Appendix E

200-WA-1 and 200-BC-1 Operable Units Sampling and Analysis Plan

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Terms

AEA	alpha energy analysis
aG	amber glass
ALARA	as low as reasonably achievable
bgs	below ground surface
BRA	baseline risk assessment
BTR	Buyer's Technical Representative
CCU	Cold Creek unit
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
DOE	U.S. Department of Energy
DOE-RL	DOE, Richland Operations Office (also known as RL)
DOT	U.S. Department of Transportation
DPT	direct push technology
DQA	data quality assessment
DQI	data quality indicator
DQO	data quality objective
EB	equipment blank
ECO	Environmental Compliance Officer
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERT	electrical resistivity characterization
FSP	field sampling plan
FTB	full trip blank
FTL	Field Team Lead
FWS	Field Work Supervisor
FXR	field transfer blank
G	glass
GC	gas chromatography
GC/MS	gas chromatograph/mass spectrometry
GEA	gamma energy analysis

GPC	gas proportional counting
GPL	geophysical logging
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document* (DOE/RL-96-68)
HEIS	Hanford Environmental Information System
HHE	human health and the environment
IC	ion chromatography
ICP	inductively coupled plasma
ICP-MS	inductively coupled plasma-mass spectrometry
MIBK	methyl isobutyl ketone
MS	mass spectrometry
N/A	not available
NCO	nuclear chemical operator
OU	operable unit
P	plastic
PCB	polychlorinated biphenyl
POC	point of contact
PRG	preliminary remediation goal
PSQ	principal study question
QA	quality assurance
QAPjP	quality assurance project plan
QC	quality control
RCT	radiological control technician
RDR	request for data review
REDOX	Reduction Oxidation (Plant)
RI/FS	remedial investigation/feasibility study
RPD	relative percent difference
RR	railroad
RTD	removal, treatment, and disposal
S&GRP	Soil and Groundwater Remediation Project
SAF	sample authorization form

SAP	sampling and analysis plan
SMR	Sample Management and Reporting
SSL	soil screening level
SVOC	semivolatile organic compound
TPA	Tri-Party Agreement
TPH	total petroleum hydrocarbon
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
UPR	unplanned release
VOA	volatile organic analysis
VOC	volatile organic compound

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E1 Introduction

This sampling and analysis plan (SAP) provides the quality assurance project plan (QAPjP) and field sampling plan (FSP) for characterization of the waste sites in the 200-WA-1 and the 200-BC-1 Operable Units (OUs), located within the Inner Area of the Central Plateau at the Hanford Site.

The characterization activities described in this SAP replace the characterization activities included for the 200-WA-1 waste sites addressed in the following documents:

- DOE/RL-2009-60, *Sampling and Analysis Plan for Selected 200-MG-1 Operable Unit Waste Sites*
- DOE/RL-2009-94, *216-U-8 Crib and 216-U-12 Crib Vadose Zone Characterization Sampling and Analysis Plan*[1]
- DOE/RL-2007-02, Rev. 0, Vol. II, *Supplemental Remedial Investigation/Feasibility Study Work Plan for the 200 Areas Central Plateau Operable Units Volume II: Site-Specific Field-Sampling Plan Addenda*, including the following addendums:
  - ADD 1, *Site-Specific Field-Sampling Plans for the 216-S-5, 216-S-6, 216-T-36, 216-B-55, 216-A-37-2, and 216-A-30 Cribs in the 200-SC-1 Operable Unit (Addendum 1)*
  - ADD 2, *Site-Specific Field-Sampling Plans for the 216-T-34, 216-T-8, 216-B-10A&B, and 216-Z-16 Cribs (Addendum 2)*
  - ADD5, *Site-Specific Field-Sampling Plans for the 216-A-5 Crib and 216-S-1&2 Cribs, 200-PW-2/4 Operable Unit (Addendum 5)*

The work plan, of which this SAP is an appendix, documents the process used to determine the data needs for 200-WA-1 and 200-BC-1 OU waste sites. Completion of this SAP allows initiation of field characterization activities for the 200-WA-1 and 200-BC-1 OU waste sites. Data collected during implementation of the SAP will serve as the basis for development of the remedial investigation/feasibility study (RI/FS) and baseline risk assessment (BRA) reports for the 200-WA-1 and 200-BC-1 OUs.

E1.1 Organization

The work plan identified the waste sites to be included in the 200-WA-1 and 200-BC-1 OUs, assessed site-specific data needs for all 200-WA-1 and 200-BC-1 OU waste sites, and outlined the process for identifying initial contaminants of potential concern for the waste sites.

This SAP is written as an appendix to the work plan, and provides the QAPjP (Section E2) and FSP (Section E3) for characterization of the waste sites, as required to complete the RI/FS.

Appendix D provides a compilation of information for individual waste sites. This includes site description, history, previous site characterization and summary of existing data, as well as the data needs and specific sampling plans for each waste site.

Before commencing field investigations described in this SAP, sampling design requirements will be converted into field instructions (e.g., work packages) providing specific direction for field activities.

[1] For sites 216-U-8 and 216-U-12, execution of this SAP will be coordinated with the 216-U-8/216-U-12 treatability test team.

E1.2 Waste Site Summary

The 200-BC-1 OU includes 27 waste sites (Figure E-1), and 200-WA-1 OU includes 145 waste sites among four plant complexes (Figures E-2 through E-5). The following is the number of 200-WA-1 OU waste sites associated with each plant complex:

- S Plant – 34 sites
- T Plant – 48 sites
- U Plant – 48 sites
- Z Plant – 15 sites

Waste sites at individual plants are shown in Figures E-1 through E-5. A general description of each waste site is presented in the work plan, and detailed summaries are provided in Appendix D. To develop consistent characterization approaches, sites were divided into three groups based on relative depth of vadose zone contamination, estimated using the following pore volume calculation:

Pore Volume = Estimated liquid discharge volume/(area of structure at base times vadose zone thickness times 30 percent porosity).

Following are descriptions of the three vadose zone depth groupings:

- **Shallow Contamination**: Sites with little or no liquid discharge volumes (approximately 0 pore volumes), where all contamination is believed to reside within the top 4.6 m (15 ft) below ground surface (bgs) (58 sites including surface debris and disposal sites, minimal unplanned releases (UPRs), minor leaks, drips, and specks of contamination).

- **Intermediate Contamination**: Sites that received less than 0.5 pore volumes of liquid discharge. Contamination is believed to reside deeper than the top 4.6 m (15 ft) bgs, but is not expected to have affected groundwater (75 sites including trenches, reverse wells, French drains, retention basins, and septic systems). Tanks and vaults are included in this category, as well as significant UPRs.

- **Deep Contamination**: Sites that received greater than 0.5 pore volumes of liquid discharge and/or are known or suspected to have affected groundwater (see Table B-6 in Appendix B) (39 sites include the cribs, trenches, French drains, and ditches where large volumes of liquid waste were disposed or conveyed).

As discussed in the work plan, a number of the 200-WA-1 and 200-BC-1 OU waste sites will not be characterized as part of this SAP, either because they are considered similar to another site or are determined to have already been adequately characterized. Brief summaries of these assessments follow Figures E-1 through E-5.

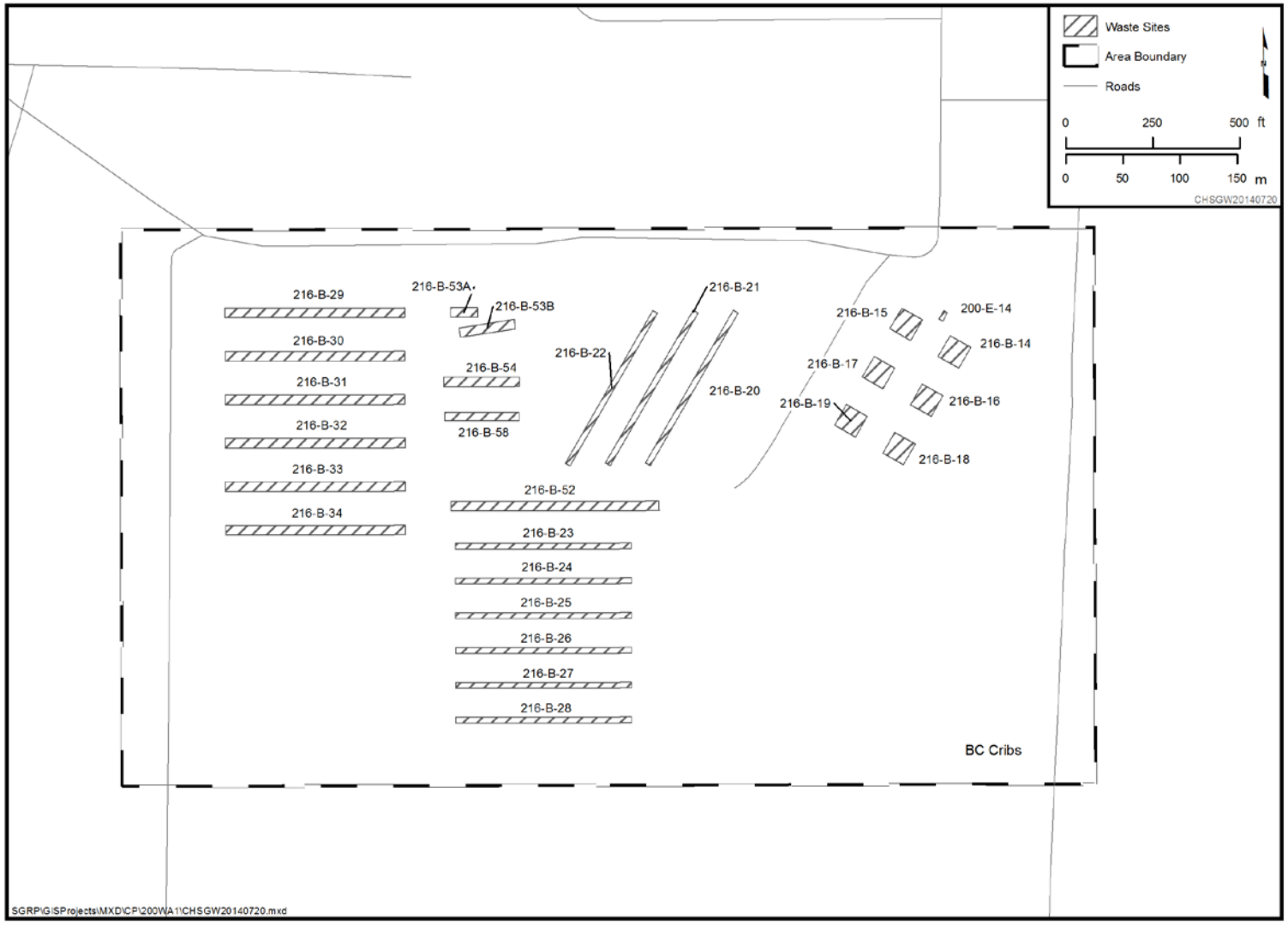

Figure E-1. 200-BC-1 OU Waste Sites: BC Cribs

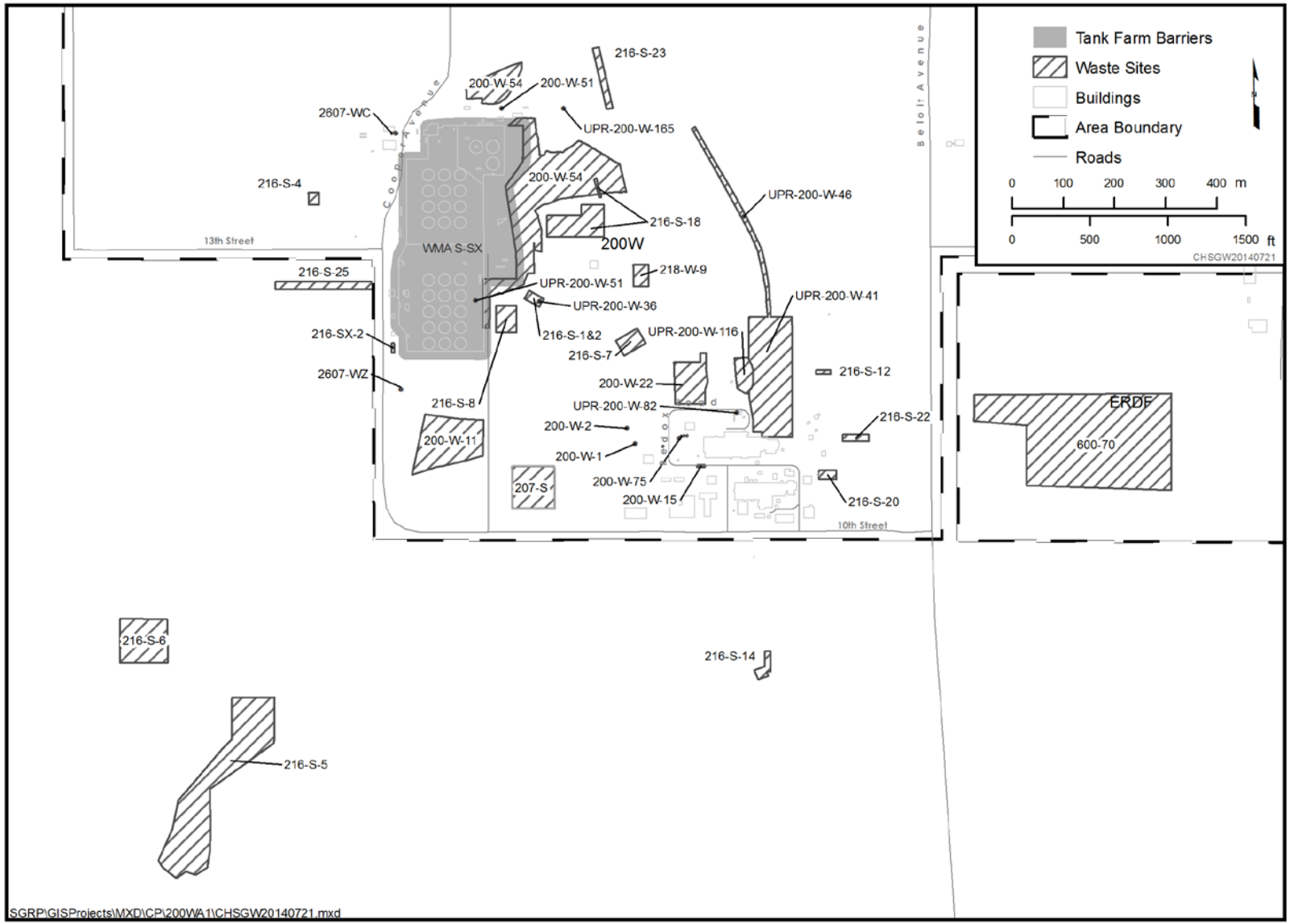

Figure E-2. 200-WA-1 OU Waste Sites: S Plant (REDOX)

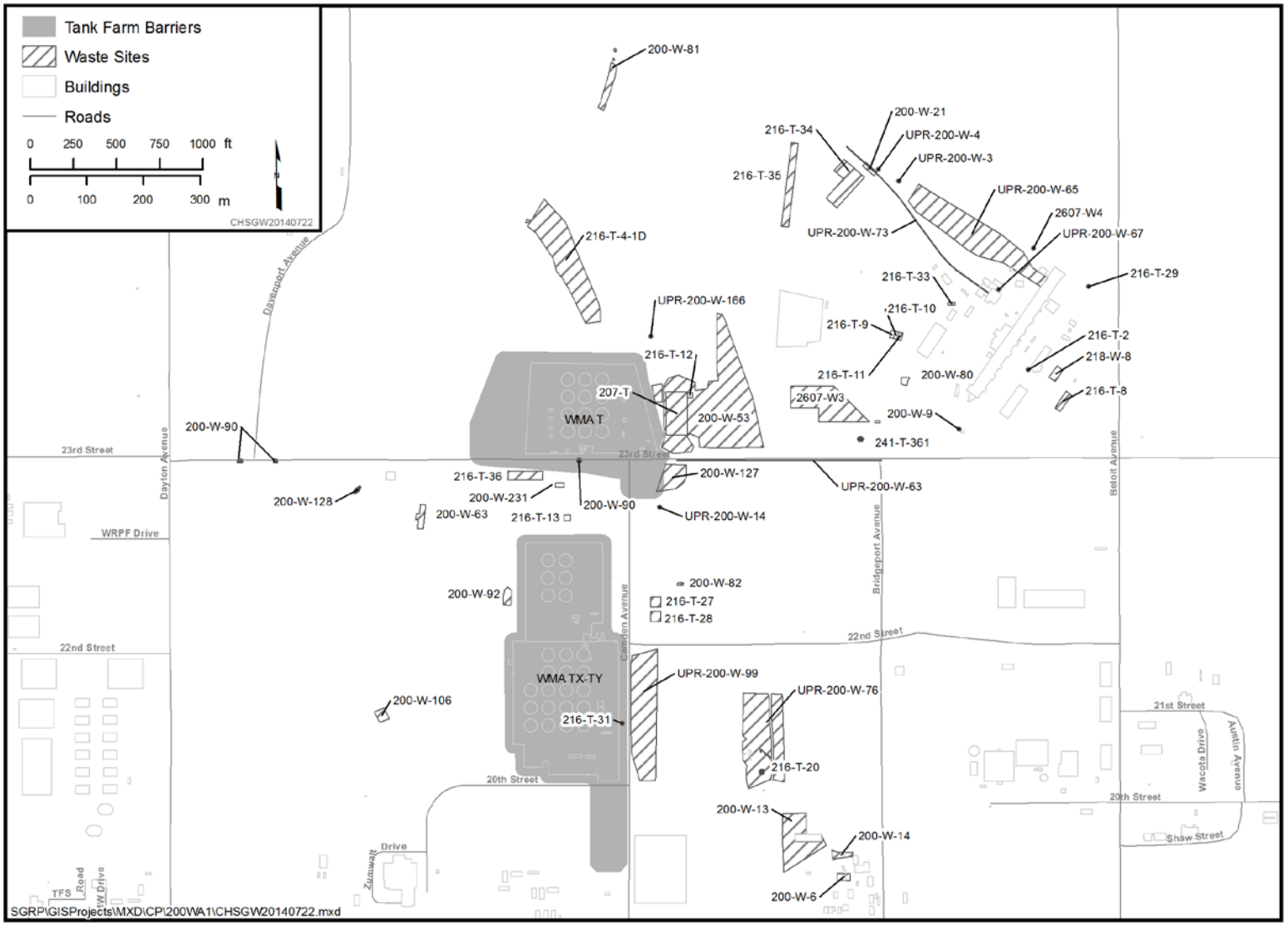

Figure E-3. 200-WA-1 OU Waste Sites: T Plant

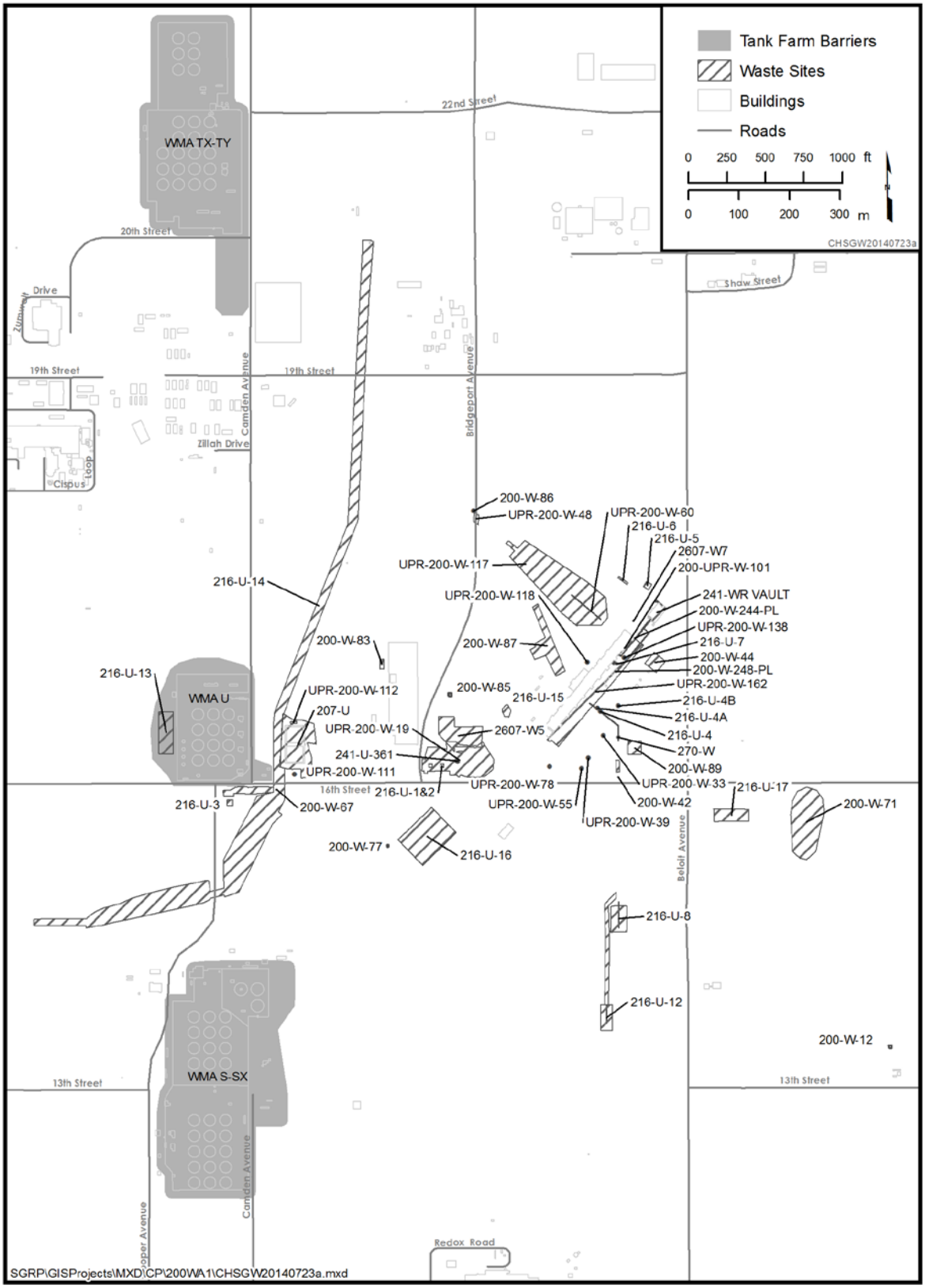

Figure E-4. 200-WA-1 OU Waste Sites: U Plant

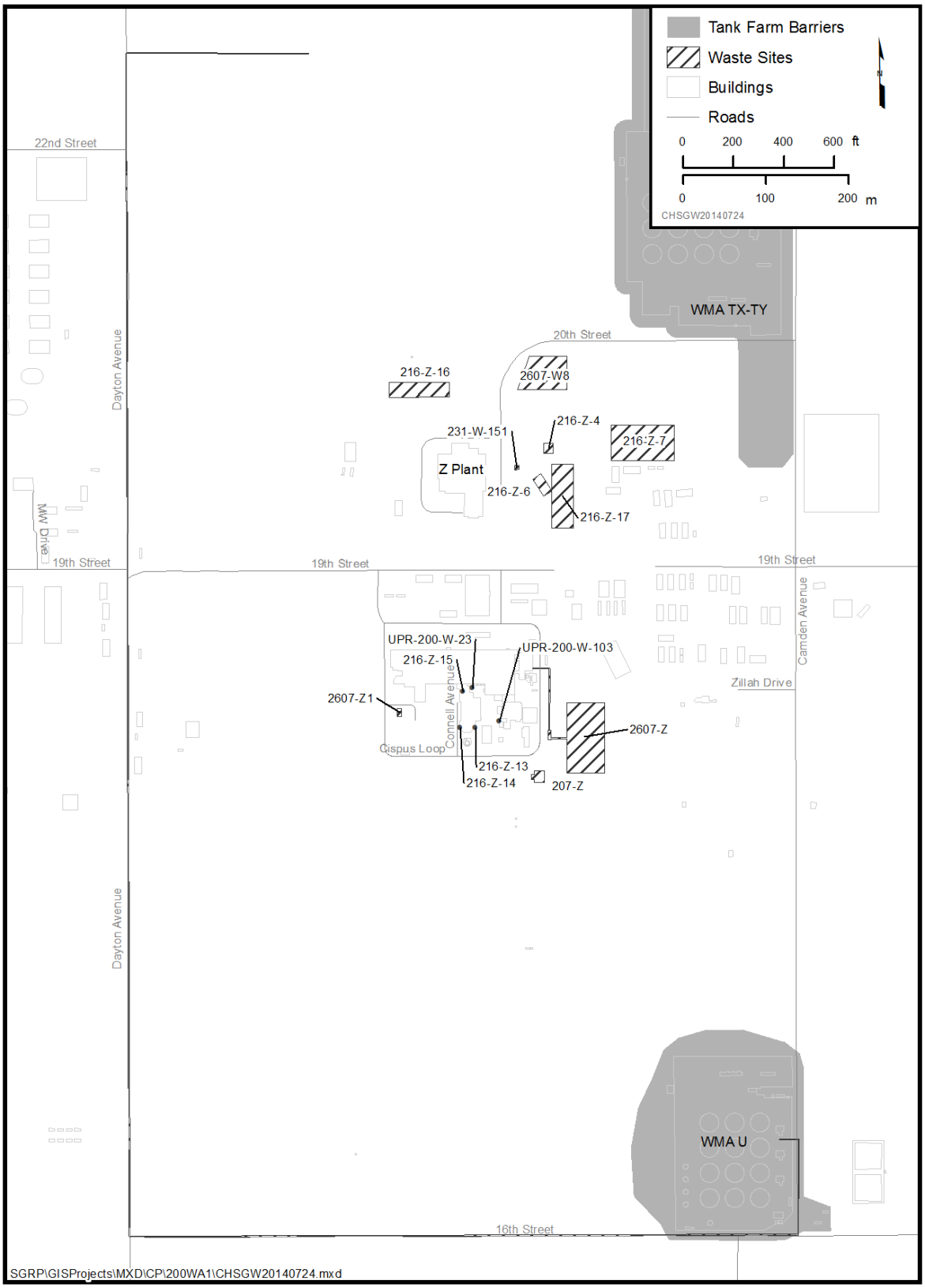

Figure E-5. 200-WA-1 OU Waste Sites: Z Plant

E1.2.1 Similar Site Approach

To streamline waste site characterization, a similar site approach was detailed in DOE/RL-98-28, *200 Areas Remedial Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program*, and used in a number of work plans since 1999, including DOE/RL-2007-02, *Supplemental Remedial Investigation/Feasibility Study Work Plan for the 200 Areas Central Plateau Operable Units Volume 1: Work Plan and Appendices*, and the 200-WA-1 and 200-BC-1 OU work plan. Following this approach, some waste sites were combined into groups based on similar location, geology, waste site history, contaminants, and additional characteristics. Within each group, one representative waste site was selected for comprehensive field investigations, including sampling. The findings from investigation of the representative waste site will be applied to other waste sites in the same group that were not investigated. Information from the representative site can be used to support evaluation of human health and the environment (HHE) risk and remedy analysis of the uncharacterized waste sites, if necessary. Appropriate remedial design characterization, as necessary to support remedial action, will be performed at all waste sites in the group during remedy implementation.

