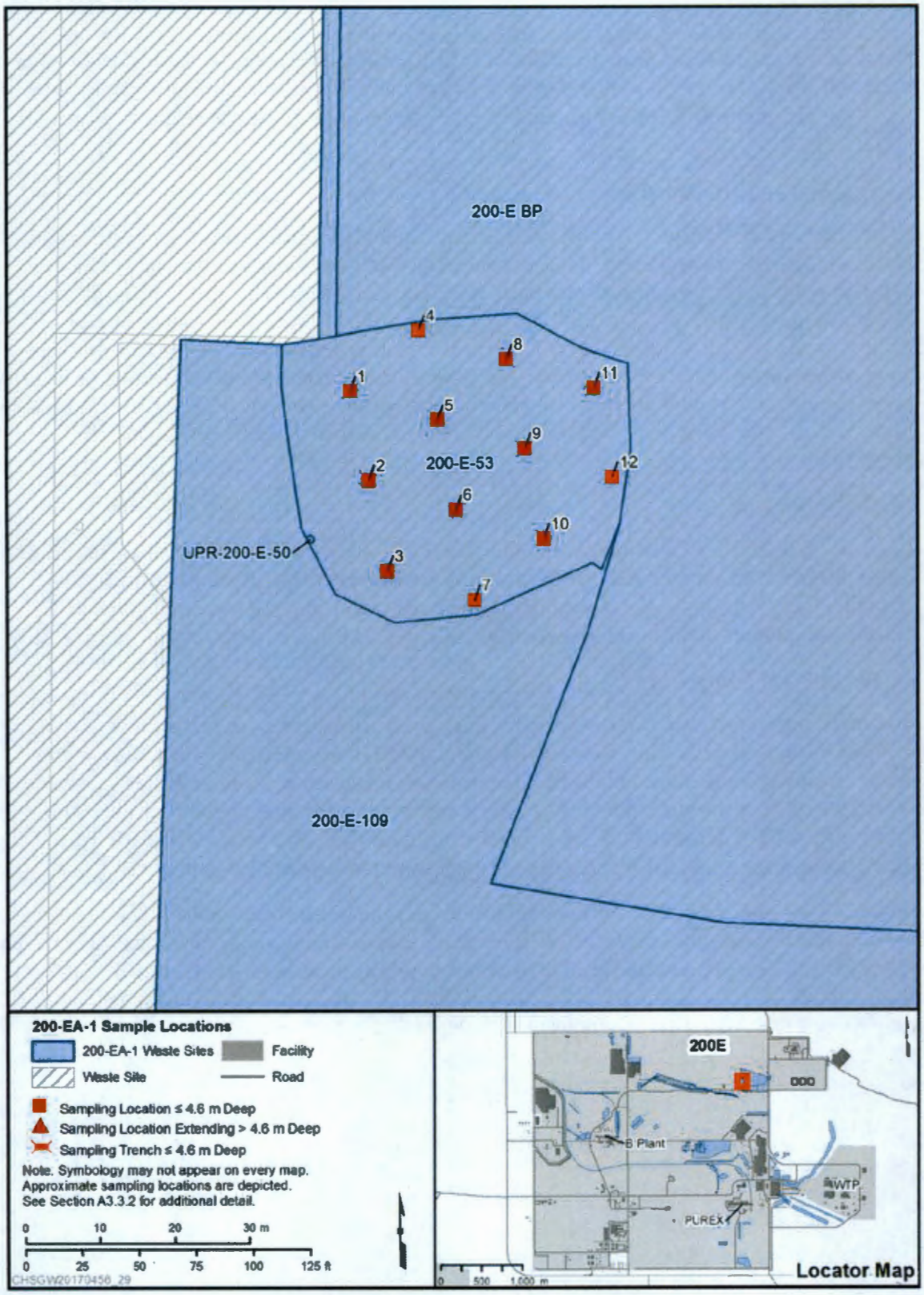

Figure A-37. 200-E-53 and UPR-200-E-50 Sample Locations (Miscellaneous Group)

A3.4.1 Surface Soil Sampling

Surface and near-surface soil samples (generally <1 m [3 ft] bgs) can generally be collected with spades, shovels, trowels, hand augers, and scoops. Surface material, including stabilization material, is removed and a stainless-steel or plastic scoop is then used to collect the grab sample of the actual surface or near-surface soil.

A3.4.2 Test Pits and Trenching

Test pits or trenches may be appropriate for investigating shallow, subsurface waste sites. These methods offer the advantage of direct inspection of a larger subsurface area (including greater ability to identify solid waste debris) than can be achieved with push or drilling methods. Test pit and trench depths are typically limited to <4.9 to 6.1 m (16 to 20 ft) bgs due to the reach of excavation equipment and engineering constraints. Test pitting and trenching are also more restricted than other methods when above-grade or subsurface interferences are present. Generally, a backhoe or trackhoe is used to excavate test pits and trenches, with grab samples of the soil collected directly from the bucket. Excavation spoils are staged adjacent to the excavations and are placed in the excavation at the completion of the field investigation.

A3.4.3 Grab Sampling

Grab samples will be collected for surface sampling and from test pits and trenches. Sample material will be collected directly from exposed soil or from an excavator bucket. VOA subsamples will be collected first. Except for the VOA subsamples, soil will be transferred to a clean, stainless-steel mixing bowl, homogenized, and placed in containers in accordance with this SAP.

A3.4.4 Direct-Push Technology

DPT involves using a diesel hammer, hydraulic hammer, cone penetrometer, or percussion probe to penetrate the vadose zone and collect soil samples and/or obtain downhole geophysical logging data. These methods are generally limited in the depth of penetration and sample volume retrieval, compared to conventional borehole drilling techniques. Also, dense stratigraphy, cobbles, or boulders will cause refusal. However, DPT is generally less expensive than drilling. Table A-20 includes descriptions of various DPT technologies that may be used to collect the soil samples specified in this SAP.

Soil samples are collected from the DPT hole using a driven sampling device, similar to a split-spoon sampler. Sampling is conducted first for VOA, if required. Then soils are homogenized and subsampled for the remainder of the required analyses. DPT methods typically provide lower volumes of soil recovery than other methods and may require prioritization or special laboratory coordination for small-volume sample analyses. Table A-20 lists the anticipated maximum depths for these technologies.

Table A-20. Direct-Push Technologies

Technology	Penetration Depth	Sample Size	State of Development	Comments	Relative Cost
Hydraulic hammer unit	Medium to deep (61.0 m [200 ft], depending on geology)	2.5 cm (1 in.) diameter, 56 cm (22 in.) long	Commercial; widely available	Stymied by competent sediments, cobbles/ boulders	Medium
Cone penetrometer	Medium (<45.7 m [150 ft], depending on geology)	2.5 cm (1 in.) diameter, 0.6 m (2 ft) long	Commercial; widely available	Stymied by competent sediments, cobbles/ boulders	Medium
Enhanced access penetration system	Medium to deep (76.2 m [250 ft], depending on geology)	2.5 cm (1 in.) diameter, 0.6 m (2 ft) long	Mature; some refinement needed for difficult conditions	Cone penetrometer that can also drill through fine sediments, boulders	Medium
Percussion probe	Shallow (<30.4 m [100 ft])	2.5 cm (1 in.) diameter, 0.3 m (1 ft) long	Commercial; widely available	Stymied by competent sediments, cobbles/ boulders; often referred to as a GeoProbe®	Low to medium

Note: GeoProbe® is a registered trademark of GeoProbe Systems, Salina, Kansas.

A3.4.5 Borehole Drilling

Borehole drilling can be conducted using a variety of equipment, depending on data needs. For application to the 200-EA-1 OU characterization, the preferred borehole drilling method will be capable of sampling using continuous coring (Section A3.4.6). Drilling technology attributes will allow for the following:

- Enable collection of intact continuous core samples
- Enable control of contaminated cuttings
- Permit spectral gamma, neutron moisture, and other types of downhole geophysical logging
- Provide adequate soil volume to support soil sampling

Table A-21 includes descriptions of various conventional borehole drilling technologies that may be used to collect the samples specified in this SAP.

All drilling will conform to site-specific technical specifications for environmental drilling services. Drill rigs for deep boreholes will generally require a gravel pad and sometimes gravel access roads.

Multiple telescoping casing strings may be used to reach the total depth for boreholes and minimize contaminant transport through the vadose zone during drilling. The casing sizes will be planned and designed to accommodate split-spoon samplers to the bottom of the borehole.

Table A-21. Conventional Borehole Drilling Technologies

Technology	Penetration Depth	Sample Size	State of Development	Comments	Relative Cost
Cable tool	Deep (>91 m [300 ft])	6 to 13 cm (2.5 to 5 in.) diameter split spoon	Commercial; widely available and routinely used	Typically used in radiologically contaminated areas.	Medium to high
Air rotary	Deep (>91 m [300 ft])	6 to 13 cm (2.5 to 5 in.) diameter split spoon	Commercial; widely available	Cannot be used to characterize volatiles.	Medium to high
Percussion (Becker Hammer, other drive casing types)	Medium (<61 m [200 ft], depending on geology)	6 to 13 cm (2.5 to 5 in.) diameter split spoon	Commercial; widely available and routinely used	Provides for the rapid and accurate collection of geologic samples. May not be suitable for environmental sampling.	Medium
Sonic	Medium (<91 m [300 ft], depending on geology)	6 to 13 cm (2.5 to 5 in.) diameter split spoon	Commercial; widely available	Allows for continuous coring; can heat formation and sample to high temperatures.	Medium
Hollow-stem auger	Shallow (<50 ft) (15 m)	6 to 13 cm (2.5 to 5 in.) diameter split spoon	Commercial; widely available	Brings spoils to surface; may be more limited by contamination control considerations.	Low
Directional drilling	Deep (>91 m [300 ft])	Up to 5 cm (2 in.) diameter grab sample	Commercial; widely available	Requires a drilling mud, which could mobilize contamination.	High

A3.4.6 Continuous Coring

An approved DPT or borehole drilling method will be used to collect intact continuous core samples and achieve the total depth, as conditions allow. Downhole geophysical logging and field screening results will determine the ideal sample intervals for analysis. Downhole geophysical logging will be performed following drilling and prior to casing downsizing, or as needed to meet required holding times. All drilling will conform to site-specific technical specifications for environmental drilling services.

Vadose zone sediments will be retrieved as intact continuous core samples with minimal disturbance to the sample material. Prior to sample collection, any formation sediment within the borehole (as a result of driving the temporary casing) will be removed.

Each core barrel device will be equipped with 1.5 m (5 ft) LEXAN liners. The liners may be obtained pre-cut according to the sampling and analysis needs (i.e., VOAs or special sampling) or to minimize the volume of soil brought to the surface if high or medium levels of radioactive contamination are expected.

Upon retrieval, each core liner will be labeled in the field, at a minimum with the borehole identification number; appropriate depths (top and bottom); the core orientation (indicated by an arrow pointing upward toward the shallowest end of the liner); and the core temperature at top, middle and bottom as measured by an infrared thermometer. The LEXAN liner ends will be sealed with snug-fitting plastic endcaps and taped to form a barrier to air and moisture. The endcaps will be further secured with evidence tape, labeled, and placed in a refrigerator or cooler with freezer packs or ice during storage (at 4°C [39.2°F]).

All intact liners shall remain sealed and stored (at 4°C [39.2°F]) until the field data and downhole geophysical logging results have been reviewed and the target sample intervals have been identified. All intact cores will be evaluated for lithology and photographed prior to sample collection, as appropriate. Prior to disposal of unused sample material, a grab sample shall be collected from each core and stored for future analysis (if needed) as the laboratory analyses are performed. The OU technical lead will determine when the grab sample is no longer needed or viable for the intended method based on the designated holding times.

In some instances, intact coring may not be possible. In those instances, the returned drill cuttings will be collected continuously in plastic sleeves as disturbed samples from the core barrel. The sleeves will be labeled in the field with the borehole identification number and the appropriate depths. All sleeves will be opened (either in the field or laboratory) and evaluated for lithology prior to disposal.

The holding-time clock will begin when the cores are retrieved from the borehole and brought to the surface. Ideally, the continuous core liners will be stored as appropriate until downhole geophysical logging results can be evaluated and target depth intervals can be selected for laboratory analysis. However, in the event that downhole geophysical logging results cannot be obtained in advance of the required holding times, alternative field screening methods may be used to select the target sample intervals as directed by the OU technical lead.

A3.4.7 Split-Spoon and Core Barrel Sampling

Split-spoon sampling may be used in cases where continuous core sampling is not viable (i.e. well installation, opportunistic sampling). Split-spoon and core barrel sampling devices will be equipped with liners, generally made of stainless steel or polycarbonate (e.g., LEXAN). Site personnel will not overdrive the sampling device. The VOA subsamples will be collected from the undisturbed cores and placed directly into sample containers. Except for the VOA subsamples, soil will be transferred to a clean, stainless-steel mixing bowl, homogenized, and containerized in accordance with this SAP.

A3.4.8 Supplemental Sampling for Soil Properties Analyses

For boreholes extending >15.2 m (50 ft) bgs, analyses for moisture content, grain-size distribution, and soil density will be conducted using the logic described in Section A2.2.2. The soil property samples will generally be collected from lithologies that represent the major facies in the vadose zone. Samples for soil density should be collected using split-spoon sampling devices, concurrent with radiological and nonradiological split-spoon sample intervals, when possible. This ensures that the physical properties can be related back to the depth of the radiological and nonradiological sample results.

The number and type of additional tests performed will be determined by the OU technical lead in consideration of available site-specific contaminant and soil properties data and the regional and site-specific data needs for fate and transport modeling.

A3.4.9 Supplemental Sampling and Testing for Attenuation and Transport Processes Evaluation

Supplemental sampling and testing for attenuation and transport processes will be performed using the logic and methods described in Section A2.2.2 at the judgment of the OU technical lead from the sampling locations identified in Section A3.3.2. Interval selection will consider available site-specific data and the regional and site-specific data needs for fate and transport modeling.

All designated attenuation and transport sample intervals will include at least sediment sequential extractability and batch leaching, partitioning behavior, or repacked leaching kinetic testing (soil column leach tests). The number and types of other tests will be determined by the OU technical lead based on an initial data assessment and information in the following natural attenuation guidance documents:

- EPA/600/R-07/139, *Monitored Natural Attenuation of Inorganic Contaminants in Ground Water Volume 1 – Technical Basis for Assessment*
- EPA/600/R-07/140, *Monitored Natural Attenuation of Inorganic Contaminants in Ground Water Volume 2 – Assessment for Non-Radionuclides Including Arsenic, Cadmium, Chromium, Copper, Lead, Nickel, Nitrate, Perchlorate, and Selenium*
- EPA/600/R-10/093, *Monitored Natural Attenuation of Inorganic Contaminants in Ground Water Volume 3 – Assessment for Radionuclides Including Tritium, Radon, Strontium, Technetium, Uranium, Iodine, Radium, Thorium, Cesium, and Plutonium-Americium*
- OSWER Directive 9283.1-36, *Use of Monitored Natural Attenuation for Inorganic Contaminants at Superfund Sites*

A3.4.10 Concrete Coring

Concrete core samples may be collected from structures (e.g., foundations and retention basins). Handheld or vehicle-mounted coring equipment will be used to collect a continuous core for analysis.

A3.4.11 Downhole Geophysical Logging

Boreholes will be geophysically logged with the high-resolution, spectral gamma ray logging system to determine the vertical distribution and concentration of gamma-emitting radionuclides. Soil moisture will be determined using a neutron logging tool. Passive neutron logs may be collected on a case-by-case basis if the gamma spectroscopy log or process history indicate that fissile materials (e.g., plutonium) may be present. The boreholes will be logged before the casing is telescoped and before the borehole is decommissioned. The starting point for logging will be recorded, usually at the ground surface or the top of the casing. In accordance with WAC 173-160, boreholes will be decommissioned with DOE-RL and Ecology approval after downhole geophysical logging and sampling are completed.

Direct-push boreholes will be geophysically logged using either a slim-hole spectral gamma ray logging system or a gross gamma logging system. Soil moisture will be determined using a neutron logging tool. Passive neutron logs may be collected on a case-by-case basis if the gamma log or process history indicate the likely presence of plutonium.

A3.4.12 Surface Geophysical Surveys

Surface-based geophysical surveys (including magnetometry, ground-penetrating radar, and resistivity) will be used at selected locations to refine the understanding of subsurface features and/or lateral contaminant distribution gradients. These surveys will generally be performed on areas larger than the associated waste sites to address the objectives identified in Section A3.3.1.

A3.4.13 Field Screening

Field screening provides alpha and beta/gamma, in situ gamma, XRF, and organic vapor monitoring data. The data will be used to support sampling and analysis efforts. Generally, cuttings from waste site penetrations, trenches, and test pits will be field screened for contamination. Screening will be conducted visually and with field instruments by qualified personnel following established sampling practices, procedures, and requirements. The field measurements will be recorded, noting the sample depth and the

instrument reading. Measurements will be relayed daily to the field geologist for inclusion in the field logbook or operation records, as applicable. Where systematic surface field surveys are required, field measurement data points will be associated with global positioning system coordinates on standard grid intervals.

A3.5 Decontamination of Sampling Equipment

Sampling equipment will be decontaminated using approved sampling equipment decontamination methods. To prevent potential sample contamination, care will be taken to use decontaminated or disposable equipment for each sampling activity. Special care will be taken to avoid the following common ways that cross-contamination or background contamination may compromise samples:

- Improperly storing or transporting sampling equipment and sample containers
- Placing sampling gear or bottles on or near potentially contaminated materials (e.g., uncovered ground)
- Handling bottles or equipment with dirty hands or gloves
- Improperly decontaminating equipment before sampling or between sampling events

Decontamination of nondisposable sampling equipment requires high-purity water in each step. In general, three rinse cycles are performed to decontaminate sampling equipment: a detergent rinse, an acid rinse, and a water rinse. During the detergent rinse, the equipment is washed in a phosphate-free detergent solution, followed by rinsing with high-purity water in three sequential containers. After the third high-purity water rinse, stainless-steel or glass equipment is rinsed in 1M nitric acid solution (pH <2). The equipment is then rinsed with high-purity water in three sequential containers (the high-purity water rinses following the acid rinse are in containers not used for the detergent rinse). Following the final high-purity water rinse, equipment is rinsed in hexane and placed on a rack to dry. Air-dried equipment that is not metal or glass is loaded into a 50°C (122°F) drying oven, while metal or glass items are placed in a 100°C (212°F) drying oven. Once the items reach these temperatures, they are baked for 20 minutes and then cooled. The equipment is removed from the oven using surgeon's gloves and wrapped in clean, unused aluminum foil. The wrapped equipment is stored in a custody-locked, controlled access area.

At a minimum, the drill rig derrick, all downhole equipment, and temporary casings will be field decontaminated (e.g., high pressure and temperature wash) before mobilization and demobilization at each drilling location. If core barrel equipment is used to collect samples, the drive head will be swapped out with a clean replacement.

A3.6 Documentation of Field Activities

Logbooks or data forms are required for field activities and will be used in accordance with HASQARD requirements (DOE/RL-96-68). A logbook must be identified with a unique project name and number. The individuals responsible for logbooks will be identified in the front of the logbook, and only authorized persons may make logbook entries. Logbook entries will be reviewed by the FWS, cognizant scientist/engineer, or another responsible manager and the review will be documented with their signature and the date. Logbooks will be permanently bound, waterproof, and ruled with sequentially numbered pages. Pages may not be removed from logbooks for any reason, and logbook entries will be made in indelible ink. Corrections will be made by marking through erroneous entries with a single line, entering the correct data or information, and initialing and dating the changes.

Data forms may be used to collect field information but must follow the logbook requirements, and the data forms must be referenced in the logbooks. A summary of information recorded in logbooks or on data forms is as follows:

- Day and date; task start and end time; weather conditions; and names, titles, and organizations of personnel performing the task.
- Purpose of visit to the task area.
- Detailed description of site activities (e.g., text, maps, and drawings) or by reference to the data forms used to record such information (e.g., soil boring log or well completion log). Also include details about field tests conducted, other data records, and methods followed when performing the activity.
- Details of field calibrations and surveys conducted. Reference any forms used, other data records, and the methods followed when performing the calibrations and surveys.
- Details of samples collected and the preparation of SPLITS, duplicates, MSs, or MBs. Reference the methods used for sample collection or preparation. List the sample locations, types, labels or tag numbers, identification numbers, containers and volume, preservation methods, packaging, chain-of-custody form numbers, and analytical request form numbers pertinent to each sample or sample set. Note the time and the name of the individual to whom custody of samples was transferred.
- Time, equipment type, serial or identification number, and methods followed for equipment decontaminations and maintenance. If using data forms in conjunction with logbooks, reference the page number(s) of any logbook where detailed information is recorded on the data form.
- Equipment failures or breakdowns, with a brief description of repairs or replacements.

A3.6.1 Corrective Actions and Deviations for Sampling Activities

The OU project manager, FWS, field crew supervisors, and SMR personnel must document deviations from protocols, issues pertaining to sample collection, chain-of-custody forms, target analytes, sample transport requirements, or noncompliant monitoring. Examples of deviations include samples not collected due to field conditions.

As appropriate, deviations or issues will be documented (e.g., in a field logbook) in accordance with internal corrective action methods. The OU project manager, FWS, field crew supervisors, or SMR personnel are responsible for communicating field corrective action requirements and for ensuring that corrective actions are applied to field activities. Changes in sample activities that require notification, approval, and documentation will be performed as specified in Table A-4.

A3.7 Calibration of Field Equipment

Onsite environmental instruments are calibrated in accordance with the manufacturer's operating instructions, internal work requirements and processes, and field instructions that provide direction for equipment calibration or verification of accuracy by analytical methods. Calibration records shall include raw calibration data, identification of the standards used, associated reports, calibration date, and the analyst's name or initials. The results from all instrument calibration activities are recorded in accordance with HASQARD requirements (DOE/RL-96-68). Field instrument calibration and QA checks will be performed as follows:

- Prior to initial use of a field analytical measurement system.
- At the frequency recommended by the manufacturer, standard methods, or as required by regulations.
- Upon failure to meet specified QC criteria.
- Calibration of radiological field instruments on the Hanford Site is performed by the Mission Support Alliance prime contractor, as specified by their calibration program.
- Daily calibration checks will be performed and documented for each instrument used. The checks will be made on standard materials that are sufficiently similar to the matrix under consideration for direct data comparison. Analysis times will be sufficient to establish detection efficiency and resolution.
- Standards used for calibration will be traceable to a nationally recognized standard agency source or measurement system. Manufacturer's recommendations for storage and handling of standards (if any) will be followed. Expired standards will not be used for calibration.

A3.8 Sample Handling

Sample handling and transfer will be in accordance with established methods, including HASQARD (DOE/RL-96-68), to preclude loss of identity, damage, deterioration, and loss of sample. Custody seals or custody tape will be used to verify that sample integrity was maintained during sample transport. The custody seal will be inscribed with the sampler's initials and date. If it is discovered that the custody tape has been tampered with or broken on both the sample bottle and the cooler, the sample may be analyzed but the results will include a flag indicating that custody was broken. If the sample data do not trend with the other data or are not as expected, the data from the sample will be flagged accordingly. A sampling and analytical database is used to track samples from the point of collection through the laboratory analysis process.