The similar site comparisons require that the following criteria be similar to their counterparts:

1. Similar design and structure
2. Waste liquids with similar radionuclides and chemical inventories
3. Similar discharge volume and loading rates
4. Similar depth to groundwater and stratigraphic sequence
5. Proximity

Based on these criteria, an assessment of all the 200-WA-1 and 200-BC-1 OU waste sites identified 9 groups consisting of 1 representative waste site in each group and up to 15 similar waste sites. The similar site groupings and representative waste sites are presented in Table E-1. With the exception of 216-B-26 (considered adequately characterized in Section E1.2.2), the following representative waste sites will be characterized under this SAP, and with the exception of 216-S-5 and 216-U-5, the 28 similar sites listed will not be characterized. Detailed summaries of both representative and similar sites are included in Appendix D.

Table E-1. Representative and Similar Waste Sites

200-WA-1 and 200-BC-1 Operable Units	
Representative Waste Sites	**Similar Waste Site Group**
216-B-26	216-B-20, 216-B-21, 216-B-22, 216-B-23, 216-B-24, 216-B-25, 216-B-27, 216-B-28, 216-B-29, 216-B-30, 216-B-31, 216-B-32, 216-B-33, 216-B-34, 216-B-52
216-B-14	216-B-15, 216-B-16, 216-B-17, 216-B-18, 216-B-19
216-B-58	216-B-53B, 216-B-54
216-S-6	216-S-5[a]
216-T-28	216-T-27
216-T-34	216-T-35
216-U-6	216-U-5[b]
216-Z-16	216-Z-17
216-Z-6	216-Z-4

a. The 216-S-5 Crib is similar to 216-S-6 and requires no additional characterization; however, the overflow trench associated with 216-S-5 does require investigation.
b. The 216-U-5 Trench is similar to 216-U-6; however, due to the uncertainty of the location and dimensions of the 216-U-5 Trench, shallow vadose zone sampling will be performed.

E1.2.2 Adequately Characterized Sites

Based on the data needs assessment conducted for each waste site during preparation of the work plan, one 200-BC-1 OU waste site and six 200-WA-1 OU waste sites are considered adequately characterized with sufficient data to evaluate HHE risk and evaluate remedial alternatives: 216-B-26, 216-U-1 & 2, 216-U-3, 216-U-4, 216-U-4A, 216-Z-7, and 241-U-361. No additional data will be collected for these sites.

The work plan provides a brief description of the characterization data available for each adequately characterized site, and Appendix D presents detailed summaries of the existing data with a brief description of the nature and extent of contamination at each waste site.

E1.2.3 Sites to Be Characterized

Of the 172 waste sites in the work plan, 7 are considered adequately characterized and 26 are similar sites that need no additional characterization, leaving 139 200-WA-1 and 200-BC-1 OU waste sites to be characterized under this SAP. Table E-2 presents a breakdown of these waste sites.

Table E-2. 200-WA-1 and 200-BC-1 Operable Unit Waste Sites to be Characterized

Plant	Number of Shallow Waste Sites	Number of Intermediate Waste Sites	Number of Deep Waste Sites	Total Number of Waste Sites to be Characterized
BC Cribs	0	3	1	4
S Plant	12	12	10	34
T Plant	20	19	7	46
U Plant	25	11	7	43
Z Plant	1	10	1	12
Totals	**58**	**55**	**26**	**139**

E1.3 Target Analytes

A target analyte is a constituent that is known or believed to have been released to the environment, based on process knowledge, sampling activities, or other information. A preliminary list of target analytes has been developed for 200-WA-1 and 200-BC-1 OU waste sites, based on several resources:

- Appendix B summarizes the composition and disposition of individual waste streams from each plant site. Waste stream chemicals were collated and applied to contamination sites that received processed waste (primarily cribs, trenches, reverse wells, French drains, and retention basins) associated with that plant. Table E-3 presents a summary of the waste stream composition.
- RHO-CD-673, *Handbook 200 Areas Waste Sites* (Parts 2 and 3), contains information about many of the deep 200-WA-1 OU contamination sites and includes an estimate of the radionuclide content of the waste stream discharged to each site, calculated from discharge data. If available, this inventory is included in Appendix D for each waste.

- Analytical data are available for soil samples from 34 waste sites. Data summaries including maximum concentrations of detected analytes are presented for each of these waste sites in their respective Waste Site Summary in Appendix D.
- The 2012 groundwater monitoring results for Inner Area OUs are presented in DOE/RL-2013-22, *Hanford Site Groundwater Monitoring Report for 2012*.

Table E-4 presents a preliminary target analyte list for the 200-WA-1 and 200-BC-1 OU waste sites compiled from these resources.

Table E-3. Waste Stream Composition in Inner Area Plants*

200-WA-1 Operable Unit	
Plant	**Waste Stream Chemical Composition**
S Plant (REDOX)	Inorganics: Al, Cr, Mn, Na, NO_3, NO_2 Organics: MIBK Radionuclides: Uranium, Fission Products
T Plant	Inorganics: Al, Bi, Ca, Cr, F, Fe, La, K, Mn, Na, NH_4, NO_3, NO_2, PO_4, Si, SO_4, Zr Radionuclides: Uranium, Plutonium, Fission Products
U Plant	Inorganics: Bi, Ca, F, Fe, K, Na, NO_3, NO_2, SO_4, PO_4 Organics: Tributyl Phosphate, Normal Paraffin Hydrocarbons (Kerosene Range Hydrocarbon) Radionuclides: Uranium, Fission Products
Z Plant (Plutonium Finishing Plant)	Inorganics: K, La, Mn, Na, NH_4, NO_3, NO_2, SO_4 Radionuclides: Plutonium, Fission Products

* From Appendix B. T Plant: Table B-1; U Plant: Table B-3; S Plant (REDOX): Table B-4; Z Plant (Plutonium Finishing Plant): Table B-2.

MIBK = methyl isobutyl ketone

REDOX = Reduction Oxidation (Plant)

Table E-4. 200-WA-1 and 200-BC-1 Operable Units Waste Sites Preliminary Target Analyte List

Radiological Constituents			
Americium241	Neptunium-237	Radium-228	Tritium
Cesium-137	Nickel-63	Strontium-90	Uranium-233/234
Cobalt-60	Plutonium-238	Technetium-99	Uranium-235
Europium-154	Plutonium-239/240	Thorium-232	Uranium-238
Europium-155	Radium-226	Iodine-129	Carbon-14

Table E-4. 200-WA-1 and 200-BC-1 Operable Units Waste Sites Preliminary Target Analyte List

Nonradioactive Metals			
Aluminum	Cadmium	Iron	Selenium
Antimony	Chromium (Total)	Lead	Silver
Arsenic	Chromium(VI)	Manganese	Uranium (Total)
Barium	Cobalt	Mercury	Vanadium
Beryllium	Copper	Nickel	Zinc
Boron			
Inorganic Constituents			
Ammonia	Fluoride	Nitrite	Phosphate
Chloride	Magnesium	Potassium	Sulfate
Cyanide	Nitrate		
Organic Constituents			
1,4-Dichlorobenzene	Acenaphthylene	Benzo(k)fluoranthene	Methyl ethyl ketone, 2-butanone
Total Polychlorinated Biphenyls	Aldrin	Bromomethane Methylene Chloride	Naphthalene Methyl Isobutyl Ketone, Hexone
2-Butoxyethanol	Anthracene	Benzyl Alcohol	n-Nitrosodi-n-dipropylamine
2-Chlorophenol	Aroclor-1254	Carbon Disulfide	Phenol
2-Hexanone	Aroclor-1260	Carbon Tetrachloride	Pyrene
2-methylnapthalene	Benzene	Chloroform	Tetrachloroethylene
4-4'-DDE	Benzo(a)anthracene	Chrysene	Total Petroleum Hydrocarbons
4-4'-DDT	Benzo(a)pyrene	Dibenzofuran	Tributyl Phosphate
4-Chloro-3-methylphenol	Benzo(b)fluoranthene	Ethyl Acetate	Trichloroethylene
Acenaphthene	Benzo(ghi)perylene	Indeno(1,2,3-cd)pyrene	Total Polychlorinated Biphenyls

Notes: The following types of analytes are not included on the preliminary target analyte list:

- Constituents lacking toxicity data and screening levels
- Essential nutrients (e.g., calcium, magnesium, potassium, and sodium) that are not elevated above background or are not associated with the waste at a waste site
- Radionuclides that are associated with background conditions and not associated with waste site activities (e.g., potassium-40)
- Radionuclides with half-lives of less than 3 years that produce no significant daughter products upon decay

The individual FSPs for each waste site in Appendix D to be characterized include a list of target analytical groups based on the data, inventory, and/or process knowledge available for that waste site. Most waste sites will be analyzed for radiological, nonradioactive metals, and inorganic constituents, with organics or groups of organics (e.g., petroleum hydrocarbons, semivolatile organic compounds [SVOCs],

and volatile organic compounds [VOCs]), included as appropriate. For many shallow 200-WA-1 and 200-BC-1 OU waste sites, the release history is not known. The analyte list for these sites will be determined after the pre-investigation site reconnaissance and field screening.

E1.4 Data Quality Objectives

The U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the Washington State Department of Ecology (Ecology) conducted a supplemental data quality objective (DQO) evaluation in 2005 and 2006 to review all process and characterization data available for the Central Plateau waste sites and to identify data gaps. Elements of the supplemental DQO evaluation were integrated into the Central Plateau Supplemental Work Plan (DOE/RL-2007-02, Vol. 1).

The Central Plateau Supplemental Work Plan (DOE/RL-2007-02) and DOE/RL-2011-104, *Characterization Sampling and Analysis Plan for the 200-DV-1 Operable Unit*, were reviewed during the planning of this document. As described in the 200-DV-1 SAP (DOE/RL-2011-104), DQOs were developed for 200-DV-1 wastes sites over a series of work sessions in 2011, producing principal study questions (PSQs), decision statements, alternative actions, and other data objectives and requirements.

Located on the Central Plateau with waste sites in the B Plant, S Plant, and T Plant areas that received large volumes of liquid waste from various plant processes, the 200-DV-1 waste sites are similar to intermediate and deep waste sites in the 200-WA-1 and 200-BC-1 OUs. Therefore, 200-DV-1 PSQs and decision statements are directly applicable to waste sites in the 200-WA-1 and 200-BC-1 OUs and have been adapted for these waste sites (Table E-5). The decision statements also include evaluation of the conditional points of compliance for direct contact and ecological protection, and groundwater protection.

Table E-5. Data Quality Objective Principal Study Questions and Decision Statements

200-WA-1 and 200-BC-1 Operable Units	
Principal Study Question 1	**Decision Statements**
Do chemical and/or radiological contaminants in the shallow (0 to 4.6 m [15 ft] below ground surface) vadose zone at 200-WA-1 and 200-BC-1 OU waste sites pose an unacceptable risk to human health and the environment under current and/or potential future land use?	Determine whether chemical and radiological contaminants within the upper 4.6 m (15 ft) at the 200-WA-1 and 200-BC-1 OU waste sites exceed acceptable risk levels for human health and the environment. Determine the extent of contamination in shallow soil (less than 4.6 m [15 ft]) sufficient for risk and remedy evaluation.
Principal Study Question 2	**Decision Statements**
Do chemical and/or radiological contaminants in the vadose zone at 200-WA-1 and 200-BC-1 OU waste sites have the potential to affect groundwater under current and/or potential future land use?	Determine whether the chemical and/or radiological contaminants in the vadose zone exceed acceptable risk levels for protection of groundwater. Determine the extent of chemical and/or radiological contamination in the vadose zone sufficiently for remedy evaluation.

OU = operable unit

The information (data) input needed to resolve the decision statements identified in Table E-5 is specified for each 200-WA-1 and 200-BC-1 OU waste site in Appendix D. Generally, the data needs can be summarized as follows:

- For shallow soil contamination in the upper 4.6 m (15 ft), soil data from surface soil sampling and shallow borings (0 to 4.6 m [15 ft] bgs) are needed to determine the following:
    1. The horizontal and vertical extent of contamination in shallow soil sufficient for remedy selection
    2. Whether chemical and radiological contaminants within the upper 4.6 m (15 ft) exceed acceptable risk levels for HHE
    3. Whether chemical and radiological contaminants within the upper 4.6 m (15 ft) exceed soil screening levels (SSLs) and preliminary remediation goals (PRGs) for protection of groundwater
- For intermediate and deep vadose zone contamination, soil data from a single deep borehole placed in proximity to the highest suspected contamination will be used to determine whether the chemical and/or radiological contaminants in the deep vadose zone exceed SSLs and PRGs for protection of groundwater.

This SAP does not include additional deep borings to determine the lateral extent of chemical and/or radiological contamination in the deep vadose zone. The lateral extent of deep contamination will be estimated during the RI/FS by extrapolating data from sites in the Central Plateau where the deep vadose zone has been well characterized (e.g., tank farms, 216-U-8 and 216-U-12 Cribs, 200-DV-1 sites, and 216-U-1 & 2 Cribs). Additional data may be collected during the remedial design phase.

For waste sites with physical structures that are “soil-like” including timber or waste distribution pipes within cribs, septic distribution piping, railroad tracks (or other structures that would be expected to exhibit chemical concentrations resulting from a release or pose risk similar to the surrounding soil), samples of the physical structure will not be collected. For physical structures that are “nonsoil-like,” including pipelines, tanks, concrete foundations, or basins, samples of the structure itself may be needed for risk evaluation and remedy selection. Additionally, samples of waste materials (e.g., liquid and sludge samples from a tank) may be needed.

E2 Quality Assurance Project Plan

This QAPjP establishes the quality requirements for environmental data collection. It includes planning, implementation, and assessment of sampling tasks, field measurements, laboratory analysis, and data review. This chapter describes the applicable environmental data collection requirements and controls based on the quality assurance (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). Sections 6.5 and 7.8 of the Tri-Party Agreement (TPA) Action Plan (Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*) require the QA, quality control (QC), and sampling and analysis activities to specify the QA requirements for treatment, storage, and disposal units, as well as for past-practice processes. Where appropriate, this QAPjP also describes the applicable requirements and controls based on guidance found 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)*. This QAPjP is intended to supplement the contractor’s environmental QA program plan.

This QAPjP is divided into the following four sections, which describe the quality requirements and controls applicable to Hanford Site OU groundwater monitoring activities: Project Management, Data Generation and Acquisition, Assessment and Oversight, and Data Validation and Usability.

E2.1 Project Management

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

E2.1.1 Project/Task Organization

The primary contractor, or its approved subcontractor, is responsible for planning, coordinating, sampling, and shipping samples to the laboratory. The project organization (in regard to sampling and characterization) is described in the following subsections and is shown graphically in Figure E-6. The 200-WA-1 and 200-BC-1 OU Project Manager maintains a list of individuals or organizations as points of contact (POCs) for each functional element in the figure. For each functional primary contractor role, there is a corresponding oversight role within DOE.

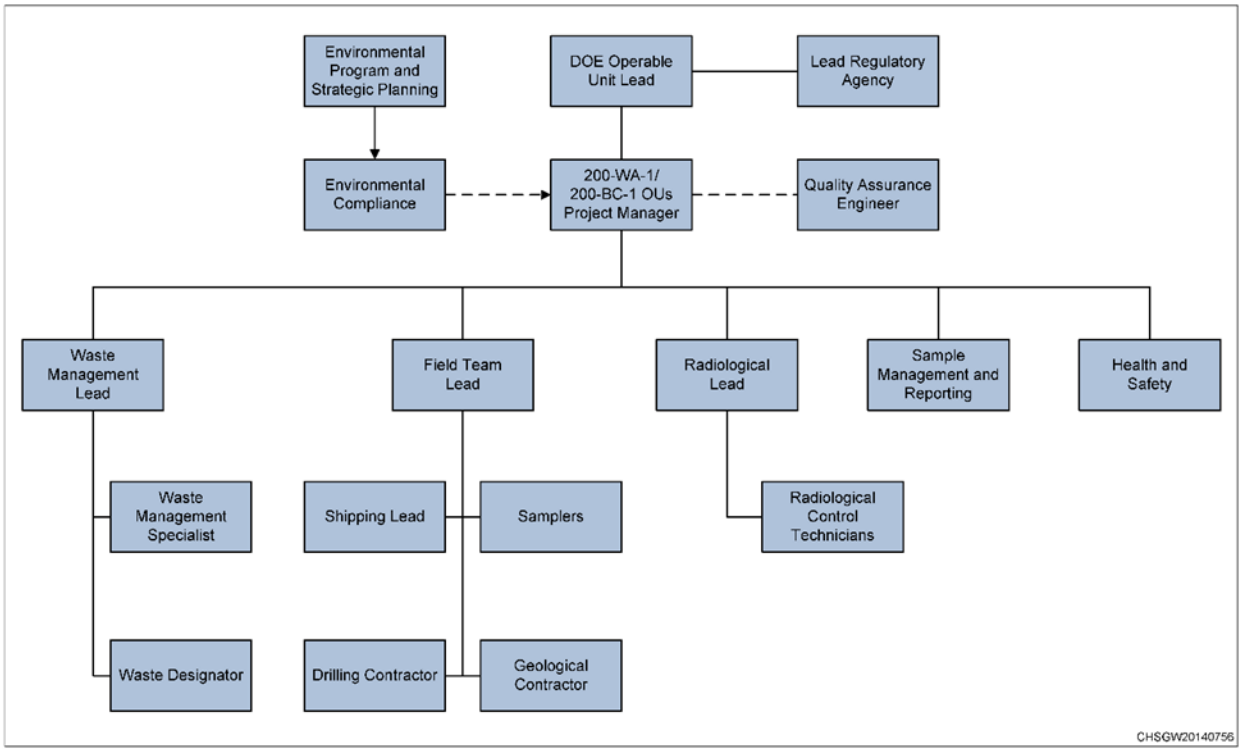

Figure E-6. Project Organization

The project has several key positions within the U.S. Department of Energy, Richland Operations Office (DOE-RL) organization, including the following:

- **Regulatory Lead**. EPA is responsible for regulatory oversight of cleanup projects and activities. EPA as the lead regulatory agency for the 200-WA-1 and 200-BC-1 OUs has approval authority for the work being performed under this SAP. The lead regulatory agency will work with DOE-RL to resolve concerns over the work described in this SAP in accordance with the Tri-Party Agreement (TPA) (Ecology et al. 1989a, *Hanford Federal Facility Agreement and Consent Order*).

- **DOE-RL Project Manager**. The DOE-RL Project Manager is responsible for the Hanford Site cleanup. The DOE-RL Project Manager is responsible for monitoring the contractor's performance of activities under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA), *Resource Conservation and Recovery Act of 1976* (RCRA), the *Atomic Energy Act of 1954*, and the TPA (Ecology et al. 1989a) for the Hanford Site. The DOE-RL Project Manager is also responsible for obtaining lead regulatory agency approval of the SAP, authorizing field sampling activities, and functioning as the primary interface with regulators.

- **DOE-RL Technical Lead**. The DOE-RL technical lead is responsible for providing day-to-day oversight of the contractor's work scope performance, working with the contractor and the regulatory agencies to identify and resolve technical issues, and providing technical input to the DOE-RL Project Manager.

- **Operable Unit Technical Lead**. The OU Technical Lead is responsible for the development of specific sampling design, analytical requirements, and QC requirements; either independently or as defined through a systematic planning process. The OU Technical Lead ensures that sampling and analysis activities as 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), QA, Health and Safety, the Field Work Supervisor (FWS), and the Sample Management and Reporting (SMR) organization to integrate these and other lead disciplines in planning and implementing the work scope.

- **Operable Unit Project Manager**. The 200-WA-1 and 200-BC-1 OU Project Manager (or designee) is responsible and accountable for project-related activities and coordinates with DOE-RL, regulators, and contactor management in support of sampling activities to ensure work is performed safely and cost effectively. In addition, the OU Project manager (or designee) is responsible for managing sampling documents and requirements, field activities, subcontracted tasks, and for ensuring the project file is properly maintained. The OU Project Manager is responsible for ensuring that the 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 providing specific direction for all field activities. The OU Project Manager works closely with the ECO, QA, Health and Safety, the FWS, and the SMR organization to integrate these and other lead disciplines in planning and implementing the work scope. The OU Project Manager maintains a list of individuals or organizations filling each of the functional elements of the project organization (Figure E-6).

- **Quality Assurance**. The QA POC is matrixed from the QA organization to the OU Project Manager. The QA POC is responsible for addressing QA issues on the project and overseeing implementation of the project QA requirements. Responsibilities include reviewing project documents, including the QAPjP, and participating in QA assessments on sample collection and analysis activities, as appropriate.

- **Environmental Compliance Officer**. The ECO, from the Environmental Program and Strategic Planning organization, provides technical oversight, direction, and acceptance of project and subcontracted environmental work, and also develops appropriate mitigation measures with a 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.

- **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 by internal primary contractor work requirements.

  In addition, the Health and Safety organization 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.

- **Radiological Engineering**. The Radiological Engineering organization is responsible for radiological engineering and health physics support within the project. Specific responsibilities include conducting as low as reasonably achievable (ALARA) reviews, exposure and release modeling, and radiological controls optimization. In addition, radiological hazards are identified and appropriate controls are implemented to maintain worker exposures to hazards at ALARA levels. The Radiological Engineering interfaces with the project Health and Safety representative and other appropriate personnel, as needed, to plan and direct radiological control technician (RCT) support for activities.

- **Sample Management and Reporting Organization**. The SMR organization coordinates laboratory analytical work to ensure that laboratories conform to the requirements of this plan. The SMR organization 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. The SMR organization receives analytical data from the laboratories, performs data entry into the Hanford Environmental Information System (HEIS) database, and arranges for data validation. The SMR organization is responsible for resolving sample documentation deficiencies or issues associated with the Field Sampling organization, laboratories, or other entities. The SMR organization is responsible for informing the project manager of any issues reported by the analytical laboratories.

- **Analytical Laboratories.** The analytical laboratories analyze samples, in accordance with established procedures and the requirements of this plan, and provide necessary data packages containing analytical and QC results. The laboratories provide explanations of results to support data review and in response to resolution of analytical issues. The laboratories are evaluated under the DOE Consolidated Audit Program and must be accredited by Ecology for the analyses performed for the Soil and Groundwater Remediation Project (S&GRP).

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

- **Soil Sampling**. Soil sampling includes activities of the field team and the Buyer's Technical Representatives (BTRs).

- **Field Sampling Organization**. The FWS, from the Field Sampling organization, is responsible for planning and coordinating field sampling activities. The FWS is also responsible for reviewing the SAP for field sample collection concerns, analytical requirements, and special sampling requirements. The FWS acts as a technical interface between the OU Project Manager and the field crew supervisors (such as the Drilling BTR and Geologist BTR) and ensures technical aspects of the field work will be met. The FWS, in consultation with the OU Project Manager and SMR, resolves issues

arising from translation of technical requirements to field operations and coordinates resolution of sampling issues.

The FWS directs the nuclear chemical operators (NCOs) and ensures the NCOs are appropriately trained and available. Additional related responsibilities include ensuring the sampling design is understood by the NCOs and can be performed as specified; this is achieved by performing mock-ups and holding practice sessions with field personnel.

The NCOs collect groundwater, soil, vapor, and multimedia samples, including replicates/duplicates; collect field parameters; and prepare QC samples in accordance with the SAP, corresponding standard methods, and field and sample instructions. The samplers complete field logbook entries, chain-of-custody forms, and shipping paperwork, and ensure delivery of the samples to the analytical laboratory.

Field personnel typically have completed the following training before starting work:

- Occupational Safety and Health Administration 40-Hour Hazardous Waste Worker Training and supervised 24-hour hazardous waste site experience
- 8-Hour Hazardous Waste Worker Refresher Training (as required)
- Hanford General Employee Radiation Training
- Hanford General Employee Training
- Radiological Worker Training

Project-specific safety training, geared specifically to the project and the day's activity, will be provided. Project-specific training includes the following:

- Training requirements or qualifications needed by sampling personnel will be in accordance with QA requirements
- Samplers are required to have training and required certifications for the type of sampling that is being performed in the field
- Qualification requirements for RCTs are established by the Radiation Protection Program; the RCTs assigned to these activities will be qualified through the prescribed training program and will undergo ongoing training and qualification activities.

In addition, pre-job briefings will be performed in accordance with work management and work release documents to evaluate an activity and associated hazards by considering various factors including the following:

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

- Training requirements for individuals assigned to perform the work
- Level of management control
- Proximity of emergency contacts

- **Well Maintenance.** The Well Maintenance Manager has overall responsibility for all well maintenance activities. The Well Maintenance Manager coordinates with the OU Technical Lead to identify field constraints that could affect sampling design. The well activities lead or POC provides direction to the Geologist BTR who oversees the field geologist and to the Drilling BTR who oversees field construction activities and is responsible for daily interface with drilling and remediation subcontractors.

- **Drilling BTR**. The Drilling BTR oversees field construction activities. The BTR is responsible for daily interface with drilling and remediation subcontractors. The Drilling BTR verifies that all pre-field activities are complete prior to initiating work, reviews and approves subcontractor drilling submittals, and ensures work is completed in accordance with specifications. The Drilling BTR submits field records as required.