A3.8.1 Containers

Prior to analysis, samples shall be stored in break-resistant containers. Field sample collection records shall indicate the laboratory lot number of the bottles used in sample collection. When commercially pre-cleaned containers are used for sample collection, the name of the manufacturer, lot identification, and certification shall be retained for documentation.

Empty sample containers shall be capped and stored in an environment that minimizes the possibility of contamination. If stored sample containers become contaminated, they cannot be used for a sampling event, and corrective actions shall be implemented to prevent reoccurrence. Container sizes may vary depending on laboratory-specific volumes or requirements for meeting analytical detection limits. Container types and sample volumes are identified on the chain-of-custody form.

When LEXAN liners are used as sample containers, the ends of the liner segment will be sealed with snug-fitting plastic endcaps and taped around the lips of the caps. The endcaps will be further secured with evidence tape and labeled to be delivered intact for laboratory testing. Field data will be evaluated to select intervals for analysis and the laboratory will be advised accordingly.

The Radiological Engineering organization will measure contamination levels and dose rates associated with filled sample containers. This information and other pertinent data will be used to select proper packaging, marking, labeling, and shipping materials and to verify that the sample can be received by the analytical laboratory in accordance with their radioactivity acceptance criteria. If the dose rate on the outside of a sample container or the curie content exceeds levels acceptable by a laboratory, the FWS (in consultation with SMR) may send smaller sample volumes to the laboratory.

A3.8.2 Container Labeling

Samples are identified by affixing a standardized label or tag to the container. This label or tag shall include the sample identification number. The label shall identify or provide reference to associate the sample with the date and time of collection, preservative used (if any), analyses required, and the collector's name or initials. Labels or tags may be pre-printed or handwritten in indelible or waterproof ink.

A3.8.3 Sample Custody

Sample custody will be maintained in accordance with existing contractor protocols to ensure that sample integrity is maintained throughout the analytical process. Chain-of-custody protocols will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained. A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples shipped to a laboratory.

Shipping requirements will determine how sample shipping containers are prepared for shipment. The analyses requested for each sample will be indicated on the accompanying chain-of-custody form. Each time the responsibility for the sample custody changes, the new and previous custodians will sign the record, also noting the date and time. The field sampling team will make a copy of the signed record before sample shipment and transmit the copy to SMR.

The following information is required on a completed chain-of-custody form:

- Project name
- Collectors' names
- Unique sample identification numbers
- Date, time, and location (or traceable reference) of sample collection
- Matrix
- Preservatives
- Chain-of-possession information (i.e., signatures and printed names of each individual involved in the transfer of sample custody and storage locations, and dates/times of receipt and relinquishment)
- Requested analyses (or reference thereto)
- Number of sample containers per unique sample identification number
- Shipped-to information (i.e., analytical laboratory performing the analysis)

Samplers should note any sample anomalies and inform SMR so special direction for analysis can be provided to the laboratory, if necessary.

A3.8.4 Sample Transportation

Transportation requirements determine how samples are prepared for shipment. Packaging and transportation instructions shall comply with applicable transportation regulations and DOE requirements. Regulations for classifying, describing, packaging, marking, labeling, and transporting hazardous materials, hazardous substances, and hazardous wastes are enforced by the U.S. Department of Transportation (DOT) as described in 49 CFR 171, "Transportation," "General Information, Regulations,

and Definitions," through 177, "Carriage by Public Highway."[4] Carrier-specific requirements defined in the current edition of International Air Transportation Association (IATA) *Dangerous Goods Regulations* shall also be used when preparing sample shipments for air freight providers.

Samples containing hazardous constituents above regulated amounts shall be considered hazardous material in transportation and transported in accordance with DOT/IATA requirements. If the sample material is known or can be identified, then it will be packaged, marked, labeled, and shipped according to the specific instructions for that material. Appropriate laboratory notifications will be made through the SMR project coordinator.

Materials are classified by DOT/IATA as radioactive when the isotope specific activity concentration and the exempt consignment limits described in 49 CFR 173, "Transportation," "Shippers—General Requirements for Shipments and Packagings," are exceeded. Samples shall be screened (or relevant historical data will be used) to determine if these values are exceeded. When screening or historical data indicate that samples are radioactive, the samples shall be properly classified, described, packaged, marked, labeled, and transported according to DOT/IATA requirements.

Prior to shipping radioactive samples to the laboratory, the shipping organization shall notify the laboratory of the approximate number and radiological levels of the samples. This notification is conducted through the SMR project coordinator. The laboratory is responsible for ensuring that applicable license limits are not exceeded. Prior to sample receipt, the laboratory shall provide SMR with written acceptance of the samples with elevated radioactive contamination or dose.

A4 Management of Waste

Waste materials will be generated during borehole drilling, sampling activities, and well development. The method for identifying, storing, and dispositioning the hazardous, radioactive, or mixed waste materials and unused samples (including unexpected waste) generated by sampling activities will be managed in accordance with the applicable waste control plan and must be characterized in accordance with DOE/RL-2011-41, *Hanford Site Strategy for Management of Investigation Derived Waste*; DOE/RL-2009-39, *Investigation-Derived Waste Purgewater Management Action Memorandum*; and DOE/RL-2009-80, *Investigation Derived Waste Purgewater Management Work Plan*. Waste materials requiring collection will be placed in containers appropriate for the material and the receiving facility in accordance with the applicable requirements document and applicable substantive federal and/or state requirements.

Packaging and labeling during waste storage and transportation will meet the requirements of DOT and WAC 173-303, "Dangerous Waste Regulations," as appropriate. DOT packaging requirement exceptions may be used for onsite waste shipments if documented as such and if the packaging provides an equivalent degree of safety during transportation.

Offsite analytical laboratories are responsible for the disposal of unused sample quantities, unless otherwise directed. To document and simplify the management of returned samples, the approval is granted with the CERCLA DOE-RL remedial project manager signature on this SAP, such that samples and associated sample waste may be returned to the project site and dispositioned with other wastes from the 200-EA-1 OU. This approval will be communicated to affected laboratories or treatment facilities, as needed.

[4] Transportation regulations 49 CFR 174, "Carriage by Rail," and 49 CFR 176, "Carriage by Vessel," are not applicable, as these two transportation methods are not used.

A5 Health and Safety

DOE has established the hazardous waste operations safety and health program pursuant to the *Price-Anderson Amendments Act of 1988* to ensure the safety and health of workers involved in mixed-waste site activities. The program was developed to comply with the requirements of 10 CFR 851, "Worker Safety and Health Program," which incorporates the standards of 29 CFR 1910.120, "Occupational Safety and Health Standards," "Hazardous Waste Operations and Emergency Response"; 10 CFR 830, "Nuclear Safety Management"; and 10 CFR 835, "Occupational Radiation Protection." The health and safety program defines the chemical, radiological, and physical hazards, and it specifies the controls and requirements for daily work activities on the overall Hanford Site. Personnel training; control of industrial safety and radiological hazards; personal protective equipment; site control; and general emergency response to spills, fire, accidents, injury, site visitors, and incident reporting are governed by the health and safety program. Site-specific health and safety plans will be used to supplement the general health and safety plan. Hanford Site workers have the right and responsibility to stop work if a safety, health, or environmental threat is witnessed or perceived.

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Appendix B

200-EA-1 Operable Unit Plate Maps

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B 200-EA-1 Operable Unit Plate Maps

This appendix provides two plate maps showing the locations of the 200-EA-1 Operable Unit (OU) waste sites.

Figure B-1 shows the 200-EA-1 OU waste sites superimposed onto an aerial photograph. Key facility and road names are included, and Central Plateau Inner Area and 200-BP-5 and 200-PO-1 Groundwater OU boundaries are shown.

Figure B-2 shows 200-EA-1 OU waste sites in relationship to other Central Plateau locations. A subsequent unit for individual development (SQUID) is a subdivision of a Central Plateau geographic implementation area that can be remediated as a separate project, independent of other actions in the area. Hydrogeologic provinces, the Central Plateau Inner Area, and 200-BP-5 and 200-PO-1 Groundwater OU boundaries are shown. Key facility and road names are also provided.

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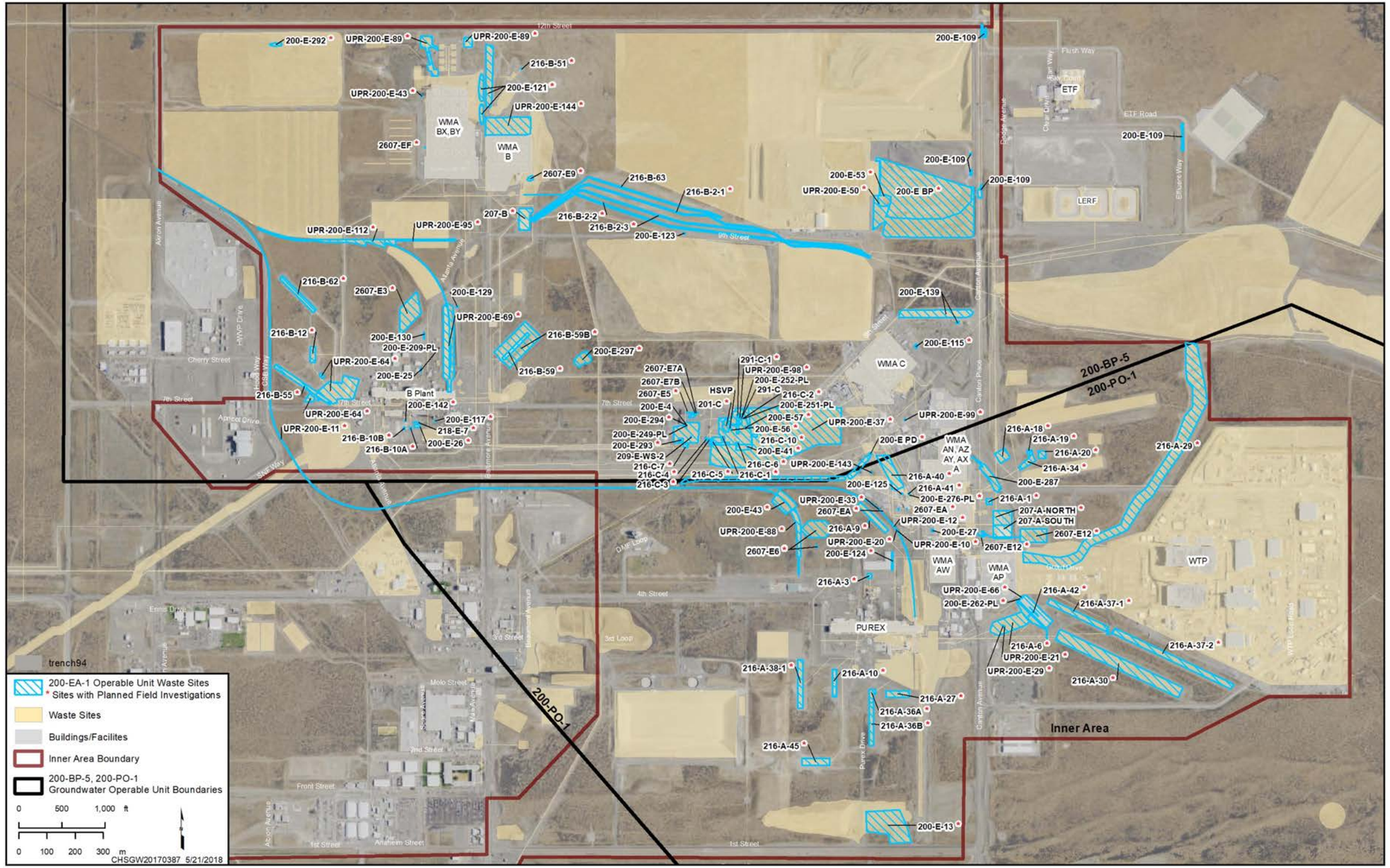

Figure B-1. 200-EA-1 OU Waste Site Map

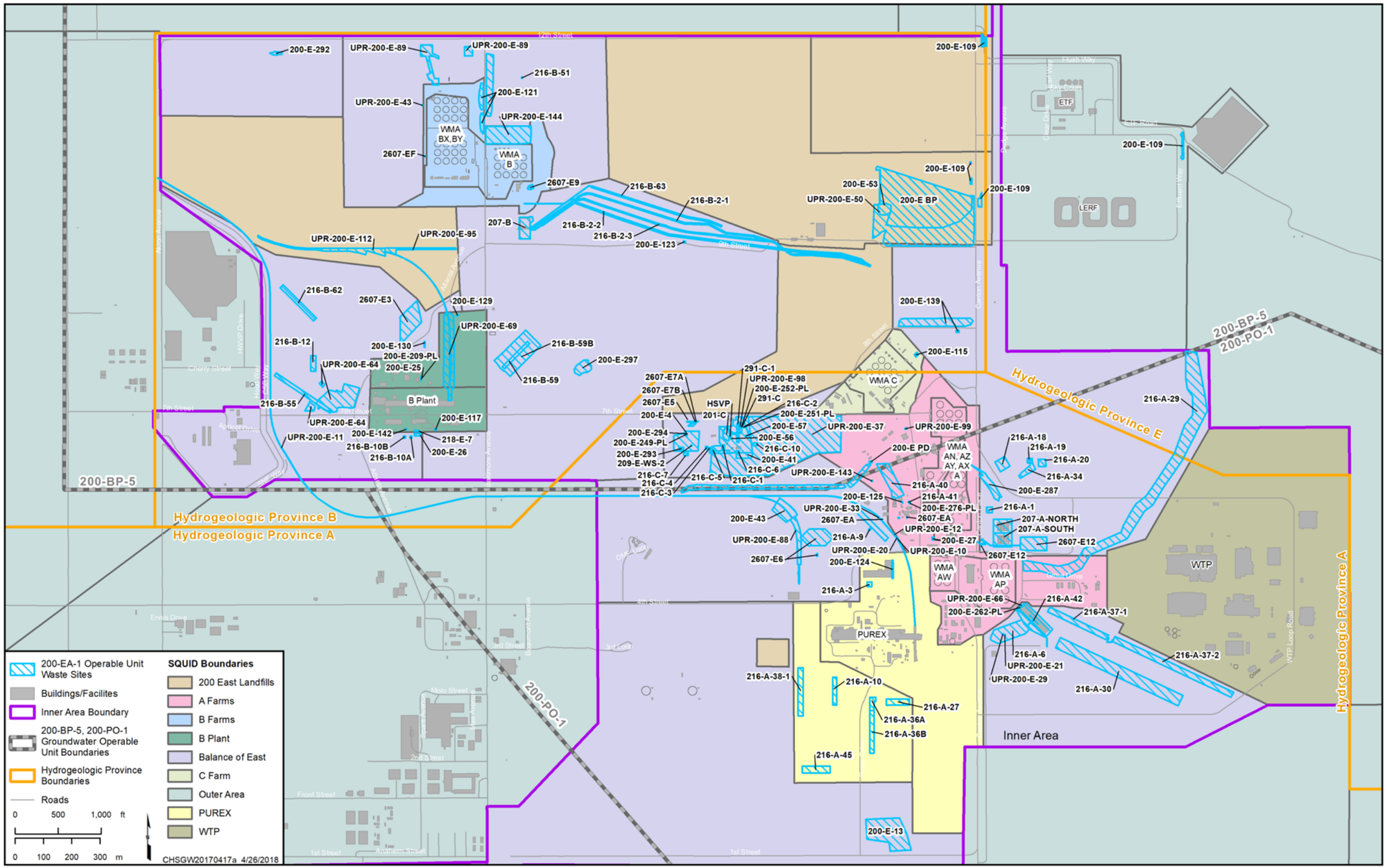

Figure B-2. 200-EA-1 OU Waste Site Geographic Interface Map

Appendix C

200-EA-1 Operable Unit Preliminary Waste Site Evaluations and Workshop Outcomes

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Tables

Table C-1. Organization of Appendix C Waste Site Information C-2
Table C-2. Workshop Outcomes for 200-EA-1 OU Waste Sites in the A Tank Farms Group C-3
Table C-3. Workshop Outcomes for 200-EA-1 OU Waste Sites in the B Tank Farms Group C-13
Table C-4. Workshop Outcomes for 200-EA-1 OU Waste Sites in the B Plant Group C-16
Table C-5. Workshop Outcomes for 200-EA-1 OU Waste Sites in the Hot Semiworks Plant Group C-25
Table C-6. Workshop Outcomes for 200-EA-1 OU Waste Sites in the PUREX Plant Group C-35
Table C-7. Workshop Outcomes for 200-EA-1 OU Waste Sites in the Miscellaneous Group C-43

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C 200-EA-1 Operable Unit Preliminary Waste Site Evaluations and Workshop Outcomes

This appendix documents the preliminary evaluations and workshop outcomes for each 200-EA-1 Operable Unit (OU) waste site. The U.S. Department of Energy, Richland Operations Office (DOE-RL) compiled 200-EA-1 OU waste site existing information as part of the data quality objectives process described in Chapter 4 of this work plan. Chapter 3 of this work plan and SGW-60540, *200-EA-1 Operable Unit Scoping*, document the existing information.

DOE-RL and the Washington State Department of Ecology used existing information to conduct workshops, identify uncertainties associated with the nature and extent of contamination warranting action, and understand the range of potential response actions that may protect potential receptors.[1]

Table C-1 shows the appendix organization, and Tables C-2 through C-7 document the preliminary evaluations and workshop outcomes (i.e., uncertainty management approach) for each waste site. Information in Table C-2 through C-7 supports defining the principal study questions and associated data needs (Chapter 4 of this work plan) and refines waste-site specific investigation activities to address data gaps in the sampling and analysis plan (SAP) (Appendix A of this work plan).[2] As shown in Tables C-2 through C-7, some waste sites were discussed in more than one workshop due to changes in the 200-EA-1 OU characterization approach.

The uncertainty management approach developed for each waste site (as summarized in this appendix and detailed in Appendix A [SAP]), is sufficient to characterize the relevant media for each waste site.

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[1] ECF-200EA1-17-0046, *Assessment and Presentation of Available Waste Site Data for the 200-EA-1 Operable Unit*; and ECF-200EA1-17-0066, *Pore Volume Calculation – 200-EA-1 OU Liquid Waste Disposal Sites*, supported existing information evaluations.

[2] As used in this work plan, a data need is the information needed to address a PSQ in support of cleanup decision making. A data gap results when existing information cannot fill a data need; data gaps are the basis for new data collection and technical evaluations.

Table C-1. Organization of Appendix C Waste Site Information

200-EA-1 OU Group*					
A Tank Farms (Table C-2)	**B Tank Farms (Table C-3)**	**B Plant (Table C-4)**	**Hot Semiworks Plant (Table C-5)**	**PUREX Plant (Table C-6)**	**Miscellaneous (Table C-7)**
200-E-27	200-E-121	200-E-25	200-E-4	200-E PD	200-E BP
200-E-125	200-E-292	200-E-26	200-E-41	200-E-13	200-E-53
200-E-262-PL	216-B-51	200-E-117	200-E-56	200-E-43	200-E-109
200-E-276-PL	2607-E9	200-E-123	200-E-57	200-E-124	200-E-115
200-E-287	2607-EF	200-E-129	200-E-249-PL	216-A-3	200-E-139
207-A-NORTH	UPR-200-E-43	200-E-130	200-E-251-PL	216-A-9	UPR-200-E-11
207-A-SOUTH	UPR-200-E-89	200-E-142	200-E-252-PL	216-A-10	UPR-200-E-50
216-A-1	UPR-200-E-144	200-E-209-PL	200-E-293	216-A-27	UPR-200-E-95
216-A-6		200-E-297	200-E-294	216-A-36A	UPR-200-E-112
216-A-18		207-B	201-C	216-A-36B	
216-A-19		216-B-2-1	209-E-WS-2	216-A-38-1	
216-A-20		216-B-2-2	216-C-1	216-A-45	
216-A-29		216-B-2-3	216-C-2	2607-E6	
216-A-30		216-B-10A	216-C-3	UPR-200-E-10	
216-A-34		216-B-10B	216-C-4	UPR-200-E-12	
216-A-37-1		216-B-12	216-C-5	UPR-200-E-20	
216-A-37-2		216-B-55	216-C-6	UPR-200-E-33	
216-A-40		216-B-59	216-C-7	UPR-200-E-88	
216-A-41		216-B-59B	216-C-10		
216-A-42		216-B-62	2607-E5		
2607-EA		216-B-63	2607-E7A		
2607-E12		218-E-7	2607-E7B		
UPR-200-E-21		2607-E3	291-C		
UPR-200-E-29		UPR-200-E-64	291-C-1		
UPR-200-E-66		UPR-200-E-69	HSVP		
UPR-200-E-99			UPR-200-E-37		
UPR-200-E-143			UPR-200-E-98		

* Chapter 3 of this work plan discusses the 200-EA-1 OU groups.

HSVP = Hot Semiworks Valve Pit

OU = operable unit

PUREX = Plutonium-Uranium Extraction (Plant)

UPR = unplanned release

Table C-2. Workshop Outcomes for 200-EA-1 OU Waste Sites in the A Tank Farms Group

Waste Site	DOE-RL/ Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
200-E-27 dumping area	1/12/2017	YES. Lead in soil and debris associated with 200-E-7 dumping area may be present at concentrations exceeding human and ecological risk-based criteria.	X			None	Undefined						Extent of lead contamination.	• Determine if there are additional details about the previous investigation that can inform extent of excavation. • RTD with verification sampling. Use XRF and metal detection technologies to inform field activities.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
200-E-125 (UPR-solid)	1/12/2017	UNCERTAIN. Radiological and chemical (PCBs, metals, PAHs) constituents in soil associated with the 200-E-125 UPR may be present at concentrations exceeding human and ecological risk-based criteria.	X	X		None	Length: 22 ft Width: 15 ft Depth: 3 ft		X				Presence and nature of contamination, if any.	DOE-RL and Ecology determined it is a more efficient use of resources to remove and dispose.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
200-E-262-PL pipeline	2/16/2017 Rescheduled 4/13/2017	UNCERTAIN, but LIKELY. Radiological and chemical constituents in piping and soil associated with 200-E-262-PL, including the 216A42A pump station, the 216A42B valve box, and the 216A42C diversion box, may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	Length: 1,166 ft Diameter: 4 in. (west and east lines) 3 in. (Central lines) Depth: 9 ft (at 216A42A valve box), basin has been leveled and may exceed 20 ft (depth of former basin)		X		X		Nature and extent of contamination.	Address with the 216-A-42 retention basin and UPR-200-E-66 (UPR-solid) (200-EA-1 OU). See the 216-A-42 retention basin for uncertainty management approach.
200-E-276-PL pipeline	1/12/2017	UNCERTAIN. Radiological and chemical constituents in piping and soil associated with 200-E-276-PL may be present at concentrations exceeding human and ecological risk-based criteria.	X	X		None	Length: 17 ft Diameter: 4 in. Depth: 4 ft bgs	X					Presence and nature of contamination, if any.	• Address with 216-A-41 Crib (200-EA-1 OU) • Investigate through and below the 216-A-41 Crib (push probe). • Sample to confirm expectation of no basis for action. • Whatever is discovered for the crib would be applied to the 200-E-276-PL.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]

Table C-2. Workshop Outcomes for 200-EA-1 OU Waste Sites in the A Tank Farms Group

Waste Site	DOE-RL/ Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
200-E-287 (UPR-solid)	4/13/2017	UNCERTAIN, but UNLIKELY. Radiologically contaminated tumbleweeds accumulate in the 200-E-287 UPR. Radiological contamination in soil associated with the 200-E-287 waste site may be present at concentrations exceeding human and ecological risk-based criteria.	X	X		None	Approximately 60 ft wide and 500 ft long					X	Presence and nature of contamination, if any.	Defer investigation of the area until reaccumulation of tumbleweeds is no longer a dynamic issue.
207-A-NORTH Retention Basin	3/9/2017	UNCERTAIN, but UNLIKELY. There are no expected CERCLA-related threats to HHE associated with the 207-A-NORTH Retention Basin.				None	Three basins, each as follows: Length: 55 ft Width: 10 ft Depth: 7 ft	X					Whether all windblown contamination has been removed.	• Confirm the waste site is clean with a radiological survey of basin surface. • If the survey indicates the site is clean, then reject the site through the MP-14 process (RL-TPA-90-0001)
207-A-SOUTH Retention Basin	11/16/16 12/8/16 Rescheduled 3/9/2017	NO. There are no CERCLA-related threats to HHE associated with the 207-A-SOUTH Retention Basin; RCRA closure work has been implemented.				TSD	Dimensions of each of three cells: Length: 55 ft Width: 10 ft Depth: 7 ft Capacity: 70,000 gal	X					None; all previous radiological detections were removed during closure actions.	Evaluate and discuss MP-14 reclassification as "no action"; bring into the 200-EA-1 OU and carry through as "no action" decision (RL-TPA-90-0001).
216-A-1 Crib	4/13/2017	UNCERTAIN, but LIKELY. Radiological constituents in soil and wood timbers associated with the 216-A-1 Crib may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.		X	X	None	Length: 30 ft Width: 30 ft Depth: 15 ft		X		X	X	Nature and extent of contamination.	• Install one penetration through the crib and look at gamma signature. • If the gamma log indicates that sampling is feasible, make a second penetration and collect shallow samples following the 200-DV-1 OU protocol for the shallow zone and deep samples to 50 ft bgs to target radiological constituents. Collect a sample at location where gamma readings begin to taper off. • If the gamma log indicates that gamma is too high (i.e., there are ALARA concerns), bias is for engineered barrier.

Table C-2. Workshop Outcomes for 200-EA-1 OU Waste Sites in the A Tank Farms Group

Waste Site	DOE-RL/ Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
216-A-6 Crib	11/15/2016	UNCERTAIN, but LIKELY. Based on process history and waste stream, radiological and chemical constituents, including nitrates, in soil and wood timbers associated with the 216-A-6 Crib and related UPRs (UPR-200-E-21; UPR-200-E-29) may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	100 ft by 100 ft ,to a total depth of 21 ft		X	X	X	X	• Extent of contamination (lateral and vertical). • Location of trench connecting to 216-A-29 Ditch. If located, presence of contamination would need to be determined. • Presence of levels or types of contamination that would require special worker health and safety considerations.	• Determine if resistivity data are available to inform extent of contamination. • Sample from within crib footprint to define nature of contamination to inform worker safety and health considerations for response actions. • Characterize vertical extent with one deep boring and two additional borings for lateral extent outward from the crib footprint. If samples show contamination in soil column extends to groundwater, additional borings may be necessary. • Review historical photos and 216-A-42 Retention Basin construction history to try to locate trench.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	6/5/2017													Sampling design modified to align with updated characterization strategy.
216-A-18 Trench	4/13/2017	UNCERTAIN, but LIKELY. Radiological and chemical constituents, including nitrates, in soil associated with the 216-A-18 Trench may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	Length: 80 ft Width: 80 ft Depth: 15 ft	X	X		X	X	Nature and extent of contamination.	• Conduct radiological survey and resistivity surface grid to locate pipe discharge area and to site penetrations. • Install one penetration to 20 ft bgs through the trench and look at gamma signature. • If the gamma log indicates that sampling is feasible, make gamma penetration through center of trench to 50 ft bgs to map sample locations, then penetrate through center of trench and collect shallow samples following the 200-DV-1 OU protocol for the shallow zone and deep samples to 50 ft bgs to target radiological constituents.[c] • If the gamma log indicates that gamma is too high (i.e., there are ALARA concerns), bias is for engineered barrier.
	6/5/2017													Sampling design modified to align with updated characterization strategy.

Table C-2. Workshop Outcomes for 200-EA-1 OU Waste Sites in the A Tank Farms Group

Waste Site	DOE-RL/ Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways: HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	Likely Exposure Pathways: HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Likely Exposure Pathways: Groundwater Protection	Other Regulatory Standards	Dimensions	Potential Response Actions[b]: No Action	Potential Response Actions[b]: RTD (Excavate for UIC Sites)	Potential Response Actions[b]: Leave in Place (Stabilize)	Potential Response Actions[b]: Leave in Place (Cover)	Potential Response Actions[b]: Leave in Place (IC)	Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
216-A-19 Trench	2/15/2017 Rescheduled 4/19/2017	UNCERTAIN, but LIKELY. Radiological and chemical constituents, including uranium and nitrates, in soil associated with the 216-A-18 Trench may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	Length: ~25 ft Width: ~25 ft Depth: ~15 ft bgs	X	X		X	X	Nature and extent of contamination.	• Conduct a GPR investigation over the entire area of bare ground and evaluate resistivity. Use the results to locate 216-A-19 and guide the locations of one penetration to 50 ft bgs at the area of highest resistivity and one test pit to 15 ft below natural grade north of C3245. • Samples will be collected following the 200-DV-1 OU protocol for the shallow zone.[c]
	6/5/2017													Sampling design modified to align with updated characterization strategy.
216-A-20 Trench	NE Area 1 2/15/2017 Rescheduled 4/19/2017	UNCERTAIN, but LIKELY. Radiological and chemical constituents, including uranium and nitrates, in soil associated with the 216-A-20 Trench may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	Length: 25 ft Width: 25 ft Depth: 15 ft bgs	X	X		X	X	Nature and extent of contamination.	• Conduct a GPR investigation over the entire area of bare ground and evaluate resistivity. Use the results to guide the locations of one penetration to 50 ft bgs and two test pits to 15 ft below natural grade in the area of the overflow. • Samples will be collected following the 200-DV-1 OU protocol for the shallow zone and will be analyzed for a full suite of contaminants.[c]
216-A-29 Ditch	TSD 3/6/2017	YES. Radiological and chemical constituents in soil associated with the 216-A-29 Ditch may present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	TSD	Length: 4,000 ft Width: 6 ft Depth: Variable, from 2 to 15 ft		X		X	X	Scope of RCRA closure action has not been defined or implemented.	• To support evaluation of impact to groundwater, one push will be located at the head end of the ditch and one at the tail end, Samples will be collected from 0 to 40 to 50 ft bgs and analyzed for the metals suite (minus mercury) and hexavalent chromium. Sampling will follow the 200-DV-1 OU protocol for the shallow zone.[c] • To confirm extent of lateral control, use existing gamma and neutron logs in the location of C9617 to identify the silty zone for additional sampling from below to ditch bottom to groundwater. • RCRA/CERCLA investigation and response action planning will be coordinated, as appropriate.
216-A-30 Crib	2/16/2017 Rescheduled 4/13/2017	UNCERTAIN, but UNLIKELY. Radiological and chemical constituents, including metals and nitrates, in soil and wood timbers associated with the 216-A-30 Crib may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	Length: 1,400 ft Width: 10 ft Depth: 12 ft Material: 5 ft gravel fill		X		X	X	Nature and extent of contamination.	• Install one penetration by the distribution box to 150 to 200 ft bgs, one penetration at the middle of the crib to groundwater, and one penetration at the east end of the crib to 150 to 200 ft bgs. Resistivity data will be used to identify the location of each penetration. The location of deep samples will be based on geology. Samples will be collected following the 200-DV-1 OU protocol for the shallow zone.[c] • Dig one test pit at C5941 and sample the alkaline deposit layer.

Table C-2. Workshop Outcomes for 200-EA-1 OU Waste Sites in the A Tank Farms Group

Waste Site	DOE-RL/ Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
216-A-34 Ditch	2/15/2017 Rescheduled 4/19/2017	UNCERTAIN, but LIKELY. Radiological constituents in soil associated with the 216-A-34 Ditch may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.		X	X	None	Length: 280 ft Width: 10 ft at west end (headwall) and 30 ft at east end Bottom depth: ~6 ft	X	X		X	X	Nature and extent of contamination.	Conduct GPR investigation over the entire area of bare ground and evaluate resistivity. Use the results to guide the locations of one penetration to 50 ft bgs at the end of 200-E-166-PL at the head end of 216-A-34 and one test pit to 15 ft below natural grade at the 216-A-34 intersection. Samples will be collected following the 200-DV-1 OU protocol for the shallow zone and will be analyzed for a full suite of contaminants.
216-A-37-1 Crib	3/9/2017	UNCERTAIN, but UNLIKELY. Radiological and chemical constituents, including nitrates and metals, in soil associated with the 216-A-37-1 Crib may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria. Previous analyses indicate no action is needed for RCRA closure.	X	X	X	TSD	Length: 700 ft Width: 10 ft Depth: 11 ft	X	X			X	Cesium-137 is indicated with geophysical logging but not corroborated with analytical data.	• Site-specific evaluation of potential groundwater impacts will be performed during RI phase. • Collect samples from within ditch to confirm radiological and chemical concentrations in soil. Specifically, install three penetrations to groundwater. One penetration should be located near C4106. Existing information of soil moisture from logs should be used to focus the investigation on specific zones. Follow the 200-DV-1 OU protocol for shallow sampling.[c] All samples will be analyzed for the full suite of contaminants with a special focus on Method 350.1 for ammonia.
216-A-37-2 Crib	3/9/2017 Rescheduled 4/13/2017	UNCERTAIN, but UNLIKELY. Radiological and chemical constituents in soil and wood timbers associated with the 216-A-37-2 Crib may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	Length: 1,400 ft Width: 10 ft Depth: to 16 ft bgs	X	X		X	X	Nature and extent of contamination.	• Install one penetration at the middle of the crib to groundwater and one penetration at the end of the crib to 150 to 200 ft bgs. Use resistivity data to identify the location of each penetration. • Use existing data from C4106 to evaluate conditions at the head end of the crib. • Analyze all samples for radiological and chemical constituents in accordance with the 200-DV-1 OU protocol for shallow sampling.[c] • Base deep sample locations on geology.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]

Table C-2. Workshop Outcomes for 200-EA-1 OU Waste Sites in the A Tank Farms Group

Waste Site	DOE-RL/ Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
216-A-40 Retention Basin	1/12/2017	YES. Radiological and chemical constituents in soil, concrete, piping, and debris associated with the 216-A-40 Retention Basin may be present at concentrations that could exceed human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	Length: 460 ft Width: 138 ft		X	X	X	X	• Nature and extent of contamination under and outside of basin is not defined. • Nature of buried debris is not defined well enough to inform waste management and handling. • Use of the unlined portion is not known. • Influence of response actions for nearby sites (e.g., 244-AR vault).	• Sample beneath south basin cell (potentially with angle boring). Sample through and beneath north basin cell. Sample through and beneath unlined portion. • Sample debris, as necessary, for waste management and handling decisions. • Sample laterally around basin (with specific focus on area near caisson and diversion box).
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
216-A-41 Crib	1/12/2017	UNCERTAIN. Radiological and chemical constituents in soil and wood timbers associated with the 216-A-41 Crib may be present at concentrations exceeding human and ecological risk-based criteria.	X	X		None	Length: 21 ft Width: 21 ft Depth: 6.5 ft	X					Presence and nature of contamination, if any.	• Address with the 200-E-276-PL pipeline (200-EA-1 OU) • Investigate through and below crib (push probe). Sample for suite of COPCs to confirm expectation of no basis for action. • Whatever is discovered would be applied to the 200-E-276-PL.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]

Table C-2. Workshop Outcomes for 200-EA-1 OU Waste Sites in the A Tank Farms Group

Waste Site	DOE-RL/ Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
216-A-42 Retention Basin	2/16/2017 Rescheduled 4/13/2017	UNCERTAIN, but LIKELY. Radiological constituents in soil and concrete associated with the 216-A-42 Retention Basin may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.		X	X	None	Length: 402 ft Width: 78 ft Depth: 23 ft Waste site area: ~1 ac		X		X		• Whether there is debris/soil on the liner and if there is soil under the liner. • The nature and extent of contamination.	• Address with 200-E-262-PL pipeline and UPR-200-E-66 (UPR-solid) (200-EA-1 OU). • To determine conditions on top/under liner, open cover and sample at a biased center location. • To determine nature and extent of contamination, install three penetrations to 50 ft bgs; one just outside the south end of the basin, one on the west side of the basin where 200-E-262-PL enters, and one in the 216A42C diversion box. If these do not indicate contamination, investigate area below cover/bottom of concrete with one additional penetration. Sample penetrations from 10 to 50 ft bgs and analyze for a full suite of radiological and chemical constituents. • Remove the 216A42D diversion box, which will result in removal of UPR-200-E-66. Make 1 penetration below diversion box after removal. Collect samples at 5 ft below bottom of excavation, 35 ft bgs, and 50 ft bgs. Collect three surface samples (at native material) to address UPR-200-E-66:; one at/near diversion box, and one on each side of the diversion box. • Coordinate actions with facilities and WMAs.
2607-EA septic system	2/9/2017 Rescheduled 3/30/2017	UNCERTAIN, but UNLIKELY. Radiological and chemical constituents may be present in the dry well, piping, and soil around the 2607-EA septic system at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	WAC 246-272A-0300	Length: ~10 ft Width: ~7 ft Calculated Total Volume: 1,000 gal	X	X			X	• Whether the septic tank was closed in accordance with WAC 246-272A-0300. • Whether there is a threat to HHE associated with the septic tank dry well.	• Verify whether the tank has been abandoned; if it has not been abandoned, then abandon in accordance with *Washington Administrative Code* requirements. • Conduct a GPR survey to confirm no other utilities are in the area. • Remove the dry well and collect samples to confirm no soil contamination remains above risk-based criteria.

Table C-2. Workshop Outcomes for 200-EA-1 OU Waste Sites in the A Tank Farms Group

		Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
			Likely Exposure Pathways					Potential Response Actions[b]						
Waste Site	DOE-RL/ Ecology Workshop Date	Potential Threat to HHE Based on Existing Information	HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection	Other Regulatory Standards	Dimensions	No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)	Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
2607-E12 septic system	2/9/2017 Rescheduled 3/30/2017	NO – Inactive tank. UNCERTAIN, but UNLIKELY inactive seepage pit and inactive drain field. Radiological and chemical constituents may be present in the seepage pit and soil of the tile field around the 2607-E12 septic system at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	WAC 246-272A-0300	Inactive septic tank: dimensions unknown Inactive seepage pit: 5 ft diameter Active dosing chamber (5,000 gal): 20 ft by 9.33 ft by 7.5 ft Inactive drain field: 40 ft by 70 ft Active septic tank (10,000 gal): dimensions unknown Active drain field (three separate fields): 300 ft by 20 ft (20 ft between each field) Covering of 1 to 2 ft	X	X				Whether the tile field associated with this septic tank represents a threat to HHE.	• Conduct a GPR survey to confirm no unexpected utilities are in the area. Open a trench along the tile field (10 ft bgs) and conduct a radiological survey to determine if samples should be analyzed for radiological constituents. • Any material removed from the trench or excavation area should be placed back in the hole while waiting for sample results to minimize risk to workers engaged in active operations.
UPR-200-E-21 (UPR-liquid) and UPR-200-E-29 (UPR-liquid)	11/15/2016	UNCERTAIN, but LIKELY. Based on process history and waste stream, radiological constituents in soil and wood timbers associated with the 216-A-6 Crib and related UPRs (UPR-200-E-21 and UPR-200-E-29), may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.		X	X	None	Not defined		X	X	X	X	Nature and extent of contamination.	Address with the 216-A-6 Crib (200-EA-1 OU); see 216-A-6 Crib for uncertainty management approach.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
UPR-200-E-66 (UPR-solid)	2/16/2017 Rescheduled 4/13/2017	UNCERTAIN, but LIKELY. Radiological constituents in soil associated with UPR-200-E-66 may be present at concentrations exceeding human and ecological risk-based criteria.		X		None	Not separately marked or posted from 216-A-42 Retention Basin		X				Nature and extent of contamination.	Address with the 216-A-42 retention basin and 200-E-262-PL pipeline (200-EA-1 OU); see the 216-A-42 Retention Basin for uncertainty management approach.

Table C-2. Workshop Outcomes for 200-EA-1 OU Waste Sites in the A Tank Farms Group

Waste Site	DOE-RL/ Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
UPR-200-E-99 (UPR-solid)	1/12/2017	UNCERTAIN. Radiological constituents in soil associated with UPR-200-E-99 may be present at concentrations exceeding human and ecological risk-based criteria.		X		None	Not defined	X					Presence and location of contamination.	Determine if there are radiological surveys more recent than 1981. If so, evaluate their conclusions. If not, evaluate details of March 1981 surveys and determine if a new survey of the area is warranted. If a new survey is conducted, take soil samples, if necessary, for areas with detections of concern.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
UPR-200-E-143 (UPR-solid)	1/12/2017	NO. 2016 surface radiological survey confirms and verifies that there is not a basis for action. Additionally, management of nearby waste sites (i.e., 216-A-40 Retention Basin and 200-E PD Ditch) appears to have eliminated the source of contaminated rabbit feces.				None	50,000 ft^2	X					Residual contamination around the northeast leg of the 200-E PD Ditch associated with the original UPR designation.	Investigation and action associated with 200-E PD Ditch will address the potential contamination collocated with the ditch.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]

References:

RL-TPA-90-0001, *Tri-Party Agreement Handbook Management Procedures,* Guideline Number TPA-MP-14, "Maintenance of the Waste Information Data System (WIDS)."

WAC 246-272A-0300 "On-site Sewage Systems – Abandonment."

a. Per Section 1.3.2.5 of the work plan, DOE-RL may choose to evaluate a conditional point of compliance for the terrestrial ecological evaluation, and an alternative point of compliance for human health direct contact.

b. Potential response actions were developed as part of scoping (40 CFR 300.430, "National Oil and Hazardous Substances Pollution Contingency Plan," "Remedial Investigation/Feasibility Study and Selection of Remedy"); may be changed based on data collected through this work plan and the remedial investigation/feasibility study and RFI/CMS process.

c. Applicable 200-DV-1 OU sampling protocols include collecting sufficient data from the shallow vadose zone to support a quantitative risk assessment and collecting samples every 0.6 m (2 ft) in the shallow vadose zone.

Table C-2. Workshop Outcomes for 200-EA-1 OU Waste Sites in the A Tank Farms Group

		Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
			Likely Exposure Pathways					Potential Response Actions[b]						
Waste Site	DOE-RL/ Ecology Workshop Date	Potential Threat to HHE Based on Existing Information	HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection	Other Regulatory Standards	Dimensions	No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)	Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*

ALARA = as low as reasonably achievable
bgs = below ground surface
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CMS = corrective measure study
COPC = contaminant of potential concern
DOE-RL = U.S. Department of Energy, Richland Operations Office
Ecology = Washington State Department of Ecology
eco = ecological
GPR = ground-penetrating radar
HH = human health
HHE = human health and the environment
IC = institutional control
OU = operable unit
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
RCRA = *Resource Conservation and Recovery Act of 1976*
RFI = RCRA facility investigation
RTD = removal, treatment, and disposal
SAP = sampling and analysis plan
TSD = treatment, storage, and disposal
UIC = underground injection control
UPR = unplanned release
WMA = waste management area
XRF = x-ray fluorescence

Table C-3. Workshop Outcomes for 200-EA-1 OU Waste Sites in the B Tank Farms Group

Waste Site	DOE-RL/ Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
200-E-121 (UPR-solid)	2/16/2017 Rescheduled 4/10/2017	UNCERTAIN, but UNLIKELY. Radiological constituents in soil and vegetation associated with the 200-E-121 UPR may be present at concentrations exceeding human and ecological risk-based criteria.		X		None	Total length: ~500 ft Total width: ~80 ft	X	X			X	Nature and extent of contamination.	• Sample native soil from 0 to 5 ft bgs. Select grid-based random sampling locations to allow for statistical evaluation to support a "no action" decision. • For decision-making purposes, evaluate site as two decision units: one to the east of Baltimore Avenue, and one to the west. • Integrate the response with WMA actions.
200-E-292 dumping area	2/16/2017 Rescheduled 4/10/2017	UNCERTAIN, but UNLIKELY. Tar and metals in soil and debris associated with 200-E-292 dumping area may be present at concentrations exceeding human and ecological risk-based criteria.	X			None	Length: 130 ft Width: 30 ft		X				Presence and nature of contamination, if any.	Use GPR to identify potential target sample locations. Use grid-based sample design for random sample locations. Sample native soil from 0 to 5 ft bgs.
216-B-51 french drain	11/15/2016	YES. Based on process history and waste stream, radiological and chemical constituents in soil and piping associated with the 216-B-51 french drain may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	UIC	5 ft diameter extending from 1 ft above grade to 14 ft below grade		X			X	• Viability of integrated response with a portion of the 200-E-114-PL (200-IS-1 OU). • Presence of levels or types of contamination that would require special worker health and safety considerations. • Whether removal is required for the UIC or if in-place closure is allowable.	• Sample from within site footprint (10 to 15 feet bgs) to define nature of contamination and to inform worker safety and health considerations for RTD implementation. • Some action is required to address the UIC. If RTD is the selected action, collect samples as part of RTD implementation to confirm cleanup levels are attained.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	6/5/2017													Sampling design modified to align with updated characterization strategy.
2607-E9 septic system	2/9/2017 Rescheduled 3/30/2017	UNCERTAIN, but UNLIKELY. There are no expected CERCLA-related threats to HHE associated with the 2607-E9 septic tank. However, contamination in the tile field may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	WAC 246-272A-0300	Septic tank volume: 500 gal Drain field (estimated): Length: 40 to 60 ft Width: 40 ft Total Area: 2,000 ft^2	X	X				Whether the tile field represents a threat to HHE.	• Conduct a GPR survey to confirm no other utilities are in the area. • Take one sample at the main line branch. Open a trench and conduct a radiological survey to determine if samples should be analyzed for radiological constituents.