E2.1.2 Problem Definition and Background

The problem description from the *Data Needs Assessment Process* documented in the work plan for the 200-WA-1 and 200-BC-1 OUs follows:

> *The waste sites in the 200-WA-1 and 200-BC-1 OUs have either received liquid waste streams or have been contaminated to some degree from Hanford Site chemical and radiological processes. Residual radiological and chemical constituents associated with these activities have potentially contaminate shallow/deep soil and may pose a threat to groundwater. Concentrations of contaminants in amounts posing an unacceptable risk to human or ecological health, or which present a current or future source of unacceptable groundwater contamination, will be identified and characterized to determine a proper remedial action.*

The purpose of this SAP is to describe the characterization activities needed to sufficiently define the nature and extent of contamination at each 200-WA-1 and 200-BC-1 OU waste site, for risk-based decisions, groundwater protection evaluations, and remedy selection, as outlined in Table E-5.

E2.1.3 Project Task and Description

This SAP describes the sampling to be conducted at the 200-WA-1 and 200-BC-1 OU waste sites. Waste sites are categorized as either shallow sites, where contamination is expected to be limited to the top 4.6 m (15 ft) bgs, or intermediate and deep waste sites where the majority of contamination is expected in the deep vadose zone. Shallow sites are further divided into sites with contamination expected only within the top foot of soil (surface contamination only) and sites where contamination is expected to extend below 0.3 m (1 ft), but not deeper than 4.6 m (15 ft) bgs (subsurface contamination). For shallow sites with surface contamination only, soil samples will be collected using hand tools. Direct push technology (DPT) will be used as needed to collect samples to characterize subsurface contamination.

Soil sampling within the deep vadose zone at intermediate and deep sites will be accomplished using DPT or conventional drilling technologies. Samples will be collected at designated depths defined in the FSP section of this SAP (Section E3). Samples will be analyzed for target analytes as discussed in Section E1, in accordance with performance and QA requirements found in the QAPjP (Section E2).

At a subset of the waste sites, samples of the physical structure or waste contained within the structure will be collected.

E2.1.4 Quality Objectives and Criteria

The QA objective of this plan is to ensure the generation of analytical data of known and appropriate quality is acceptable and useful for decision making. In support of this objective, statistics and data descriptors known as data quality indicators (DQIs) are used to determine the acceptability and utility of data to the user. The principal DQIs are precision, accuracy, representativeness, comparability, completeness, bias, and sensitivity (Table E-6). These are defined for the purposes of this document in the following sections.

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. DQIs are evaluated during the data quality assessment (DQA) process (Tables E-7 and E-8). In consultation with the laboratory, the 200-WA-1 and 200-BC-1 OU manager, and/or others, as appropriate, the SMR organization identifies appropriate analytical methods.

E2.1.4.1 Analytical Priority

Analyte groups are listed in order of priority in the Appendix D sampling plans, and will be analyzed based on the available sample volume. If sample volume is insufficient to analyze for all analytes listed for a given waste site, the highest priority analytes, critical for supporting waste site decisions, are required to be analyzed. 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.

Table E-6. Data Quality Indicators

DQI	Definition	Determination Methodologies	Corrective Actions
Precision	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

Table E-6. Data Quality Indicators

DQI	Definition	Determination Methodologies	Corrective Actions
Accuracy	Accuracy is the closeness of a measured result to an accepted reference value. Accuracy is usually measured as a percent recovery. Quality control 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	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 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 them 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
Comparability	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 QA 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

Table E-6. Data Quality Indicators

DQI	Definition	Determination Methodologies	Corrective Actions
Completeness	Completeness is a measure of the amount of valid data collected compared to the amount planned. Measurements are considered to be 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's quality criteria (data quality objectives or performance/ acceptance criteria).	If data set does not meet 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
Bias	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 (MS).	For sampling bias: • Properly select and use sampling tools • Institute correct sampling and subsampling procedures to limit preferential selection or loss of sample media • Use sample handling procedures, including proper sample preservation, that limit the loss or gain of constituents to the sample media • Analytical data that are known to be affected by either sampling or analytical bias are flagged to indicate possible bias. • Laboratories that are 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 labs for analysis.

Table E-6. Data Quality Indicators

DQI	Definition	Determination Methodologies	Corrective Actions
Sensitivity	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 practical quantitation limit is the lowest concentration that can be routinely quantified and reported by a laboratory for a given analytical method.	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, *Pending, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*, Third Edition; Final Update V, as amended.

DQI = data quality indicator

MS = matrix spike

QA = quality assurance

E2.1.5 Special Training and Certification

A graded approach is used to ensure that workers receive a level of training commensurate with responsibilities and that complies with applicable DOE orders and government regulations. The FWS, in coordination with line management, will ensure special training requirements for field personnel are met.

Typical training requirements or qualifications have been instituted by the contractor management team to meet training and qualification programs to satisfy multiple training drivers imposed by the applicable *Codes of Federal Regulation*, and *Washington Administrative Code* requirements. For example, the environmental, safety, and health training program provides workers with the knowledge and skills necessary to execute assigned duties safely.

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

Table E-7. Analytical Performance Requirements for Radionuclides

Analyte Name	Chemical Abstracts Service No.	Preliminary Screening Levels[a] (pCi/g)				Hanford Site Background[e] (pCi/g)	Name/ Analytical Technology	Soil		
		Human Health		Groundwater Protection	Ecological Protection[d]			Estimated Quantitation Limit[f] (pCi/g)	Precision[g] (%)	Accuracy[g] (%)
		Industrial[b]	Residential[c]							
Americium-241	14596-10-2	942	155	--	4,840	--	**Americium isotopic – AEA**	1	≤30	70-130
Carbon-14	14762-75-5	1,600,000	81	--	32	--	**Liquid Scintillation**	50	≤30	70-130
Cesium-137	10045-97-3	18	4.4	--	924	1.05	**GEA**	0.1	≤30	70-130
Cobalt-60	10198-40-0	9.4	3.1	--	805	0.00842	GEA	0.05	≤30	70-130
Europium-154	15585-10-1	13	4.4	--	1,610	0.0334	GEA	0.1	≤30	70-130
Europium-155	14391-16-3	966	327	--	33,400	0.0539	GEA	0.1	≤30	70-130
Iodine-129	15046-84-1	1,943	0.076	--	--	--	Chemical Separation Low-Energy Photon Spectroscopy	2	≤30	70-130
Neptunium-237	13994-20-2	42	8.9	--	7,880	--	Np-237 – AEA	1	≤30	70-130
Nickel-63	13981-37-8	1,100,000	608	--	--	--	Ni-63 – Liquid Scintillation	30	≤30	70-130
Plutonium-238	13981-16-3	3,370	236	--	5,980	0.00378	Plutonium Isotopic – AEA	1	≤30	70-130
Plutonium-239/240	PU-239/240	2,906	203	--	6,270	0.0248	Plutonium Isotopic – AEA	1	≤30	70-130
Radium-226	13982-63-3	7.03	--	--	50.6	0.815	AEA	0.1	≤30	70-130
Radium-228	15262-20-1	8.15	--	--	43.9	--	Chemical Separation – GPC	0.2	≤30	70-130
Strontium-90	10098-97-2	1,968	2.3	--	91	0.178	Total Radioactive Strontium – GPC	1	≤30	70-130
Technetium-99	14133-76-7	165,700	1.5	--	5,360	--	Tc-99 – Liquid Scintillation or GPC	15	≤30	70-130
Thorium-232	TH-232	4.8	--	--	174,000	1.32	Th Isotopic – AEA	1	≤30	70-130
Hydrogen-3 (Tritium)	10028-17-8	49,800	623	--	420	--	Tritium – Liquid Scintillation	400	≤30	70-130
Uranium-233/234[h]	U-233/234	1,757	133	--	--	1.1[i]	U isotopic – AEA or ICP-MS	1	≤30	70-130
Uranium-235	15117-96-1	61	16	--	4,360	0.109	U isotopic – AEA or ICP-MS	1	≤30	70-130
Uranium-238	U-238	283	54	--	5,150	1.06	U isotopic – AEA or ICP-MS	1	≤30	70-130

Table E-7. Analytical Performance Requirements for Radionuclides

Analyte Name	Chemical Abstracts Service No.	Preliminary Screening Levels[a] (pCi/g)				Hanford Site Background[e] (pCi/g)	Name/ Analytical Technology	Soil		
		Human Health		Groundwater Protection	Ecological Protection[d]			Estimated Quantitation Limit[f] (pCi/g)	Precision[g] (%)	Accuracy[g] (%)
		Industrial[b]	Residential[c]							

a. The preliminary screening level (from the data quality objectives process) 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 remediation of the sites.

b. Values are from ECF-HANFORD-10-0452, *Calculation of Radiological Preliminary Remediation Goals in Soil for an Industrial Worker Exposure Scenario for the 100 Areas and 300 Area Remedial Investigation/Feasibility Study Reports*.

c. Values are from ECF-HANFORD-10-0429, *Documentation of Preliminary Remediation Goals (PRGs) for Radionuclides Using the IAROD Exposure Scenario for the 100 and 300 Area Remedial Investigation/Feasibility Study (RI/FS) Reports.*

d. Represents the lowest screening value available for protection of biota, invertebrates, and wildlife.

e. Values are from DOE/RL-96-12, *Hanford Site Background: Part 2, Soil Background for Radionuclides*, at the 90th percentile for a lognormal distribution.

f. Highest allowable minimum detectable concentration values are specified in contracts with analytical laboratories. Actual MDCs vary by laboratory and may be lower than required contractually.

g. Precision and accuracy requirements as identified and defined in the referenced U.S. Environmental Protection Agency procedures implemented by laboratory analysis and quality assurance procedures.

If ICP-MS is used, individual isotopes will be quantified.

AEA = alpha energy analysis
EPA = U.S. Environmental Protection Agency
GEA = gamma energy analysis
GPC = gas proportional counting
ICP-MS = inductively coupled plasma-mass spectrometer

Table E-8. Analytical Performance Requirements for Nonradionuclides

Analyte Name	Chemical Abstracts Service No.	Preliminary Screening Levels[a] (mg/kg)				Hanford Site Background[h] (mg/kg)	Name/ Analytical Technology	Soil		
		Direct Contact, WAC 173-340[b] (mg/kg)		Groundwater Protection[e,f]	Ecological Protection[g]			Required Detection Limits (mg/kg)[j]	Precision (%)[k]	Accuracy (%)[k]
		Method C Industrial[c]	Method B Unrestricted[d]							
Nonradioactive Metals										
Aluminum	7429-90-5	3,500,000	80,000	480,000	11,800	11,800	EPA Method 6020 or EPA Method 200.8	0.2	<30	70-130
Antimony	7440-36-0	1,400	32	5.4	5.2	0.13[i]	EPA Method 6010 ICP Trace or EPA Method 6020	0.6	<30	70-130
Arsenic	7440-38-2	88	0.67	0.034	10	6.47	EPA Method 6010 ICP Trace or EPA Method 6020	2	<30	70-130
Barium	7440-39-3	700,000	16,000	1,650	330	132	EPA Method 6010 ICP Trace or EPA Method 6020	0.5	<30	70-130
Beryllium	7440-41-7	7,000	--	63	10	1.51	EPA Method 6010 ICP Trace or EPA Method 6020	0.2	<30	70-130
Boron	7440-42-8	700,000	--	205	0.5	5.86[i]	EPA Method 6010 ICP Trace or EPA Method 6020	0.5	<30	70-130
Cadmium	7440-43-9	3,500	80	0.69	4	0.563[i]	EPA Method 6010 ICP Trace or EPA Method 6020	0.5	<30	70-130
Chromium (Total)	7440-47-3	5,250,000	120,000	2,000	18.5	18.5	EPA Method 6010 ICP Trace or EPA Method 6020	0.2	<30	70-130
Chromium(VI)	18540-29-9	10,500	240	0.96	--	--	EPA Method 7196 – colorimetric	0.5	<30	70-130
Cobalt	7440-48-4	1,050	--	4.3	15.7	15.7	EPA Method 6010 ICP Trace or EPA Method 6020 or EPA Method 200.8	0.4	<30	70-130
Copper	7440-50-8	140,000	3,200	284	50	22	EPA Method 6010 ICP Trace or EPA Method 6020 or EPA Method 200.8	1	<30	70-130
Iron	7439-89-6	2,450,000	--	5,640	--	32,600	EPA Method 6010 ICP Trace or EPA Method 6020 or EPA Method 200.8	5	<30	70-130
Lead	7439-92-1	1,000[p]	250[p]	3,000	50	10.2	EPA Method 6010 ICP Trace or EPA Method 6020 or EPA Method 200.8	0.5	<30	70-130
Magnesium	7439-95-4	--	--	--	--	32,300	EPA Method 6010 – ICP-AES	75	<30	70-130
Manganese	7439-96-5	490,000	11,200	500	512	512	EPA Method 6010 ICP Trace or EPA Method 6020 or EPA Method 200.8	5	<30	70-130
Mercury	7439-97-6	1,050	24	2.1	0.33	0.013[i]	EPA Method 7471 (soil) or EPA Method 6020 or EPA Method 200.8	0.2	<30	70-130
Nickel	7440-02-0	70,000	1,600	130	30	19.1	EPA Method 6010 ICP or EPA Method 6020 or EPA Method 200.8	4	<30	70-130
Potassium	7440-09-7	--	--	--	--	7,900	EPA Method 6010 – ICP-AES	400	<30	70-130

Table E-8. Analytical Performance Requirements for Nonradionuclides

Analyte Name	Chemical Abstracts Service No.	Preliminary Screening Levels[a] (mg/kg)				Hanford Site Background[h] (mg/kg)	Name/ Analytical Technology	Soil		
		Direct Contact, WAC 173-340[b] (mg/kg)		Groundwater Protection[e,f]	Ecological Protection[g]			Required Detection Limits (mg/kg)[j]	Precision (%)[k]	Accuracy (%)[k]
		Method C Industrial[c]	Method B Unrestricted[d]							
Selenium	7782-49-2	17,500	400	5.2	0.78	0.78[m]	EPA Method 6010 ICP or EPA Method 6020 or EPA Method 200.8	1	<30	70-130
Silver	7440-22-4	17,500	400	14	2	0.167[i]	EPA Method 6010 ICP or EPA Method 6020 or EPA Method 200.8	0.2	<30	70-130
Uranium (Total)	7440-61-1	10,500	240	270	5	3.21	U total – kinetic phosphorescence analysis or EPA Method 200.8 or EPA Method 6020	1	<30	70-130
Vanadium	7440-62-2	17,500	--	1,600	85.1	85.1	EPA Method 6010 ICP or EPA Method 6020 or EPA Method 200.8	1	<30	70-130
Zinc	7440-66-6	1,050,000	24,000	5,970	67.8	67.8	EPA Method 6010 ICP or EPA Method 6020 or EPA Method 200.8	1	<30	70-130
Inorganics										
pH (Corrosivity)	pH	--	--	--	--	--	EPA Method 9045 or SM4500 PH or EPA Method 150.1 or EPA Method 9040	0.1 pH unit	<30	70-130
Ammonia/Ammonium	7664-41-7 / 14798-03-9	--	--	--	9.23	9.23	EPA Method 350.1[m] or EPA Method 300.7[n]	0.5	<30	70-130
Chloride	16887-00-6	--	--	1,000	100	100	EPA Method 300.0[o] – IC	2	<30	70-130
Cyanide	57-12-5	2,100	48	0.97	--	--	EPA Method 9010 or EPA Method 9014 or SM4500E CN	0.5	<30	70-130
Fluoride	16984-48-8	210,000	4,800	2,880	2.81	2.81	EPA Method 300.0[o] – IC	5	<30	70-130
Nitrate	14797-55-8	24,900,000	568,000	180	52	52	EPA Method 300.0[o] – IC	2.5	<30	70-130
Nitrite	14797-65-0	1,050,000	24,000	13	52	--	EPA Method 300.0[o] – IC	2.5	<30	70-130
Phosphate	14265-44-2	--	--	--	0.785	0.79	EPA Method 300.0[o] – IC	5	<30	70-130
Sulfate	14808-79-8	--	--	1,000	237	237	EPA Method 300.0[o] – IC	5	<30	70-130
Organics										
1,4-Dichlorobenzene	106-46-7	24,300	185	0.13	--	--	EPA Method 8260 – GC/MS	0.004	<30	70-130
2-Butoxyethanol	111-76-2	350,000	8,000	3.3	--	--	EPA Method 8270 – GC/MS	5	<30	70-130
2-Chlorophenol	95-57-8	17,500	400	0.47	--	--	EPA Method 8270 – GC/MS	0.33	<30	70-130
2-Hexanone	591-78-6	17,500	400	0.17	--	--	EPA Method 8260 – GC/MS	0.02	<30	70-130

Table E-8. Analytical Performance Requirements for Nonradionuclides

Analyte Name	Chemical Abstracts Service No.	Preliminary Screening Levels[a] (mg/kg)				Hanford Site Background[h] (mg/kg)	Name/ Analytical Technology	Soil		
		Direct Contact, WAC 173-340[b] (mg/kg)		Groundwater Protection[e,f]	Ecological Protection[g]			Required Detection Limits (mg/kg)[j]	Precision (%)[k]	Accuracy (%)[k]
		Method C Industrial[c]	Method B Unrestricted[d]							
2-Methylnaphthalene	91-57-6	14,000	320	1.7	29	--	EPA Method 8270 – GC/MS	0.33	<30	70-130
4,4'-DDE (Dichlorodiphenyldichloroethylene)	72-55-9	386	2.9	0.45	--	--	EPA Method 8081 – GC	0.0033	<30	70-130
4,4'-DDT (Dichlorodiphenyltrichloroethane)	50-29-3	386	2.9	3.5	--	--	EPA Method 8081 – GC	0.0033	<30	70-130
4-Chloro-3-methylphenol	59-50-7	350,000	8,000	22	--	--	EPA Method 8270 – GC/MS	0.33	<30	70-130
Acenaphthene	83-32-9	210,000	4,800	98	20	--	EPA Method 8270 – GC/MS	0.33	<30	70-130
Acenaphthylene	208-96-8	--	--	--	29	--	EPA Method 8270 – GC/MS	0.33	<30	70-130
Aldrin	309-00-2	7.7	0.059	0.0025	--	--	EPA Method 8081 – GC	0.00165	<30	70-130
Anthracene	120-12-7	1,050,000	24,000	2,270	29	--	EPA Method 8270 – GC/MS	0.33	<30	70-130
Aroclor-1254	11097-69-1	66	0.50	0.11	40	--	EPA Method 8082 – GC	0.008	<30	70-130
Aroclor-1260	11096-82-5	66	0.50	0.72	40	--	EPA Method 8082 – GC	0.008	<30	70-130
Benzene	71-43-2	2,390	18	0.0045	--	--	EPA Method 8260 – GC/MS	0.005	<30	70-130
Benzo(a)anthracene	56-55-3	180	1.4	0.86	18	--	EPA Method 8270 – GC/MS	0.33	<30	70-130
Benzo(a)pyrene	50-32-8	18	0.14	0.23	18	--	EPA Method 8270 – GC/MS	0.33	<30	70-130
Benzo(b)fluoranthene	205-99-2	180	1.4	2.9	18	--	EPA Method 8270 – GC/MS	0.33	<30	70-130
Benzo(ghi)perylene	191-24-2	--	--	--	18	--	EPA Method 8270 – GC/MS	0.33	<30	70-130
Benzo(k)fluoranthene	207-08-9	180	1.4	2.9	18	--	EPA Method 8270 – GC/MS	0.33	<30	70-130
Benzyl Alcohol	100-51-6	350,000	8,000	--	--	--	EPA Method 8270 – GC/MS	0.01	<30	70-130
Bromomethane	74-83-9	4,900	112	0.052	--	--	EPA Method 8260 – GC/MS	0.01	<30	70-130
Carbon Disulfide	75-15-0	350,000	8,000	5.65	--	--	EPA Method 8260 – GC/MS	0.005	<30	70-130
Carbon Tetrachloride	56-23-5	1,880	14	0.0058	--	--	EPA Method 8260 – GC/MS	0.005	<30	70-130
Chloroform (Trichloromethane)	67-66-3	4,230	32	0.0075	--	--	EPA Method 8260 – GC/MS	0.005	<30	70-130
Chrysene	218-01-9	1,800	14	9.5	18	--	EPA Method 8270 – GC/MS	0.33	<30	70-130

Table E-8. Analytical Performance Requirements for Nonradionuclides

Analyte Name	Chemical Abstracts Service No.	Preliminary Screening Levels[a] (mg/kg)				Hanford Site Background[h] (mg/kg)	Name/ Analytical Technology	Soil		
		Direct Contact, WAC 173-340[b] (mg/kg)		Groundwater Protection[e,f]	Ecological Protection[g]			Required Detection Limits (mg/kg)[j]	Precision (%)[k]	Accuracy (%)[k]
		Method C Industrial[c]	Method B Unrestricted[d]							
Dibenzofuran	132-64-9	3,500	80	3.0	--	--	EPA Method 8270 – GC/MS	0.33	<30	70-130
Ethyl Acetate	141-78-6	3,150,000	72,000	30	--	--	EPA Method 8260 – GC/MS	5	<30	70-130
Ethylbenzene	100-41-4	11,900	91	0.034	--	--	EPA Method 8260 – GC/MS	0.005	<30	70-130
Indeno[1,2,3-cd]pyrene	193-39-5	180	1.4	8.3	18	--	EPA Method 8270 – GC/MS	0.33	<30	70-130
Methyl Ethyl Ketone (2-butanone)	78-93-3	2,100,000	48,000	20	--	--	EPA Method 8260 – GC/MS	0.01	<30	70-130
Methyl Isobutyl Ketone (MIBK, hexone, 4-methyl-2-pentanone)	108-10-1	280,000	6,400	2.7	--	--	EPA Method 8260 – GC/MS	0.01	<30	70-130
Methylene Chloride (Dichloromethane)	75-09-2	21,000	480	0.022	--	--	EPA Method 8260 – GC/MS	0.005	<30	70-130
Naphthalene	91-20-3	70,000	1,600	4. 5	29	--	EPA Method 8270 – GC/MS	.033	<30	70-130
n-Nitrosodi-n-dipropylamine	621-64-7	19	0.14	0.000056	--	--	EPA Method 8270 – GC/MS	0.33	<30	70-130
Phenol	108-95-2	1,050,000	24,000	11	--	--	EPA Method 8270 – GC/MS	0.33	<30	70-130
Pyrene	129-00-0	105,000	2,400	655	18	--	EPA Method 8270 – GC/MS	0.33	<30	70-130
Tetrachloroethene	127-18-4	21,000	476	0.053	--	--	EPA Method 8260 – GC/MS	0.005	<30	70-130
Total Polychlorinated Biphenyls[r]	1336-36-3	66	0.5	--	40	--	EPA Method 8082 – GC	0.0165	<30	70-130
Tributyl Phosphate	126-73-8	14,600	111	0.50	--	--	EPA Method 8270 – GC/MS	3.3	<30	70-130
Trichloroethene	79-01-6	1,750	22	0.0063	--	--	EPA Method 8260 – GC/MS	0.005	<30	70-130
Total Petroleum Hydrocarbons – Diesel to Oil Range (Kerosene)	TPH-DIESEL, TPH KEROSENE	2,000[q]	2,000[q]	2,000[q]	200	--	Northwest TPH-D[s]	5	<30	70-130
Soil Physical Properties										
Bulk Density	N/A	N/A	--	N/A	N/A	--	ASTM D2937-04, *Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method*[p]	N/A	N/A	N/A
Moisture Content	N/A	N/A	--	N/A	N/A	--	ASTM D2216-05, *Standard Test Methods for Laboratory Determination of Water (Moisture)*	N/A	N/A	N/A

Table E-8. Analytical Performance Requirements for Nonradionuclides

Analyte Name	Chemical Abstracts Service No.	Preliminary Screening Levels[a] (mg/kg)				Hanford Site Background[h] (mg/kg)	Name/ Analytical Technology	Soil		
		Direct Contact, WAC 173-340[b] (mg/kg)		Groundwater Protection[e,f]	Ecological Protection[g]			Required Detection Limits (mg/kg)[j]	Precision (%)[k]	Accuracy (%)[k]
		Method C Industrial[c]	Method B Unrestricted[d]							
							Content of Soil and Rock by Mass[p]			
Particle Size Distribution	N/A	N/A	--	N/A	N/A	--	ASTM D422, *Sieve Analysis*[p]	N/A	N/A	N/A

Note: The accuracy criteria for organics is statistically determined at the laboratory and transmitted with the data.

a. The preliminary screening level (from the data quality objectives process) is the risk-based value used to determine appropriate analytical requirements (e.g., estimated quantitation limits). Remedial action levels will be proposed in the feasibility study, will be finalized in the record of decision, and will guide remediation of the sites.

b. Method C industrial is WAC 173-340-745(5), "Soil Cleanup Standards for Industrial Properties," "Method C Industrial Soil Cleanup Levels," or Method B unrestricted is WAC 173-340-740(3), "Unrestricted Land Use Soil Cleanup Standards," "Method B Soil Cleanup Levels for Unrestricted Land Use.

c. Values are from 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*.

d. Values are from ECF-HANFORD-10-0444, *Documentation of Standard Method B Soil Cleanup Levels for Unrestricted Land Use*.

e. Calculated using WAC 173-340, "Model Toxics Control Act—Cleanup," three-phase model for soil concentrations protective of groundwater per WAC 173-340-747(4), "Deriving Soil Concentrations for Groundwater Protection," "Fixed Parameter Three-Phase Partitioning Model."

f. Values are 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.*

g. Value selected is the lowest screening value available for protection of biota, invertebrates, and wildlife.

h. Unless noted, values are from DOE/RL-92-24, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes*, using the 90th percentile with a lognormal distribution.