Table C-3. Workshop Outcomes for 200-EA-1 OU Waste Sites in the B Tank Farms Group

Waste Site	DOE-RL/ Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
2607-EF septic system	2/9/2017 Rescheduled 3/30/2017	UNCERTAIN, but UNLIKELY. Radiological and chemical constituents may be present in the soil of the tile field around the 2607-EF septic system drain field at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	WAC 246-272A-0300	Length: ~7ft Width: ~11 ft		X				The tile field location and the nature and extent of contamination are uncertain.	• Conduct a GPR survey to locate the tile field and confirm no other utilities are in the area. • Trench across the tile field (10 ft bgs), if found. • Conduct a radiological survey to determine sample locations and to decide if samples should be analyzed for radiological constituents.
UPR-200-E-43 (UPR-liquid)	12/13/2016	UNCERTAIN. Radiological and chemical constituents in soil associated with UPR-200-E-43 may be present at concentrations exceeding human and ecological risk-based criteria.	X	X		None	Not defined	X	X		X	X	Presence and nature of contamination, if any. Historical decontamination may have addressed all potential threats at this site.	Review 2011 radiological survey. If coverage was insufficient, conduct a radiological survey. If no radiological constituents are identified, reject the site. If radiological constituents are found, use XRF to investigate for chemical constituents.
UPR-200-E-89 (UPR-solid)	2/16/2017 Rescheduled 4/10/2017	UNCERTAIN, but LIKELY. Radiological and chemical constituents in soil, vegetation, and concrete associated with UPR-200-E-89 may be present at concentrations exceeding human and ecological risk-based criteria.		X		None	Area: ~47,000 ft^2	X	X			X	Nature and extent of contamination.	• Sample native soil from 0 to 5 ft bgs. Select grid-based random sampling locations to allow for statistical evaluation to support a "no action" decision. Analyze all samples for the full suite of radiological and chemical constituents. • Integrate the response with 200-DV-1 OU actions.
UPR-200-E-144 (UPR-solid)	2/16/2017 Rescheduled 4/10/2017	UNCERTAIN, but LIKELY Radiological and chemical constituents in soil associated with UPR-200-E-144 may be present at concentrations exceeding human and ecological risk-based criteria.		X		None	Consolidated Area: ~130,680 ft^2	X	X			X	Nature and extent of contamination.	• Coordinate sampling with 200-DV-1 OU for underlying cribs. • Investigate the "soil pile" to determine COPCs and basis for action. Sampling should support a statistical evaluation to support a "no action" decision. • Dig one test pit or auger to about 5 ft bgs in the middle of the pile. Analyze samples for the full suite of radiological and chemical constituents. • Integrate response with WMA actions.

Reference: WAC 246-272A-0300 "On-site Sewage Systems – Abandonment."

a. Per Section 1.3.2.5 of the work plan, DOE-RL may choose to evaluate a conditional point of compliance for the terrestrial ecological evaluation, and an alternative point of compliance for human health direct contact.

b. Potential response actions were developed as part of scoping (40 CFR 300.430, "National Oil and Hazardous Substances Pollution Contingency Plan," "Remedial Investigation/Feasibility Study and Selection of Remedy"); may be changed based on data collected through this work plan and the remedial investigation/feasibility study and RFI/CMS process.

c. Applicable 200-DV-1 OU sampling protocols include collecting sufficient data from the shallow vadose zone to support a quantitative risk assessment and collecting samples every 0.6 m (2 ft) in the shallow vadose zone.

Table C-3. Workshop Outcomes for 200-EA-1 OU Waste Sites in the B Tank Farms Group

		Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
			Likely Exposure Pathways					Potential Response Actions[b]						
Waste Site	**DOE-RL/ Ecology Workshop Date**	**Potential Threat to HHE Based on Existing Information**	**HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]**	**HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]**	**Groundwater Protection**	**Other Regulatory Standards**	**Dimensions**	**No Action**	**RTD (Excavate for UIC Sites)**	**Leave in Place (Stabilize)**	**Leave in Place (Cover)**	**Leave in Place (IC)**	**Uncertainty**	**Uncertainty Management Approach** ***(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)***

bgs = below ground surface
CERCLA= *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CMS = corrective measure study
COPC = contaminant of potential concern
DOE-RL = U.S. Department of Energy, Richland Operations Office
Ecology = Washington State Department of Ecology
eco = ecological
GPR = ground-penetrating radar
HH = human health
HHE = human health and the environment
IC = institutional control
OU = operable unit
RFI = RCRA facility investigation
RTD = removal, treatment, and disposal
SAP = sampling and analysis plan
UIC = underground injection control
UPR = unplanned release
WMA = waste management area
XRF = x-ray fluorescence

Table C-4. Workshop Outcomes for 200-EA-1 OU Waste Sites in the B Plant Group

Waste Site	DOE-RL / Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 o 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
200-E-25 french drain	11/15/2016	UNCERTAIN, but UNLIKELY. Radionuclides, VOCs, SVOCs, and TPH in soil and piping associated with the 200-E-25 french drain may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	UIC	Diameter: 2 ft Depth: ~20 ft		X				• Presence and extent of contamination is not defined. • It is uncertain if removal is required for the UIC or if in-place closure is allowable.	Some action is required to address the UIC. If RTD is the selected action, collect samples as part of RTD implementation to confirm cleanup levels are attained.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
200-E-26 (UPR-liquid)	11/15/2016	UNCERTAIN, but UNLIKELY. Diesel fuel, oil, and grease in soil associated with the 200-E-26 UPR may be present at concentrations exceeding human and ecological risk-based criteria.	X			None	Potentially impacted area is 120 ft by 30 ft 1 to 2 ft of gravel cover.		X				• Exact location of the spill. • Nature and extent of contamination. • Whether contamination is present at levels that exceed risk-based criteria.	• Evaluate and select characterization strategies (borehole grid versus test pit/trenching versus RTD with verification sampling). • If RTD is more cost-effective than sampling, implement RTD. Otherwise, collect samples to determine if RTD is necessary. Focus sampling on SVOA, PAH, TPH, PCBs, and VOAs.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
200-E-117 (UPR-liquid)	1/30/2017	UNCERTAIN, but LIKELY. Radiological constituents in soil and piping associated with the 200-E-117 UPR may be present at concentrations exceeding human and ecological risk-based criteria.		X		None	Length: 10 ft Width: 20 ft		X				• Whether the pipes are currently contaminated (internally or externally). • The status of the main steam line.	• DOE-RL will confirm the status of the steam line with facility personnel. • Survey the connection to the steam line for radiological and chemical constituents.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	3/29/2017													Characterization strategy modified after site visit. Penetration to groundwater added.
200-E-123 (UPR-solid)	12/13/2016	UNCERTAIN. Radiological constituents in soil associated with the 200-E-123 UPR may be present at concentrations exceeding human and ecological risk-based criteria.		X		None	Length: ~23 ft Width: ~15 ft Surface cover thickness is an estimated 1 to 2 ft		X				Depth and nature of contamination.	• Bias to RTD hot spot, perform verification sampling, and determine path forward. Use COPC list from DOE/RL-2008-44, *Engineering Evaluation/Cost Analysis for the 200-MG-1 Operable Unit Waste Sites*. • For field screening, use XRF (for metals) and organic vapor monitoring.

Table C-4. Workshop Outcomes for 200-EA-1 OU Waste Sites in the B Plant Group

Waste Site	DOE-RL / Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 o 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
200-E-129 (UPR-solid)	11/15/2016	UNCERTAIN, but LIKELY. Radiological constituents in soil associated with the 200-E-129 UPR may be present at concentrations exceeding human and ecological risk-based criteria.		X		None	Posted area: 8 ft by 15 ft Covering: 1 to 2 ft of gravel		X				• Whether contamination remains below the stabilized area, impacting the ability to define the nature and extent. • None impacting response selection. • Administrative path for action.	• DOE-RL and Ecology determined it is a more efficient use of resources to remove and dispose. • Evaluate feasibility of leveraging DOE/RL-2008-44, *Engineering Evaluation/Cost Analysis for the 200-MG-1 Operable Unit Waste Sites*, and putting site in new action memorandum.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
200-E-130 (UPR-solid)	12/13/2016	YES. Radiological constituents in soil associated with the 200-E-130 UPR may be present at concentrations exceeding human and ecological risk-based criteria.		X		None	Original area: 2 ft by 50 ft Estimated removal area: 10 ft by 65 ft Covering: 1 to 2 ft of gravel		X				Extent of radiological contamination and the presence and extent of chemical contamination.	• Bias to RTD hot spot, perform confirmation sampling, and determine path forward. • For field screening, use XRF (for metals) and organic vapor monitoring.
200-E-142 depression	1/30/2017	UNCERTAIN, but LIKELY. Metals and organics in soil and concrete associated with the 200-E-142 depression may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X		X	None	Unknown	X	X				Nature and extent of contamination.	• Dig shallow trench next to end of concrete slab and make visual examination for soil stains. • Make one direct push under concrete and collect data for chemical constituents (not radiological constituents). • If action levels are exceeded, remove slab. If action levels are not exceeded, leave slab.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
200-E-209-PL pipeline	11/15/2016	Radionuclides, VOCs, SVOCs, oil, asbestos, and grease in soil and piping associated with the 200-E-209-PL may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	Length: 50 ft Diameter: 2 in. Depth: 30.5 in. bgs		X				• None impacting response selection. • Presence of contamination not defined.	• Address with the 200-E-25 french drain (200-EA-1 OU). • Remediation would be incidental to RTD of the 200-E-25 french drain. Collect samples as part of RTD implementation to confirm cleanup levels are attained.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]

Table C-4. Workshop Outcomes for 200-EA-1 OU Waste Sites in the B Plant Group

Waste Site	DOE-RL / Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 o 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
200-E-297 dumping area	2/1/2017	UNCERTAIN, but LIKELY. Asbestos-containing construction debris, metals, and chemicals in soil may be present at concentrations exceeding human and ecological risk-based criteria.	X			None	Width: ~120 ft Length: ~120 ft Depth: Unknown	X	X			X	• Nature of waste site; photographs suggest it is an open pit, but this has not been confirmed. • Nature and extent of contamination, if any.	• Conduct a site visit to gain an understanding of the site conditions and boundary. • Use GPR survey to determine extent and depth of debris, conduct radiological survey, and use XFR and visual inspections to survey for lead and other heavy metals. If no contamination is detected using GPR/XFR, then reject site and place on the housekeeping list to address debris.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
207-B Retention Basin	3/9/2017	UNCERTAIN, but LIKELY. Radiological constituents in soil associated with the 207-B Retention Basin may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.		X		None	*Two concrete basins:* Depth: 6.5 ft Bottom dimensions, per basin section: Length: 106 ft Width: 106 ft Top dimensions, total basin: Length: 243 ft Width: 123 ft	X	X		X	X	Contamination extent.	• Conduct a radiological survey of the basin surface to support selecting the locations of four penetrations. Penetrations should be located as follows: one at the seam in the northeast corner of the basin, one on the west (inflow), one on the east (outflow) and one outside the basin on the northeast side. • Collect samples from 5 to 15 ft below concrete. Soil samples will be analyzed for the full suite of contaminants. Concrete samples will be analyzed for radiological constituents. • If all samples are clean, then no action is acceptable.
	3/39/2017													Characterization strategy modified after site visit.
	6/5/2017													Sampling design modified to align with updated characterization strategy.
216-B-2-1 Ditch	3/6/2017	UNCERTAIN, but LIKELY. Radiological and chemical constituents, including nitrates, in soil and vegetation associated with the 216-B-2-1 Ditch may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	Length: 3,500 ft Width: 15 ft Depth: 6 ft		X		X	X	• Nature and extent of contamination, particularly the COPCs in the first 1,000 ft of the ditch. • Whether the whole ditch was backfilled and had a barrier applied.	To determine the nature and extent of contamination, install three penetrations in the first 1,000 ft of the ditch. Extend pushes 40 to 50 ft, sampling at 5 ft intervals below 15 ft depth. Extend the penetration near the dam to groundwater. Install an additional penetration to 40 to 50 ft bgs at the downstream end of the trench. Collect samples following the 200-DV-1 OU protocol for the shallow zone; analyze for the same contaminant suite as 200-DV-1 OU.[c]
	6/5/2017													Sampling design modified to align with updated characterization strategy.

Table C-4. Workshop Outcomes for 200-EA-1 OU Waste Sites in the B Plant Group

Waste Site	DOE-RL / Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 o 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
216-B-2-2 Ditch	3/6/2017	YES. Radiological and chemical constituents in soil associated with the 216-B-2-2 ditch may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	Length: 3,500 ft Width: 8 ft (top); 3 ft (bottom) Depth: 6 to 8 ft deep		X		X	X	Contamination extent in the tail end of the ditch.	To define the extent of contamination, install one shallow push (40 to 50 ft bgs) in tail end of ditch, upstream of the 218-E-12 Burial Ground cap area (200-SW-2 OU). Collect samples following the 200-DV-1 OU protocol for the shallow zone; analyze for the same contaminant suite as 200-DV-1 OU.[c]
216-B-2-3 Ditch	3/6/2017	UNCERTAIN, but LIKELY. Radiological and chemical constituents in soil associated with the 216-B-2-2 Ditch may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	Depth: 8 ft Length: 4,000 ft Width: 20 ft (top) Width: 6 ft (bottom)		X		X	X	The nature and extent of contamination in the tail end of the ditch are uncertain, but contamination is likely present based on process history and contamination status of other ditches.	To define the nature and extent of contamination, install two shallow pushes (40 to 50 ft bgs). One at the head end of the ditch and one in the tail end where the 216-B-2-1, 216-B-2-2, and 216-B-2-3 Ditches join. Collect samples following the 200-DV-1 OU protocol for the shallow zone; analyze for the same contaminant suite as 200-DV-1 OU.[c]
216-B-10A Crib	1/30/2017	UNCERTAIN, but LIKELY. Radiological and chemical constituents, including nitrates, in soil and wood timbers associated with the 216-B-10A Crib may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	*Crib box:* Length: 12 ft Width: 12 ft Height: 4 ft Bottom of structure (depth): 20 ft bgs Top of structure (depth): 16 ft bgs *Excavation:* Length: 14 ft at bottom, 54 ft at top Width: 14 ft at bottom, 54 ft at top Depth: 20 ft bgs		X			X	Presence and nature of contamination, if any.	• Push through the crib edge and center and collect samples for a full laboratory suite, including hexavalent chromium. Collect samples at 5 ft intervals from 20 to 80 ft bgs. • Integrate investigation with 200-E-174 PL and a portion of 200-E-175-PL (200-IS-1 OU).***
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	6/5/2017													Sampling design modified to align with updated characterization strategy. Deep penetration extended to groundwater.

Table C-4. Workshop Outcomes for 200-EA-1 OU Waste Sites in the B Plant Group

Waste Site	DOE-RL / Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 o 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
216-B-10B Crib	1/30/2017	UNCERTAIN, but LIKELY. Radiological and chemical constituents, including nitrates, in soil and wood timbers associated with the 216-B-10B Crib may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	*Crib Box:* Length: 12 ft Width: 12 ft Height: 4 ft Bottom of structure (depth): 20 ft bgs Top of structure (depth): 16 ft bgs *Excavation:* Length: 14 ft at bottom, 54 ft at top Width: 14 ft at bottom, 54 ft at top Depth: 20 ft bgs		X			X	Presence and nature of contamination, if any.	• Push through the crib edge and center and collect samples for a full laboratory suite, including hexavalent chromium. Collect samples at 5 ft intervals from 20 to 80 ft bgs. • Integrate investigation with 200-E-174 PL and a portion of 200-E-175-PL (200-IS-1 OU).
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	6/5/2017													Sampling design modified to align with updated characterization strategy. Deep penetration depth reduced to 15.2 m (50 ft) bgs.
216-B-12 Crib	1/30/2017 Two-dimensional revisit 2/23/2017	YES – At depth. UNCERTAIN, but UNLIKELY – Shallow. Radiological and chemical constituents, including nitrates, in soil and wood timbers associated with the 216-B-12 Crib may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X[2]	X	X	None	Length, at grade: 180 ft Width, at grade: 60 ft Length, at base: 161 ft Width, at base: 51 ft Depth: 0 to 30 ft bgs, including 15 ft of crushed stone at base *Three wooden boxes:* Length: 16 ft Width: 16 ft Depth: 10 ft		X	X	X	X	Nature and extent of contamination.	Install 3 penetrations and sample following the 200-DV-1 OU protocol for the shallow zone.[c] One penetration will be in the north end of the crib and one will be in the south end. One penetration will be installed near wells 299-E-28-62 and 299-E28-66 and borehole C3246. Analyze samples for the full suite of radiological and chemical constituents; do not analyze samples from below 15 ft bgs for pesticides.
216-B-55 Crib	1/30/2017 Two-dimensional revisit 2/23/2017	YES. Radiological and chemical constituents in soil and wood timbers associated with the 216-B-55 Crib are present at concentrations exceeding human, ecological, and protection of groundwater risk-based criteria.	X	X	X	None	Length: 750 ft Width: 10 ft (at bottom) Depth: ~13 ft Side slope: 1.5:1 at base, 2:1 at top		X		X	X	Nature and extent of contamination.	Install 3 penetrations and sample following the 200-DV-1 OU protocol for the shallow zone.[c] Two penetrations will be at opposite ends of the crib. Install the third penetration near borehole C5929. Install one penetration to groundwater and sample at 5 ft intervals at the point where contamination starts.

Table C-4. Workshop Outcomes for 200-EA-1 OU Waste Sites in the B Plant Group

		Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
			Likely Exposure Pathways					Potential Response Actions[b]						
Waste Site	**DOE-RL / Ecology Workshop Date**	**Potential Threat to HHE Based on Existing Information**	**HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]**	**HH & Eco (Radiological) 0 o 4.6 m (15 ft) bgs[a]**	**Groundwater Protection**	**Other Regulatory Standards**	**Dimensions**	**No Action**	**RTD (Excavate for UIC Sites)**	**Leave in Place (Stabilize)**	**Leave in Place (Cover)**	**Leave in Place (IC)**	**Uncertainty**	**Uncertainty Management Approach** ***(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)***
216-B-59 Trench *(Address with the 216-B-59B Retention Basin)*	2/1/2017 Two-dimensional revisit 2/23/2017 Rescheduled 4/10/2017	UNCERTAIN, but LIKELY. Radiological and chemical constituents in soil associated with the 216-B-59 Trench may be present at concentrations exceeding human and ecological risk-based criteria.		X		None	Length: 400 ft Depth: ~14 ft bgs Bottom width: 20 ft Side slope: 2:1	X	X	X	X		Nature and extent of contamination.	• Install the following four penetrations to 15 ft bgs: – Through left side of the berm (sample at two different depths) – Through right side of the berm (sample at two different depths) – In the overflow area – Below the pump pit • After diversion boxes/valve pit removal, sample at the diversion box/valve pits at approximately 15 ft bgs.
216-B-59B Retention Basin *(Address with the 216-B-59 Trench)*	2/1/2017 Two-dimensional revisit 2/23/2017 Rescheduled 4/10/2017	UNCERTAIN, but LIKELY. Radiological and chemical constituents in soil and concrete associated with the 216-B-59B Retention Basin may be present at concentrations exceeding human and ecological risk-based criteria.		X		None	Length: 307 ft Cover Width: 50 ft Bottom Width: 20 ft Depth: ~6 ft bgs Side slope: 1:2	X	X	X	X		• Whether it is within the 200-EA-1 OU scope to address the basin structure. • Nature and extent of contamination.	• Determine the "facility" plan for the concrete basin, as this will influence sampling under the basin. • See the 216-B-59 trench uncertainty management approach
216-B-62 Crib	1/30/2017 Two-dimensional revisit 2/23/2017 Rescheduled 4/10/2017	UNCERTAIN, but LIKELY. Radiological and chemical constituents, including nitrates, in soil and wood timbers associated with the 216-B-62 Crib may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	Length: 500 ft Width: 10 ft Depth: 15 ft bgs		X		X	X	Nature and extent of contamination.	Install three deep penetrations in the following locations: one between wells 299-E28-75 and 299-E28-84, one between 299-E28-91 and 299-E28-87, and one near 299-E28-18. Install two shallow penetrations between the deep penetrations. Collect shallow samples using the 200-DV-1 OU protocol for the shallow zone and less frequently at depth.[c] Analyze all samples for the full suite of radiological and chemical constituents.
	6/5/2017													Sampling design modified to align with updated characterization strategy.
216-B-63 Ditch	3/6/2017	YES. Radiological and chemical constituents, in soil associated with the 216-B-63 Ditch may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria. Previous analyses indicate no action is needed for RCRA closure.	X	X	X	TSD	Length: 1,600 ft Width: 38 ft Top, 8 ft Bottom Depth: 10 ft Side slope: 1.5:1	X	X		X	X	Representativeness of previous remedial investigation conclusions.	Review the previous remedial investigation conclusions and determine if those conclusions are still valid in light of the current evaluation using different data evaluation thresholds.

Table C-4. Workshop Outcomes for 200-EA-1 OU Waste Sites in the B Plant Group

Waste Site	DOE-RL / Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 o 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
218-E-7 burial vault	1/30/2017	UNCERTAIN, but LIKELY. Based on process history, radiological and chemical constituents in soil and vault structure associated with the 218-E-7 burial vault may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	*Eastern and center vaults:* Vault tops: 5 ft bgs (original surface level) Length: 10 ft Width: 10 ft Depth: 12 ft *Replacement vault (western vault):* Vault top: 3 ft bgs (original surface level) Diameter: 8 ft Depth: 25 ft		X			X	• Exact location. • Nature and extent of contamination.	• Use GPR to locate the vaults. • Install penetrations at each vault and conduct a downhole gamma survey. Collect samples below the structures.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	6/5/2017													Sampling design modified to align with updated characterization strategy. Soil gas analysis removed.
2607-E3 septic system	2/9/2017 Rescheduled 3/30/2017	UNCERTAIN, but UNLIKELY. There are no expected CERCLA-related threats to human health and the environment associated with the 2607-E septic tank; however, contamination in the tile field may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	WAC 246-272A-0300	Length: 17 ft Width: 7 ft 4 in. Height: 6 ft 2 in.	X	X				Whether the tile field associated with this septic tank represents a threat to HHE.	• Conduct a GPR survey to confirm no other utilities are in the area. • Open a trench 10 to 15 bgs and conduct a radiological survey to determine if samples should be analyzed for radiological constituents. • Collect samples near the inflow location.

Table C-4. Workshop Outcomes for 200-EA-1 OU Waste Sites in the B Plant Group

Waste Site	DOE-RL / Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 o 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
UPR-200-E-64 (UPR-solid)	1/30/2017	UNCERTAIN, but UNLIKELY. Radiological constituents in soil associated with UPR-200-E-64 may be present at concentrations exceeding human and ecological risk-based criteria.		X		None	Area: ~2 ac Size and shape changes periodically, based on radiological surveys	X	X		X		• Presence and nature of contamination, if any. • Whether the posted URMA is the entire UPR, or just a portion. • Whether there is additional contamination at the swab riser.	• Divide UPR into the following decision units: – Unit 1, east of 200-E-217-PL: 3 to 4 ft bgs soil samples in east side of 200-E-217-PL; then grid-based random sampling to depth of original grade. – Unit 2, swab riser: Direct push at swab riser in coordination with 200-IS-1 OU. – Unit 3, west of 200-E-217-PL: Same as unit 1 approach; coordinate with other sites to determining timing of investigation. – Unit 4, northern block: Use grid-based random sampling for 3 to 4 ft bgs soil samples. • If samples show contamination above action levels, RTD. If samples show contamination below action levels, no action. If samples show no contamination, reject site.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol[c]
UPR-200-E-69 (UPR-liquid)	2/1/2017	UNCERTAIN, but LIKELY. Radiological constituents in soil associated with UPR-200-E-69 may be present at concentrations exceeding human and ecological risk-based criteria.		X		None	Length: ~1,015 ft Tracks and rail bed remain		X				Nature and extent of radiological contamination.	• Investigate subsurface contamination to determine lateral and vertical extent of contamination. Analyze all samples for the full suite of radiological and chemical constituents. • Coordinate response action with B Plant and 200-IS-1 OU pipelines. • Consider as possible candidate for early action.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol[c]
	2/21/2018													Characterization strategy modified for UPRs associated with railroads; general discussion to consider as possible candidate for removal based on cost comparison.

References:

DOE/RL-2008-44, *Engineering Evaluation/Cost Analysis for the 200-MG-1 Operable Unit Waste Sites.*

WAC 246-272A-0300 "On-site Sewage Systems – Abandonment."

a. Per Section 1.3.2.5 of the work plan, DOE-RL may choose to evaluate a conditional point of compliance for the terrestrial ecological evaluation, and an alternative point of compliance for human health direct contact.

b. Potential response actions were developed as part of scoping (40 CFR 300.430, "National Oil and Hazardous Substances Pollution Contingency Plan," "Remedial Investigation/Feasibility Study and Selection of Remedy"); may be changed based on data collected through this work plan and the remedial investigation/feasibility study and RFI/CMS process.

c. Applicable 200-DV-1 OU sampling protocols include collecting sufficient data from the shallow vadose zone to support a quantitative risk assessment and collecting samples every 0.6 m (2 ft) in the shallow vadose zone.

Table C-4. Workshop Outcomes for 200-EA-1 OU Waste Sites in the B Plant Group

		Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
			Likely Exposure Pathways					Potential Response Actions[b]						
Waste Site	DOE-RL / Ecology Workshop Date	Potential Threat to HHE Based on Existing Information	HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 o 4.6 m (15 ft) bgs[a]	Groundwater Protection	Other Regulatory Standards	Dimensions	No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)	Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*

bgs = below ground surface
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CMS = corrective measure study
COPC = contaminant of potential concern
DOE-RL = U.S. Department of Energy, Richland Operations Office
Eco = ecological
Ecology = Washington State Department of Ecology
GPR = ground-penetrating radar
HH = human health
HHE = human health and the environment
HSVP = Hot Semiworks Valve Pit
IC = institutional control
OU = operable unit
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
RFI = RCRA facility investigation
RTD = removal, treatment, and disposal
SAP = sampling and analysis plan
SVOA = semivolatile organic analyte
SVOC = semivolatile organic compound
TPH = total petroleum hydrocarbons
UIC = underground injection control
UPR = unplanned release
VOA = volatile organic analyte
VOC = volatile organic compound
XRF = x-ray fluorescence

Table C-5. Workshop Outcomes for 200-EA-1 OU Waste Sites in the Hot Semiworks Plant Group

		Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
			Likely Exposure Pathways					Potential Response Actions[b]						
Waste Site	**DOE-RL / Ecology Workshop Date**	**Potential Threat to HHE Based on Existing Information**	**HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]**	**HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]**	**Groundwater Protection**	**Other Regulatory Standards**	**Dimensions**	**No Action**	**RTD (Excavate for UIC Sites)**	**Leave in Place (Stabilize)**	**Leave in Place (Cover)**	**Leave in Place (IC)**	**Uncertainty**	**Uncertainty Management Approach** *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
200-E-4 french drain	1/25/2017	YES. Radiological and chemical constituents in soil associated with the 200-E-4 french drain may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	UIC	Diameter: 4 ft Depth: 6 to 8 ft		X			-	• Potential impact to groundwater, is uncertain given the conservative basis for screening thresholds. • Whether removal is required for the UIC or if in-place closure is allowable.	• Coordinate planned action with the 200-E-249-PL (200-EA-1 OU). • Some action is required to address the UIC. If RTD is the selected action, collect samples as part of RTD implementation to confirm cleanup levels are attained.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	6/5/2017													Sampling design modified to align with updated characterization strategy.
200-E-41 (UPR-solid)	1/24/2017	YES – portion under cover. UNCERTAIN, but LIKELY – portion not under cover. Historical records do not indicate that 200-E-41 UPR is a waste site from a unique release, but rather an administrative designation for a broad stabilized area		X	X	None	Width: 493 ft Length: 493 ft Irregular shape		X		X	X	Nature and extent of contamination.	• Integrate investigation and response strategy with other 200-EA-1 OU Hot Semiworks Plant group site investigations and response strategies. • Use grid-based random sampling.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
200-E-56 (UPR-liquid)	1/23/2017	YES. Radiological and chemical constituents, including strontium-90, in soil associated with the 200-E-56 UPR may be present at concentrations exceeding human and ecological risk-based criteria risk-based criteria.		X		None	Undefined, but expected to be localized laterally.		X		X		Nature and extent of contamination.	• Integrate investigation and response strategy with other 200-EA-1 OU Hot Semiworks Plant group site investigations and response strategies; site is collocated with multiple former effluent discharge points from the 201C processing facility. • Two borings: one near pipeline leak, and one near soil contamination. Use gamma logs to determine feasibility of sample collection.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]

Table C-5. Workshop Outcomes for 200-EA-1 OU Waste Sites in the Hot Semiworks Plant Group

Waste Site	DOE-RL / Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
200-E-57 (UPR-liquid)	1/24/2017	YES. Radiological and chemical constituents in soil associated with the 200-E-57 UPR may be present at concentrations exceeding human and ecological risk-based criteria risk-based criteria.		X		None	30 ft along pipeline		X		X		Nature and extent of contamination.	• Integrate investigation and response strategy with other 200-EA-1 OU Hot Semiworks Plant group site investigations and response strategies. • Coordinate with 200-E-149-PL action (200-IS-1 OU). • Two pushes (one near each end of capped pipe). • Collect samples at ash/native soil interface, at 6 ft bgs below pipe and 3 ft below pipe.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
200-E-249-PL pipeline	1/25/2017	UNCERTAIN. Radiological and chemical constituents in piping associated with 200-E-249-PL pipeline may be present at concentrations exceeding human and ecological risk-based criteria.	X	X		None	Length: 200-E-249-PL:1: 18.1 ft 200-E-249-PL:2: 5.9 ft Diameter: 200-E-249-PL:1: 1.5 in. 200-E-249-PL:2: 0.75 in. Depth: 4 ft to 6.5 ft bgs		X				Nature and extent of contamination.	Integrate with 200-E-4 french drain (200-EA-1 OU) investigation and response strategy.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
200-E-251-PL pipeline	1/23/2017	UNCERTAIN, but UNLIKELY. Radiological and chemical constituents in piping and soil associated with 200-E-251-PL pipeline may be present at concentrations exceeding human and ecological risk-based criteria.		X		None	Length: 111 ft Diameter: 4 in. Depth: 11 ft to 14 ft bgs	X	X		X		Nature and extent of contamination.	• Integrate investigation and response strategy with other 200-EA-1 OU Hot Semiworks Plant group site investigations and response strategies. • Coordinate with 200-E-252-PL pipeline and 216-C-2 injection/reverse well (200-EA-1 OU) actions. • Sample soil where pipelines show alignment. Anticipate one push to 40 ft bgs next to the 216-C-2 injection/reverse well.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]

Table C-5. Workshop Outcomes for 200-EA-1 OU Waste Sites in the Hot Semiworks Plant Group

Waste Site	DOE-RL / Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
200-E-252-PL pipeline	1/23/2017	UNCERTAIN, but UNLIKELY. Radiological and chemical constituents in piping and soil associated with 200-E-252-PL pipeline may be present at concentrations exceeding human and ecological risk-based criteria.		X		None	Length: ~45 ft Diameter: 2 in. Depth: 15 ft bgs	X	X		X		Nature and extent of contamination.	• Integrate investigation and response strategy with other 200-EA-1 OU Hot Semiworks Plant group site investigations and response strategies. • Coordinate with 200-E-251-PL pipeline and 216-C-2 injection/reverse well (200-EA-1 OU) actions. • Sample soil where pipelines show alignment. Anticipate one push to 40 ft bgs next to the 216-C-2 injection/reverse well.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
200-E-293 foundation	1/25/2017	UNCERTAIN, but LIKELY. Fixed radiological contamination of the 200-E-293 foundation is present on the concrete slab (now buried under plastic, plywood, clean fill, and gravel) at concentrations that may exceed human and ecological risk-based criteria.		X		None	53 ft by 34 ft		X				Whether fixed radiological contamination on concrete slab poses a threat to human and ecological receptors.	• Remove soil cover and conduct radiological survey. • Collect concrete samples at targeted locations for verification and disposal determination • Collect soil samples at targeted locations, including beneath the foundation, for verification and disposal determination • Perform cost benefit analysis of whether it is more cost effective to remove contaminated slab; or collect samples to quantify risk.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
200-E-294 foundation	1/25/2017	YES. Fixed radiological contamination of the 200-E-294 foundation is present on the concrete slab (now buried under a steel plate, clean fill, and gravel) at concentrations that may exceed human and ecological risk-based criteria. Additionally, radiological constituents in piping and soil beneath the 200-E-294 foundation may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X		None	Approximately 1,800 ft^2 of contaminated concrete with a maximum thickness of 2 ft		X	X		X	• The extent of fixed radiological contamination on concrete slab that poses a threat to human and ecological receptors is uncertain. • Presence and nature of contamination, if any, below the slab.	Concrete slab: • Take rad survey of slab surface under existing soil cover. • Remove areas of slab with remaining contamination above action levels. Under the concrete slab: • Excavate short trench along south side of building and collect soil sample. • Collect soil sample from one angled direct push targeting under piping at enclosed pipe run.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]

Table C-5. Workshop Outcomes for 200-EA-1 OU Waste Sites in the Hot Semiworks Plant Group

Waste Site	DOE-RL / Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
201-C process unit	1/23/2017	YES. Radiological and chemical constituents are present in the entombed remains (piping and concrete) of the 201-C process unit at concentrations that may exceed human and ecological risk-based criteria.	X	X		None	Length: 140 ft Width: 80 ft Currently dismantled to 10 ft above grade and filled with grout All below-grade features are filled with grout		X		X[d]		• Extent of subsurface contamination beyond the remaining structure is not defined. • The efficacy of completing the previously planned and designed cover system.	• Integrate investigation and response strategy with other 200-EA-1 OU Hot Semiworks Plant group site investigations and response strategies. • Angle boring to sample below process unit. • DOE-RL and Ecology to discuss the end-state vision for the Hot Semiworks Plant area, including the viability of completing the planned cover system.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	6/5/2017													Sampling design modified to align with updated characterization strategy.
209-E-WS-2 french drain	12/13/2016	UNCERTAIN. It is unknown if there are any CERCLA-related threats to HHE associated with the 209-E-WS-2 french drain.	X	X	X	UIC	Diameter: 4 ft Depth: 8 ft bgs		X			X	• Presence and nature of contamination, if any. • Whether removal is required for the UIC, or if in-place closure is allowable.	Some action is required to address the UIC. If RTD is the selected action, collect samples as part of RTD implementation to confirm cleanup levels are attained.
216-C-1 Crib	1/24/2017	YES. Radiological and chemical constituents in soil associated with the 216-C-1 Crib may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	Length: ~23 ft Width: 8 ft Top of structure depth: ~7.5 ft Bottom of structure depth: ~13 ft bgs		X		X		Nature and extent of contamination.	• Perform site-specific evaluation of potential impact to groundwater will be performed during remedial investigation phase of the project. • Sample from within crib footprint to define nature of contamination to inform worker safety and health considerations for response actions. • Characterize vertical extent with one deep angled boring .
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	6/5/2017													Sampling design modified to align with updated characterization strategy.

Table C-5. Workshop Outcomes for 200-EA-1 OU Waste Sites in the Hot Semiworks Plant Group

Waste Site	DOE-RL / Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
216-C-2 injection/reverse well	1/24/2017	YES. Radiological and chemical constituents in soil and piping associated with the 216-C-2 reverse well may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.		X	X	None	Diameter: 12 in. Depth: 1 ft above grade to 40 ft bgs Bottom 25 ft was perforated		X		X		Nature and extent of contamination.	• Integrate investigation and response strategy with other 200-EA-1 OU Hot Semiworks Plant group site investigations and response strategies. • Characterize vertical and lateral extent with two borings; one identified as a deep location.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	6/5/2017													Sampling design modified to align with updated characterization strategy.
216-C-3 Crib	1/24/2017	YES. Radiological and chemical constituents in soil associated with the 216-C-3 Crib may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	Bottom length: 50 ft Bottom width: 10 ft Depth: 10 ft bgs		X				Nature and extent of contamination.	• Characterize vertical extent with angle pushes: – One push south of 216-C-5 Crib (200-EA-1 OU) angled to extend below 216-C-3 Crib – One push west of 216-C-4 Crib (200-EA-1 OU) angled to extend below 216-C-3 Crib • Collect opportunistic samples from within pipelines for 200-IS-1 OU work plan.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	6/5/2017													Sampling design modified to align with updated characterization strategy.
216-C-4 Crib	1/24/2017	YES. Radiological and chemical constituents in soil associated with the 216-C-4 Crib may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	Length: 20 ft Width: 10 ft Depth: 16 ft bgs		X				Nature and extent of contamination.	• Characterize vertical extent with angle pushes: – One push south of 216-C-5 Crib (200-EA-1 OU) angled to extend below 216-C-3 Crib – One push west of 216-C-4 Crib angled to extend below 216-C-3 Crib (200-EA-1 OU) • Collect opportunistic samples from within pipelines for 200-IS-1 OU work plan.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]

Table C-5. Workshop Outcomes for 200-EA-1 OU Waste Sites in the Hot Semiworks Plant Group

Waste Site	DOE-RL / Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
216-C-5 Crib	1/24/2017	YES. Radiological and chemical constituents in soil associated with the 216-C-5 Crib may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	Length: 20 ft Width: 10 ft Depth: 16 ft bgs		X				Nature and extent of contamination.	• Characterize vertical extent with angle pushes: – One push south of 216-C-5 Crib angled to extend below 216-C-3 Crib (200-EA-1 OU) – One push west of 216-C-4 Crib (200-EA-1 OU) angled to extend below 216-C-3 Crib (200-EA-1 OU) • Collect opportunistic samples from within pipelines for 200-IS-1 OU work plan.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
216-C-6 Crib	1/25/2017	UNCERTAIN, but LIKELY. Radiological and chemical constituents in soil associated with the 216-C-6 Crib may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	Length: 20 ft Width: 10 ft Depth: 16 ft bgs		X		X		Nature and extent of contamination.	• Gather data about vadose zone beneath crib via direct/angled pushes, depending on crib construction and risk for subsidence. • Collect samples at approximately one foot below crib base of crib (estimated at 17 ft bgs), and sample at 5 ft intervals to maximum depth.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	6/5/2017													Sampling design modified to align with updated characterization strategy.
216-C-7 Crib	1/25/2017	UNCERTAIN, but LIKELY. Radiological and chemical constituents in soil associated with the 216-C-7 Crib may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	Length: 40 ft Width: 40 ft Depth: 10 ft bgs		X		X		Nature and extent of contamination.	• Gather data about vadose zone beneath crib via direct/angled pushes, depending on crib construction and risk for subsidence. • Collect samples at approximately one foot below crib base of crib and sample at 5 ft intervals to maximum depth.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	6/5/2017													Sampling design modified to align with updated characterization strategy.

Table C-5. Workshop Outcomes for 200-EA-1 OU Waste Sites in the Hot Semiworks Plant Group

Waste Site	DOE-RL / Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
216-C-10 Crib	1/24/2017	UNCERTAIN, but UNLIKELY. Radiological and chemical constituents in soil associated with the 216-C-10 Crib may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.		X	X	None	Length: 32.5 ft Width: 5 ft Depth: ~7 ft bgs		X		X		Nature and extent of contamination.	• Gather data about vadose zone beneath crib via direct/angled pushes, depending on crib construction and risk for subsidence. • Collect samples at approximately one foot below crib base and sample at 5 ft intervals to maximum depth.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	6/5/2017													Sampling design modified to align with updated characterization strategy.
2607-E5 septic system	2/9/2017 Rescheduled 3/30/2017	UNCERTAIN, but UNLIKELY. There are no expected CERCLA-related threats to HHE associated with the 2607-E5 septic tank. However, radiological and chemical constituents may be present in the soil around the 2607-E5 tile field and leaching trench at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	WAC 246-272A-0300	Length: 17 ft Width: 7 ft 4 in. Height: 6 ft 2 in.	X	X				Nature and extent of contamination.	• Conduct a GPR survey to confirm no other utilities are in the area. • Trench across the tile field and leaching trench. • Conduct a radiological survey to determine sample locations and to decide if samples should be analyzed for radiological constituents. Collect samples, including near the inflow location.
2607-E7A septic system	2/9/2017 Rescheduled 3/30/2017	UNCERTAIN, but UNLIKELY. There are no expected CERCLA-related threats to HHE associated with the 2607-E7A septic tank. However, radiological and chemical constituents may be present in the soil around the 2607-E7A drain field at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	WAC 246-272A-0300	Length: 8 ft 9 in. Width: 5 ft 4 in. Height: 8 ft 4 in.	X	X				Nature and extent of contamination.	• Conduct a GPR survey to confirm no other utilities are in the area. • Trench across the tile field and leaching trench. • Conduct a radiological survey to determine sample locations and to decide if samples should be analyzed for radiological constituents. Collect samples, including near the inflow location.
2607-E7B septic system	2/9/2017 Rescheduled 3/30/2017	UNCERTAIN, but UNLIKELY. There are no expected CERCLA-related threats to HHE associated with the 2607-E7B septic tank. However, radiological and chemical constituents may be present in the soil of the tile field around the 2607-E7B septic system at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	WAC 246-272A-0300	Length: 8 ft 9 in. Width: 5 ft 6 in. Height: 8 ft 4 in.	X	X				Nature and extent of contamination.	• Conduct a GPR survey to confirm no other utilities are in the area. • Trench across the tile field and leaching trench. • Conduct a radiological survey to determine sample locations and to decide if samples should be analyzed for radiological constituents. Collect samples, including near the inflow location.

Table C-5. Workshop Outcomes for 200-EA-1 OU Waste Sites in the Hot Semiworks Plant Group

		Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
			Likely Exposure Pathways					Potential Response Actions[b]						
Waste Site	DOE-RL / Ecology Workshop Date	Potential Threat to HHE Based on Existing Information	HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection	Other Regulatory Standards	Dimensions	No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)	Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
291-C process unit	1/23/2017	YES. Radiological and chemical constituents may be present in entombed filters and concrete associated with the 291-C process unit at concentrations exceeding human and ecological risk-based criteria.	X	X		None	*Fan house slab:* ~860 ft^2 *Underground air tunnel:* Length: 200 ft long Depth: first 100 ft is 20 ft bgs, second 100 ft is 5 ft bgs *Underground fiberglass concrete unit (grouted and capped):* Length: 52 ft Width: 27 ft Depth: 8.5 ft *Underground HEPA filter concrete unit (grouted and capped)* Length: 13 ft Width: 6 ft Depth: 6.5 ft		X		X		Nature of contamination associated with the concrete rubble.	• Uncertainty will not significantly impact the response evaluation or selection. • Coordinate with 291-C-1 Burial Ground, 200-E-251-PL pipeline, and 200-E-252-PL pipeline (200-EA-1 OU). • Uncertainty will not significantly impact the response evaluation or selection.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	6/5/2017													Sampling design modified to align with updated characterization strategy.
291-C-1 Burial Ground	1/23/2017	YES. Radiological constituents in soil and debris associated with the 291-C-1 stack may be present at concentrations exceeding human and ecological risk-based criteria.		X		None	Undefined.		X		X		• Specific burial trench dimensions of the burial trench are not defined. • Nature of contamination associated with the concrete rubble.	• Uncertainty will not significantly impact the response evaluation or selection. • Review existing light detection and ranging data; perform electromagnetometry/GPR surveys. • Place two or three angled pushes in soil below trench. Collect sample at ash/native material interface and every 5 ft, to 10 to 20 ft bgs. • Place one angled push under stack base. Collect sample at ash/native material interface and every 5 ft to 15 ft bgs.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]

Table C-5. Workshop Outcomes for 200-EA-1 OU Waste Sites in the Hot Semiworks Plant Group

Waste Site	DOE-RL / Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
HSVP (valve pit)	1/23/2017	UNCERTAIN, but LIKELY. Radiological and chemical constituents in soil and piping associated with the HSVP may be present at concentrations exceeding human and ecological risk-based criteria.	X	X		None	Cylinder diameter: 5.5 ft Depth: undefined				X		• Depth of the HSVP is undefined. • Concentrations of contaminants stabilized in-place as part of decommissioning are unknown.	• Coordinate direct push with 200-E-56 (UPR-liquid; 200-EA-1 OU). • No additional data are necessary on the HSVP. Integrate response with the end state decided for the 201C facility remnants. • Coordinate direct push with 200-E-56 (UPR-liquid).
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
UPR-200-E-37 (UPR-solid)	1/24/2017	UNCERTAIN. Radiological constituents in soil associated with UPR-200-E-37 may be present at concentrations exceeding human and ecological risk-based criteria.		X		None	14 ac	X					Presence and nature of contamination, if any. Historical documentation is inconsistent regarding whether or not radiological concerns still exist.	• Review existing radiological survey information; perform additional surface survey, if needed. • Collect surface soil samples on a random-start systematic grid across the waste site (both subsites).
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
UPR-200-E-98 (UPR-solid)	1/24/2017	UNCERTAIN, but LIKELY. Radiological constituents in soil associated with UPR-200-E-98 may be present at concentrations exceeding human and ecological risk-based criteria.		X		None	5,000 ft^2		X		X		Presence and location of contamination.	• Integrate investigation and response strategy with other 200-EA-1 OU Hot Semiworks Plant group site investigations and response strategies (in particular, activities associated with 216-C-2 injection/reverse well and 291-C-1 Burial Ground [200-EA-1 OU]). • Collect samples at interface of fly ash and native material.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]

Reference: WAC 246-272A-0300 "On-site Sewage Systems – Abandonment."

a. Per Section 1.3.2.5 of the work plan, DOE-RL may choose to evaluate a conditional point of compliance for the terrestrial ecological evaluation, and an alternative point of compliance for human health direct contact.

b. Potential response actions were developed as part of scoping (40 CFR 300.430, "National Oil and Hazardous Substances Pollution Contingency Plan," "Remedial Investigation/Feasibility Study and Selection of Remedy"); may be changed based on data collected through this work plan and the remedial investigation/feasibility study and RFI/CMS process.

c. Applicable 200-DV-1 OU sampling protocols include collecting sufficient data from the shallow vadose zone to support a quantitative risk assessment and collecting samples every 0.6 m (2 ft) in the shallow vadose zone.

d. A cover of ash as thick as 10 ft is in place on top of the facility remnants. The ash cover was originally placed as a base layer for an engineered earthen barrier that was designed but not constructed.