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

j. Estimated quantitation limit for setting laboratory detection limits generally is established using the preliminary action levels or background, whichever is lower.

k. Precision and accuracy requirements as defined in EPA procedures and implemented by laboratory analysis and quality assurance procedures. Precision criteria for batch laboratory replicate sample analyses. Accuracy criteria for associated batch laboratory control sample percent with additional evaluations also performed for matrix spikes, tracers, and carriers as appropriate to the method.

l. All samples analyzed in accordance with SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*, or AWWA/APHA/WEF, 2005, *Standard Methods for the Examination of Water and Wastewater* (4500-CN^- Cyanide; 4500-H+ pH value) unless otherwise noted.

m. EPA Method 350.1 from EPA-600/4-79-020, *Methods for Chemical Analysis of Water and Wastes*.

n. EPA Method 300.7 in EPA/600/S4-86/024, *Development of Standard Methods for the Collection and Analysis of Precipitation*.

o. EPA Method 300.0 in EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples.*

p. Based on Method A values from WAC 173-340-900, Tables 740-1 and 745-1, amended November 2007.

q. Based on WAC 173-340-900, Table 747-5, amended November 2007.

r. Polychlorinated biphenyls (PCBs) will be evaluated in samples from 0 to 4.6 m (15 ft) bgs using a phased approach. Aroclors (total PCBs) will be evaluated initially using EPA Method 8082. If Aroclors are not detected, additional analyses will be conducted using EPA Method 1668a to confirm that PCB congeners are not present or are present at low levels. The PCB congeners will be evaluated in accordance with WAC 173-340-708(8)(f), "Human Health Risk Assessment Procedures."

s. From Ecology Publication ECY 97-602, *Analytical Methods for Petroleum Hydrocarbons*. The Ecology methods use a modification to EPA Method 8015.

t. 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

bgs = below ground surface
EPA = U.S. Environmental Protection Agency
GC = gas chromatography
GC/MS = gas chromatograph/mass spectrometry
IC = ion chromatography
ICP = inductively coupled plasma
MIBK = methyl isobutyl ketone
N/A = not available
PQL = practical quantitation limit
TPH = total petroleum hydrocarbon

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E2.1.6 Documents and Records

The 200-WA-1 and 200-BC-1 OU Project Manager 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 the sampling document are handled consistent with the HASQARD (DOE/RL-96-68) and the TPA Action Plan (Ecology et al., 1989b). Table E-9 defines the types of changes that may impact the SAP and the associated approvals, notifications, and documentation requirements.

Table E-9. Change Control for Sampling Projects

Type of Change[a]	Type of Change (TPA Action Plan[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 the DQOs specified in the sampling and analysis plan.	**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 shall include the field change, the reason for the field change, and the names and titles of those approving the filed change.
Significant Change. Change has a considerable effect on performance or cost, but still allow for meeting the DQOs specified in the sampling and analysis plan.	**Minor Change**. Changes to approved plans which 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 Manager's Meeting or comparable forum. The lead regulatory agency determines there is no need to revise the document.	Documentation of this change approval would be in the Unit Manager's Meeting minutes or comparable record such as 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 in the DQOs in the sampling document.	**Revision Necessary.** Lead regulatory agency determines changes to approved plans require revision to document.	If it is anticipated that a fundamental change will require the approval of the Regulatory Lead, 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 determines the change requires a revision to the document.	Formal revision of the sampling document.

Table E-9. Change Control for Sampling Projects

Type of Change[a]	Type of Change (TPA Action Plan[b])	Action	Documentation

a. Consistent with *Hanford Analytical Services Quality Assurance Requirements Document* (DOE/RL-96-68 [HASQARD]).

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

c. The TPA Action Plan, Section 9.3, defines the minimum elements of a change notice.

DOE-RL = U.S. Department of Energy-Richland Operations Office

DQO = data quality objective

OU = operable unit

The FWS or BTR is responsible for ensuring that the field instructions are maintained and aligned with any revisions or approved changes to the SAP. The FWS or BTR will ensure that deviations from the SAP or problems encountered in the field are documented appropriately (e.g., in the field logbook or on nonconformance report forms) in accordance with internal corrective action protocols.

The OU Project Manager is responsible for tracking all changes and obtaining appropriate reviews by contractor staff. The OU Project Manager will discuss the change and provide appropriate documentation notifications with DOE-RL.

Logbooks are required for field activities. A logbook must be identified with a unique project name and number. The individual(s) responsible for logbooks will be identified in the front of the logbook, and only authorized persons may make entries in logbooks. Logbooks will be signed by the field manager, supervisor, cognizant scientist/engineer, or other responsible individual. Logbooks will be permanently bound, waterproofed, and ruled with sequentially numbered pages. Pages will not be removed from logbooks for any reason. Entries will be made in indelible ink. Corrections will be made by marking through the erroneous data with a single line, entering the correct data, and initialing and dating the changes.

The 200-WA-1 and 200-BC-1 OU Project Manager is responsible for communicating field corrective action requirements and ensuring that immediate corrective actions are applied to field activities. The S&GRP OU Project Manager is also responsible for ensuring that project files are set up, as appropriate, and/or maintained. The project files will contain project records or references to their storage locations. Project files generally include, as appropriate, the following information:

- Operational records and logbooks
- Data forms
- Global positioning system data (a copy will be provided to the SMR organization)
- Inspection or assessment reports and corrective action reports
- Field summary reports
- Interim progress reports
- Final reports

- Forms required by WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," and the master drilling contract

The following records are managed and maintained by SMR personnel:

- Field sampling logbooks
- Groundwater sample reports and field sample reports
- 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 offsite analytical laboratories

The laboratory is responsible for maintaining, and having available upon request, the following items:

- Analytical logbooks
- Raw data and QC sample records
- Standard reference material and/or proficiency test sample data
- Instrument calibration information

Convenience copies of laboratory analytical results are kept 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 TPA (Ecology et al., 1989a) will be managed in accordance with the requirements therein.

E2.2 Data Generation and Acquisition

The following subsections address data generation and acquisition to ensure that the project's methods for sampling, measurement and analysis, data collection or generation, data handling, and QC activities are appropriate and documented. The requirements for instrument calibration and maintenance, supply inspections, and data management are also addressed.

The FWS is responsible for ensuring that all field procedures are followed completely and that field sampling personnel are adequately trained to perform sampling activities under this SAP. The FWS must document all deviations from procedures or other problems pertaining to sample collection, chain-of-custody, sample analytes, sample transport, or noncompliant monitoring. As appropriate, such deviations or problems will be documented in the field logbook or in nonconformance report forms in accordance with internal corrective action procedures. The 200-WA-1 and 200-BC-1 OU Project Manager or FWS is responsible for communicating field corrective action requirements and for ensuring that immediate corrective actions are applied to field activities.

E2.2.1 Sampling Process Design

For the 200-WA-1 and 200-BC-1 OU waste sites that are well defined, the sampling design is focused. In focused sampling, the selection of sampling units is based on knowledge of the feature or condition under

investigation and on professional judgment. Focused sampling will be conducted at known locations as indicated from background information, site reconnaissance, and surface screening. Focused sampling is to obtain representative samples from the most probable zones of contamination for characterization.

At many sites at the 200-WA-1 and 200-BC-1 OUs, the location of the site and/or contamination is poorly defined. Area-wide grid sampling may be appropriate for these sites. An initial location is chosen at random, and then the remaining sampling locations are defined so that locations are at regular intervals across the waste site. Area-wide grid sampling provides a practical method for designating sample locations and ensures uniform coverage with the goals of delineating waste sites and/or contaminated areas within waste site boundaries, and estimating average contaminant concentrations.

For large, poorly defined sites where contamination is expected to be patchy or intermittent, composite sampling may be used as a screening tool to search for areas of contamination. With this design, samples from a number of locations systematically distributed across an area are collected, individually homogenized and subsampled, and then combined to form one representative sample. The individual subsamples are retained. The analytical result for the composite sample provides an estimate of the average concentration for that area. If that result exceeds a calculated screening level[2], then all retained subsamples will be analyzed to determine the specific location(s) of the exceedance. If the result is less than the screening level, the area represented by the composite sample is likely to demonstrate compliance with the cleanup level. To increase the chances of demonstrating compliance for an area that is actually clean, at least 10 to 20 samples should be included in the composite (Ecology Publication 94-49, *Guidance on Sampling and Data Analysis Methods*).

Sampling activities are summarized in Section E3; detailed site-specific sampling plans are provided in Appendix D.

E2.2.2 Sampling Methods

Section E3.5 describes the sampling methods. The specific information includes the following:

- Field sampling methods
- Sample preservation, containers, and holding times
- Corrective actions for sampling activities
- Decontamination of sampling equipment

E2.2.3 Sample Handling and Custody

Sample custody will be maintained in accordance with existing protocols to ensure the maintenance of sample integrity throughout the analytical process. Chain-of-custody protocols will be followed throughout sample collection, transfer, analysis, and disposal to ensure 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 any 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 changes for the custody of the sample, the new and previous custodians will sign the record and note the date and time. The sampler will make a copy of the signed record before sample shipment and will transmit the copy to the SMR organization within 48 hours of shipping.

[2] Screening level = Cleanup level or quantitation limit for target analyte(s)/number of samples.

The following minimum information is required on a completed chain-of-custody form:

- Project name
- Collectors' names
- Unique sample number
- Date and time of collection
- Matrix
- Preservatives
- Chain of possession information (i.e., signatures and printed names of all individuals involved in the transfer of sample custody and storage locations, and dates of receipt and relinquishment)
- Shipped-to information (i.e., analytical laboratory performing the analysis)
- Requested analyses (or reference thereto).

E2.2.4 Analytical Methods Requirements

Analytical method requirements for samples collected are presented in Tables E-7 and E-8. Updated EPA methods may be substituted for analytical methods identified in Tables E-7 and E-8. Deviations from the analytical methods noted in Tables E-7 and E-8 must be approved in accordance with Table E-9 and in accordance with the HASQARD (DOE/RL-96-68). The SMR organization in consultation with the OU Project Manager and the laboratory shall take the lead in ensuring that deviations from the analytical methods noted in Tables E-7 and E-8 are properly approved.

Issues that may affect analytical results are to be resolved by the SMR organization in coordination with the OU Project Manager. These analytical methods are controlled in accordance with the laboratory's QA Plan and the requirements of this QAPjP. The primary contractor participates in overseeing offsite analytical laboratories to qualify them for performing Hanford Site analytical work.

If the laboratory uses a nonstandard or unapproved method, then justification for the use of that method must be provided here. The laboratory using nonstandard methods, if any, must provide method validation data to confirm that the method is adequate for the intended use of the data. This includes information such as determination of detection limits, acceptance limits, corrective actions, quantitation limits, typical recoveries, and analytical precision and bias. Approval of this SAP by a regulatory agency constitutes approval of any nonstandard method.

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 are to be resolved by the SMR organization in coordination with the 200-WA-1 and 200-BC-1 OU Project Manager.

E2.2.5 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 provide information pertinent to field sampling variability. Laboratory QC samples estimate the precision, bias, and matrix effects of the analytical data. Field and laboratory QC sample requirements are summarized in Table E-10. Acceptance criteria for field and laboratory QC are shown in Table E-11. Data will be qualified and flagged in HEIS, as appropriate.

Table E-10. Field and Laboratory Quality Control Requirements

Sample Type	Purpose	Frequency
Field Quality Control		
Field Duplicate	Estimate precision, including sampling and analytical variability.	One per 20 samples collected.
Equipment Rinsate Blanks	Verify adequacy of sampling equipment decontamination.	As needed[a]. If only disposable equipment is used, then an equipment rinsate blank is not required. Otherwise, 1 per 10 soil samples.
Field Split	Estimate precision, including sampling, analytical, and inter-laboratory variability.	As needed.
Full Trip Blank	Assess contamination from containers or transportation.	1 per 20 samples.
Field Transfer Blank	Assess contamination from sampling site.	One each day VOCs sampled.
Laboratory Quality Control[b]		
Method Blank	Assess response of an entire laboratory analytical system.	At least one per batch[b] or as identified by the method guidance.
Matrix Spike	Identify analytical (preparation + analysis) accuracy; possible matrix effect on the analytical method used.	When required by the method guidance, at least one per batch [b] or as identified by the method guidance.
Matrix Duplicate or Matrix Spike Duplicate	Estimate analytical accuracy and precision.	When required by the method guidance, at least one per batch[b] or as identified by the method guidance, *per media sampled*.
Laboratory Control Samples	Assess method accuracy.	At least one per batch[b] or as identified by the method guidance, *per media sampled*.

a. 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.

b. Batching across projects is allowed for similar matrices (e.g., Hanford Site groundwater). The maximum batch size is 20 samples.

VOC = volatile organic compound

Table E-11. Laboratory Quality Control and Acceptance Criteria

Analysis	Quality Control	Acceptance Criteria	Corrective Action
Radiochemical Analyses			
Gamma Spectroscopy (GEA)[e]	MB	< MDL < 5% Sample concentration	Flagged with "B"
	LCS	70–130% recovery	Data reviewed[b]
	Laboratory Duplicate or MS/MSD	≤ 30% RPD[c]	Data reviewed[b]
	EB, FTB	< 2 times MDL	Flagged with "Q"
	Field Duplicate	≤ 30% RPD[c]	Flagged with "Q"
Alpha Energy Analysis(AEA)[e]	MB	< MDL < 5% Sample concentration	Flagged with "B"
	LCS	70–130% recovery	Data reviewed[b]
	Laboratory Duplicate or MS/MSD	≤ 30% RPD[c]	Data reviewed[b]
	EB, FTB	< 2 times MDL	Flagged with "Q"
	Field Duplicate	≤ 30% RPD[c]	Flagged with "Q"
	Tracer (where applicable)	20-105%	Data reviewed[b]
Liquid Scintillation Counting (LSC)[e]	MB	< MDL < 5% Sample concentration	Flagged with "B"
	LCS	70–130% recovery	Data reviewed[b]
	MS and MSD	60-140% recovery	Flagged with "N"
	Laboratory Duplicate or MS/MSD	≤ 30% RPD[c]	Data reviewed[b]
	EB, FTB	< 2 times MDL	Flagged with "Q"
	Field Duplicate	≤ 30% RPD[c]	Flagged with "Q"
Gas Proportional Counting (GPC)[e]	MB	< MDL < 5% Sample concentration	Flagged with "B"
	LCS	70–130% recovery	Data reviewed[b]
	Laboratory Duplicate or MS/MSD	≤ 30% RPD[c]	Data reviewed[b]
	EB, FTB	< 2 times MDL	Flagged with "Q"
	Field Duplicate	≤ 30% RPD[c]	Flagged with "Q"

Table E-11. Laboratory Quality Control and Acceptance Criteria

Analysis	Quality Control	Acceptance Criteria	Corrective Action
	Carrier	30-105%	Data reviewed[b]
General Chemical Analyses			
Cyanide	MB	< MDL < 5% Sample concentration	Flagged with "C"
	LCS	70–130% recovery	Data reviewed[b]
	MS and MSD	75–125% recovery	Flagged with "N"
	Laboratory Duplicate or MS/MSD	≤ 30% RPD[c]	Data reviewed[b]
	EB, FTB	< 2 times MDL	Flagged with "Q"
	Field Duplicate	≤ 30% RPD[c]	Flagged with "Q"
Anions by Ion Chromatography[f]	MB	< RDL < 5% Sample concentration	Flagged with "C"
	LCS	70–130% recovery	Data reviewed[b]
	MS or PS, and MSD	75–125% recovery	Flagged with "N"
	MS/MSD	≤ 30% RPD	Data reviewed[b]
	EB, FTB	< 2 times MDL	Flagged with "Q"
	Field Duplicate	≤ 30% RPD[c]	Flagged with "Q"
Ammonia by Ion Chromatography	MB	< MDL < 5% Sample concentration	Flagged with "C"
	LCS	70–130% recovery	Data reviewed[b]
	MS or PS, and MSD	75–125% recovery	Flagged with "N"
	Laboratory Duplicate or MS/MSD	≤ 30% RPD[c]	Data reviewed[b]
	EB, FTB	< 2 times MDL	Flagged with "Q"
	Field Duplicate	≤ 30% RPD[c]	Flagged with "Q"
Metals			
Metals -ICP-AES/ICP-MS[f]	MB	< RDL < 5% Sample concentration	Flagged with "C"
	LCS	70–130% recovery	Data reviewed[b]
	MS or PS, and MSD	75–125% recovery	Flagged with "N"

Table E-11. Laboratory Quality Control and Acceptance Criteria

Analysis	Quality Control	Acceptance Criteria	Corrective Action
	MS/MSD	≤ 30% RPD	Data reviewed[b]
	EB, FTB	< 2 times MDL	Flagged with "Q"
	Field Duplicate	≤ 30% RPD[c]	Flagged with "Q"
Chromium (VI) by Colorimetric	MB	< RDL < 5% Sample concentration	Flagged with "C"
	LCS	70–130% recovery	Data reviewed[b]
	MS or PS, and MSD	75–125% recovery	Flagged with "N"
	MS/MSD	≤ 30% RPD	Data reviewed[b]
	EB, FTB	< 2 times MDL	Flagged with "Q"
	Field Duplicate	≤ 30% RPD[c]	Flagged with "Q"
Mercury by Cold Vapor AA	MB	< RDL < 5% Sample concentration	Flagged with "C"
	LCS	70–130% recovery	Data reviewed[b]
	MS and MSD	75–125% recovery	Flagged with "N"
	Laboratory Duplicate or MS/MSD	≤ 30% RPD	Data reviewed[b]
	EB, FTB	< 2 times MDL	Flagged with "Q"
	Field Duplicate	≤ 30% RPD[c]	Flagged with "Q"
Volatile Organic Compounds			
Volatiles by GC/MS[f]	MB	< MDL[d] < 5% sample concentration	Flagged with "B"
	LCS	Statistically derived[a]	Data reviewed[b]
	MS or PS and MSD or PSD	%Recovery statistically derived[a]	Flagged with "T" if analyzed by GC/MS, otherwise "N" based on FEAD
	MS/MSD or PS/PSD	%RPD statistically derived[a]	Data reviewed[b]
	SUR	Statistically derived[a]	Data reviewed[b]
	EB, FTB,FXR	< 2 times MDL	Flagged with "Q"
	Field Duplicate	≤ 30% RPD[c]	Flagged with "Q"

Table E-11. Laboratory Quality Control and Acceptance Criteria

Analysis	Quality Control	Acceptance Criteria	Corrective Action
Semivolatile Organic Compounds			
Semivolatiles by GC or GC/MS[f]	MB	< MDL < 5% sample concentration	Flagged with "B"
	LCS	Statistically derived[a]	Data reviewed[b]
	MS and MSD	%Recovery statistically derived[a]	Flagged with "T" if analyzed by GC/MS, otherwise "N" based on FEAD
	MS/MSD	%RPD statistically derived[a]	Data reviewed[b]
	SUR	Statistically derived[a]	Data reviewed[b]
	EB, FTB	< 2 times MDL	Flagged with "Q"
	Field Duplicate	≤ 30% RPD[c]	Flagged with "Q"
Pesticides by GC[f]	MB	< MDL < 5% sample concentration	Flagged with "B"
	LCS	Statistically derived[a]	Data reviewed[b]
	MS and MSD	%Recovery statistically derived[a]	Flagged with "T" if analyzed by GC/MS, otherwise "N" based on FEAD
	Laboratory Duplicate or MS/MSD	%RPD statistically derived[a]	Data reviewed[b]
	SUR	Statistically derived[a]	Data reviewed[b]
	EB, FTB	< 2 times MDL	Flagged with "Q"
	Field Duplicate	≤ 30% RPD[c]	Flagged with "Q"
PCBs by GC[f]	MB	< MDL < 5% sample concentration	Flagged with "B"
	LCS	Statistically derived[a]	Data reviewed[b]
	MS and MSD	%Recovery statistically derived[a]	Flagged with "T" if analyzed by GC/MS, otherwise "N" based on FEAD
	Laboratory Duplicate or MS/MSD	%RPD statistically derived[a]	Data reviewed[b]

Table E-11. Laboratory Quality Control and Acceptance Criteria

Analysis	Quality Control	Acceptance Criteria	Corrective Action
	SUR	Statistically derived[a]	Data reviewed[b]
	EB, FTB	< 2 times MDL	Flagged with "Q"
	Field Duplicate	≤ 30% RPD[c]	Flagged with "Q"

Notes:

The information in this table does not represent EPA requirements but is intended solely as guidance.

This table only applies to laboratory analyses. Specific conductance, pH, dissolved oxygen, temperature, and turbidity are not listed as they are measured in the field.

a. 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.

b. After review, corrective actions are determined on a case-by-case basis.

c. Applies only in cases where both results are greater than 5 times the method detection limit.

d. For common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the acceptance criteria is < 5 times the MDL.

e. See Table E-7 for constituent list.

f. See Table E-8 for constituent list.

EB = equipment blank
EPA = U.S. Environmental Protection Agency
FEAD = format for electronic analytical data
FTB = full trip blank
FXR = field transfer blank
GC/MS = gas chromatography/mass spectrometry
ICP-AES = inductively coupled plasma atomic emission spectrometry
LCS = laboratory control sample
MB = method blank
MDL = method detection limit
MS = matrix spike
PS = post-digestion spike
PSD = post-digestion spike duplicate
MSD = matrix spike duplicate
RDL = required detection limit
RPD = relative percent difference
SUR = surrogate

Data Flags

B (organics) = analyte was detected in both the associated QC blank and the sample)

C (inorganics/wetchem) = The analyte was detected in both the sample and the associated QC blank and the blank value exceeds 5% of the measured concentration present in the associated sample.

N = all except GC/MS – matrix spike outlier

T = volatile organic analysis and semivolatile organic analysis GC/MS – matrix spike outlier

Q = associated QC sample is out of limits

The QC protocols must be followed in the field and laboratory to ensure that reliable data are obtained. Field QC samples will be collected to evaluate the potential for cross-contamination and provide information pertinent to field sampling variability. Field QC sampling will include the collection of full trip blank, field transfer blank, equipment rinsate blank, field duplicate, and field split samples. Laboratory QC samples estimate the precision and bias of the analytical data. Field and laboratory QC samples are summarized in Table E-10.

E2.2.5.1 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, split samples, and two types of field blanks

(full trip and equipment blanks). Field blanks are typically prepared using high-purity reagent water. The QC sample definitions and their required frequency for collection are described in this section.

Full Trip Blanks (FTBs) are prepared by the sampling team prior to traveling to the sampling site. The preserved bottle set is either for volatile organic analysis (VOA) only or identical to the set that will be collected in the field. It is filled with high-purity reagent water or dead water from Well 699-S11-E12AP for low-level tritium FTBs[3], or silica sand, as appropriate to the primary sample media. The bottles are sealed and will be transported, unopened, to the field in the same storage containers used for samples collected the same day. The collected FTBs are typically analyzed for the same constituents as the samples from the associated sampling event. FTBs are used to evaluate potential contamination of the samples attributable to the sample bottles, preservative, handling, storage, and transportation.

Field Transfer Blanks (FXRs) are preserved VOA sample vials filled with high-purity reagent water or silica sand (as appropriate to the primary sample media) at the sample collection site where VOC samples are collected. The samples will be prepared during sampling to evaluate potential contamination attributable to field conditions. After collection, FXR sample vials will be sealed and placed in the same storage containers with the samples collected the same day for the associated sampling event. FXR samples will be analyzed for VOCs only.

Equipment blanks (EBs) consist of reagent water or silica sand (as appropriate to the primary sample media) passed through or poured over the decontaminated sampling equipment identical to the sample set that will be collected and placed in sample containers, as identified on the SAF. The EB sample bottles will be placed in the same storage containers with the samples from the associated sampling event. The EB samples will be analyzed for the same constituents as the samples from the associated sampling event. The EBs will be used to evaluate the effectiveness of the decontamination process.

EBs are collected from reusable sampling devices on a 1-in-20 basis and are not required for disposable sampling equipment.

For the field blanks (i.e., FTB, FXR, and EB), results greater than two times the method detection limit are identified as containing suspected contamination. However, for common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the limit is five times the method detection limit. For radiological analytical data, blank results are flagged if they are greater than two times the total minimum detectable activity.

Field duplicates are independent samples collected as close as possible to the same time and same location as the schedule sample, and are intended to be identical. Duplicates are placed in separate sample containers and analyzed independently. The duplicates are collected at a frequency of 1 in 20 samples and should be collected generally from an area expected to have some contamination so valid comparisons between the samples can be made (i.e., some constituents that will likely be greater than their detection limit). 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. VOC analysis soil duplicates are not to be homogenized or split and will be collected as collocated samples, described below. 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

[3] Because of the low detection levels achieved in the low-level tritium analysis, special low-level tritium water must be used. This low-level tritium water, known as “dead water,” is collected yearly, or as needed, from well 699-S11-E12AP or other approved source.

Duplicates must agree within 20% (for water samples) and 30% (for soil samples), as measured by the relative percent difference (RPD), to be acceptable. Only those duplicates with at least one result greater than five times the appropriate detection limit are evaluated. Large RPDs can be an indication of potential laboratory performance problems, filed sampling problems, or sample heterogeneity and should be investigated. Duplicate results not satisfying evaluation criteria will be qualified and flagged in HEIS, as appropriate.

Field splits are two samples collected as close as possible to the same time and same location and are intended to be identical. Soil SPLITs for VOA will be sampled as collocated samples, as described above. SPLITs will be stored in separate containers and analyzed by different laboratories for the same or similar analytes. SPLITs are inter-laboratory comparison samples used to evaluate comparability between laboratories. Large RPDs can be an indication of potential laboratory performance problems and should be investigated.

E2.2.5.2 Laboratory Quality Control Samples

Internal QA/QC programs are maintained by the laboratories utilized by the project. Laboratory QA includes a comprehensive QC program that includes the use of matrix spikes, matrix duplicates, matrix spike duplicates, laboratory control samples, surrogates, tracers, and method blanks. These QC analyses are required by EPA (e.g., those in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B,* as amended) and will be run at the frequency specified in the respective reference unless superseded by agreement. Laboratory QC requirements are also specified in the HASQARD (DOE/RL-96-68).

The QC checks outside of control limits are documented in analytical laboratory reports and during DQAs, if performed. Laboratory QC and their typical frequencies are listed in Table E-10.

For organic analyses QC acceptance criteria are typically statistically derived from historical data at the laboratories in accordance with SW-846. Laboratory QC criteria, acceptance criteria, and corrective actions by analysis type are provided in Table E-11.

E2.2.5.3 Quality Control Requirements

Field duplicates and splits must agree within 30 percent, as measured by the RPD, to be acceptable. Only those field duplicates with at least one result greater than five times the appropriate detection limit are evaluated. Field duplicate results not satisfying evaluation criteria will be qualified and flagged in HEIS, as appropriate.