Table C-5. Workshop Outcomes for 200-EA-1 OU Waste Sites in the Hot Semiworks Plant Group

		Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
			Likely Exposure Pathways					Potential Response Actions[b]						
Waste Site	DOE-RL / Ecology Workshop Date	Potential Threat to HHE Based on Existing Information	HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection	Other Regulatory Standards	Dimensions	No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)	Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*

bgs = below ground surface*
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CMS = corrective measure study
DOE-RL = U.S. Department of Energy, Richland Operations Office
Eco = ecological
Ecology = Washington State Department of Ecology
GPR = ground-penetrating radar
HEPA = high-efficiency particulate air
HH = human health
HHE = human health and the environment
HSVP = Hot Semiworks Valve Pit
IC = institutional control
OU = operable unit
RFI = RCRA facility investigation
RTD = removal, treatment, and disposal
SAP = sampling and analysis plan
UIC = underground injection control
UPR = unplanned release

Table C-6. Workshop Outcomes for 200-EA-1 OU Waste Sites in the PUREX Plant Group

Waste Site	DOE-RL/ Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways: HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	Likely Exposure Pathways: HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Likely Exposure Pathways: Groundwater Protection	Other Regulatory Standards	Dimensions	Potential Response Actions[b]: No Action	Potential Response Actions[b]: RTD (Excavate for UIC Sites)	Potential Response Actions[b]: Leave in Place (Stabilize)	Potential Response Actions[b]: Leave in Place (Cover)	Potential Response Actions[b]: Leave in Place (IC)	Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
200-E PD Ditch	1/12/2017	YES – short leg to northeast. UNCERTAIN – long east-to-west run. Radiological and chemical constituents in soil from windblown events associated with the 200-E PD Ditch may be present at concentrations exceeding human and ecological risk-based criteria.	X	X		None	Length: 1,921 ft Width: 49 ft (top) Depth: 11.5 ft	X	X[d]	X	X	X	• Presence and extent of contamination in long east-to-west run. • Impact of subsurface soil conditions on nearby TSD units. • Physical relationship to the 200-E-237-PL (TEDF pipeline). • Whether active discharges to the ditch have ceased.	• Determine if there were radiological surveys conducted as part of TEDF pipeline placement that could inform presence of contamination. • Determine the extent of the radiological surveys conducted in 2012 and 2016. • Investigate east-to-west run with three pushes to 50 ft bgs, then decide whether or not it is necessary to go deeper and whether or not (and where) to step out laterally. • Collect samples as part of RTD implementation of short leg to northeast to confirm cleanup levels are attained.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
200-E-13 dumping area	2/6/2017	UNCERTAIN, but UNLIKELY. Radionuclides and chemicals (including PAHs) in soil and debris associated with 200-E-13 dumping area may be present at concentrations exceeding human and ecological risk-based criteria.	X	X		None	Area: 141,000 sq. ft Site shape: Irregular	X	X				Presence, nature, and extent of contamination.	• Use GPR or EM surveys to define the extent and depth of the dumping area. • Include organic vapor screening or volatile organic analysis. • Following delineation of boundary, conduct field investigation and determine appropriate response action (RTD, no action, or reject).
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]

Table C-6. Workshop Outcomes for 200-EA-1 OU Waste Sites in the PUREX Plant Group

Waste Site	DOE-RL/ Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways: HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	Likely Exposure Pathways: HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Likely Exposure Pathways: Groundwater Protection	Other Regulatory Standards	Dimensions	Potential Response Actions[b]: No Action	Potential Response Actions[b]: RTD (Excavate for UIC Sites)	Potential Response Actions[b]: Leave in Place (Stabilize)	Potential Response Actions[b]: Leave in Place (Cover)	Potential Response Actions[b]: Leave in Place (IC)	Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
200-E-43 storage area	1/19/2017	YES. Radiological and chemical constituents in soil associated with 200-E-43 storage area may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.		X	X	None	Length: 215 ft Width: 164 ft Depth: 1 to 2 ft fill over contamination of undefined depth		X				Nature and extent of contamination.	• Investigate subsurface contamination to determine lateral and vertical extent of contamination. Consider PUREX waste stream constituents for sampling. • Review prior radiological surveys and historical aerial photos to determine period of use. • Ensure actions consistent with 200-EA-1 OU waste sites UPR-200-E-88 (UPR-liquid) and UPR-200-E-11 (UPR-liquid). • Consider as possible candidate for early action.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	2/21/18													Characterization strategy was not modified during the UPRs associated with railroads workshop; general discussion to consider as possible candidate for removal based on cost comparison.
200-E-124 (UPR-liquid)	2/6/2017	UNCERTAIN, but LIKELY. Radiological constituents in soil associated with the 200-E-124 UPR may be present at concentrations exceeding human and ecological risk-based criteria.		X		None	Length: 210 ft Width: 15 ft		X				Presence and nature of contamination, if any. The 12 in. of stabilized soil covering the UPR impacts access to the waste site.	• After RTD (including removal of tracks, ties, and supporting soil), perform verification sampling. • If building foundations remain, collect samples to delineate seepage beneath foundation. • Consider as possible candidate for early action.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	2/21/2018													Characterization strategy modified for UPRs associated with railroads.
216-A-3 Crib	2/8/2017 Rescheduled 2/15/2016	UNCERTAIN, but LIKELY. Radiological and chemical constituents, including nitrates, in soil and wood timbers associated with the 216-A-3 Crib may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	Length: 71 ft Width: 71 ft Depth: 15 ft bgs		X	X	X	X	Nature and extent of contamination.	• Conduct resistivity evaluation (SGE) to select a sampling location. • Based on SGE results, make one penetration and sample at 5 ft intervals to groundwater. Analyze all samples for the full suite of radiological and chemical constituents.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]

Table C-6. Workshop Outcomes for 200-EA-1 OU Waste Sites in the PUREX Plant Group

Waste Site	DOE-RL/ Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways: HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	Likely Exposure Pathways: HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Likely Exposure Pathways: Groundwater Protection	Other Regulatory Standards	Dimensions	Potential Response Actions[b]: No Action	Potential Response Actions[b]: RTD (Excavate for UIC Sites)	Potential Response Actions[b]: Leave in Place (Stabilize)	Potential Response Actions[b]: Leave in Place (Cover)	Potential Response Actions[b]: Leave in Place (IC)	Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
216-A-9 Crib	2/8/2017 Rescheduled 2/15/2016	UNCERTAIN, but LIKELY. Radiological and chemical constituents, including nitrates, in soil and wood timbers associated with the 216-A-9 Crib may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	Length: 420 ft Width: 20 ft Depth: 13 ft bgs		X		X		Nature and extent of contamination.	• Conduct resistivity evaluation (SGE) to select a sampling location. • Based on SGE results make one penetration through the crib and sample at 5 ft intervals to groundwater. Analyze all samples for the full suite of radiological and chemical constituents.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
216-A-10 Crib	2/8/2017 Rescheduled 2/9/2016	YES. Radiological and chemical constituents, including nitrates, in soil and wood timbers associated with the 216-A-10 Crib are present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	Length: 275 ft Width: 45 ft Depth: 45 ft bgs		X		X		• Why plutonium was detected outside the crib footprint. • Lateral extent of contamination.	• Conduct resistivity evaluation (SGE) to determine lateral extent. • Based on SGE results, make one penetration to 100 ft bgs or to groundwater; collect data to support groundwater risk assessment. • Make one penetration in crib head end to 100 ft bgs, or to refusal, to collect data to support human health and ecological risk evaluations.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	6/5/2017													Sampling design modified to align with updated characterization strategy.
216-A-27 Crib	2/8/2017 Rescheduled 2/15/2016	YES. Radiological and chemical constituents in soil and wood timbers associated with the 216-A-27 Crib are present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	None	Length: 250 ft Width: 60 ft Depth: 14 ft bgs		X		X		Contaminant concentration.	Install two penetrations through the crib, one at the head end and one at the north end, and sample at 5 ft intervals to groundwater. Analyze all samples for the full suite of radiological and chemical constituents.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]

Table C-6. Workshop Outcomes for 200-EA-1 OU Waste Sites in the PUREX Plant Group

Waste Site	DOE-RL/ Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
216-A-36A Crib	2/8/2017 Rescheduled 3/9/2017	YES. Radiological and chemical constituents in soil and wood timbers associated with the 216-A-36A Crib are present at concentrations exceeding human, ecological, and protection of groundwater risk-based criteria.	X	X	X	None	Length: 100 ft Width: 85 ft Depth: 22 ft bgs		X		X	X	• Whether known contamination of a riser presents a risk to outdoor workers or ecological receptors. • Whether logs are available for wells 299-E17-14, 299-E17-15, 299-E17-16, and 299-E17-17.	• To address the uncertainty of risk to outdoor workers or eco receptors, the stabilized area and near risers will be investigated by installing test pits. • Test pits will be 5 ft deep and samples will be analyzed for the full suite of contaminants. • Integrate investigation and response implementation with the 216-A-36B Crib. • If logs are not available for wells 299-E17-14, 299-E17-15, 299-E17-16, and 299-E17-17, then the wells will be logged. • Because there are existing analytical data indicating the presence of contamination from 30 to 50 ft bgs, install an additional penetration to groundwater to bound the lower vertical extent.
	6/5/2017													Sampling design modified to align with updated characterization strategy.
216-A-36B Crib	3/9/2017	YES. Radiological and chemical constituents in soil and wood timbers associated with the 216-A-36B Crib are present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	TSD	Length: 500 ft Width: 11 ft Depth: 24 ft		X	X	X		• Whether known contamination of a riser presents a risk to outdoor workers or ecological receptors. • Whether logs are available for wells 299-E17-14, 299-E17-15, 299-E17-16, and 299-E17-17.	• Integrate investigation and response implementation with the 216-A-36A Crib. • To address the uncertainty of risk to outdoor workers or ecological receptors, install test pits to investigate the stabilized area and near risers. Test pits will be 5 ft deep; analyze samples for the full suite of radiological and chemical contaminants. • If logs are not available for wells 299-E17-14, 299-E17-15, 299-E17-16, and 299-E17-17, then the wells will be logged. • Existing deep data are sufficient to support basis for action and alternative evaluation. • Perform site-specific groundwater impact evaluation during remedial investigation phase of the project.
	6/5/2017													Sampling design modified to align with updated characterization strategy. Penetrations extended to 15.2 m [50 ft] bgs.

Table C-6. Workshop Outcomes for 200-EA-1 OU Waste Sites in the PUREX Plant Group

Waste Site	DOE-RL/ Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
216-A-38-1 Crib	2/8/2017 Rescheduled 2/15/2016	UNCERTAIN, but UNLIKELY. There are no expected CERCLA-related threats to HHE associated with the 216-A-38-1 Crib.				None	Bottom width: 15 ft Bottom length: 520 ft Depth: 37 ft bgs	X	X		X	X	Whether this crib was ever used.	• To confirm that the crib is unused (as expected), make one direct push near the pipe/valve area from 5 to 15 ft below the crib bottom. Conduct a radiological survey of the push looking for a gamma signature. – If no gamma signature is present, then reject the site through the MP-14 process (RL-TPA-90-0001). – If a gamma signature is present, then collect samples at three other locations and analyze for radiological and chemical constituents to support evaluation of viable alternatives. • Investigation results and path forward for this crib will be applied to the 200-E-240-PL pipeline (200-IS-1 OU).
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
216-A-45 Crib	2/8/2017 Rescheduled 2/15/2016	UNCERTAIN, but LIKELY. Radiological and chemical constituents, including nitrates, in soil associated with the 216-A-45 Crib may be present at concentrations exceeding groundwater protection risk-based criteria.	X	X	X	None	Length: 310 ft Width: 60 ft Depth: 44.5 ft		X	X	X	X	• Contaminant concentrations at depth. • Lateral extent of contamination.	• To resolve uncertainties, use high-resolution SGE to determine contaminant depth and lateral extent, and to site new boreholes. • Based on SGE results, install two boreholes through the crib; collect samples from 45 ft bgs to groundwater; analyze all samples for the full suite of radiological and chemical constituents. • Coordinated data planning and collections efforts with groundwater OU.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
2607-E6 septic system	2/9/2017 Rescheduled 3/30/2017	UNCERTAIN, but UNLIKELY. There are no expected CERCLA-related threats to HHE associated with the 2607-E6 septic tank; however, contamination may be present in the two tile fields at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X	X	X	WAC 246-272A-0300	Length: 28 ft 4 in. Width: 9 ft 8 in. Height: 17 ft 10 in.	X	X				Nature and extent of contamination.	• Coordinate efforts with the 218-E-4 (200-SW-2 OU) and UPR-200-E-88 (UPR-liquid; 200-EA-1 OU). • Conduct a GPR survey to confirm no other utilities are in the area. • Trench near the diversion box and at the head end of both tile fields (10 ft bgs). Conduct radiological surveys of the trenches to determine sample locations and to decide if samples should be analyzed for radiological constituents.

Table C-6. Workshop Outcomes for 200-EA-1 OU Waste Sites in the PUREX Plant Group

Waste Site	DOE-RL/ Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways: HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	Likely Exposure Pathways: HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Likely Exposure Pathways: Groundwater Protection	Other Regulatory Standards	Dimensions	Potential Response Actions[b]: No Action	Potential Response Actions[b]: RTD (Excavate for UIC Sites)	Potential Response Actions[b]: Leave in Place (Stabilize)	Potential Response Actions[b]: Leave in Place (Cover)	Potential Response Actions[b]: Leave in Place (IC)	Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
UPR-200-E-10 (UPR-solid)	1/19/2017	UNCERTAIN, but LIKELY. Radiological and chemical constituents in soil associated with UPR-200-E-10 may be present at concentrations exceeding human and ecological risk-based criteria.	X	X		None	Not defined		X				Nature and extent of contamination.	• RTD rail and rail bed. • Integrate with investigations (and possibly responses) for other similar and collocated 200-EA-1 OU waste sites (i.e., 200-E-43 storage area, UPR 200-E-12, UPR-200-E-20, UPR-200-E-33, and UPR-200-E-88)
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	2/21/2018													Characterization strategy modified for UPRs associated with railroads.
UPR-200-E-12 (UPR-liquid)	1/19/2017	UNCERTAIN, but LIKELY. Radiological and chemical constituents in soil associated with UPR-200-E-12 may be present at concentrations exceeding human and ecological risk-based criteria.	X	X		None	Not defined		X				Nature and extent of contamination.	• RTD rail and rail bed. • Integrate with investigations (and possibly responses) for other similar and collocated 200-EA-1 OU waste sites (i.e., 200-E-43 storage area, UPR-200-E-10, UPR-200-E-20, UPR-200-E-33, and UPR-200-E-88)
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	2/21/2018													Characterization strategy modified for UPRs associated with railroads.
UPR-200-E-20 (UPR-solid)	1/19/2017	UNCERTAIN, but LIKELY. Radiological and chemical constituents in soil associated with UPR-200-E-20 may be present at concentrations exceeding human and ecological risk-based criteria.	X	X		None	Not defined		X				Nature and extent of contamination.	• RTD rail and rail bed. • Integrate with investigations (and possibly responses) for other similar and collocated 200-EA-1 OU waste sites (i.e., 200-E-43 storage area, UPR-200-E-10, UPR-200-E-12, UPR-200-E-33, and UPR-200-E-88)
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	2/21/2018													Characterization strategy modified for UPRs associated with railroads.

Table C-6. Workshop Outcomes for 200-EA-1 OU Waste Sites in the PUREX Plant Group

Waste Site	DOE-RL/ Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways: HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	Likely Exposure Pathways: HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Likely Exposure Pathways: Groundwater Protection	Other Regulatory Standards	Dimensions	Potential Response Actions[b]: No Action	Potential Response Actions[b]: RTD (Excavate for UIC Sites)	Potential Response Actions[b]: Leave in Place (Stabilize)	Potential Response Actions[b]: Leave in Place (Cover)	Potential Response Actions[b]: Leave in Place (IC)	Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
UPR-200-E-33 (UPR-liquid)	1/19/2017	UNCERTAIN, but LIKELY. Radiological and chemical constituents in soil associated with UPR-200-E-33 may be present at concentrations exceeding human and ecological risk-based criteria.	X	X		None	Not defined		X				Nature and extent of contamination.	• RTD rail and rail bed. • Integrate with investigations (and possibly responses) for other similar and collocated 200-EA-1 OU waste sites (i.e., 200-E-43 storage area, UPR-200-E-10, UPR-200-E-12, UPR-200-E-20, and UPR-200-E-88)
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	2/21/2018													Characterization strategy modified for UPRs associated with railroads.
UPR-200-E-88 (UPR-liquid)	1/19/2017	YES. Radiological and chemical constituents in soil associated with UPR-200-E-88 may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.		X	X	None	Stabilized area is 19,858 ft^2		X				Nature and extent of contamination.	• Investigate subsurface contamination to determine lateral and vertical extent of contamination; analyze samples for full suite of radiological and chemical constituents. • Integrate with 200-EA OU1 waste sites 200-E-43 storage area and UPR-200-E-11 (UPR-liquid).
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	2/21/2018													Characterization strategy modified for UPRs associated with railroads.

Reference: RL-TPA-90-0001, *Tri-Party Agreement Handbook Management Procedures,* Guideline Number TPA-MP-14, "Maintenance of the Waste Information Data System (WIDS)."

a. Per Section 1.3.2.5 of the work plan, DOE-RL may choose to evaluate a conditional point of compliance for the terrestrial ecological evaluation, and an alternative point of compliance for human health direct contact.

b. Potential response actions were developed as part of scoping (40 CFR 300.430, "National Oil and Hazardous Substances Pollution Contingency Plan," "Remedial Investigation/Feasibility Study and Selection of Remedy"); may be changed based on data collected through this work plan and the remedial investigation/feasibility study and RFI/CMS process.

c. Applicable 200-DV-1 OU sampling protocols include collecting sufficient data from the shallow vadose zone to support a quantitative risk assessment and collecting samples every 0.6 m (2 ft) in the shallow vadose zone.

d. At a scoping meeting on January 12, 2017, DOE-RL and Ecology concurred that the short leg to northeast would be addressed through RTD consistent with DOE/RL-2009-86, *Action Memorandum for Non-Time-Critical Removal Action for 37 Waste Sites in the 200-MG-1 Operable Unit.*

Table C-6. Workshop Outcomes for 200-EA-1 OU Waste Sites in the PUREX Plant Group

		Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
			Likely Exposure Pathways					Potential Response Actions[b]						
Waste Site	DOE-RL/ Ecology Workshop Date	Potential Threat to HHE Based on Existing Information	HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection	Other Regulatory Standards	Dimensions	No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)	Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*

bgs = below ground surface
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CMS = corrective measure study
DOE-RL = U.S. Department of Energy, Richland Operations Office
Eco = ecological
Ecology = Washington State Department of Ecology
GPR = ground-penetrating radar
HH = human health
HHE = human health and the environment
IC = institutional control
OU = operable unit
PAH = polycyclic aromatic hydrocarbon
PUREX = plutonium-uranium extraction
RCRA = *Resource Conservation and Recovery Act of 1976*
RFI = RCRA facility investigation
RTD = removal, treatment, and disposal
SAP = sampling and analysis plan
SGE = surface geophysical exploration
TEDF = Treated Effluent Disposal Facility
TSD = treatment, storage, and disposal
UIC = underground injection control
UPR = unplanned release

Table C-7. Workshop Outcomes for 200-EA-1 OU Waste Sites in the Miscellaneous Group

		Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
			Likely Exposure Pathways					Potential Response Actions[b]						
Waste Site	DOE-RL/ Ecology Workshop Date	Potential Threat to HHE Based on Existing Information	HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection	Other Regulatory Standards	Dimensions	No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)	Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
200-E BP burn pit	2/15/2017 Rescheduled 3/22/2017	UNCERTAIN, but LIKELY. Chemicals and solvents in soil and debris associated with the 200-E burn pit may be present at concentrations exceeding human, ecological, and groundwater protection risk-based criteria.	X		X	None	Length: 394 ft Width: 201 ft Depth of pit: 15 ft	X	X		X	X	Nature and extent of contamination.	• Use GPR to locate burn trenches and other buried anomalies. Conduct EM and radiological surface surveys. For any identified anomalies, dig a test pit and sample soil from below the identified waste or soil in contact with the waste. • If no anomalies are found, sample 3-ft intervals to 15 ft bgs at grid-based random locations.
UPR-200-E-53 (UPR-solid)	2/15/2017 Rescheduled 3/22/2017	UNCERTAIN, but UNLIKELY. Radiological constituents in soil associated with the UPR-200-E-53 may be present at concentrations exceeding human and ecological risk-based criteria.		X		None	Length: ~410 ft Width: ~265 ft	X	X		X	X	Whether there is a threat to HHE.	• Use grid-based random sampling below the stabilization layer. Take samples from the top of native soil to 2 ft below that point. • Consider as possible candidate for early action.
UPR-200-E-109 (UPR-solid)	2/15/2017 Rescheduled 3/22/2017	YES. Radiological constituents in soil and vegetation associated with the UPR-200-E-109 are present at concentrations exceeding human and ecological risk-based criteria.	X	X		None	Multiple locations, based on tumbleweed sightings. No waste site boundaries.		X		X		Potential for re-contamination.	Plan the timing of any response action to take into account the removal of the tumbleweed source (218-E-12B [200-SW-2 OU] Burial Ground).
UPR-200-E-115 (UPR-solid)	2/15/2017 Rescheduled 3/22/2017	UNCERTAIN, but UNLIKELY. Radiological constituents in soil and vegetation associated with the UPR-200-E-115 may be present at concentrations exceeding human and ecological risk-based criteria.		X		None	Length: ~40 ft Width: ~33 ft		X		X	X	Nature and extent of contamination.	• Review existing radiological survey data to select a sample location. • Place one borehole in the area indicated by radiological surveys (or in the middle of a low spot if surveys do not indicate a target area). Take samples at 3 ft intervals to 15 ft bgs, and then at 5 ft internals to 30 ft bgs.
	6/5/2017													Sampling design modified to align with updated characterization strategy. Samples below 15 ft removed based on review of data from adjacent deep borings.

Table C-7. Workshop Outcomes for 200-EA-1 OU Waste Sites in the Miscellaneous Group

Waste Site	DOE-RL/ Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways: HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	Likely Exposure Pathways: HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Likely Exposure Pathways: Groundwater Protection	Other Regulatory Standards	Dimensions	Potential Response Actions[b]: No Action	Potential Response Actions[b]: RTD (Excavate for UIC Sites)	Potential Response Actions[b]: Leave in Place (Stabilize)	Potential Response Actions[b]: Leave in Place (Cover)	Potential Response Actions[b]: Leave in Place (IC)	Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
UPR-200-E-139 (UPR-solid)	12/13/2016	YES – South side of road. UNCERTAIN – North side of road. Radiological constituents in soil and vegetation associated with the UPR-200-E-139 may be present at concentrations exceeding human and ecological risk-based criteria.		X		None	*North of 8th Street URMA dimensions:* Length: 850 ft Width: 100 ft *South of 8th Street URMA dimensions:* Length: 43 ft Width: 40 ft		X				• Whether there is a basis for action for the area north of 8th Street. • What material was used to stabilize this area.	• For smaller, southern area: RTD, perform confirmation sampling, and determine path forward. For field screening, use XRF and organic vapor monitoring. • For the larger, northern area: use grid-based random sampling and boreholes to 15 ft bgs to determine if actionable. • Clarify biobarrier material (gravel, plastic covered with gravel, other).
	2/23/17													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
UPR-200-E-11 (UPR-liquid)	1/19/2017	UNCERTAIN, but LIKELY. Radiological and chemical constituents in soil and gravel associated with UPR-200-E-11 may be present at concentrations exceeding human and ecological risk-based criteria.	X	X		None	Material: Railroad tracks and rail bed rock Length: 12,540 ft		X				Nature and extent of contamination.	• RTD rail and rail bed. • Integrate with investigations (and possibly responses) for other similar and collocated 200-EA-1 OU waste sites (i.e., 200-E-43 storage area, UPR-200-E-10, UPR 200-E-12, UPR-200-E-20, UPR 200-E-33, and UPR-200-E-88).
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	2/21/2018													Characterization strategy modified for UPRs associated with railroads.
UPR-200-E-50 (UPR-solid)	11/15/2016 and 3/22/2017	UNCERTAIN, but UNLIKELY. Radiological constituents in soil associated with UPR-200-E-50 may be present at concentrations exceeding human and ecological risk-based criteria.		X		None	Not defined	X	X		X	X	Whether there is a threat to HHE.	• Data needs for this waste site will be satisfied by sampling for 200-E-53 (UPR-solid; 200-EA-1 OU). • Potential candidate for early action.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]

Table C-7. Workshop Outcomes for 200-EA-1 OU Waste Sites in the Miscellaneous Group

Waste Site	DOE-RL/ Ecology Workshop Date	Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
		Potential Threat to HHE Based on Existing Information	Likely Exposure Pathways			Other Regulatory Standards	Dimensions	Potential Response Actions[b]					Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*
			HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection			No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)		
UPR-200-E-95 (UPR-solid)	2/1/2017	UNCERTAIN, but LIKELY. Radiological and chemical constituents in soil associated with UPR-200-E-95 may be present at concentrations exceeding human and ecological risk-based criteria.	X	X		None	Length: 820 ft Width: 16 ft		X				Nature and extent of contamination.	• Investigate subsurface contamination to determine lateral and vertical extent of contamination; analyze for full suite of radiological and chemical constituents. • Coordinate response action with the 200-SW-2 and 200-IS-1 OUs. • Consider as possible candidate for early action.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	2/21/2018													Characterization strategy modified for UPRs associated with railroads; general discussion to consider as possible candidate for removal based on cost comparison.
UPR-200-E-112 (UPR-liquid)	2/1/2017	UNCERTAIN, but LIKELY. Radiological constituents in soil and gravel associated with UPR-200-E-112 may be present at concentrations exceeding human and ecological risk-based criteria.		X		None	Length:.~3,435 ft		X				Nature and extent of contamination.	• RTD tracks, ties, and associated soil. Investigate subsurface contamination to determine lateral and vertical extent of contamination; analyze for the full suite of radiological constituents. • Coordinate response action with the 200-CB-1 (B Plant), 200-SW-2, and 200-IS-1 OUs. • Consider as possible candidate for early action.
	2/23/2017													Characterization strategy modified in accordance with 200-DV-1 OU sampling protocol.[c]
	2/21/2018													Characterization strategy modified for UPRs associated with railroads; general discussion to consider as possible candidate for removal based on cost comparison.

a. Per Section 1.3.2.5 of the work plan, DOE-RL may choose to evaluate a conditional point of compliance for the terrestrial ecological evaluation, and an alternative point of compliance for human health direct contact.

b. Potential response actions were developed as part of scoping (40 CFR 300.430, "National Oil and Hazardous Substances Pollution Contingency Plan," "Remedial Investigation/Feasibility Study and Selection of Remedy"); may be changed based on data collected through this work plan and the remedial investigation/feasibility study and RFI/CMS process.

c. Applicable 200-DV-1 OU sampling protocols include collecting sufficient data from the shallow vadose zone to support a quantitative risk assessment and collecting samples every 0.6 m (2 ft) in the shallow vadose zone.

Table C-7. Workshop Outcomes for 200-EA-1 OU Waste Sites in the Miscellaneous Group

		Basis for Action Considerations					Response Identification and Evaluation Considerations						Data Needs and Data Gaps Identification	
			Likely Exposure Pathways					Potential Response Actions[b]						
Waste Site	DOE-RL/ Ecology Workshop Date	Potential Threat to HHE Based on Existing Information	HH & Eco (Chemical) 0 to 4.6 m (15 ft) bgs[a]	HH & Eco (Radiological) 0 to 4.6 m (15 ft) bgs[a]	Groundwater Protection	Other Regulatory Standards	Dimensions	No Action	RTD (Excavate for UIC Sites)	Leave in Place (Stabilize)	Leave in Place (Cover)	Leave in Place (IC)	Uncertainty	Uncertainty Management Approach *(Based on DOE-RL/Ecology workshop discussions; the SAP [Appendix A] provides final investigation approach details)*

bgs = below ground surface
CMS = corrective measure study
DOE-RL = U.S. Department of Energy, Richland Operations Office
Eco = ecological
Ecology = Washington State Department of Ecology
EM = electromagnetometry
GPR = ground-penetrating radar
HH = human health
HHE = human health and the environment
IC = institutional control
OU = operable unit
RFI = RCRA facility investigation
RTD = removal, treatment, and disposal
SAP = sampling and analysis plan
UIC = underground injection control
UPR = unplanned release
URMA = underground radioactive material area
XRF = x-ray fluorescence

References

40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=8a7691fe4a40d88b69ec75922ca9534b&mc=true&node=pt40.28.300&rgn=div5.

300.430, "Remedial Investigation/Feasibility Study and Selection of Remedy."

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DOE/RL-2008-44, 2009, *Engineering Evaluation/Cost Analysis for the 200-MG-1 Operable Unit Waste Sites*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0096350.

DOE/RL-2009-86, 2010, *Action Memorandum for Non-Time-Critical Removal Action for 37 Waste Sites in the 200-MG-1 Operable Unit*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/pdf.cfm?accession=0077686H.

ECF-200EA1-17-0046, 2017, *Assessment and Presentation of Available Waste Site Data for the 200-EA-1 Operable Unit*, Rev 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/pdf.cfm?accession=0068836H.

ECF-200EA1-17-0066, 2017, *Pore Volume Calculation – 200-EA-1 OU Liquid Waste Disposal Sites*, Rev 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/pdf.cfm?accession=0068332H.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq. Available at: https://elr.info/sites/default/files/docs/statutes/full/rcra.pdf.

RL-TPA-90-0001, 2011, *Tri-Party Agreement Handbook Management Procedures*, Guideline Number TPA-MP-14, "Maintenance of the Waste Information Data System (WIDS)," Rev. 2, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www.hanford.gov/files.cfm/TPA-MP14.pdf.

SGW-60540, 2017, *200-EA-1 Operable Unit Scoping*, CH2M HILL Plateau Remediation Company. Richland, Washington. Available at: http://pdw.hanford.gov/arpir/pdf.cfm?accession=0068822H.

WAC 246-272A-0300 "On-site Sewage Systems – Abandonment," *Washington State Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=246-272A-0300.

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Appendix D

Supporting Calculation Files

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D Supporting Calculation Files

Table D-1 is organized by general topic and provides a list and links to the supporting calculation files for this work plan.

Table D-1. Calculations Supporting 200-EA-1 Operable Unit Initial Evaluations and Risk Characterization

Document Citation	Summary
Human Exposure*	
ECF-HANFORD-16-0132, 2016 *Calculation of Soil Radiological Preliminary Remedial Goals for the Construction Worker Scenario*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0071880H.	Documents radiological contaminant soil PRG development for the construction worker scenario.
ECF-HANFORD-16-0133, 2016, *Calculation of Soil Radiological Preliminary Remedial Goals for the Outdoor Worker Scenario*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0071881H.	Documents radiological contaminant soil PRG development for the outdoor worker scenario.
ECF-HANFORD-16-0134, 2016, *Calculation of Soil Nonradiological Preliminary Remediation Goals for the Outdoor Worker Scenario*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0071879H.	Documents nonradiological contaminant soil PRG development for the outdoor worker scenario.
Ecological Exposure	
CHPRC-00784, 2014, *Tier 1 Risk-Based Soil Concentrations Protective of Ecological Receptors at the Hanford Site*, Rev. 1, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0081638H.	Documents SSLs for ecological receptors.
CHPRC-01311, 2014, *Tier 2 Risk-Based Soil Concentrations Protective of Ecological Receptors at the Hanford Site*, Rev. 2, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: https://pdw.hanford.gov/arpir/pdf.cfm?accession=0068835H.	Documents soil PRGs for ecological receptors.
ECF-HANFORD-11-0158, 2014, *Tier 2 Terrestrial Plant and Invertebrate Preliminary Remediation Goals (PRGs) for Nonradionuclides for Use at the Hanford Site*, Rev. 1, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0081636H.	Documents soil PRGs for ecological receptors.
Groundwater Protection Considerations	
DOE/RL-2011-50, 2012, *Regulatory Basis and Implementation of a Graded Approach to Evaluation of Groundwater Protection*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0093361.	Defines the regulatory basis and general methodology for vadose zone models to calculate soil concentrations protective of groundwater.
Other	
DOE/RL-92-24, 2001, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes*, Rev. 4, 2 vols., U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0096062. http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0096061.	Documents soil background values for nonradioactive analytes.

Table D-1. Calculations Supporting 200-EA-1 Operable Unit Initial Evaluations and Risk Characterization

Document Citation	Summary
DOE/RL-96-12, 1996, *Hanford Site Background: Part 2, Soil Background for Radionuclides*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D1808987.	Documents soil background values for radionuclide analytes.
ECF-HANFORD-11-0038, 2012, *Soil Background for Interim Use at the Hanford Site*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0088381.	Documents supplemental soil background values for constituents not available in other sources.
ECF-200EA1-17-0066, 2017, *Pore Volume Calculation - 200-EA-1 OU Liquid Waste Disposal Sites*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/pdf.cfm?accession=0068332H.	Documents the pore volumes discharged to the 200-EA-1 Operable Unit liquid waste disposal sites.

* The environmental calculation documents will be revised, as needed, to incorporate updates to the PRGs that may result from changes to the remedial action objectives during development of the Central Plateau remedial investigation/feasibility study reports.

PRG = preliminary remediation goal

SSL = soil screening level

Appendix E

Potential Applicable or Relevant and Appropriate Requirements and To-Be-Considered Criteria for the 200-EA-1 Operable Unit

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E Potential Applicable or Relevant and Appropriate Requirements and To-Be-Considered Criteria for the 200-EA-1 Operable Unit

This appendix describes the potential applicable or relevant and appropriate requirements (ARARs) and to-be-considered (TBC) information that may apply to the 200-EA-1 Operable Unit (OU).[1] Potential ARARs were identified in accordance with EPA/540/G-89/006, *CERCLA Compliance with Other Laws Manual: Interim Final*, and the potential ARAR evaluation was conducted in accordance with the National Contingency Plan (40 CFR 300.430(f)(1)(ii)(B)(2) "Remedial Investigation/Feasibility Study and Selection of Remedy").

The ARARs consist of the following sets of requirements under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA): (1) those promulgated environmental substantive standards that would be applicable requirements if the remediation were not being conducted under authority of CERCLA (CERCLA response actions are exempt from permitting requirements by authority of Section 121(e)(1), "Permits and Enforcement");[2] and (2) those substantive standards that are relevant and appropriate requirements of promulgated environmental regulations.[3]

Table E-1 identifies the potentially applicable ARARs and TBC criteria for the 200-EA-1 OU, which fall into one of the following three categories:

- **Chemical-specific requirements:** Usually health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of public and worker safety levels and site cleanup levels.
- **Location-specific requirements:** Restrictions placed on the concentration of dangerous substances or the conduct of activities solely because they occur in special geographic areas.
- **Action-specific requirements:** Usually technology-based or activity-based requirements or limitations triggered by the remedial actions performed at the site.

Only the substantive portions of the requirements in the listed ARARs (e.g., use of control/containment equipment or compliance with numerical standards) may apply to CERCLA onsite activities. ARAR administrative requirements (e.g., permitting) are not applicable to CERCLA onsite activities (CERCLA Section 121(e)(1)). CERCLA Section 121 describes the circumstances in which ARARs for onsite remedial/removal actions may be waived.

Potential ARARs and TBCs are subject to further review, with final ARARs documented in the remedial investigation/feasibility study and the *Resource Conservation and Recovery Act of 1976* facility investigation /corrective measure study report.

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[1] TBC information is nonpromulgated advisories or guidance issued by federal or state governments that is not legally binding and does not have the status of potential ARARs. In some circumstances, TBC information will be considered along with ARARs in determining the remedial action necessary for protection of human health and the environment.

[2] An "applicable" requirement at the Hanford Site is an environmental requirement that the U.S. Department of Energy would have to comply with by law if the same action were being undertaken apart from CERCLA authority.

[3] "Relevant and appropriate" requirements refer to those environmental requirements, such as cleanup standards, that 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 300.400(g)(2), "General").

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Table E-1. Potential Federal and Washington State ARARs and TBC Materials for the 200-EA-1 OU

Citation	ARAR Category	Description of Requirement	Rationale for Use	Potential Relevancy	Possible Application
Groundwater					
RCW 18.104, "Water Well Construction"; WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"					
WAC 173-160-161, "How Shall Each Water Well Be Planned and Constructed?"	Action	Identifies well planning and construction requirements.	Groundwater monitoring and treatment wells, and borings that may be installed.	ARAR	Investigative and remediation activities that require siting, installation, construction, operation, maintenance, and decommissioning of wells and borings.
WAC 173-160-171, "What Are the Requirements for the Location of the Well Site and Access to the Well?"	Action	Identifies the requirements for locating a well.	Groundwater monitoring and treatment wells, and borings that may be installed.	ARAR	Investigative and remediation activities that require siting, installation, construction, operation, maintenance, and decommissioning of wells and borings.
WAC 173-160-181, "What Are the Requirements for Preserving the Natural Barriers to Ground Water Movement Between Aquifers?"	Action	Identifies the requirements for preserving natural barriers to groundwater movement between aquifers.	Groundwater monitoring and treatment wells, and borings that may be installed.	ARAR	Investigative and remediation activities that require siting, installation, construction, operation, maintenance, and decommissioning of wells and borings.
WAC 173-160-400, "What Are the Minimum Standards for Resource Protection Wells and Geotechnical Soil Borings?"	Action	Identifies the minimum standards for resource protection wells and geotechnical soil borings.	Groundwater monitoring and treatment wells, and borings that may be installed.	ARAR	Investigative and remediation activities that require siting, installation, construction, operation, maintenance, and decommissioning of wells and borings.
WAC 173-160-420(2 – 8), (10)(b) – (e), "What Are the General Construction Requirements for Resource Protection Wells?"	Action	Identifies the general construction requirements for resource protection wells.	Groundwater monitoring and treatment wells, and borings that may be installed.	ARAR	Investigative and remediation activities that require siting, installation, construction, operation, maintenance, and decommissioning of wells and borings.
WAC 173-160-430, "What Are the Minimum Casing Standards?"	Action	Identifies the minimum casing standards.	Groundwater monitoring and treatment wells, and borings that may be installed.	ARAR	Investigative and remediation activities that require siting, installation, construction, operation, maintenance, and decommissioning of wells and borings.
WAC 173-160-440, "What Are the Equipment Cleaning Standards?"	Action	Identifies the equipment cleaning standards.	Groundwater monitoring and treatment wells, and borings that may be installed.	ARAR	Investigative and remediation activities that require siting, installation, construction, operation, maintenance, and decommissioning of wells and borings.
WAC 173-160-450, "What are the Well Sealing Requirements?"	Action	Identifies the well sealing requirements.	Groundwater monitoring and treatment wells, and borings that may be installed.	ARAR	Investigative and remediation activities that require siting, installation, construction, operation, maintenance, and decommissioning of wells and borings.
WAC 173-160-460, "What is the Decommissioning Process for Resource Protection Wells?"	Action	Identifies the requirements of the decommissioning process for resource protection wells.	Wells and borings for soil and vadose zone characterization may occur in the 200-EA-1 OU.	ARAR	Investigative and remedial activities that require siting, installation, construction, operation, maintenance, and decommissioning of wells and borings.
RCW 90.48, "Water Pollution Control" (as amended); WAC 173-218, "Underground Injection Control Program"					
WAC 173-218-120, "Decommissioning a UIC Well"	Action	Identifies the requirements of the decommissioning process for UIC points/wells.	UICs are present in the 200-EA-1 OU.	ARAR	Decommissioning of UICs.
WAC 173-218-040(4), "UIC Well Classification Including Allowed and Prohibited Wells"	Action	Establishes criteria and standards for an underground injection control program.	UICs are present in the 200-EA-1 OU.	ARAR	UICs in the 200-EA-1 OU are considered Class IV wells and must be decommissioned.

Table E-1. Potential Federal and Washington State ARARs and TBC Materials for the 200-EA-1 OU

Citation	ARAR Category	Description of Requirement	Rationale for Use	Potential Relevancy	Possible Application
Vadose Zone Soil					
RCW 70.105D "Hazardous Waste Cleanup -- Model Toxics Control Act" (as amended); WAC 173-340, "Model Toxics Control Act—Cleanup"					
WAC 173-340-745(5) and (6), "Model Toxics Control Act—Cleanup," "Soil Cleanup Standards for Industrial Properties"	Chemical	Establishes soil chemical cleanup levels where industrial land use represents the reasonable maximum exposure under both current and reasonably anticipated future land-use conditions. Cleanup standards require specification of the following: hazardous chemical substance concentrations that protect human health and the environment (cleanup levels), the location of the site where cleanup levels must be attained (points of compliance), and other regulatory requirements that apply to the cleanup action because of the type of action or the location of the site. These requirements are specified in applicable state and federal laws and are generally established in conjunction with the selection of a specific cleanup action.	Soil in the 200-EA-1 OU contains chemical contaminants that require remediation. The human health conceptual exposure model for the current and reasonably anticipated future land use for this OU is industrial.	ARAR	Soil chemical cleanup actions where concentration of hazardous substances in the soil exceed MTCA Method C cleanup levels.
OSWER Directive 9285.7-55, *Guidance for Developing Ecological Soil Screening Levels*	Chemical	Provides a set of risk-based ecological soil screening levels for several soil contaminants of ecological concern for terrestrial plants and animals at hazardous waste sites. Also describes the process used to derive these levels and provides guidance for their use.	Target analytes detected in soil and vadose zone soil includes constituents that could pose ecological risks.	TBC	Assistance in identifying areas, contaminants, and conditions that may require further RI.
EPA, 2018, "Regional Screening Levels for Chemical Contaminants at Superfund Sites," "Regional Screening Levels (RSLs) – Generic Tables, Tables as of: May 2018"	Chemical	Provides a set of risk-based screening levels; the regional screening levels provide tables of human health risk-based screening levels calculated using the latest toxicity values, default exposure assumptions, and physical and chemical properties. Risk-based screening levels may help determine whether levels of contamination found at CERCLA hazardous waste sites warrant further investigation or site cleanup or if no further investigation or action is required.	Target analytes detected in soil and vadose zone soil includes constituents that could pose risks to human health.	TBC	Assistance in identifying areas, contaminants, and conditions that may require further RI.
WAC 173-340-747(3) through (8), "Deriving Soil Concentrations for Groundwater Protection"	Chemical	Establishes soil chemical concentrations that will not cause contamination of groundwater at levels that exceed the groundwater cleanup levels established under WAC 173-340-720, "Groundwater Cleanup Standards."	Soil in the 200-EA-1 OU contains chemical contaminants that require remediation to protect groundwater. The requirements corresponding to soil cleanup levels may be used to calculate cleanup levels to ensure protection of groundwater. Although groundwater is not currently used for drinking water, it is a potential drinking water source.	ARAR	Soil cleanup actions where concentrations of hazardous chemical substances in the soil exceed soil concentrations for protection of groundwater. As allowed, WAC 173-340-747(8), "Alternative fate and transport models" (one of the seven allowable methods under WAC 173-340-747), will be used to determine appropriate cleanup levels.

Table E-1. Potential Federal and Washington State ARARs and TBC Materials for the 200-EA-1 OU

Citation	ARAR Category	Description of Requirement	Rationale for Use	Potential Relevancy	Possible Application
WAC 173-340-7490(2), "Terrestrial Ecological Evaluation Procedures" WAC 173-340-7493(3), "Site-Specific Terrestrial Ecological Evaluation Procedures" WAC 173-340-7494, "Priority Contaminants of Ecological Concern"	Chemical	Defines administrative goals and procedures for determining whether a release of hazardous substances to soil and vadose zone soil may pose a threat to the terrestrial environment; characterizes existing or potential threats to terrestrial plants or animals exposed to hazardous substances in soil and vadose zone soil; and establishes site-specific cleanup standards for the protection of terrestrial plants and animals. WAC 173-340-7494 provides for numeric concentrations of hazardous substances determined to persist, bioaccumulate, or be highly toxic to terrestrial ecological receptors.	Soil and vadose zone soil in the 200-EA-1 OU contain contaminants that require evaluation to determine whether ecological exposures have the potential to cause significant adverse effects.	TBC	Soil and vadose zone soil remedial activities (e.g., containment or RTD) that may pose risks to terrestrial ecological plants and animals.
Land-Use and Exposure Scenarios					
DOE/EIS-0222-F, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement* DOE/EIS-0222-SA-01, *Supplement Analysis: Hanford Comprehensive Land-Use Plan Environmental Impact Statement*	Location	Establishes DOE reasonably anticipated future land use projections for the Inner Area.	The reasonably anticipated future land use, as stated in the Hanford Comprehensive Land-Use Plan for the Inner Area of the Central Plateau is industrial exclusive.	TBC	The RI will be performed within the industrial-exclusion zone of the Central Plateau.
Radionuclide ARAR Dose Compliance Concentrations for Superfund					
OSWER Directive 9200.4-18, *Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination* EPA 540/R/99/006, *Radiation Risk Assessment At CERCLA Sites: Q&A* (Directive 9200.4-31P)	Chemical	This memorandum presents clarification for establishing protective cleanup levels in media for radioactive contamination at CERCLA sites. EPA has determined that the dose limits established by the U.S. Nuclear Regulatory Commission (62 FR 39058, "Radiological Criteria for License Termination") of 25 mrem/yr, which is equivalent to 5×10^{-4} increased lifetime risk, will not provide a protective basis for establishing preliminary remedial goals under CERCLA. Instead, EPA has identified a 15 mrem/yr effective dose (approximately equivalent to 3×10^{-4} increase in lifetime risk), which is preferred as the maximum dose limit for humans. (However, depending upon the radionuclide involved, a 15 mrem/yr effective dose equivalent could represent a significantly higher or lower lifetime cancer risk than 3×10^{-4}.) The EPA guidance further clarifies that 15 mrem/yr is not a presumptive cleanup level under CERCLA. Rather, site decision makers should continue to use the CERCLA risk range when ARARs are not used to set cleanup levels because using dose-based guidance would result in unnecessary inconsistency in how radiological and nonradiological (chemical) contaminants are addressed at CERCLA sites.	Target analytes detected in soil and vadose zone soil contain radioactive contaminants that may pose unacceptable risk to human health.	TBC	Development of media cleanup levels for remediation and verification.