For chemical analyses, the control limits for laboratory duplicate samples, matrix spike samples, matrix spike duplicate samples, and laboratory control samples are typically derived from historical data at the laboratories in accordance with SW-846. Typical control limits are within 30 percent of the expected values, although the limits may vary considerably depending upon the method and analyte. For this project, the control limits for laboratory QC samples are specified in Table E-11.

Holding time is the elapsed period between sample collection and analysis. Exceeding required holding times could result in changes in constituent concentrations due to volatilization, decomposition, or other chemical alterations. If holding times are exceeded, the effects of the holding time exceedance on the results will be evaluated on a case-by-case basis. Required holding times depend on the analytical method, as specified for three-digit EPA methods (EPA-600/4-79-020) or for the four-digit EPA methods (SW-846).

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. The CH2M Hill Plateau Remediation Company S&GRP periodically audits the analytical laboratories to identify, resolve, and prevent quality problems. Audit results are used to improve performance. Summaries of audit results and performance evaluation studies are presented in the annual groundwater monitoring report.

Failure of QC will be determined and evaluated during data validation and DQA processes. Data will be qualified and flagged in HEIS, as appropriate.

E2.2.5.4 Instrument and Equipment Testing, Inspection, and Maintenance

Collection, measurement, and testing equipment should meet applicable standards (e.g., ASTM International, formerly the American Society for Testing and Materials) or should have been evaluated as 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 in the laboratory directly affecting the quality of analytical data will be subject to preventive maintenance measures to ensure minimization of measurement system downtime. Laboratories and onsite measurement organizations 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. Maintenance of laboratory instruments will be performed in a manner consistent with applicable Hanford Site requirements.

E2.2.5.5 Instrument and Equipment Calibration and Frequency

Specific field equipment calibration information is provided in Section E3.7. Analytical laboratory instruments and measuring equipment are calibrated in accordance with the laboratory's QA plan and applicable Hanford Site requirements.

E2.2.5.6 Inspection and Acceptance of Supplies and Consumables

Consumables, supplies, and reagents will be reviewed in accordance with internal work requirements and processes described in the contractor acquisition system. Supplies and consumables used in support of sampling and analysis activities are procured in accordance with internal work requirements and processes. 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 purchased items comply with applicable procurement specifications. Supplies and consumables are checked and accepted by users prior to use.

E2.2.5.7 Nondirect Measurements

Nondirect measurements include data obtained from sources such as computer databases, programs, literature files, and historical databases, will be technically reviewed to the same extent as the data generated as part of any sampling and analysis QA/QC effort. All data used in evaluations will be identified by source.

E2.2.6 Data Management

Environmental data will be managed to ensure the integrity and quality of the data are preserved. Data processing activities will be controlled to ensure that the introduction of errors is minimized while environmental data are being collected, transferred, stored, analyzed, and reviewed. The SMR organization, in coordination with the 200-WA-1 and 200-BC-1 OU Project Manager, is responsible for ensuring that analytical data are appropriately reviewed, managed, and stored in accordance with the

applicable programmatic requirements governing data management methods. Data processing practices will include some or all of the following controls to avoid errors during data handling and manipulation:

- Perform periodic checks/reviews to ensure data is not lost or incorrectly transcribed when transferred from one format to another
- Minimize the number of data transfer steps and the number of personnel handling the data
- Institute access control and accountability measures to protect hardcopy and electronic database files.

Electronic data access, when appropriate, will be through a Hanford Site database (e.g., HEIS) or a project-specific database, whichever is applicable for the data being stored. Where electronic data are not available, hard copies will be provided in accordance with Section 9.6 of the TPA Action Plan (Ecology et al., 1989b).

Laboratory errors are reported to the SMR organization on a routine basis. 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 their 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.

Further details on documentation of field activities are provided in Section E3.6 and shall be prepared, reviewed, approved, and maintained according to prescribed processes.

E2.3 Assessment and Oversight

The elements in assessment and oversight address the effectiveness of project implementation and associated QA and QC activities. The purpose of assessment is to ensure that the QAPjP is implemented as prescribed.

E2.3.1 Assessments and Response Actions

Random surveillances and assessments verify compliance with the requirements outlined in this SAP, project field instructions, the QAPjP, methods, and regulatory requirements. Assessments include, but are not limited to, surveillances, management systems reviews, readiness reviews, technical systems audits, performance evaluations, audits of data quality, and DQAs. Assessment processes, roles and responsibilities will be in accordance with existing QA program methods and as directed jointly by the OU Project Manager and the QA POC. Deficiencies identified by these assessments will be reported in accordance with existing programmatic requirements. The project's line management chain coordinates the corrective actions/deficiencies resolutions in accordance with the QA program, the corrective action management program, and associated methods implementing these programs. When appropriate, corrective actions will be taken by the OU Project Manager (or designee).

The OU Project Manager will determine whether a DQA will be performed for the activities identified in this SAP. The DQA process, if performed, is discussed in Section E2.2.5. The results of the DQA 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 assessment activities, then additional assessments would be performed.

Oversight activities in the analytical laboratories, including corrective action management, are conducted in accordance with the laboratories' QA plans. The contractor oversees offsite analytical laboratories and verifies the laboratories are qualified for performing Hanford Site analytical work.

E2.3.2 Reports to Management

Management 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 the SMR organization, 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.

E2.4 Data Validation and Usability

This section addresses the QA activities that occur after the data collection phase. Implementation of these activities determines whether or not the data conform to the specified criteria, thus satisfying the project objectives.

E2.4.1 Data Review, Verification, and Validation

Data review and verification are performed to confirm that sampling and chain-of-custody documentation are complete. This review shall include linking sample numbers to specific sampling locations, reviewing sample collection dates and sample preparation and analysis dates to assess whether holding times, if any, have been met, and reviewing QC data to determine whether analysis have met the data quality requirements specified in this 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 also will be reviewed to ensure that they are usable.

Errors identified by the laboratories are reported to the SMR organization's project coordinator, who initiates a sample issue resolution form. This process is used to document analytical errors and to 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 that physical property data and/or field screening results are usable.

The OU Technical Lead data review will help determine if observed changes reflect improved/degraded groundwater quality or potential data errors and may result in submittal of a request for data review (RDR) on questionable data. The laboratory may be asked to check calculations or reanalyze the sample, or the well may be resampled. Results of the RDR process are used to flag the data appropriately in the HEIS database and/or to add comments.

E2.4.2 Data Validation

Data validation activities will be performed at the discretion of the OU Project Manager and under the direction of the SMR organization. If performed, data validation activities will be based on EPA functional guidelines. Data validation qualifiers must be compatible with the HEIS database.

Data validation is an independent assessment to ensure that the reliability of data is known. Analytical data validation provides a level of assurance that an analyte is present or absent. Validation might also include verification of instrument calibrations, evaluation of analytical results based upon 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 the reliability of the data. Data validation will be in accordance with internal 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 percent review of all data (e.g., calibration data,

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, matrix spike/matrix spike duplicate results, surrogate recoveries, and duplicate sample results. Level C data validation will be performed on at least 5 percent of the data by matrix and analyte group. Analyte group refers to categories, such as radionuclides, volatile chemicals, semivolatiles, polychlorinated biphenyls (PCBs), metals, anions, etc. The goal is to include each of the various analyte groups and matrices during the data validation process.

E2.4.3 Reconciliation with User Requirements

The DQA process compares completed field sampling activities to those proposed in corresponding sampling documents and provides an evaluation of the resulting data. The purpose of the DQA is to determine whether quantitative data are of the correct type and are of adequate quality and quantity to meet the project DQOs. DQA will be performed at the discretion of the OU Project Manager and documented in a report. The results of the DQA will be used in interpreting the data and determining if the objectives of this activity have been met.

E3 Field Sampling Plan

The objective of the FSP is to identify project sampling and analysis activities. The FSP uses the sampling design identified during the systematic planning process and includes defining the number of sample locations, sampling methods, field documentation, field equipment calibration requirements, and specific information on the various data collection technologies.

E3.1 Sampling Activities

This FSP identifies the soil sampling activities designed to meet the 200-WA-1 and 200-BC-1 OU data needs. Data needs were defined in Section E1.4 and include the following:

- An estimate of the extent of contamination and the baseline contaminant concentrations within the top 4.6 m (15 ft) of ground surface to evaluate potential risk to HHE
- A determination of the horizontal and vertical extent of shallow contamination for remedy selection
- An estimate of the potential current and future threat to groundwater from the contamination that resulted from these sites
- A determination of the vertical extent of deep vadose contamination

Table E-12 presents a summary of the 200-WA-1 and 200-BC-1 OU waste site sampling activities with their respective rationales, grouped by plant site and contamination depth. The detailed FSPs for each waste site are provided in Appendix D.

Similar and adequately characterized sites are addressed in Table E-12 and Appendix D, but no sampling is planned for them under this FSP. Sampling strategies for each waste site category—shallow, intermediate, or deep—are described in the following sections.

E3.2 Waste Site Boundaries

For many sites, the lateral boundaries are well defined by a crib, trench, or other structure. However, determining the boundaries of some waste sites, especially windblown speck sites or small UPRs, will be

challenging, and sites previously stabilized with a gravel cover may be particularly problematic. Some or all of the following tools/procedures may be required to accomplish this task.

1. Review background information. Appendix D provides a site map as well as a summary of historical information and previous characterization (if conducted) for consideration during initial planning of sampling events.

2. Site reconnaissance is essential for detecting slabs or other structures, potential contamination sources such as pipe outfalls, stressed or unusual vegetation, stained soil, etc., that will aid in identifying and delineating a given waste site.

3. Portable radiological detection instruments for screening the soil surface (or physical structures exposed at the surface) may provide useful data for site delineation. Stabilization covers are likely to require spot removal (based on an area-wide grid sampling strategy) for surface radiological screening to be effective.

4. In the absence of any visual or radiological clues, the Field Team Lead (FTL) may resort to soil sampling and analysis to locate/define a waste site. Depending on the suspected size of the site, area-wide grid or composite sampling strategy may be necessary to provide adequate data to delineate a waste site.

E3.3 Asbestos

Site background information in Appendix D indicates that asbestos is likely to be present at three waste sites: 200-W-13 (T Plant), 200-W-89 (U Plant), and 600-70 (S Plant). Additionally, the presence of transite is not uncommon across the Central Plateau and may be encountered during fieldwork at other waste sites. Collection and disposal of transite pieces will be conducted in accordance with applicable or relevant and appropriate requirements.

E3.4 Sampling Strategies

The purpose of field sampling is to obtain representative samples from the most probable zones of contamination for characterization. For sites with shallow contamination, sampling activities define the horizontal and vertical boundaries of the waste site, and collect representative samples for the BRA (exposure point calculations) for each point of compliance that is impacted, including surface soil (0 to 0.3 m [0 to 1 ft]), and subsurface soil 0 to 4.6 m [0 to 15 ft]). Sites with deep vadose zone contamination will be sampled to determine the vertical boundaries (top and bottom) of contamination, to estimate maximum concentrations within the deep vadose zone profile for groundwater protection modeling, and to collect data for vadose zone modeling. This section provides the criteria for selecting the depths, interval thicknesses, and number of samples used to characterize contamination at shallow, deep, and intermediate sites (as defined in Section E1.2).

E3.4.1 Shallow Sites

For the shallow sites, contamination is not expected to extend deeper than 4.6 m (15 ft), and generally results from surface debris disposal, UPRs, minor leaks, and windblown specks. Because sampling techniques often differ between surface and subsurface soil, shallow contamination sites were divided into two categories: surface contamination only sites and subsurface contamination sites. For the surface contamination only sites, contamination is believed to be limited to the top foot (beneath the stabilization cover, if present). For the subsurface contamination sites, contamination is expected to be between 0.3 and 4.6 m (1 and 15 ft) bgs, but may also be present at the surface.

E3.4.1.1 Shallow Sites, Surface Contamination Only (0 to 0.3 m [0 to 1 ft])

While contamination is expected to be limited to the top foot for these sites, if field screening or sampling results indicate that contamination extends below this depth, then additional sampling as described for shallow sites, subsurface contamination (0 to 4.6 m [0 to 15 ft] bgs) will be conducted.

For well-defined sites, focused sampling will be completed at locations where contamination is expected based on background information, site reconnaissance, and surface radiological screening. Targeting the most probable zones of contamination, representative surface samples will be obtained and sample number will depend on the area of the waste site. Eight samples are the minimum needed to run exposure point concentration calculations. However, for sites with very limited areas, only one or two samples may be practical. In these cases, exposure point concentrations will be based on the maximum concentration detected.

Area-wide grid or composite sampling (described in Section E2.2.1) will be conducted if site reconnaissance and surface screening give no indication of contaminant location. Sample design and number of samples will be based on professional judgment and depend on the expected extent of the waste site and contaminant homogeneity. Surface soil samples will be collected, visually analyzed, and field screened for radiological, organic, or metal constituents, as appropriate. If contamination is detected in a screening sample, it will be retained for laboratory analyses. Ideally, a minimum of eight samples providing representative coverage of the waste site will be collected for analysis. If screening provides no indication of contamination, approximately eight representative samples will be collected to confirm the absence of contamination in the top foot of soil.

E3.4.1.2 Shallow Sites, Subsurface Contamination (0 to 4.6 m [0 to 15 ft] bgs)

While the majority of contamination at these sites is expected to be between 0.3 and 4.6 m (1 and 15 ft) bgs, contamination also may be present at the surface. At well-defined waste sites, focused sampling will be conducted using DPT at locations where contamination is expected, based on background information, site reconnaissance, surface screening, and/or screening conducted during surface sample collection. Continuous sampling will be conducted from the soil surface (below stabilization cover if present) to approximately 4.6 m (15 ft) bgs, recovering soil in 0.6 m (2 ft) thick cores from (approximately) 0 to 0.6 m (0 to 2 ft), 0.6 to 1.2 m (2 to 4 ft), 1.2 to 1.8 m (4 to 6 ft), 1.8 to 2.4 m (6 to 8 ft), 2.4 to 3.0 m (8 to 10 ft), 3.0 to 3.6 m (10 to 12 ft), 3.6 to 4.3 m (12 to 14 ft), and 4.3 to 4.9 m (14 to 16 ft) bgs. Cores will be opened to allow screening, both visually and by appropriate portable detection instrument, and samples collected for laboratory analyses from cores exhibiting positive screening results.

A total of 8 to 15 samples per point of compliance (0 to 4.6 m [0 to 15 ft]), depending on vertical extent of contamination, will be recovered from approximately two to three DPT borings at each waste site. The number of samples will be adjusted depending on the size, configuration, and heterogeneity of the site. For very small waste sites, it may not be practical to conduct more than one DPT. Each DPT will terminate at clean soil, stopping above or continuing below 4.6 m (15 ft) bgs as indicated by screening results. At least one interval of clean soil will be collected to confirm (lower) vertical extent of contamination. If field screening or sampling results indicate that contamination extends well below 4.6 m (15 ft), then additional sampling as described below for intermediate and deep sites, deep vadose zone contamination, will be conducted.

As necessary, soil samples will be collected and screened from additional DPTs to estimate the lateral extent of subsurface contamination.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
200-E-14	BC Cribs and Trenches	Intermediate	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep and two shallow borings will be installed adjacent to the siphon tank. The deep boring will be installed adjacent to the discharge pipe near the siphon piping to the depth of contamination based on field screening. The tank and its contents will be evaluated consistent with the approach developed in the 200-IS-1 OU Work Plan.	Siphon tank may have leaked an unknown volume of liquid waste. Data are needed to evaluate the nature and extent of shallow and deep vadose zone contamination. Data are needed to characterize the tank and its contents.
200-W-1	S Plant	Intermediate	Follow the SAP protocol for intermediate and deep sites using a focused sampling approach. Complete two shallow borings (0 to 4.6 m [0 to 15 ft] bgs), and one deep boring if shallow borings indicate contamination at a greater depth.	Mud Pit received unknown volume of liquid waste. Data are needed to evaluate nature and extent of shallow and deep vadose zone contamination.
200-W-106	T Plant	Shallow – Subsurface	Follow the SAP protocol for shallow sites, subsurface contamination, using an area-wide grid sampling strategy.	Contaminated soil and miscellaneous debris disposal site. Covered with clean backfill. No characterization data. Release history is poorly defined. Data are needed to evaluate the nature and extent of subsurface soil contamination above 4.6 m (15 ft).

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
200-W-11	S Plant	Shallow – Subsurface	A pre-investigation is needed to identify locations of potential releases (e.g., foundation perimeter, burn sites, trenches, buried debris, distinct disposal areas). The foundation investigation will follow the SAP protocol for concrete slabs and foundations. Subsequently, the soil investigation for this site will follow the SAP protocol for shallow, subsurface contamination, using a focused sampling strategy.	Approximately 1.2 ha (3 ac) miscellaneous disposal site, unspecified waste, and release volume. Scattered construction debris, foundation. Data are needed to evaluate the foundation and shallow (0 to 4.5 m [0 to 15 ft]) soil contamination.
200-W-12	U Plant	Shallow – Subsurface	Follow SAP protocol for shallow sites, subsurface contamination using a focused sampling strategy. Field reconnaissance and test pits will be used to determine if an underground tank exists. If a tank is discovered, the tank and its contents will be evaluated consistent with the approach developed in the 200-IS-1 OU Work Plan.	Soil mound with two pipes extending above ground, and visible wires and electrical equipment. Purpose unknown, possibly a test site. No characterization data are available. The release history is poorly defined. Site reconnaissance and field screening are needed to determine the nature of the waste site and sampling is needed to determine contaminant concentration(s). If it is determined a UST is present, data are needed to characterize the tank and its contents.
200-W-127	T Plant	Intermediate	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep and two shallow (0 to 4.6 m [0 to 15 ft] bgs) borings will be installed adjacent to the two pipelines buried beneath the site. The deep boring will be installed to the depth of contamination based on field screening.	Release near two pipelines, content, and volume unknown. Data are needed to evaluate shallow and deep vadose zone contamination.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
200-W-128	T Plant	Shallow – Surface Only	Follow the SAP protocol for shallow sites, surface contamination, using an area-wide grid sampling strategy.	Contaminated windblown sand from burial ground with additional unknown sand deposition. No characterization data. Release history and site boundaries are poorly defined. Data are needed to evaluate the nature and extent of surface soil contamination (0 to 0.3 m [0 to 1 ft]).
200-W-13	T Plant	Intermediate	Site reconnaissance and surface radiation screening are needed to identify locations of potential releases (for example, stained soil, debris areas, and distinct disposal areas). Subsequently, the soil investigation will follow the SAP protocol for intermediate subsurface contamination using a focused sampling strategy. Propose surface and shallow sample collection from at least five potential release locations, plus a deep boring near the underground radiation posting in the southwest portion of the site to depth of contamination based on field screening.	0.9 ha (2.3 ac) storage yard and maintenance facility for contaminated equipment. Type and volume of waste not specified. Data are needed to delineate contaminated areas and evaluate shallow and deep vadose zone contamination.
200-W-14	T Plant	Shallow – Subsurface	Follow the SAP protocol for shallow sites, subsurface contamination, using an area-wide grid sampling strategy.	Heavy equipment storage with 5-6 patches of petroleum-contaminated soil. No characterization data. Release history and site boundaries are poorly defined. Depth of stabilization cover is unknown. Data are needed to evaluate the nature and extent of subsurface soil contamination (0 to 4.6 m [0 to 15 ft]).

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
200-W-15	S Plant	Intermediate	Field investigation will follow protocol for intermediate and deep sites, using a focused sampling strategy. Two shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be installed within the pipe trench boundaries, through the asphalt covering the site and adjacent to the pipeline. The deep borehole will be installed only if shallow borings indicate contamination at a greater depth.	MIBK and surfactant contaminated soil used to backfill trench. Volume of release is unknown. Location covered with asphalt. Data are needed to evaluate shallow and deep vadose zone contamination.
200-W-2	S Plant	Shallow –Subsurface	Follow the SAP protocol for shallow sites, subsurface contamination, using an area-wide grid sampling strategy. Focused sampling may be conducted in bermed areas.	Several acres of disturbed soil and two unmarked bermed areas. Waste type and volume unknown, boundaries poorly defined. Data are needed to evaluate the nature and extent of subsurface (0 to 4.6 m [0 to 15 ft]) soil contamination.
200-W-21	T Plant	Shallow –Subsurface	The soil investigation will follow the SAP protocol for shallow sites, subsurface contamination, using an area-wide grid sampling strategy in the area surrounding the two concrete foundation pads, with some focused sampling adjacent to pads. Investigation of the unloading pads will follow the SAP protocol for concrete slabs and foundations.	204-T Unloading Station for 300 Area liquid laboratory waste, leaks, and contaminated foundation. No characterization data. Release history and site boundaries are poorly defined. Depth of stabilization cover is not known. Data are needed to evaluate the unloading pads. Data are needed to evaluate nature and extent of shallow, subsurface soil contamination (0 to 4.6 m [0 to 15 ft] bgs).

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
200-W-22	S Plant	Intermediate	A geophysical survey is needed to identify the foundations of former structures. Investigation of the unloading pads will follow the SAP protocol for concrete slabs and foundations. Soil investigation will follow the SAP protocol for intermediate and deep waste sites using an area-wide grid strategy, working around former structures. Approximately 15 to 20 potential release locations (foundations, rail lines, buried pipes, unloading facilities, etc.) will be selected for a screening-level field investigation to locate contaminated soil. Once located, soil samples will be collected from 2 to 3 DPTs (0 to 4.6 m [0 to 15 ft] bgs) as described for focused sampling. A deep boring will be installed in the area of highest contamination, to a depth based on field screening.	Approximately 0.6 ha (1.4 ac) affected by releases associated with unloading, transportation, storing and processing of uranyl nitrate hexahydrate. Release volumes are unknown. Surface features have been removed and at least part of area blacktopped. Data are needed to delineate sources and evaluate shallow and deep vadose zone contamination. Data are needed to evaluate the unloading pads.
200-W-231	T Plant	Intermediate	The septic tank contents (if present) will be sampled. Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. Shallow borings will be installed at the septic tank and near the septic drain field inlet. A deep boring will be installed only if contamination is evident below 4.6 m (15 ft).	Septic system included x-ray laboratory bathrooms. Release volume is unknown. Data are needed to evaluate shallow and deep vadose zone contamination. Data are needed to evaluate the tank contents.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
200-W-244-PL	U Plant	Shallow – Subsurface	Once the 200-IS-1 OU Work Plan has determined a methodology for pipeline data needs assessment, the 200-W-244-PL will be evaluated consistently with that approach. If additional data needs are identified for 200-W-244-PL using the 200-IS-1 OU approach, the 200-WA-1 and 200-BC-1 OU SAP will be amended to incorporate characterization required to fulfill those data needs.	Six pipelines in a concrete encasement connecting the 221-U Canyon to the 241-WR Vault. No release has been documented along the 200-W-244-PL. The specific data needs assessment methodology for 200-W-244-PL should be consistent with the approach for assessing data needs for other similar 200 Areas pipeline sites. The RI/FS Work Plan for the 200-IS-1 OU is under development.
200-W-248-PL	U Plant	Shallow – Subsurface	Once 200-IS-1 OU Work Plan has determined a methodology for pipeline data needs assessment, the 200-W-248-PL will be evaluated consistently with that approach. If additional data needs are identified for 200-W-248-PL using the 200-IS-1 OU approach, the 200-WA-1 and 200-BC-1 OU SAP will be amended to incorporate characterization required to fulfill those data needs.	Three buried stainless steel pipelines connecting 241-UX-154 Diversion Box to the 200-W-244-PL concrete encasement near the south wall of the 241-WR Vault. No release has been documented along the 200-W-248-PL. The specific data needs assessment methodology for 200-W-248-PL should be consistent with the approach for assessing data needs for other similar 200 Areas pipeline sites. The RI/FS Work Plan for the 200-IS-1 OU is under development.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
200-W-42	U Plant	Intermediate	No sampling is proposed for the 244 m (800 ft) of the VCP pipeline, downstream of the 270-W Neutralization Tank have been remediated (RTD) and sampled. If additional characterization is warranted in the area of the removed portion of the pipeline based on any final cleanup level exceedances, a SAP revision may be necessary at that time. The specific data needs assessment methodology for 200-W-42-PL for the remaining stainless steel segment of the 200-W-42 pipeline should be consistent with the approach developed in the 200-IS-1 OU Work Plan. If additional data needs are identified for 200-W-42 using the 200-IS-1 OU approach, the 200-WA-1/ 200-BC-1 OU SAP will be amended to incorporate characterization required to fulfill those data needs.	Approximately 610 m (~2,000 ft) process sewer pipeline. 244 m (800 ft) of the VCP pipeline, downstream of the 270-W Neutralization Tank have been remediated (RTD) and sampled. However, regulatory approval of final cleanup levels for this site have not been obtained. No characterization data are available for the remaining stainless steel segment of the pipeline upstream of the 270-W neutralization tank, though in-line camera surveys of a similar feed line to 216-U-1&2 indicate the line is in the same condition as installed; thus, it can be inferred that the likelihood of release from the stainless steel segments of the 200-W-42 pipeline is low. The specific data needs assessment methodology for 200-W-42 should be consistent with the approach for assessing data needs for other similar 200 Areas pipeline sites. The RI/FS Work Plan for the 200-IS-1 OU is under development.
200-W-44	U Plant	Intermediate	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep borehole will be installed adjacent to the French drain and soil samples collected to evaluate the nature and extent of contamination in shallow and deep soil. The contents of the sand filter will not be sampled.	No shallow or deep data are available from within the waste site footprint. Data are needed to reduce uncertainty associated with nature and extent of contamination resulting from discharge of liquid waste to the 200-W-44 sand filter French drain. The contents of the sand filter will not be sampled. Existing inventory, process knowledge, and construction details will be used for risk calculations and to evaluate remedial alternatives, so no samples of the filter media are needed.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
200-W-51	S Plant	Intermediate	A pre-investigation consisting of a site reconnaissance and possibly field screening to determine the presence of a drain field. Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. Two shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be installed, including one at the septic tank and one in the drain field (if located). The deep borehole will be installed only if contamination is evident below 4.6 m (15 ft).	The operational history of the 200-W-51 septic tank is unknown. No shallow or deep data are available from within the waste site footprint. The septic tank found during the construction activities was associated with the new SY Exhauster. The tank was decommissioned in 1994 in accordance with WAC 246-272.
200-W-53	T Plant	Shallow – Surface Only	Follow SAP protocol for shallow sites, surface contamination using an area-wide grid sampling strategy.	1.5 ha (3.6 ac) surface speck contamination, area scraped and soil removed. No surface soil characterization data. Release history and site boundaries are poorly defined. Data are needed to evaluate the nature and extent of surface soil contamination (0 to 0.3 m [0 to 1 ft]).
200-W-54	S Plant	Shallow – Surface Only	Follow SAP protocol for shallow sites, surface contamination only using area-wide grid sampling strategy.	Migrating and expanding contaminated specks, vegetation, and feces originated from tank farm activities or adjacent areas. No stabilization cover. Data are needed to evaluate the nature and extent of surface soil contamination (0 to 0.3 m [0 to 1 ft]).
200-W-6	T Plant	Intermediate	Determine waste site location from historical records, site reconnaissance, and field screening. Subsequently, soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. Two shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be installed. A deep borehole will be installed only if shallow borings indicate contamination at a greater depth.	Paint solvent disposal area beneath painter's shop. Release location and volume unknown. Data are needed to determine location and evaluate shallow and deep vadose zone contamination.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
200-W-63	T Plant	Shallow – Subsurface	Follow SAP protocol for shallow sites, subsurface contamination using an area wide grid sampling strategy for soil surrounding the pad. Additionally, determine contaminant levels on pad surface and whether it is smearable or fixed. The concrete pad investigation will follow the SAP protocol for concrete slabs and foundations.	Contaminated concrete pad and debris, covered with gravel. Release history poorly defined. Need to determine contaminant levels for the pad, and evaluate the nature and extent of shallow, subsurface contamination (0 to 4.6 m [0 to 15 ft] bgs) surrounding the pad.
200-W-67	U Plant	Shallow – Surface Only	Follow SAP protocol for shallow sites, surface contamination using an area-wide grid sampling strategy.	UPR adjacent to the 216-U-3 French drain. Stabilization cover present. No characterization data are available. The release history and site boundaries are poorly defined. Sampling is needed to evaluate the nature and extent of surface contamination (0 to 0.3 m [0 to 1 ft] bgs) surrounding the pad.
200-W-71	U Plant	Shallow – Subsurface	Follow SAP protocol for shallow sites, subsurface contamination using area-wide grid sampling strategy to locate former trench, followed by 3 DPT within trench boundaries.	Trench possibly used for maintenance disposal, or as burn pit. Site has been backfilled, and no longer visible. The release history is poorly defined. Data are needed to evaluate the nature and extent of shallow, subsurface contamination (0 to 4.6 m [0 to 15 ft] bgs).
200-W-75	S Plant	Shallow – Subsurface	Follow SAP protocol for shallow sites, subsurface contamination using a focused sampling strategy. The silo contents will be sampled.	Four buried silos used for storage of solid radioactive material. Covered with clean backfill. No characterization data are available and the release history is poorly defined. Data are needed to characterize the silo contents. Data are needed to evaluate the nature and extent of shallow, subsurface contamination (0 to 4.6 m [0 to 15 ft] bgs).