Table E-1. Potential Federal and Washington State ARARs and TBC Materials for the 200-EA-1 OU

Citation	ARAR Category	Description of Requirement	Rationale for Use	Potential Relevancy	Possible Application
Air					
RCW 70.94, "Washington Clean Air Act"; WAC 173-400, "General Regulations for Air Pollution Sources"					
WAC 173-400-035(3) "Nonroad Engines"	Action	Requirement for nonroad engines to use low or ultra-low sulfur diesel.	Project may use nonroad engines.	ARAR	Investigation and remediation activities with potential to use nonroad engines. Substantive requirement is use of low or ultra-low sulfur diesel.
WAC 173-400-040, "General Standards for Maximum Emissions"	Action	All sources and emissions units are required to meet the general emission standards unless a specific source standard is available. General standards apply to visible emissions, particulate fallout, fugitive emissions, odors, emission detrimental to health and property, sulfur dioxide, and fugitive dust.	Soil and vadose zone remedial actions implemented have the potential to emit air pollutants because contaminants detected in the 200-EA-1 OU include regulated pollutants subject to these standards.	ARAR	Remedial actions that have the potential to release air pollutants subject to these regulations.
WAC 173-400-075(1), (3), and (6), "Emission Standards for Sources Emitting Hazardous Air Pollutants"	Action	Establishes national emission standards for hazardous air pollutants. Adopts, by reference, 40 CFR 61 and appendices.	Soil and vadose zone remedial actions implemented have the potential to emit air pollutants because contaminants detected in the 200-EA-1 OU include regulated pollutants subject to these standards. Combustion and incineration not part of anticipated remedies/ technologies for these waste sites.	ARAR	Actions performed that could result in the emission of hazardous air pollutants, including decontamination, demolition, and excavation activities implemented during the RFI/CMS and RI/FS that have the potential to release air pollutants subject to these regulations.
RCW 70.94, "Washington Clean Air Act"; WAC 173-460, "Controls for New Sources of Toxic Air Pollutants"					
WAC 173-460-060, "Control Technology Requirements" WAC 173-460-070, "Ambient Impact Requirement" WAC 173-460-080, "First Tier Review" WAC 173-460-150, "Table of ASIL, SQER and de Minimis Emission Values"	Action	Establishes requirements for controlling new sources emitting toxic air pollutants to prevent air pollution, reducing emissions to the extent reasonably possible, and maintaining such levels of air quality that will protect human health and safety. Toxic air pollutants include carcinogens and noncarcinogens listed in WAC 173-460-150. Three major requirements of this regulation include implementing best available control technology for toxics, quantifying toxic air pollutant emissions, and demonstrating protection of health and safety.	Hazardous contaminants detected in soil in the 200-EA-1 OU include constituents that would constitute toxic air pollutants if released to the air.	ARAR	Soil remediation activities such as treatment systems that have the potential to emit toxic air emissions would be considered a new source.
RCW 70.94, "Washington Clean Air Act"; WAC 173-480, "Ambient Air Quality Standards and Emission Limits for Radionuclides"					
WAC 173-480-040, "Ambient Standard"	Action	Requires that emissions of radionuclides in the air will not cause a maximum effective dose equivalent of more than 10 mrem/yr to the whole body to any member of the public.	Hazardous contaminants detected in soil in the 200-EA-1 OU include radionuclides that could be emitted to ambient air during remedial actions.	ARAR	Investigative and remediation activities (e.g., excavation, RTD, demolition, ventilation, and vacuuming/exhaust) that have the potential to emit radionuclides above maximum acceptable levels.
WAC 173-480-050(1), "General Standards for Maximum Permissible Emissions"	Action	At a minimum, all emission units will make every reasonable effort to maintain radioactive materials in effluents to unrestricted areas ALARA.* Control equipment requirements for sites operating under ALARA will be defined as reasonably available control technology and ALARA control technology.	The potential for fugitive and diffuse emissions resulting from demolition, excavation, and related activities will require efforts to minimize emissions. This requirement is action specific.	ARAR	Investigative and remediation activities (e.g., excavation, RTD, demolition, ventilation, and vacuuming/exhaust) that have the potential to emit radionuclides above maximum acceptable levels.
WAC 173-480-060, "Emission Standards for New and Modified Emission Units"	Action	Requires that construction, installation, or establishment of a new air emission control units will use best available retrofit control technology.	Hazardous contaminants detected in soil in the 200-EA-1 OU include radionuclides that could be emitted to the ambient air during remedial actions.	ARAR	Investigative and remediation activities (e.g., excavation, RTD, demolition, ventilation, and vacuuming/exhaust) that require air pollution control equipment or other methods to best control emissions and have the potential to emit airborne radionuclides.

Table E-1. Potential Federal and Washington State ARARs and TBC Materials for the 200-EA-1 OU

Citation	ARAR Category	Description of Requirement	Rationale for Use	Potential Relevancy	Possible Application
WAC 173-480-070(2), "Emission Monitoring and Compliance Procedures"	Action	Requires that procedures specified in WAC 246-247, "Radiation Protection—Air Emissions, "will be used to determine emissions compliance with the 10 mrem/yr standard for dose to any member of the public. Compliance is determined by calculating the dose to members of the public at the point of maximum annual air concentration in an unrestricted area where any member of the public may be.	Hazardous contaminants detected in soil in the 200-EA-1 OU include radionuclides that could be emitted to unrestricted areas during remedial actions and, therefore, could require monitoring.	ARAR	Investigative and remediation activities (e.g., excavation, RTD, demolition, ventilation, and vacuuming/exhaust) that have the potential to emit radionuclides to the ambient air.
RCW 70.98, "Nuclear Energy and Radiation"; WAC 246-247, "Radiation Protection—Air Emissions"					
WAC 246-247-035(1)(a)(i) and (ii), "National Standards Adopted by Reference for Sources of Radionuclide Emissions" (Adopts, by reference, provisions of 40 CFR 61, Subpart A, "General Provisions"; and 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities")	Action	Requires the owner or operator of each stationary source of hazardous air pollutants subject to a national emission standard for a hazardous air pollutant to determine compliance with numerical emission limits in accordance with emission tests established in NESHAP (40 CFR 61.13, "Emission Tests and Waiver of Emission Tests") or as otherwise specified in an individual subpart. Compliance with the requirements of design, equipment, work practice, or operational standards shall be determined as specified in the individual subpart. Also, the source will be maintained and operated (including associated equipment for air pollution control) in a manner consistent with good air pollution control practice for minimizing emissions.	Substantive requirements of this standard are applicable because remedial actions in the 200-EA-1 OU would be subject to NESHAP radionuclides air pollutant standards and resulting requirements. The radionuclide hazardous air pollutants have the potential to be detected in and emitted from structures, components, debris, or soil involved in the remedial action.	ARAR	Investigative and remedial actions involve stationary sources that provide a potential to emit regulated hazardous air pollutants (e.g., vapor extraction systems, decontamination stations, deactivation, demolition, or waste removal or storage activities). Associated design, equipment, work practice, or air emissions controls may be maintained and operated.
WAC 246-247-040(2), (3), and (4), "General Standards"	Action	Requires that emissions be controlled to ensure that ALARA-based and best available control technology standards are not exceeded.	Hazardous contaminants that would be subject to radionuclide air emission standards and resulting requirements have the potential to be detected in and emitted from structures, components, debris, or soil involved in the remedial actions in the 200-EA-1 OU.	ARAR	Investigative and remedial soil, air, decontamination, and stabilization of contaminated structures, treatment of sludge, and operation of exhausters and vacuums that may produce airborne emissions of hazardous radionuclide pollutants to residential areas.
WAC 246-247-075(2), (4), (8) through (14), "Monitoring, Testing and Quality Assurance"	Action	Establishes the monitoring, testing, and quality assurance requirements for radioactive air emissions. Requires that emissions from nonpoint and fugitive sources of airborne radioactive material be measured. Measurement techniques may include, but are not limited to, sampling, calculation, smears, or other reasonable method for identifying emissions as determined by the lead agency.	Hazardous contaminants in the 200-EA-1 OU waste sites that would be subject to radionuclide air emission standards and resulting requirements have the potential to be detected in and emitted from structures, components, debris, or soil involved in the remedial actions.	ARAR	Investigative and remediation activities (e.g., RTD, excavation, demolition, and ventilation) that could emit airborne radionuclides.
***Clean Air Act of 1990*; 40 CFR 60, "Standards of Performance for New Stationary Sources"**					
40 CFR 60, Subpart IIII, "Standards of Performance for Stationary Compression Ignition Internal Combustion Engines" 40 CFR 60, Subpart JJJJ, "Standards of Performance for Stationary Spark Ignition Internal Combustion Engine" 40 CFR 63, Subpart ZZZZ, "National Emission Standard for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines"	Action	Establishes substantive requirements for stationary engines.	Stationary engines (e.g., used to support lighting poles) may be used during the RFI/RI and subsequent remedial actions.	ARAR	During RFI/RI activities and subsequent remedial actions.

Table E-1. Potential Federal and Washington State ARARs and TBC Materials for the 200-EA-1 OU

Citation	ARAR Category	Description of Requirement	Rationale for Use	Potential Relevancy	Possible Application
***Clean Air Act of 1990*; 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants"**					
40 CFR 61.140, "Applicability" 40 CFR 61.145, "Standard for Demolition and Renovation"	Action	Defines regulated ACM and the substantive requirements for removal and handling. Specifies sampling, inspection, handling, and disposal requirements for regulated sources having the potential to emit asbestos. Specifically, no visible emissions are allowed during handling, packaging, and transport of ACM.	Encountering ACM (e.g., on pipelines, facilities, or buried asbestos) is possible during the RFI/RI or remedial activities.	ARAR	Site investigation and remedial activities that include demolition or renovation and associated handling, packaging, and transporting ACM including IDW management and disposal.
40 CFR 61.150, "Standard for Waste Disposal for Manufacturing, Fabricating, Demolition, Renovation, and Spraying Operations"	Action	Identifies requirements for removing and disposing asbestos from demolition and renovation activities.	Encountering ACM on pipelines, facilities, or buried asbestos is possible during the RFI/RI or remedial activities.	ARAR	Site investigation and remedial activities that include demolition or renovation and associated handling, packaging, and transporting ACM, including IDW management and disposal.
Solid Waste					
***Toxic Substances Control Act of 1976* (15 USC 2601, et seq.); 40 CFR 761, "Polychlorinated Biphenyls (PCB) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions"**					
40 CFR 761.50(b)1, 2, 3, 4 and 7, "Applicability," "PCB Waste" 40 CFR 761.50(c), "Applicability," "Storage for Disposal"	Action	Establishes general PCB disposal requirements for storing and disposing PCB wastes, including liquid PCB wastes, PCB items, PCB remedial waste, PCB bulk product wastes, and PCB/radioactive wastes at concentrations greater than 50 ppm.	PCB wastes greater than 50 ppm may be encountered or generated during the RFI/RI and subsequent remediation.	ARAR	Soil and vadose zone excavation and RI, equipment and debris handling and disposal, and IDW management.
40 CFR 761.60(a), (b), and (c), "Disposal Requirements"	Action	Establishes requirements applicable to the handling and disposal of PCB liquids, PCB articles, and PCB containers.	PCB liquids, articles, or containers may be encountered or generated during the RFI/RI and subsequent remediation.	ARAR	Equipment and debris handling, storage, and disposal; IDW management and disposal.
40 CFR 761.61, "PCB Remediation Waste"	Action	Provides cleanup and disposal options for PCB remediation waste based on the concentration at which the PCBs are found.	PCB remediation wastes may be encountered or generated during the remedial actions for the 200-EA-1 OU.	ARAR	Soil remediation, RTD, and IDW management and disposal.
RCW 70.105, "Hazardous Waste Management"; WAC 173-303, "Dangerous Waste Regulations"					
WAC 173-303-016, "Identifying Solid Waste" WAC 173-303-017, "Recycling Processes Involving Solid Waste"	Action	Establishes criteria for solid and recycled solid wastes.	Solid wastes and/or recycled solid wastes may be generated during the RFI/RI and the implementation of the remedial action.	ARAR	Investigative and remedial activities that generate solid wastes (e.g., drums, barrels, tanks, containers, bulk wastes, debris, contaminated soil, and vadose zone soil).
WAC 173-303-070 (1,3), "Designation of Dangerous Waste"	Action	Establishes the method for determining whether a solid waste is a dangerous waste (or an extremely hazardous waste).	Dangerous/hazardous waste may be generated during the RFI/RI and the implementation of the remedial action.	ARAR	Investigative and remedial (including waste treatment) activities that generate solid wastes that may be dangerous waste.
WAC 173-303-077, "Requirements for Universal Waste"	Action	Identifies those wastes exempted from regulation under WAC 173-303-140, "Land Disposal Restrictions"; and WAC 173-303-170, "Requirements for Generators of Dangerous Waste"; through WAC 173-303-9907, "Reserved" (excluding WAC 173-303-960, "Special Powers and Authorities of the Department"). These wastes are subject to regulation under WAC 173-303-573, "Standards for Universal Waste Management."	Universal wastes may be generated during the RFI/RI and implementation of the remedial action.	ARAR	Investigative and remedial activities (disposal, storage, recycling, and onsite treatment) that manage universal wastes consistent with *Washington Administrative Code* requirements.

Table E-1. Potential Federal and Washington State ARARs and TBC Materials for the 200-EA-1 OU

Citation	ARAR Category	Description of Requirement	Rationale for Use	Potential Relevancy	Possible Application
WAC 173-303-120 (3) and (5), "Recycled, Reclaimed, and Recovered Wastes"	Action	These regulations define the requirements for recycling materials that are solid and dangerous waste. Specifically, WAC 173-303-120(3) provides for the management of certain recyclable materials, including spent refrigerants, antifreeze, and lead acid batteries. WAC 173-303-120(5) provides for the recycling of used oil.	Recycled, reclaimed, and recovered wastes may be generated during the RFI/RI and implementation of the remedial action.	ARAR	RFI/CMS and RI/FS recycling activities are consistent with the requirements of the *Washington Administrative Code* and are not otherwise subject to CERCLA as hazardous substances.
WAC 173-303-140, "Land Disposal Restrictions"	Action	This regulation establishes the treatment requirements and disposal prohibitions for land disposal of dangerous waste and incorporates, by reference, the federal land disposal restrictions of 40 CFR 268, "Land Disposal Restrictions," that are applicable to solid waste that is designated as dangerous or mixed waste in accordance with substantive portions of WAC 173-303-070(3).	Onsite land disposal may be needed of dangerous waste and debris during the RFI/RI phase and during implementation of the remedial action.	ARAR	Investigative and remedial wastes destined for onsite land disposal.
WAC 173-303-170 (1) and (3), "Requirements for Generators of Dangerous Waste"	Action	Establishes the requirements for dangerous waste generators. WAC 173-303-170(3) includes the substantive provisions of WAC 173-303-200, "Accumulating Dangerous Waste Onsite," by reference. WAC 173-303-200 further includes certain substantive standards from WAC 173-303-630, "Use and Management of Containers"; and WAC 173-303-640, "Tank Systems," by reference. Specifically, the substantive standards for management of dangerous or mixed waste are relevant and appropriate to the management of dangerous waste that will be generated during the remedial action.	Dangerous wastes may be generated during the RFI/RI phase and during implementation of the remedial action.	ARAR	IDW and remedial wastes (e.g., contaminated soil, vadose zone soil, IDW treatment chemicals).
WAC 173-303-200, "Accumulating Dangerous Waste On-Site"	Action	Establishes the requirements for accumulating wastes onsite. WAC 173-303-200 further includes certain substantive standards from WAC 173-303-630 and WAC 173-303-640, by reference.	Dangerous waste may be generated during the RI phase and during implementation of the remedial action.	ARAR	Management of dangerous waste during remedial and investigative actions.
WAC 173-303-64620, "Requirements"	Action	Establishes requirements for corrective action for releases of dangerous wastes and dangerous constituents, including releases from solid waste management units.	Releases of dangerous wastes and dangerous constituents have occurred within the 200-EA-1 OU that may present a threat to human health and the environment.	ARAR	Investigative and remediation of dangerous wastes and dangerous constituents from solid waste management units and spill sites. Corrective action can also be applied at treatment, storage, and/or disposal units whenever a release occurs.
WAC 173-303-610(2), "Closure Performance Standard"	Action	Establishes requirements for closing units that have treated, stored, or disposed dangerous waste.	Dangerous wastes may remain in the 200-EA-1 OU after closure.	ARAR	Remedial design and operation of regulated units that contain dangerous wastes and that will remain in the 200-EA-1 OU after closure.
WAC 173-303-665(6), "Landfills," "Closure and Post-Closure Care"	Action	Specifies closure and post-closure requirements for landfills.	Containment may be considered as a remedial alternative.	ARAR	Design and operation of an engineered landfill cover, including associated groundwater monitoring.
RCW 70.95, "Solid Waste Management—Reduction and Recycling"; WAC 173-350, "Solid Waste Handling Standards"					
WAC 173-350-025, "Owner Responsibilities for Solid Waste" WAC 173-350-040, "Performance Standards" WAC 173-350-300, "On-Site Storage, Collection and Transportation Standards" WAC 173-350-900, "Remedial Action"	Action	Establishes minimum substantive requirements for the proper handling and disposal of solid waste materials originating from residences, commercial, agricultural, and industrial operations; and other sources.	Solid, nondangerous waste may be generated during implementation of the RFI/RI process and remedial action.	ARAR	Investigative and remedial actions that generate solid, nondangerous waste.

Table E-1. Potential Federal and Washington State ARARs and TBC Materials for the 200-EA-1 OU

Citation	ARAR Category	Description of Requirement	Rationale for Use	Potential Relevancy	Possible Application
Historical and Archeological Resources					
Archeological and Historic Preservation Act of 1974					
Archeological and Historic Preservation Act of 1974 (16 USC 469a-1 through 469a-2(d))	Location	Requires that remedial actions do not cause the loss of any archaeological or historical data. This act mandates preservation of data; it does not require protection of the actual site or facility.	Archaeological and historical sites have been identified within the 200-EA-1 OU.	ARAR	Investigation and remedial activities that occur in or near archaeological or historical sites.
***National Historic Preservation Act of 1966* (Pub. L 89-665, as amended, 16 USC 470, et seq.)**					
36 CFR 800, "Protection of Historic Properties"	Location	Requires federal agencies to consider the impacts of their undertaking on cultural properties through identification, evaluation, mitigation processes, and consultation with interested parties.	Cultural and historical sites have been identified within the 200-EA-1 OU.	ARAR	Investigation and remedial activities that affect cultural or historical sites. Regulations implementing Section 106 of the *National Historic Preservation Act* will be followed.
Executive Order 11593, *Protection and Enhancement of the Cultural Environment*					
36 CFR 65, "National Historic Landmarks Program"	Location	These regulations set forth the criteria for establishing national significance. Requires that federal agencies shall, to the maximum extent possible, undertake planning and actions as may be necessary to minimize harm to landmarks.	Cultural and historical sites have been identified within the 200-EA-1 OU.	ARAR	Remedial actions shall comply with this standard.
***Native American Graves Protection and Repatriation Act of 1990*; 43 CFR 10, "Native American Graves Protection and Repatriation Regulations"**					
43 CFR 10, "Native American Graves Protection and Repatriation Regulations"	Location	Establishes federal agency responsibility for discovery of human remains, associated and unassociated funerary objects, sacred objects, and items of cultural patrimony. Requires Native American Tribal consultation in the event of discovery.	Native American archaeological, cultural, and historical sites have been identified within the 200-EA-1 OU. Native American remains and associated objects may be present.	ARAR	Investigation and remedial activities that affect Native American archeological and cultural areas and historic sites that contain associated remains and objects.
Natural and Ecological Resources					
***Migratory Bird Treaty Act of 1918* (16 USC 703-712)**					
50 CFR 10, "Wildlife and Fisheries," "General Provisions" 50 CFR 21, "Wildlife and Fisheries," "Migratory Bird Permits"	Location	Protects all migratory bird species and prevents "take" of protected migratory birds, their young, or their eggs.	Migratory birds occur within the 200-EA-1 OU.	ARAR	Investigation and remediation activities that have the potential to kill migratory birds or destroy their eggs or nests.
***Endangered Species Act of 1973* (16 USC 1531, et seq.)**					
Endangered Species Act of 1973, as amended (16 USC 1541-1544), specifically Sections 7 and 9(a). 50 CFR 17, "Wildlife and Fisheries," "Endangered and Threatened Wildlife and Plants" (listings and prohibitions)	Location	Action to conserve endangered species or threatened species.	There are no identified federal endangered and/or threatened species found within the 200-EA-1 OU. This regulation will apply if any endangered and/or threatened species are identified.	ARAR	Remedial actions and investigation activities that occur within critical habitats or designated buffer zones of federally listed species.

* ALARA is defined as making every reasonable effort to maintain exposures to radiation as far below the 10 mrem/yr dose standard as practical, consistent with which the activity is performed, taking into account the state of technology, the economics of improvements in relation to the state of technology, the economics of improvements in relation to benefits to the public health and safety, and other socioeconomic considerations; and in relation to the use of nuclear energy, ionizing radiation, and radioactive materials in the public interest.

Table E-1. Potential Federal and Washington State ARARs and TBC Materials for the 200-EA-1 OU

Citation	ARAR Category	Description of Requirement	Rationale for Use	Potential Relevancy	Possible Application

ACM = asbestos-containing material
ALARA = as low as reasonably achievable
ARAR = applicable or relevant and appropriate requirement
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
DOE = U.S. Department of Energy
EPA = U.S. Environmental Protection Agency
FS = feasibility study
IDW = investigation-derived waste
MTCA = Model Toxics Control Act (WAC 173-340, "Model Toxics Control Act–Cleanup")
NESHAP = National Emission Standards for Hazardous Air Pollutants
OU = operable unit
PCB = polychlorinated biphenyl
ppm = parts per million
RCRA = *Resource Conservation and Recovery Act of 1976*
RFI = RCRA facility investigation
RI = remedial investigation
RTD = removal, treatment, and disposal
TBC = to be considered
UIC = underground injection control

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E2 References

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