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
200-W-77	U Plant	Shallow – Surface Only	Follow SAP protocol for shallow sites, surface contamination using a focused sampling strategy.	UPR to ground at RR tracks. Stabilization cover present. No characterization data are available. The release history and site boundaries are poorly defined. Data are needed to evaluate the nature and extent of surface soil contamination (0 to 0.3 m [0 to 1 ft]).
200-W-80	T Plant	Shallow – Subsurface	Follow the SAP protocol for shallow sites, subsurface contamination, using an area-wide grid sampling strategy.	Potentially contaminated mound was leveled in 2000 and surface stabilized. No soil data. Release history and site boundaries are poorly defined. Data are needed to evaluate the nature and extent of shallow, subsurface contamination (0 to 4.6 m [0 to 15 ft] bgs).
200-W-81	T Plant	Shallow – Surface Only	Follow SAP protocol for shallow sites, surface contamination only using an area-wide grid sampling strategy.	Three areas along RR track contaminated by tumbleweed fragments, each covered with clean gravel. Release history and site boundaries are poorly defined. Data are needed to evaluate the nature and extent of surface contamination (0 to 0.3 m [0 to 1 ft]), beneath the stabilization cover.
200-W-82	T Plant	Shallow – Subsurface	Follow SAP protocol for shallow sites, subsurface contamination using focused sampling strategy. The unloading station investigation will follow the SAP protocol for concrete slabs and foundations.	Area around unloading station is contaminated. No characterization data. Release history poorly defined. Data are needed to evaluate contamination level for the pad and to evaluate the nature and extent of shallow, subsurface contamination (0 to 4.6 m [0 to 15 ft] bgs).
200-W-83	U Plant	Shallow – Surface Only	Follow SAP protocol for shallow sites, surface contamination using an area-wide grid sampling strategy.	UPR to ground at RR tracks. Stabilization cover present. No characterization data are available. The release history and site boundaries are poorly defined. Data are needed to evaluate the nature and extent of surface soil contamination (0 to 0.3 m [0 to 1 ft]).

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
200-W-85	U Plant	Shallow – Surface Only	Follow SAP protocol for shallow sites, surface contamination using an area-wide grid sampling strategy.	UPR to ground, covered with clean backfill. The source of contamination and date of release at the site is unknown. The type and volume of waste are not specified. No characterization data are available. Data are needed to evaluate the nature and extent of surface soil contamination (0 to 0.3 m [0 to 1 ft]).
200-W-86	U Plant	Shallow – Subsurface	Follow SAP protocol for shallow sites, subsurface contamination using focused sampling strategy.	UPR around power pole. Stabilization cover present. No characterization data are available. The release history and site boundaries are poorly defined. Data are needed to evaluate the nature and extent of subsurface soil contamination (0 to 4.6 m [0 to 15 ft]).
200-W-87	U Plant	Shallow – Surface Only	Follow SAP protocol for shallow sites, surface contamination using area-wide grid sampling strategy.	Potential UPR from parked RR cars on track. Contamination unlikely beneath stabilization cover. No characterization data are available. Release history and site boundaries are poorly defined. Data are needed to evaluate the nature and extent of surface soil contamination (0 to 0.3 m [0 to 1 ft]).
200-W-89	U Plant	Shallow – Surface Only	Follow SAP protocol for shallow sites, surface contamination using an area-wide grid sampling strategy. The substation foundation investigation will follow the SAP protocol for concrete slabs and foundations.	Waste site at location of former electrical substation, lingering radioactive contamination in soil. Stabilization cover present. No soil characterization data are available. Release history and site boundaries are poorly defined. Data are needed to evaluate contamination levels for the concrete pad and to evaluate the nature and extent of surface soil contamination (0 to 0.3 m [0 to 1 ft]).

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
200-W-9	T Plant	Intermediate	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using an area-wide grid strategy, approximately 4 to 8 potential release locations will be selected for a screening-level field investigation to locate contaminated soil. Once located, two shallow borings will be installed adjacent to the old vitrified clay pipeline. Information from the two shallow borings will be used to plan a deep boring. If contamination appears to be significant in the top 4.6 m (15 ft) bgs, the deeper boring will be installed at the location of suspected release.	Possible pipeline leak. The liquid release volume and location are not known. Data are needed to evaluate shallow and deep vadose zone contamination.
200-W-90	T Plant	Shallow – Surface Only	Follow the SAP protocol for shallow sites, surface contamination, using an area-wide grid sampling strategy.	Three posted UPR sites in proximity, but no information on release. No characterization data. Release history poorly defined. Data are needed to evaluate the nature and extent of surface soil contamination (0 to 0.3 m [0 to 1 ft]).
200-W-92	T Plant	Shallow – Subsurface	Follow SAP protocol for shallow sites, subsurface contamination using focused sampling strategy.	Mound of contaminated soil and miscellaneous debris, location verified and mound stabilized with clean gravel cover. No characterization data. Release history poorly defined. Data are needed to evaluate the nature and extent of shallow, subsurface contamination (0 to 4.6 m [0 to 15 ft] bgs), below the stabilization cover.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
207-S	S Plant	Intermediate	Soil investigation will follow the SAP protocol for intermediate and deep waste sites, using the focused sampling strategy. The shallow borings will be installed within the basin to the top of the concrete floor (approximately 2 m [6.75 ft] bgs). The deep borehole will be advanced adjacent to the discharge pipe through the basin floor to the depth of contamination based on field screening. Sampling of the retention basin floor will follow the SAP protocol for retention basins.	Concrete retention basin, backfilled with contaminated soil, covered with clean soil. Release volume is unknown. Data are needed to evaluate shallow and deep vadose zone contamination, inside and beneath the basin. Data are needed to evaluate the concrete basin.
207-T	T Plant	Intermediate	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. Borings will be spatially distributed within the basin footprint. Three shallow borings will extend to basin floor (0.6 to 2 m [2 to 6.5 ft] bgs) to collect sufficient soil data for risk assessment. The deep boring will be installed within one of the basins, through the basin floor, to the depth of contamination based on field screening. Sampling of the retention basin floor will follow the SAP protocol for retention basins.	Two adjacent retention basins backfilled with contaminated soil. Release volume is unknown. Data are needed to evaluate shallow and deep vadose zone contamination beneath the basin. Data are needed to evaluate the concrete basin.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
207-U	U Plant	Intermediate	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep and two shallow borings will be installed. The two shallow boreholes will be installed adjacent to the inlet valve pit on the east side and the outlet valve pit on the west side of the basins. The deep boring will be advanced through the basin floor to extent of contamination, as determined by field screening. Sampling of the retention basin floor will follow the SAP protocol for foundations. Sediment accumulated in the basin floor will also be sampled.	Two adjacent empty retention basins lined with plastic. Release volume is unknown. Data are needed to evaluate shallow and deep vadose zone contamination beneath the basin and the concrete basin structure.
207-Z	Z Plant	Intermediate	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep and two shallow borings will be installed. The shallow borings will be located to obtain spatially distributed data beneath the basin floor to 4.6 m (15 ft) bgs. The deep boring will be advanced within the basin footprint, to extent of contamination, approximately 9.2 m [30 ft] bgs (0.2 pore volumes beneath the basin bottom). Sampling of the retention basin floor will follow the SAP protocol for retention basins.	Double basin used as a holding facility for steam condensate and cooling water. ~151,416 L (~40,000 gal) (0.04 pore volumes) leaked from basins. Basin has been deactivated and filled with high-density grout. Data are needed to evaluate shallow and deep vadose zone contamination. Data are needed to evaluate the concrete basin.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
216-B-14	BC Cribs and Trenches	Deep - Representative Site	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. Two shallow borings will be installed, one within the waste site floor footprint (outside the crib structure [near previous boreholes C6797 and C6800, which had high shallow cesium-137 readings]) and the other within the sidewall footprint (near previous borehole C6796, which had the highest shallow cesium-137 reading). One deep boring will be installed adjacent to the crib structure and near previous borehole C6803 (which had the highest deep cesium-137 reading) to groundwater (~103.6 m [~340 ft] bgs). Soil data for 216-B-14 will be used to characterize soil at 216-B-15, 216-B-16, 216-B-17, 216-B-18, and 216-B-19 Cribs.	Crib received 2.0 pore volumes of scavenged tank waste supernatant. No soil data available for this site, although extensive geophysical logging was performed in 2008 treatability study. Data are needed to evaluate shallow and deep vadose zone contamination.
216-B-15	BC Cribs and Trenches	Deep – Similar Site	Similar site to 216-B-14, no data will be collected for this site.	Crib received 1.4 pore volumes of scavenged tank waste supernatant. The shallow and deep soil data from the 216-B-14 Crib soil borings will be used to characterize this crib.
216-B-16	BC Cribs and Trenches	Deep – Similar Site	Similar site to 216-B-14, no data will be collected for this site.	Crib received 1.3 pore volumes of scavenged tank waste supernatant. The shallow and deep soil data from the 216-B-14 Crib soil borings will be used to characterize this crib.
216-B-17	BC Cribs and Trenches	Deep – Similar Site	Similar site to 216-B-14, no data will be collected for this site.	Crib received 0.8 pore volumes of scavenged tank waste supernatant. The shallow and deep soil data from the 216-B-14 Crib soil borings will be used to characterize this crib.
216-B-18	BC Cribs and Trenches	Deep – Similar Site	Similar site to 216-B-14, no data will be collected for this site.	Crib received 1.9 pore volumes of scavenged tank waste supernatant. The shallow and deep soil data from the 216-B-14 Crib soil borings will be used to characterize this crib.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
216-B-19	BC Cribs and Trenches	Deep – Similar Site	Similar site to 216-B-14, no data will be collected for this site.	Crib received 1.4 pore volumes of scavenged tank waste supernatant. The shallow and deep soil data from the 216-B-14 Crib soil borings will be used to characterize this crib.
216-B-20	BC Cribs and Trenches	Intermediate - Similar Site	Similar site to 216-B-26, no data will be collected for this site.	Trench received 0.34 pore volumes of scavenged tank waste supernatant. The existing shallow and deep soil data from the 216-B-26 Trench soil borings will be used to characterize this trench.
216-B-21	BC Cribs and Trenches	Intermediate - Similar Site	Similar site to 216-B-26, no data will be collected for this site.	Trench received 0.34 pore volumes of scavenged tank waste supernatant. The existing shallow and deep soil data from the 216-B-26 Trench soil borings will be used to characterize this trench.
216-B-22	BC Cribs and Trenches	Intermediate - Similar Site	Similar site to 216-B-26, no data will be collected for this site.	Trench received 0.34 pore volumes of scavenged tank waste supernatant. The existing shallow and deep soil data from the 216-B-26 Trench soil borings will be used to characterize this trench.
216-B-23	BC Cribs and Trenches	Intermediate - Similar Site	Similar site to 216-B-26, no data will be collected for this site.	Trench received 0.32 pore volumes of scavenged tank waste supernatant. The existing shallow and deep soil data from the 216-B-26 Trench soil borings will be used to characterize this trench.
216-B-24	BC Cribs and Trenches	Intermediate - Similar Site	Similar site to 216-B-26, no data will be collected for this site.	Trench received 0.34 pore volumes of scavenged tank waste supernatant. The existing shallow and deep soil data from the 216-B-26 Trench soil borings will be used to characterize this trench.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
216-B-25	BC Cribs and Trenches	Intermediate - Similar Site	Similar site to 216-B-26, no data will be collected for this site.	Trench received 0.27 pore volumes of scavenged tank waste supernatant. The existing shallow and deep soil data from the 216-B-26 Trench soil borings will be used to characterize this trench.
216-B-26	BC Cribs and Trenches	Intermediate - Representative Site – Adequately Characterized	Site is considered adequately characterized. No additional data will be collected. 216-B-26 is a representative site. Existing soil data for 216-B-26 will be used to characterize soil at trenches 216-B-20, 216-B-21, 216-B-22, 216-B-23, 216-B-24, 216-B-25, 216-B-27, 216-B-28, 216-B-29, 216-B-30, 216-B-31, 216-B-32, 216-B-33, 216-B-34, and 216-B-52.	Crib received 0.42 pore volumes of scavenged tank waste supernatant. Existing deep borehole within trench to 108.5 m (356 ft) bgs. Eight shallow boreholes with soil data from 2.4 to 5.1 m (8 to 17 ft) bgs.
216-B-27	BC Cribs and Trenches	Intermediate - Similar Site	Similar site to 216-B-26, no data will be collected for this site.	Trench received 0.31 pore volumes of scavenged tank waste supernatant. The existing shallow and deep soil data from the 216-B-26 Trench soil borings will be used to characterize this trench.
216-B-28	BC Cribs and Trenches	Intermediate - Similar Site	Similar site to 216-B-26, no data will be collected for this site.	Trench received 0.36 pore volumes of scavenged tank waste supernatant. The existing shallow and deep soil data from the 216-B-26 Trench soil borings will be used to characterize this trench.
216-B-29	BC Cribs and Trenches	Intermediate - Similar Site	Similar site to 216-B-26, no data will be collected for this site.	Trench received 0.34 pore volumes of scavenged tank waste supernatant. The existing shallow and deep soil data from the 216-B-26 Trench soil borings will be used to characterize this trench.
216-B-30	BC Cribs and Trenches	Intermediate - Similar Site	Similar site to 216-B-26, no data will be collected for this site.	Trench received 0.34 pore volumes of scavenged tank waste supernatant. The existing shallow and deep soil data from the 216-B-26 Trench soil borings will be used to characterize this trench.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
216-B-31	BC Cribs and Trenches	Intermediate - Similar Site	Similar site to 216-B-26, no data will be collected for this site.	Trench received 0.33 pore volumes of scavenged tank waste supernatant. The existing shallow and deep soil data from the 216-B-26 Trench soil borings will be used to characterize this trench.
216-B-32	BC Cribs and Trenches	Intermediate - Similar Site	Similar site to 216-B-26, no data will be collected for this site.	Trench received 0.34 pore volumes of scavenged tank waste supernatant. The existing shallow and deep soil data from the 216-B-26 Trench soil borings will be used to characterize this trench.
216-B-33	BC Cribs and Trenches	Intermediate - Similar Site	Similar site to 216-B-26, no data will be collected for this site.	Trench received 0.33 pore volumes of scavenged tank waste supernatant. The existing shallow and deep soil data from the 216-B-26 Trench soil borings will be used to characterize this trench.
216-B-34	BC Cribs and Trenches	Intermediate - Similar Site	Similar site to 216-B-26, no data will be collected for this site.	Trench received 0.35 pore volumes of scavenged tank waste supernatant. The existing shallow and deep soil data from the 216-B-26 Trench soil borings will be used to characterize this trench.
216-B-52	BC Cribs and Trenches	Intermediate - Similar Site	Similar site to 216-B-26, no data will be collected for this site.	Trench received 0.53 pore volumes of scavenged tank waste supernatant. The existing shallow and deep soil data from the 216-B-26 Trench soil borings will be used to characterize this trench.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
216-B-53A	BC Cribs and Trenches	Intermediate	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep boring will be advanced near previous borehole C6761, which had the highest cesium-137 reading below 4.6 m (15 ft), to the depth of contamination based on field screening (approximately 68.5 m [225 ft] bgs based on pore volumes). One shallow boring will be installed within the trench floor near previous borehole C6768, which had high cesium-37 readings in the top 4.6 m (15 ft). The other shallow boring will be installed within the trench sidewall near previous borehole C6755, which also had high cesium-37 readings in the top 4.6 m (15 ft).	Trench received 0.32 pore volumes of scavenged tank waste supernatant. No soil data available for this site, although extensive geophysical logging was performed in 2008 treatability study. Data are needed to evaluate shallow and deep vadose zone contamination.
216-B-53B	BC Cribs and Trenches	Intermediate - Similar Site	Similar site to 216-B-58, no data will be collected for this site.	Trench received 0.005 pore volumes of scavenged tank waste supernatant. The shallow and existing deep soil data from the 216-B-58 Trench soil borings will be used to characterize this trench.
216-B-54	BC Cribs and Trenches	Intermediate - Similar Site	Similar site to 216-B-58, no data will be collected for this site.	Trench received 0.18 pore volumes of scavenged tank waste supernatant. The shallow and existing deep soil data from the 216-B-58 Trench soil borings will be used to characterize this trench.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
216-B-58	BC Cribs and Trenches	Intermediate - Representative Site	Soil investigation will follow the SAP protocol for intermediate and deep waste sites, shallow subsurface contamination, using a focused sampling strategy. Two shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be placed in the bottom of the trench and one shallow boring in the sidewall of the trench. Soil data collected for the 216-B-58 Trench will be used to characterize soil at the 216-B-54 and 216-B-53B Trenches.	Trench received 0.07 pore volumes of scavenged tank waste supernatant. Two existing deep boreholes to 30.4 m (100 ft) bgs, but only two samples were collected in each borehole in the 0 to 4.6 m (0 to 15 ft) bgs interval. The nature and vertical extent (maximum depth) of deep vadose zone contamination has been defined, but data are needed to evaluate shallow soil contamination.
216-S-1&2	S Plant	Deep	Soil investigation will follow SAP protocol for intermediate and deep waste sites, using a focused sampling strategy. Two shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be installed adjacent to the S-1 wooden crib structure, and one deep boring will be installed between S-2 and former well 299-W22-3, to assess contamination associated with UPR-200-W-36. This borehole will extend to groundwater.	Two cribs received 2.8 pore volumes of cell drainage and process condensate. Data are needed to evaluate shallow and deep vadose zone contamination to groundwater.
216-S-12	S Plant	Intermediate	Soil investigation will follow SAP protocol for intermediate and deep waste sites, using a focused sampling strategy. Two shallow borings will be installed to 4.6 m (15 ft), and a deep boring will be advanced to a depth of 6 m (20 ft) (from PV estimate) or extent of contamination based on field screening.	Single use (0.04 pore volumes) liquid waste disposal trench. Data are needed to evaluate shallow and deep vadose zone contamination.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
216-S-14	S Plant	Intermediate	Soil investigation will follow SAP protocol for intermediate and deep waste sites, using a focused sampling strategy. Two shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be installed within the trench boundaries. If shallow soil contamination is confirmed by field screening, a deep boring will be installed to a depth of 9.1 m (30 ft) (from PV estimate) or extent of contamination based on field screening.	Single use (0.2 pore volume) liquid waste (MIBK) disposal trench. Data are needed to evaluate shallow and deep vadose zone contamination.
216-S-18	S Plant	Intermediate	Soil investigation will follow SAP protocol for intermediate and deep waste sites, using a focused sampling strategy. Three shallow borings will be installed within the depression where contaminated soil from UPR-200-W-114 was consolidated If field reconnaissance and geophysical surveys performed at two additional potential locations of the 216-S-18 Trench, identified in historical drawings H-2-44511 and H-2-32535, indicate the likelihood of a former trench location, additional boreholes will be installed. The depth and location of additional boreholes will be based on the results of the field reconnaissance and geophysical surveys.	Trench originally used for vehicle decontamination, then disposal of contaminated soil. Received approx. 0.03 pore volumes of liquid waste. Data are needed to evaluate shallow and deep vadose zone contamination. Uncertainty in the location of the 216-S-18 Trench warrants field reconnaissance and investigation of three locations associated with the 216-S-18 Trench. Geophysical surveys will be performed on the locations identified in drawings H-2-44511 and H-2-32535. The location filled with contaminated soil from UPR-200-W-114 is well documented and requires sampling to determine the nature and extent of contamination.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
216-S-20	S Plant	Deep	Soil investigation will follow protocol for shallow sites, surface contamination only, using focused sampling strategy. Three surface soil samples (0 to 0.3 m [0 to 1 ft] bgs) will be collected from within the waste site footprint.	Crib site received 22 pore volumes miscellaneous waste. Previous characterization: Four borings inside crib; soil data collected from one boring between 3.8 m (12.5 ft) bgs and groundwater, GPL data only from 3 boreholes. 6.4 m (21 ft) of cover material was emplaced after cribs were abandoned. Characterization sufficient, however, elevated cesium-137 at 1 ft bgs at one GPL location; therefore, data are needed to evaluate surface soil contamination.
216-S-22	S Plant	Intermediate	Soil investigation will follow SAP protocol for intermediate and deep waste sites, using a focused sampling strategy. One deep and two shallow borings will be installed. The deep borehole will be advanced along the crib midline, adjacent to the point of discharge to a depth of 22.8 m (75 ft) (from PV estimate) or extent of contamination based on field screening. The shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be installed within the waste site footprint.	Crib received 0.14 pore volumes process effluent. Data are needed to evaluate shallow and deep vadose zone contamination.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
216-S-23	S Plant	Deep	Soil investigation will follow SAP protocol for intermediate and deep waste sites, deep vadose zone contamination. One deep boring will be installed along the waste site midline at the discharge end. The borehole will be installed to groundwater (approximately 70.4 m [231 ft]).	Crib received 5.5 pore volumes condensate. Discharge depth >4.6 m (>15 ft] bgs; shallow data not needed. Data are needed to evaluate the deep vadose zone contamination to groundwater.
216-S-25	S Plant	Deep	Soil investigation will follow SAP protocol for intermediate and deep waste sites, using a focused sampling strategy. One deep boring will be installed in the center of the waste site (adjacent to the distribution pipe) to groundwater (66 m [217 ft] bgs). Two shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will also be installed within the waste site footprint.	Crib received 28.5 pore volumes condensate, cooling water, and pump and treat effluent. Data are needed to evaluate shallow and deep vadose zone contamination to groundwater.
216-S-4	S Plant	Deep	Soil investigation will follow SAP protocol for intermediate and deep waste sites, using a focused sampling strategy. However, because the two inverted culvert pipes are located so close together, only one deep boring will be installed for collection of shallow and deep vadose zone samples. Boring will be located between the culverts and extend to groundwater.	Two French drains (discharge depth = 6.6 m [21.8 ft]) received 3.9 pore volumes of cooling water and condensate. While most of the contamination is likely to be present beneath the sumps from approximately 6 m (20 ft) bgs, shallow soil beneath the stabilization cover could be contaminated if the sumps backed up and overflowed. Data are needed to evaluate shallow and deep vadose zone contamination to groundwater.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
216-S-5	S Plant	Deep - Similar Site	Soil investigation in the overflow trench will follow SAP protocol for intermediate and deep waste sites, using a focused sampling strategy. Two shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be installed within the trench, and if these borings indicate contamination at greater depth, a deep boring will be installed. Depth of deep boring will be based on the extent of contamination based on field screening.	Crib received 58 pore volumes cooling water and condensate. Data from 216-S-6 Crib will be used to characterize shallow and deep soil within and beneath the 216-S-5 Crib. However, data are needed to evaluate shallow and deep vadose zone contamination in the overflow trench connected to 216-S-5.
216-S-6	S Plant	Deep - Representative Site	Soil investigation will follow SAP protocol for intermediate and deep waste sites, using a focused sampling strategy. One deep (to groundwater) and one shallow (0 to 4.6 m [0 to 15 ft] bgs) boring will be installed to supplement 2008 data. Borings will be installed inside the gravel-filled crib structure.	Crib received 64 pore volumes cooling water and condensate. Soil boring from 2008 provides data from 9 samples to 30.4 m (100 ft) bgs. Additional data are needed to evaluate shallow and deep vadose zone contamination to groundwater.
216-S-7	S Plant	Deep	Soil investigation will follow SAP protocol for intermediate and deep waste sites, shallow subsurface contamination, using a focused sampling strategy. Three shallow borings will be installed within the waste site footprint.	Crib received 44 pore volumes mixed waste including REDOX cell drainage, process condensate, etc. Adequate soil data representative of deep vadose zone are available from one deep boring. Data are needed to evaluate shallow soil contamination (0 to 4.6 m [0 to 15 ft] bgs).

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
216-S-8	S Plant	Deep	Soil investigation will follow SAP protocol for intermediate and deep waste sites, deep vadose zone contamination, using a focused sampling strategy. One deep boring will be installed inside the trench to groundwater.	Single-use trench that received 1 pore volume unirradiated uranium startup waste. Discharge depth was 7.6 m (25 ft) bgs; therefore, no data needed to evaluate shallow soil contamination (0 to 4.6 m [0 to 15 ft] bgs). Data are needed to evaluate deep vadose zone contamination beneath the trench.
216-SX-2	S Plant	Intermediate	Soil investigation will follow SAP protocol for intermediate and deep waste sites, using a focused sampling strategy. One deep boring will be installed in the center of the waste site (adjacent to the distribution pipe) to the depth of contamination based on field screening. Two shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be installed within the waste site footprint.	Crib received unknown volume of condensate. Data are needed to evaluate shallow and deep vadose zone contamination.
216-T-10	T Plant	Intermediate	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep and two shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be installed within the trench footprint at locations selected to obtain spatially distributed data. Deep boring will extend to depth of contamination based on field screening.	Trench received liquid decontamination waste, release volume unknown. An unknown quantity of this waste was removed; trench was then backfilled with unspecified fill material. Data are needed to evaluate shallow and deep vadose zone contamination.
216-T-11	T Plant	Intermediate	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep and two shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be installed within the trench footprint at locations selected to obtain spatially distributed data. Deep boring will extend to depth of contamination based on field screening.	Trench received liquid decontamination waste, release volume unknown. An unknown quantity of this waste was removed; trench was then backfilled with unspecified fill material. Data are needed to evaluate shallow and deep vadose zone contamination.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
216-T-12	T Plant	Deep	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep and two shallow borings will be installed within trench footprint at locations selected to obtain spatially distributed data. The deep borehole will be advanced to groundwater.	Small trench used for disposal of 17.8 pore volumes of sludge dredged from 207-T retention basin. Subsequently backfilled and covered. Data are needed to evaluate shallow and deep vadose zone contamination.
216-T-13	T Plant	Intermediate	Records review, site reconnaissance, geophysical survey, and/or pre-investigation screening per area-wide grid sampling strategy may be necessary to confirm trench location. Subsequent soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep boring will be advanced within the trench footprint to a depth of contamination based on field screening. The shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be installed at locations selected to obtain spatially distributed data.	37.2 m^2 (400 ft^2) trench received vehicle decontaminate waste for 10 years. Release volume unknown. Trench backfilled with contaminated soil, which was later removed. Data are needed to evaluate shallow and deep vadose zone contamination. The location of the trench needs to be verified.
216-T-2	T Plant	Deep	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep boring only will be installed adjacent to the reverse well to groundwater. Based on the discharge depth (below 16.7 m [55 ft] bgs), the potential for shallow soil contamination is low. However, both shallow and deep samples will be collected to confirm the nature and extent of contamination.	Reverse well extending 22.9 m (75 ft) bgs. Received over 6 million L (1.6 million gal) “hot” lab and slurper waste (calculated pore volume = 175). Data are needed to evaluate shallow (well may have backed up and overflowed), and deep vadose zone contamination to groundwater.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
216-T-20	T Plant	Intermediate	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep boring will be advanced within the trench footprint, to the depth of contamination based on field screening. Two shallow borings (0 to 4.6 m [0 to 15 ft] bgs) located to obtain spatially distributed data for the trench.	Trench used for disposal of a single release of contaminated nitric acid (0.1 pore volumes). Data are needed to evaluate shallow and deep vadose zone contamination.
216-T-27	T Plant	Deep - Similar Site	Similar site to 216-T-28, no data will be collected for this site.	Crib received condensate, decontamination and lab waste, release volume estimated to be 4.5 pore volumes. GPL results indicate shallow and deep soil are contaminated. Shallow data to be collected for adjacent crib 216-T-28 will be used to characterize shallow soil at this crib. Existing deep soil data for adjacent crib 216-T-28 will be used to characterize deep soil at crib 216-T-27.
216-T-28	T Plant	Deep - Representative Site	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. Two shallow borings ((0 to 4.6 m [0 to 15 ft] bgs) will be installed within the waste site footprint.	Site received 26 pore volumes of condensate, decontamination and lab waste. Soil data are available for 5.3 m (17.5 ft) bgs to groundwater (68.5 m [225 ft] bgs). No shallow soil data. Data are needed to evaluate shallow soil contamination.
216-T-29	T Plant	Intermediate	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. A records review and/or site reconnaissance will be performed to determine the location of this site. Install one deep boring adjacent to the drain, to the depth of contamination based on field screening.	French drain conveyed moisture condensed canyon air away from the 291-T Sand Filter. 75,708 L (20,000 gal) of steam condensate was discharged to this site. (Location of site is uncertain). Data are needed to evaluate shallow and deep vadose zone contamination.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
216-T-31	T Plant	Intermediate	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep borehole will be installed adjacent to the French drain to the depth of contamination based on field screening.	French drain accidentally contaminated by radioactive steam condensate. Release volume unknown. Data are needed to evaluate shallow and deep vadose zone contamination.
216-T-33	T Plant	Deep	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep borehole will be installed within the waste site footprint, adjacent to the crib discharge to groundwater. The shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be installed at locations selected to obtain spatially distributed data within the waste site footprint.	Crib received 5.6 pore volumes decontamination waste. Soil boring data available between 3.8 and 40.5 m (12.5 and 133 ft) bgs. Depth to groundwater = 84.4 m (277 ft). Supplemental data are needed to evaluate shallow and deep vadose zone contamination to groundwater.
216-T-34	T Plant	Deep - Representative Site	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. Borings will be installed within the waste site footprint. One deep borehole will be advanced to groundwater, adjacent to the waste site discharge. Two shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be installed at locations selected to obtain spatially distributed data.	Crib received 1.4 pore volumes of liquid disposal waste. Data are needed to evaluate shallow and deep vadose zone contamination to groundwater
216-T-35	T Plant	Deep - Similar Site	Similar site to 216-T-34, no data will be collected for this site.	Crib received 0.6 pore volumes of liquid disposal waste. The shallow and deep soil data from the 216-T-34 Crib soil borings will be used to characterize this crib.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
216-T-36	T Plant	Intermediate	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep borehole will be advanced adjacent to the crib discharge to depth of contamination based on field screening. Two shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be installed at locations selected to obtain spatially distributed data within the crib footprint.	Crib received 0.18 pore volumes condensate, decontamination waste, and miscellaneous waste. Data are needed to evaluate shallow and deep vadose zone contamination.
216-T-4-1D	T Plant	Deep	Soil investigation will follow the SAP protocol for intermediate and deep waste sites. An area-wide grid sampling strategy will be used to select borehole locations along the length of the ditch. Soil samples will be collected from approximately four shallow (0 to 4.6 m [0 to 15 ft]) borings installed in the first 30.4 m (100 ft) of the ditch (relative to pipe discharge), and from five additional shallow DPTs distributed along the length of the ditch. One deep boring will be installed in the first section of ditch at location of highest field screening results. Two additional deep borings will be located based on the field screening results for the five DPT borings for the ditch. Depth of deep borings will be based on depth of contamination based on field screening.	259 m (850 ft) long ditch received cooling water and condensate. Release volume unknown. Ditch was backfilled and covered. Data are needed to evaluate shallow and deep vadose zone contamination to groundwater.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
216-T-8	T Plant	Deep	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. The deep borehole will be advanced adjacent to the wooden crib structure, to groundwater (approximately 85.6 m [281 ft] bgs). Two shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be installed at locations selected to obtain spatially distributed data within the waste site footprint.	Crib received 0.78 pore volumes of decontamination sink waste and slurper waste. Data are needed to evaluate shallow and deep vadose zone contamination.
216-T-9	T Plant	Intermediate	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. Two shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be installed within the trench, and if these borings indicate contamination at greater depth, a deep boring will be installed. Depth of deep boring will be based on the extent of contamination based on field screening.	Trench received liquid disposal of vehicle decontamination waste from heavy equipment and other vehicles. Release volume is unknown. Trench was excavated and backfilled. Data are needed to evaluate shallow and deep vadose zone contamination.
216-U-1&2	U Plant	Deep – Adequately Characterized	Site is considered adequately characterized, and no additional sampling is planned. However, if significant contamination is found between the bottom of the CCU and the water table at the deep borings (to groundwater) planned for 216-U-8 and 216-U-12, then an additional deep boring (to groundwater) within the 216-U-2 Crib footprint may be warranted.	Cribs received 27 pore volumes mixed waste. Surface radiation surveys performed at overlying UPR-200-W-19 site with five focused surface soil samples. Six shallow subsurface samples at three boreholes between 0 and 4.6 m (0 to 15 ft) bgs. One deep borehole near center of 216-U-1 Crib extends to 53.6 m (176 ft) bgs with soil analytical data. Borehole did not extend to groundwater, but low contaminant concentrations at CCU. Two lateral borings to CCU bound lateral extent. Twelve direct push borings 15 to 18 m (50 to 60 ft) bgs (GPL only). Nine auger borings to ~15 m (~50 ft) bgs with limited sampling. Site is adequately characterized by existing data.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
216-U-12	U Plant	Deep	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep boring will be advanced within the crib footprint, near the north-south centerline of the crib, but avoiding the waste distribution pipe, the wooden timbered crib structures, and previous boring locations. Based on existing data, the deep boring will be installed in the southern portion of the crib where GPL results showed deeper detections but no soil samples were collected. The deep boring will be advanced to 91.4 m (300 ft) bgs, which is 3 m (10 ft) below the depth of the estimated pre-Hanford water table in the unconfined aquifer beneath the site. The shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be installed within the crib footprint.	Crib replaced 216-U-8 crib, received 78 pore volumes mixed waste. One deep borehole adjacent to crib extends to 71.3 m (234 ft) bgs with soil analytical data. Borehole did not extend to groundwater, but low contaminant concentrations at CCU. Nine direct push borings to 15 to 18 m (50 to 60 ft) bgs (GPL only). Eight auger borings to ~15 m (~50 ft) bgs with limited sampling for technetium-99, nitrogen as nitrate/nitrite, mercury, cadmium, uranium (metal), uranium-235, uranium-238, antimony, and arsenic and other ICP-MS metals. GPL available for three existing wells in vicinity of 216-U-12. No soil analytical data available within crib footprint, or extending to groundwater table. Insufficient shallow soil analytical data within crib footprint.
216-U-13	U Plant	Intermediate	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep boring will be advanced within the center of one of the trenches, where it is assumed that discharges of decontamination liquids would have occurred, to a depth of approximately 7.9 m (26 ft) bgs (based on the low pore volume and estimated depth of the first change in lithology). Two shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be installed within the trenches, stepping out from the trench centers to obtain spatially distributed data.	Two trenches used for vehicle decontamination. Estimated pore volume is approx. 0.001. Contaminated sludge from bottom of trenches was removed and trenches were backfilled. Data are needed to evaluate shallow and deep vadose zone contamination.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
216-U-14	U Plant	Deep	Due to the length of the ditch, an area-wide grid sampling approach will be developed to identify contaminated soil and select approximately 15 shallow borehole locations along the length of the ditch for screening. Four shallow boreholes will be installed within the first 30.4 m (100 ft) of the ditch (at the head end), with additional shallow borehole locations spaced approximately every 152 m (500 ft) along the ditch centerline. Shallow borings will be advanced to 4.6 m (15 ft) below the bottom of the ditch (total 7.6 m [25 ft] bgs). Three deep borings will be installed within the ditch near the head end, near the 207-U discharge point, and at the downstream end, depending on results from shallow boreholes. The borings will be advanced to groundwater.	The 1,731 m (5,680 ft) ditch was original effluent route to 216-U-Pond. It received wastewater, steam condensate, and cooling water. Total volume of effluent discharged through the ditch is estimated at 13.9 pore volumes. The percentage of discharge volume that infiltrated to the vadose zone is unknown. Data are needed to evaluate shallow and deep vadose zone contamination.
216-U-15	U Plant	Intermediate	Follow SAP protocol for intermediate and deep sites using an area-wide grid sampling strategy to determine trench location. Two shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be installed within trench. Information from these borings will be used to determine if deep borehole is necessary.	Trench received solid and liquid waste amounting to less than 0.1 pore volume. Exact location of trench is unknown. Data are needed to determine location and evaluate shallow and deep vadose zone contamination.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
216-U-16	U Plant	Deep	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep borehole will be advanced within the waste site footprint, near the distribution box and header pipes located at the crib inlet to groundwater, ~77.7 m (255 ft) bgs. Two shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be installed within the crib footprint to provide spatially distributed data for the crib.	Crib received 4 pore volumes mixed waste. Data are needed to evaluate shallow and deep vadose zone contamination to groundwater.
216-U-17	U Plant	Deep	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep borehole will be installed within the crib to evaluate shallow and deep soil to groundwater (estimated 77.1 m [253 ft] bgs). The borehole will be installed adjacent to the discharge pipe. Sampling at deep borehole will begin at 2.4 m (8 ft) bgs (to provide vertical delineation above the discharge depth) and no shallow borings will be installed unless field screening results indicate shallow contamination.	Crib received 1.7 pore volumes process condensate. Geophysical logs show no manmade radioactivity throughout vadose zone; however, no soil data are available from within the crib footprint. Data are needed to evaluate shallow soil below the discharge (3.5 m [11.5 ft] bgs), and deep vadose zone contamination to groundwater.
216-U-3	U Plant	Deep – Adequately Characterized	Site is considered adequately characterized. No additional data will be collected.	French drain received 5.4 pore volumes of steam condensate. One deep (39.5 m [129.5 ft] bgs) borehole was installed adjacent to the drain and sampled. Only one shallow soil sample was collected from 0 to 4.6 m [0 to 15 ft] bgs; however, the release depth of French drain is at 3.6 m (12 ft), and very low concentrations of contaminants at that depth. Existing data are sufficient for characterizing the site.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
216-U-4	U Plant	Deep – Adequately Characterized	Site is considered adequately characterized. No additional data will be collected.	Reverse well received 9.8 pore volumes of laboratory decontamination waste. Deep vadose zone adequately characterized to 59 m (194 ft) (CCU at 53.6 m [176 ft] bgs). No shallow characterization warranted due to release depth well below 4.6 m [15 ft] bgs.
216-U-4A	U Plant	Deep – Adequately Characterized	No additional sampling is proposed.	French drain received 5.4 pore volumes of steam condensate. One deep (39.5 m [129.5 ft] bgs) borehole was installed adjacent to the drain and sampled. Deep vadose zone is adequately characterized. Based on the small size of site and location within U Plant canyon barrier footprint, additional characterization from 0 to 4.6 m [0 to 15 ft] is not warranted. Existing data are sufficient to characterize contamination at this site.
216-U-4B	U Plant	Intermediate	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep borehole will be installed adjacent to the French drain to depth of contamination, approximately 34.4 m (113 ft) (based on pore volumes). Shallow (0 to 4.6 m [0 to 15 ft] bgs) and deep vadose zone samples will be collected from this borehole.	French drain received 0.2 pore volumes laboratory waste (hot cell and hood). Data are needed to evaluate shallow and deep vadose zone contamination.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
216-U-5	U Plant	Deep – Similar Site	The 216-U-5 Trench is a similar site to the 216-U-6 Trench, which will serve as a representative site. However, to determine the site location and boundaries, soil investigation will follow the SAP protocol for intermediate and deep waste sites using an area-wide grid strategy. Approximately 10 locations will be selected for a screening-level field investigation to locate contaminated soil. Once located, two shallow (0 to 4.6 m [0 to 15 ft] bgs) borings will be installed within the trench as described for focused sampling.	Trench received 0.64 pore volumes unirradiated uranium waste. Data are needed to evaluate shallow and deep vadose zone contamination to groundwater. Data collected at representative site 216-U-6 will be used to characterize contamination below 4.6 m (15 ft) at the 216-U-5 Trench.
216-U-6	U Plant	Deep – Representative Site	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused strategy. One deep boring will be advanced within the trench footprint near the center, to groundwater (estimated 81.6 m [268 ft] bgs). Two shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be installed near each end of the trench to obtain spatially distributed data. Soil data collected for the 216-U-6 Trench will be used to characterize soil at the 216-U-5 Trench.	Trench received 1.4 pore volumes unirradiated uranium waste. Data are needed to evaluate shallow and deep vadose zone contamination to groundwater.
216-U-7	U Plant	Intermediate	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep borehole will be installed adjacent to the French drain. The borehole will be installed to a depth of 11.5 m (38 ft) (depth based on 0.1 pore volumes [two times the discharged pore volumes]) or to the depth of contamination, as determined by field screening.	French drain received an estimated 0.05 pore volumes of liquid waste. No data are available. Data are needed to evaluate shallow and deep vadose zone contamination.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
216-U-8	U Plant	Deep	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. Two deep and two shallow borings will be installed. One of the deep borings and the two shallow borings will be advanced near the north-south centerline of the crib, but avoiding the waste distribution pipe, the wooden timbered crib structures, and previous boring locations. Based on existing data, this location should exhibit the highest residual soil contamination over the entire thickness of the vadose zone. The second deep boring will be installed about 30.4 m (100 ft) east of the crib centerline, near the former Well 299-W19-2, avoiding underground obstructions and the locations of former wells and/ or borings. Both deep borings will be advanced to 91.4 m (300 ft).	Crib received 25 pore volumes mixed waste. One deep borehole through crib footprint extends to 60 m (199 ft) bgs with soil analytical data. Borehole did not extend to groundwater. 13 direct push borings to 15 to 18 m (50 to 60 ft) bgs (GPL only). Nine auger borings to ~15 m (~50 ft) bgs with limited sampling for technetium-99, nitrogen as nitrate/nitrite, mercury, cadmium, uranium (metal), uranium-235, uranium-238, antimony, and arsenic and other ICP-MS metals. GPL available for two existing wells near 216-U-8. No soil analytical data available extending to groundwater table. Insufficient shallow soil analytical data within crib footprint. Suspected lateral migration at dip in CCU not adequately characterized.
216-Z-13	Z Plant	Intermediate Site	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep boring will be installed adjacent to the French drain. The borehole will be installed to the depth of contamination, as determined by field screening.	French drain received an unknown volume of liquid waste. No data are available. Data are needed to evaluate shallow and deep vadose zone contamination.
216-Z-14	Z Plant	Intermediate Site	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep boring will be installed adjacent to the French drain. The borehole will be installed to the depth of contamination, as determined by field screening.	French drain received an unknown volume of liquid waste. No data are available. Data are needed to evaluate shallow and deep vadose zone contamination.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
216-Z-15	Z Plant	Intermediate Site	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep boring will be installed adjacent to the French drain. The borehole will be installed to the depth of contamination, as determined by field screening.	French drain received an unknown volume of liquid waste. No data are available. Data are needed to evaluate shallow and deep vadose zone contamination.
216-Z-16	Z Plant	Deep - Representative Site	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep boring will be installed in the center of the crib adjacent to the perforated pipe soil to groundwater (66 m [217 ft] bgs). Two shallow borings will be installed at locations selected to obtain spatially distributed data within the crib footprint. Soil data collected for the 216-Z-16 Crib will be used to characterize soil at the adjacent 216-Z-17 Trench.	Crib received 30 pore volumes of liquid lab waste. Data are needed to evaluate shallow soil contamination (2.7 to 4.6 m [9 to 15 ft] bgs) and deep vadose zone contamination to groundwater.
216-Z-17	Z Plant	Deep - Similar Site	No samples will be collected at 216-Z-17. Results for soil samples collected at representative site 216-Z-16 will be used to characterize contamination at the 216-Z-17 Trench.	Trench received 9.8 pore volumes of liquid lab waste. Data collected at representative site 216-Z-16 will be used to characterize contamination at the 216-Z-17 Trench.
216-Z-4	Z Plant	Intermediate - Similar Site	Similar site to 216-Z-6, no data will be collected for this site.	Trench received 0.06 pore volumes of liquid lab waste. Data are needed to evaluate shallow and deep vadose zone soil contamination. Data collected at representative site 216-Z-6 will be used to characterize contamination at the 216-Z-4 Trench.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
216-Z-6	Z Plant	Intermediate - Representative Site	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep boring will be installed near the inlet at the northern end of the crib (where the highest contamination level would be expected) to depth of contamination, approx. 19 m (60 ft) bgs (based on pore volumes). Two shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be located to obtain spatially distributed data within the crib footprint.	Trench received 0.12 pore volumes process waste. Data are needed to evaluate nature and extent of shallow and deep vadose zone contamination.
216-Z-7	Z Plant	Deep – Adequately Characterized	Site is considered adequately characterized. No additional data will be collected.	Crib received 24-pore volumes process waste, lab waste, and waste from 340 Bldg. Existing characterization includes one borehole within the trench footprint to groundwater and one direct push boring with soil sampling data and geophysical logs. Sufficient soil sampling data are available to perform human health/Eco risk assessment, groundwater protection modeling, and evaluate nature and extent of contamination.
218-W-8	T Plant	Intermediate	If possible, the vault contents will be surveyed and sampled, if warranted. If empty, the vaults will be evaluated following the protocol for foundations, slabs, and vaults. Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep boring will be installed adjacent to one of the wooden vaults, to depth of contamination based on field screening. Two shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be installed adjacent to the other wooden vault and the concrete vault.	Three underground vaults received 68 m^3 (89 yd^3) laboratory process sample waste categorized as miscellaneous solid trash and debris. Data are needed to evaluate the vaults and their contents. Data are needed to evaluate shallow and deep vadose zone contamination outside the vaults.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
218-W-9	S Plant	Shallow – Subsurface	Follow the SAP protocol for shallow, subsurface contamination, using a focused sampling strategy, in vicinity of pipeline leaks. If field screening indicates contamination at depth, DPT will continue below 4.6 m (15 ft) bgs, to depth of contamination.	0.12 ha (0.3 ac) burial ground, contaminated metal scrap inch 211-S Tank. In addition, two leaks causing UPRs from 200-W-139-PL waste line. Data are needed to evaluate nature and extent of shallow, subsurface soil contamination (0 to 4.6 m [0 to 15 ft] bgs).
231-W-151	Z Plant	Intermediate	The soil sampling approach will include pre-investigation surface screening for contamination of shallow soil around the vault to determine soil sample locations. Subsequently, soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep and two shallow (0 to 4.6 m [0 to 15 ft] bgs) borings will be installed adjacent to the vault. Deep boring will extend to depth of contamination based on field screening. Characterization of the inner tanks and vault will follow the approach developed in the 200-IS-1 OU Work Plan.	Concrete vault with two inner tanks, collected drainage from 75 floor drains. Release volume unknown. Contamination detected at vault surface. Also potential for leak from vault, and report of leaking flange. Data are needed to evaluate shallow and deep vadose zone contamination, surrounding and beneath the vault. Data are also needed to characterize the tanks and vault.
241-T-361	T Plant	Intermediate	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep and two shallow (0 to 4.6 m [0 to 15 ft] bgs) borings will be installed adjacent to the settling tank and to former piping locations. If field screening indicates no contamination, the deep borehole will extend only to 4.6 m [15 ft] bgs. Otherwise, the deep boring will extend to depth of contamination based on field screening. No further sampling of the tank contents is proposed.	The settling tank received 10.6E+4 L (2.8E+4 gal) of radioactive liquid waste. No documented releases from tank but releases or associated piping to surrounding soil possible. Data are needed to evaluate shallow and deep vadose zone contamination. Sampling data for the tank contents is available.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
241-U-361	U Plant	Intermediate – Adequately Characterized	Existing data do not suggest a subsurface release from the tank. Shallow soil contamination from a UPR from the 241-U-361 and 216-U-1 & 2 Crib risers has been characterized as part of UPR-200-W-19. No additional data are needed. No further sampling of the tank contents is proposed.	Various wastes flowed through the 241-U-361 reinforced concrete settling tank and then to the 216-U-1 and & 2 Cribs, located 26 m (85 ft) west, via an underground pipe. No specific release from tank has been confirmed. Sampling data for the tank contents is available.
241-WR Vault	U Plant	Intermediate	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep boring will be installed adjacent to the vault. The deep boring will be installed at a 30 to 40 degree angle under the common wall between tanks 241-WR-001 and 241-WR-002 to approximately 30.4 m (100 ft) bgs (vertical) or to the depth of contamination based on field screening. The soil boring location was selected because tanks 241-WR-001 and 241-WR-002 had the largest documented leaks. If the exhaust stack dry well can be found a shallow borehole to 4.6 m (15 ft) or to the depth of contamination will be installed next to it. If the DQO process identifies the need for investigation of the vault tank and sump contents, entry into the vault structure may be necessary. Initial reconnaissance would include determining the contents of each of the nine tanks and any materials collected in vault sumps. Samples of the liquids and solids contained in each tank or sump will be collected and volumes estimated based on the results of the reconnaissance entry. Because of the	Tanks within the vault leaked in the 1960s and samples indicated the liquid to be slightly contaminated. No soil characterization data has been collected. Data are needed to evaluate the nature and vertical extent of deep vadose zone contamination under the 241-WR Vault and shallow vadose zone contamination at the exhaust stack dry well. A records review was conducted to determine if the contents of the tanks and sumps had been removed or if the condition of the vault or tanks was documented at the time the 241-WR-Vault was taken out of service. Documentation was found that indicated the pipelines were disconnected and the vault was sealed, but no definitive documentation was found that indicated the contents were removed or the condition of the tanks and the structure at the time the WR vault was isolated. Due to uncertainty with the current status of tank and vault sump contents within the 241-WR-Vault, a separate DQO will be performed to determine if additional data must be obtained for this site, or if process knowledge and historical records can provide sufficient information to perform remedy evaluation and to determine whether contaminants exceed acceptable risk levels for

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
			in-depth need for planning, developing a safe approach, and obtaining the various approvals, a separate scope of work and SAP amendment would be developed, if necessary, and submitted to the regulatory agencies.	groundwater protection.
2607-W3	T Plant	Intermediate	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. Three shallow borings will be installed and soil samples collected to evaluate the nature and extent of contamination in soil near the septic tank and within the areas occupied by the original and replacement septic drain fields. A deep boring will be installed only if contamination is evident below 4.6 m [15 ft].	Septic tank and drain field received nondangerous and nonradioactive sanitary sewer effluent for over 50 years. Data are needed to evaluate shallow and deep vadose zone contamination.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
2607-W4	T Plant	Intermediate	A pre-investigation consisting of a site reconnaissance to determine the locations of the original and replacement septic systems may be needed. The contents of the original tank will be sampled. Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. Three shallow borings will be installed and soil samples collected to evaluate the nature and extent of contamination in shallow and deep soil. One of the shallow borings will be installed within the estimated area of the old septic drain field, assumed to be northwest of the original tank. The second boring will be installed within the area occupied by the newer septic drain field. The third shallow boring will be installed between the old and new septic tanks. If contamination is indicated, one deep boring will be installed at the location exhibiting the highest contamination. The deep boring will be advanced to the depth of contamination determined based on field screening.	This site includes two septic systems. The original septic system received nondangerous and nonradioactive sanitary sewer effluent for over 40 years. Data are needed to evaluate the contents of the original tank. Data are needed to evaluate shallow and deep vadose zone contamination at the original and replacement system.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
2607-W5	U Plant	Intermediate	The tank contents, if present, will be sampled. One deep and two shallow borings will be installed. One shallow boring will be installed in the original drain field, and the second will be installed between the septic tank and diversion box. The deep boring will be installed in the replacement drain field to the depth of contamination determined based on field screening.	Septic tank and drain field received nondangerous and nonradioactive sanitary sewer effluent for over 50 years. Data are needed to reduce uncertainty associated with nature and extent of contamination resulting from discharges of liquid waste to the septic system. Southern portion of site footprint overlaps with UPR-200-W-19. Data are needed outside the limits of UPR-200-W-19 to evaluate potential contamination related to discharges of liquid waste to the drain field. Data are needed to evaluate the tank contents.
2607-W7	U Plant	Intermediate	A pre-investigation may be needed to confirm the location of the drain field. Soil investigation will follow the protocol for intermediate and deep waste sites using a focused sampling strategy. Two shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be installed. The deep borehole will be installed only if contamination is evident below 4.6 m (15 ft).	The septic system received sanitary waste from a single restroom in the 221-U Canyon Building for over 40 years. Release volume unknown. The septic system lies between two Underground Radioactive Material areas. The tank was decommissioned in 1999 in accordance with WAC 246-272. Data are needed to evaluate shallow and deep vadose zone contamination.
2607-W8	Z Plant	Intermediate	Three shallow borings (0 to 4.6 m [0 to 15 ft] bgs) will be installed at the septic tank and within the tile drain field to obtain spatially distributed data.. The deep borehole will be installed only if contamination is evident below 4.6 m (15 ft).	Septic tank and tile field received nondangerous and nonradioactive sanitary sewer effluent for over 50 years. Release volume unknown. Located outside posted radiation area. The tank was decommissioned in 1998 in accordance with WAC. Data are needed to evaluate shallow and deep vadose zone contamination.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
2607-WC	S Plant	Intermediate	The tank contents, if present, will be sampled. Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One shallow boring will be installed at the inlet end of the septic tank to evaluate potential leaks from the piping and the tank. One deep boring will be installed at the seepage pit. The deep borehole will be installed to the depth of contamination based on field screening.	Site consists of septic tank and a 4.9 m (16 ft) deep seepage pit. Some uncertainty regarding site construction. Data are needed to evaluate shallow and deep vadose zone contamination at the tank and seepage pit. Data are needed to evaluate the tank contents.
2607-WZ	S Plant	Intermediate	The tank contents, if present, will be sampled. A pre-investigation may be needed to determine if the object located during the 2005 geophysical survey is associated with a septic system and to identify the location of the septic tank and drain field associated with the tank. Soil investigation will follow the protocol for intermediate and deep waste sites using a focused sampling strategy. Two shallow (0 to 4.6 m [0 to 15 ft] bgs) borings will be installed, including one at the tank and one in the drain field. The deep borehole will be installed only if contamination is evident below 4.6 m [15 ft].	Unspecified volume of liquid (assumed to be sanitary sewage) was received from an unknown building for over 50 years. Data are needed to reduce uncertainty associated with nature and extent of contamination resulting from discharges of liquid waste to the tank and drain field associated with the 2607-WZ septic tank. Data are needed to evaluate the tank contents.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
2607-Z	Z Plant	Intermediate	Two deep and one shallow boring will be installed. One deep boring will be installed at the junction of the septic tank and outlet pipe and one will be installed at the drain field distribution box. The deep boreholes will be installed to 17 m (56 ft) bgs or the depth of contamination. One shallow boring (0 to 4.6 m [0 to 15 ft] bgs) will be installed in the drainfield to obtain spatially distributed data.	Received an estimated 23,000 L (6,000 gal) of sanitary sewage from the 234-5Z and 2704-Z Buildings for 50 years. The tank was decommissioned in 1999 in accordance with WAC 246-272. Data are needed to reduce uncertainty associated with nature and extent of contamination, primarily in the deep vadose zone, resulting from discharges of liquid waste to the drain field associated with the 2607-Z septic tank. The septic tank and drainfield bottom depths are greater than 4.6 m [15 ft] bgs.
2607-Z1	Z Plant	Intermediate	A pre-investigation may be needed to confirm the location of the tank and drain field. Two shallow borings will be installed and soil samples collected to evaluate the nature and extent of contamination soil within the tile drain field. The deep borehole will be installed only if contamination is evident below 4.6 m (15 ft).	Received an unknown volume of sanitary sewage from the 234-5Z Annex and the 232-Z and 2736-ZB Buildings. The tank was decommissioned in 1999 in accordance with WAC 246-272. Data are needed to reduce uncertainty associated with nature and extent of contamination resulting from discharges of liquid waste to the drain field associated with the 2607-Z1 septic tank.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
270-W	U Plant	Intermediate	Soil investigation will follow the SAP protocol for intermediate and deep waste sites using a focused sampling strategy. One deep borehole will be installed adjacent to the neutralization tank and soil samples collected to evaluate shallow and deep soil. The borehole will be installed to the depth of contamination, based on field screening. Due to the existing building foundation, utilities, and other potential obstructions near the 270-W Neutralization Tank, the exact location of proposed borehole cannot be determined without further evaluation. The borehole should be placed as close to the tank as feasible and coring through the slab may be required.. Data for the tank contents will be collected consistent with the approach developed in the 200-IS-1 OU Work Plan.	Tank used to neutralize acidic 224-U process condensate, located beneath former 2715-U Building foundation. Records indicate that the tank was blanked off in 1970, but no indication whether tank contents were sampled or removed. Bottom of tank located at 6 m (20 ft) bgs. Information suggests tank bottom may have corroded and leaked, but the source of this information has not been confirmed. Data are needed to evaluate shallow and deep vadose zone contamination. Data are needed to evaluate the tank and its contents.
600-70	S Plant	Shallow – Subsurface	Conduct recon and surface radiation screening to identify locations of potential releases (e.g., burn sites, trenches, buried debris, distinct disposal areas). Subsequent soil investigation to follow SAP protocol for shallow, subsurface contamination, using a focused sampling strategy.	10.1 ha (25 ac) dumpsite, primarily solid material. French drain in unknown location, used for liquid wastes. Data needed to evaluate the nature and extent of shallow, subsurface soil contamination (0 to 4.6 m [0 to 15 ft] bgs).
UPR-200-W-101	U Plant	Shallow – Surface Only	Follow SAP protocol for shallow sites, surface contamination using a focused sampling strategy. Because this site is collocated with UPR-200-W-138 and UPR-200-W-162, sampling efforts between these three sites will be combined into a single sampling effort.	Reclaimed acid containing 1 curie Sr-90 released to ground surface. Data are needed to delineate waste site and determine contaminant concentration(s).

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
UPR-200-W-103	Z Plant	Intermediate	Follow the SAP protocol for intermediate and deep vadose zone contamination, using a focused sampling approach if excavation boundaries can be delineated, or area-wide grid sampling if not. One deep and two shallow borings will be installed for sample collection.	Pipeline break released ~10 g (0.4 oz) liquid plutonium. Incomplete excavation and backfill cover. Data are needed to evaluate remaining shallow and deep vadose zone contamination.
UPR-200-W-111	U Plant	Shallow – Subsurface	Follow SAP protocol for shallow sites, subsurface contamination using an area-wide grid sampling strategy to locate trench. Install two direct push borings based on field screening and grid sampling results.	Single use disposal trench 3 m (10 ft) deep received sludge from 207-U South Retention Basin. Trench has been scraped, consolidated, and covered with clean soil. No characterization data are available. Release history is moderately well defined, site boundaries are poorly defined. Data are needed to evaluate the nature and extent of subsurface soil contamination (0 to 4.6 m [0 to 15 ft]).
UPR-200-W-112	U Plant	Shallow – Subsurface	Follow SAP protocol for shallow sites, subsurface contamination using focused sampling strategy. Conduct two shallow boreholes (0 to 4.6 m [0 to 15 ft]) within trench.	Single use disposal trench 3 m (10 ft) deep received sludge from 207-U North Retention Basin. Trench has been scraped, consolidated, and covered with clean soil. No characterization data are available. Data are needed to evaluate the nature and extent of subsurface soil contamination (0 to 4.6 m [0 to 15 ft]).
UPR-200-W-116	S Plant	Shallow – Surface only	The boundaries for this site are tentative. Soil investigation will follow the SAP protocol for shallow, surface only contamination, using an area-wide grid sampling strategy, to determine site boundaries and level of contamination.	Windblown radioactive particulates across 0.8 ha (2 ac) site. No reported liquid release. Data are needed to evaluate the nature and extent of surface contamination (0 to 0.3 m [0 to 1 ft]), beneath the stabilization cover.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
UPR-200-W-117	U Plant	Shallow – Surface only	Follow SAP protocol for shallow sites, surface contamination using an area-wide grid sampling strategy to locate track beneath stabilization cover. Conduct focused subsurface sampling via test pits or boreholes from transects across original track surface soil.	Site along railroad tracks, result of contaminated liquid and particulate matter dropping from railroad cars moving equipment and waste into and out of the 221-U Facility over time. No characterization data are available. UPR-200-W-60 is within the boundary of UPR-200-W-117; thus, the characterization approaches of these sites have been combined.
UPR-200-W-118	U Plant	Shallow – Subsurface	Site reconnaissance and field screening are needed to locate former pump pit, then follow SAP protocol for shallow sites, subsurface contamination using focused sampling strategy. One or two shallow boreholes as appropriate in contaminated area.	Slightly radioactive nitric acid contamination around RR spur. Waste was transferred to railcars via underground lines and pump pit, some leakage associated with pumping process. Stabilization cover is present. No characterization data available. Release location is poorly defined. Data are needed to evaluate the nature and extent of subsurface soil contamination (0 to 4.6 m [0 to 15 ft]).
UPR-200-W-138	U Plant	Shallow – Subsurface	Follow SAP protocol for shallow sites, subsurface contamination using area-wide grid sampling strategy. Because this site is collocated with UPR-200-W-101 and UPR-200-W-162, sampling efforts between these three sites will be combined into a single sampling effort.	UPR-200-W-138 is a shallow surface site resulting 136 kg (300 lb) of uranyl nitrate hexahydrate solution, representing a very limited liquid release volume. Furthermore, it is believed that the spilled material was released to the subsurface through the 216-U-7 French Drain. Due to the limited liquid release volume, this release is not likely to affect groundwater. Data are needed to evaluate the nature and extent of shallow, subsurface contamination (0 to 4.6 m [0 to 15 ft] bgs).

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
UPR-200-W-14	T Plant	Intermediate	Follow SAP protocol for intermediate and deep sites using an area-wide grid sampling strategy to determine release location and define site boundaries. One deep and two shallow borings will be installed adjacent to the release location. Information learned from the two shallow borings will be used to plan the deep borehole.	Pipeline leak, quantity unknown and location poorly defined. Data are needed to determine release location and evaluate shallow and deep soil contamination.
UPR-200-W-162	U Plant	Shallow – Surface Only	Follow the SAP protocol for shallow, surface contamination, using a focused sampling strategy. Because this site is collocated with UPR-200-W-101 and UPR-200-W-138, sampling efforts between these three sites will be combined into a single sampling effort.	Site consists of radiological speck contamination, covered with clean backfill. Data are needed to evaluate the nature and extent of surface contamination (0 to 0.3 m [0 to 1 ft]), beneath the stabilization cover.
UPR-200-W-165	S Plant	Shallow – Subsurface	Soil investigation will follow SAP protocol for shallow sites, surface contamination only using an area-wide grid sampling approach. Stabilization cover is not present.	No shallow data are available from within the waste site footprint. The release history and the release location are moderately well defined. Sampling is needed to determine residual contaminant concentration(s) in areas of the site that were decontaminated as part of the stabilization work between 1992 and 1995. Data are needed to evaluate the nature and extent of surface contamination (0 to 0.3 m [0 to 1 ft]).
UPR-200-W-166	T Plant	Shallow – Subsurface	Follow SAP protocol for shallow sites, subsurface contamination using area-wide grid sampling strategy.	Six acres speck contamination from 216-T-14 through 17 trenches scraped up and placed here in 1991-92. No stabilization cover documented. Data are needed to evaluate the nature and extent of shallow, subsurface contamination (0 to 4.6 m [0 to 15 ft] bgs).

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
UPR-200-W-19	U Plant	Shallow – Subsurface	An area-wide grid sampling strategy will be used to locate contamination. Using a focused sampling strategy, install 10 direct push borings based on GPL borehole locations showing elevated Cesium-137 concentrations. Soil samples will be collected at the depth of maximum detected radionuclide concentrations within the top 4.6 m (15 ft). Additional shallow DPTs may be warranted based on field screening and surface soil grid sampling results.	Characterized as part of U-1 and U-2 Crib complex. Five surface soil samples + four subsurface borehole samples. Surface soil samples collected based on judgmental/ focused sampling based on surface radiation surveys. However, spatial distribution of these samples is poor due to the samples being located outside of the Waste Information Data System site boundary and well away from the release point. The portion of the site nearest to the 216-U-1&2 Cribs (the release point) was not available for radiological survey and surface soil sampling at the time of the investigation. Multiple direct pushes installed as part of remedial design investigation that help support N+E in top 4.6 m (15 ft); however, no soil samples were collected in the top 4.6 m (15 ft) at the DPT borehole locations.
UPR-200-W-23	Z Plant	Shallow – Surface Only	Follow the SAP protocol for shallow sites, surface contamination, using an area-wide grid sampling strategy.	A fire in a waste box resulted in spread of plutonium contamination. Release history and site boundaries are poorly defined. Data are needed to evaluate the nature and extent of surface contamination (0 to 0.3 m [0 to 1 ft]).
UPR-200-W-3	T Plant	Shallow – Surface Only	Use radiation survey to confirm location of contamination, and then follow SAP protocol for shallow sites, surface contamination using focused sampling strategy.	Very small area contaminated from equipment hauled on RR track. No soil characterization data. Data are needed to evaluate the nature and extent of surface contamination (0 to 0.3 m [0 to 1 ft]).

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
UPR-200-W-33	U Plant	Shallow – Subsurface	Follow the SAP protocol for shallow sites, subsurface contamination, using a focused sampling strategy.	UPR-200-W-33 is a shallow surface site resulting from a pipeline flange leak to the surface. Contaminated surface soil from the original spill was removed shortly after the release; therefore, remaining contamination is not likely to affect groundwater. Data are needed to evaluate the nature and extent of subsurface soil contamination (0 to 4.6 m [0 to 15 ft]).
UPR-200-W-36	S Plant	Deep	Soil investigation at this site will be conducted under the FSP for the 216-S-1&2 Cribs.	Well near 216-S-1&2 Cribs with cracked casing resulted in UPR of unknown volume. Adjacent soil boring confirms cesium-137 contamination throughout vadose zone. Data are needed to evaluate the nature and extent of deep vadose zone contamination to groundwater.
UPR-200-W-39	U Plant	Shallow – Subsurface	Follow the SAP protocol for shallow sites, subsurface contamination, using a focused sampling strategy. Characterization of the 200-W-136 site includes a borehole through the slab of the former 224-UA Building. Because UPR-200-W-39 was covered by the 224-UA Building slab, this borehole will provide characterization for both 200-W-136 and UPR-200-W-39.	UPR-200-W-39 is a shallow subsurface site with contaminated soil from the original release consolidated under the 224-UA building slab. Data are needed to evaluate the nature and extent of subsurface soil contamination (0 to 4.6 m [0 to 15 ft]).
UPR-200-W-4	T Plant	Shallow – Surface Only	Follow the SAP protocol for shallow sites, surface contamination, using an area-wide grid sampling strategy.	Speck contamination along RR from burial box transport. Release history and site boundaries are poorly defined. Data are needed to evaluate the nature and extent of surface contamination (0 to 0.3 m [0 to 1 ft]).
UPR-200-W-41	S Plant	Shallow – Surface only	The soil investigation will follow the SAP protocol for shallow, surface only contamination, using an area-wide sampling strategy.	UPR along RR tracks from transport of contaminated equipment. Data are needed to evaluate the nature and extent of shallow soil contamination (0 to 0.3 m [0 to 1 ft]), beneath the stabilization cover along the RR track.

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
UPR-200-W-46	S Plant	Shallow – Surface Only	The soil investigation will follow the SAP protocol for shallow, surface only contamination, using an area-wide grid sampling strategy.	UPR during transport and burial of contaminated centrifuge, along RR track, overlap with UPR-200-W-41. Data are needed to evaluate the nature and extent of shallow soil contamination (0 to 0.3 m [0 to 1 ft]), beneath the stabilization cover along the railroad track.
UPR-200-W-48	U Plant	Shallow - Subsurface	Follow SAP protocol for shallow sites, surface contamination only using an area-wide grid sampling approach. Stabilization cover not present.	The incident occurred when a jumper, wrapped in plastic, was transferred from a flat-bed truck to a railroad flat-car at the railroad crossing. The contamination spread was caused by the plastic wrapping on the jumper being damaged during transfer. Data are needed to evaluate the nature and extent of shallow soil contamination (0 to 0.3 m [0 to 1 ft])
UPR-200-W-51	S Plant	Shallow – Surface only	The soil investigation will follow the SAP protocol for shallow, surface only contamination, using an area-wide grid sampling strategy, to determine site boundaries and level of contamination.	UPR of high-pressure steam from 241-S-151- Diversion Box. Areas flushed with water, site boundaries indeterminate. Data are needed to evaluate nature and extent of surface contamination (0 to 0.3 m [0 to 1 ft]).
UPR-200-W-55	U Plant	Shallow – Subsurface	Follow SAP protocol for shallow subsurface contamination using an area-wide grid sampling strategy.	UPR of uranium powder spill from broken loading hose to asphalt loading dock. Most of the powder was swept up and put in drums for recovery. However, the rest was washed off the asphalt onto the adjacent ground surface. Areas flushed with water, site boundaries indeterminate. Data are needed to evaluate the nature and extent of subsurface soil contamination (0 to 4.6 m [0 to 15 ft]).

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
UPR-200-W-60	U Plant	Shallow – Subsurface	Follow SAP protocol for shallow subsurface contamination using an area-wide grid sampling strategy to locate track beneath stabilization cover. Conduct focused subsurface sampling via test pits or boreholes from transects across original track surface soil.	Spotty contamination along railroad tracks caused by drips from railcars. Contamination isolated, cleaned, covered with 1.5 m (5 ft) clean soil. No characterization data. Release history is poorly defined. UPR-200-W-60 is within the boundary of UPR-200-W-117, thus the characterization approaches of these sites have been combined.
UPR-200-W-63	T Plant	Shallow – Surface Only	Follow the SAP protocol for shallow sites, surface contamination, using an area-wide grid sampling strategy.	Speck contamination along road shoulder from transport of diversion box jumper. Shoulder covered with 15.2 cm (6 in.) soil. Release history and site boundaries are poorly defined. Data are needed to evaluate the nature and extent of surface contamination (0 to 0.3 m [0 to 1 ft]).
UPR-200-W-65	T Plant	Shallow – Surface Only	Follow the SAP protocol for shallow sites, surface contamination, using an area-wide grid sampling strategy.	Spot contamination along RR cut. No characterization data. Release history and site boundaries are poorly defined. Data are needed to evaluate the nature and extent of surface contamination (0 to 0.3 m [0 to 1 ft]).
UPR-200-W-67	T Plant	Shallow – Surface Only	Follow the SAP protocol for shallow sites, surface contamination, using an area-wide grid sampling strategy.	Contaminated electric lift affected ground beneath. Data are needed to evaluate the nature and extent of surface contamination (0 to 0.3 m [0 to 1 ft]).
UPR-200-W-73	T Plant	Shallow – Subsurface	Follow the SAP protocol for shallow sites, subsurface contamination, using an area-wide grid sampling strategy along the tracks.	Contaminated decontamination liquid along railroad track. No soil characterization data. Release history and site boundaries are poorly defined. Data are needed to evaluate the nature and extent of subsurface soil contamination (0 to 4.6 m [0 to 15 ft]).

Table E-12. Characterization Strategy for Each Waste Site

Waste Site	Plant	Depth Group	Characterization	Rationale
UPR-200-W-76	T Plant	Shallow – Surface Only	The boundaries for this site are tentative. The soil investigation follow the SAP protocol for shallow, surface only contamination, using an area-wide grid sampling strategy, to determine site boundaries and level of contamination.	Contaminated rabbit pellets around diversion box 241-TX-155 have spread across approximately 1 acre. Data are needed to evaluate the nature and extent of surface contamination (0 to 0.3 m [0 to 1 ft]), beneath the gravel cover.
UPR-200-W-78	U Plant	Shallow – Surface Only	Follow SAP protocol for shallow sites, surface contamination using an area-wide grid sampling strategy.	Shovel and bucket used to clean up uranium powder spill. 3.7 m^2 (40 ft^2) area delineated by radiation survey. No characterization data are available. Data are needed to evaluate the nature and extent of surface soil contamination (0 to 0.3 m [0 to 1 ft]).
UPR-200-W-82	S Plant	Shallow – Subsurface	Follow SAP protocol for shallow sites, subsurface contamination using a focused sampling strategy.	Contaminated runoff, area covered with Fabrofilm. Data are needed to evaluate the nature and extent of subsurface soil contamination (0 to 4.6 m [0 to 15 ft]).
UPR-200-W-99	T Plant	Shallow – Subsurface	Follow SAP protocol for shallow sites, subsurface contamination using an area-wide grid sampling strategy with emphasis on the windrows.	Windblown contamination was graded into windrows and stabilized. Data are needed to evaluate the nature and extent of subsurface soil contamination (0 to 4.6 m [0 to 15 ft]).

H-2-44511, 1983 (drawing), *Area Map 200 West "S" Plant Facilities*, Rev. 7, Atlantic Richfield Hanford Company, Richland, Washington.

H-2-32535, 1964 (drawing), *REDOX Plant Liquid Waste Disposal Sites 216-S-Series*, Rev. 1. U.S. Atomic Energy Commission, Hanford Atomic Products Operation, General Electric.

WAC 246-272, "Wastewater and Reclaimed Water Use Fees," *Washington Administrative Code*, Olympia, Washington.

bgs	=	below ground surface	RAD	=	radionuclides
CCU	=	Cold Creek unit	REDOX	=	Reduction Oxidation (Plant)
DPT	=	direct push technology	RR	=	railroad
DQO	=	data quality objective	RTD	=	removal, treatment, and disposal
GPL	=	geophysical logging	SAP	=	sampling and analysis plan
ICP-MS	=	inductively coupled plasma/mass spectrometer	UPR	=	unplanned release
MIBK	=	methyl isobutyl ketone	UST	=	underground storage tank
PV	=	?	VCP	=	vitrified clay pipe

For waste sites that are poorly defined, and where site reconnaissance and surface screening give no indication of contaminant location, area-wide grid or composite sampling will be conducted as described in Section E2.2.1, to locate contaminated soil. Continuous sampling will be conducted via DPTs to the depth of likely contamination. Each 0.6 m (2 ft) soil core will be screened and results assessed to map contamination. Once contamination is located, soil samples will be collected from two to three DPTs for analysis, as described for focused sampling. If contamination is not located, representative soil samples will be collected to confirm screening results.

E3.4.2 Intermediate and Deep Sites

At intermediate sites, contamination is expected to extend below 4.6 m (15 ft) but not have affected groundwater. These are generally liquid release sites such as trenches, reverse wells, French drains, retention basins, and process sewers. Tanks and vaults are included in this category, as well as significant UPRs. Deep contamination sites include the cribs, trenches, French drains, and ditches where the large volumes of liquid waste that were disposed may have affected groundwater.

E3.4.2.1 Intermediate and Deep Sites, Shallow Subsurface Contamination (0 to 4.6 m [0 to 15 ft] bgs)

Although the bottoms of the cribs, trenches, or other discharge points were often well below the ground surface, some structures overflowed, many had risers extending above ground level, and some structures were backfilled with contaminated soil. For most intermediate and deep waste sites, there is a degree of uncertainty regarding whether the soil within the waste site footprint above the level of discharge is contaminated, and this soil will usually be characterized. If the upper vertical extent is defined by site history or previous characterization, at least one verification sample will be collected.

Most of the intermediate and deep waste sites are well defined with respect to contaminant location, and the shallow subsurface soil investigation will follow a focused sampling strategy. Generally, two to three DPTs will be sufficient for characterization of the subsurface contamination (0 to 4.6 m [0 to 15 ft] bgs). Two of the three shallow borings will terminate at 4.6 m (15 ft) bgs; the third will be driven deeper to investigate deep vadose zone contamination as described in the next subsection.

Note that samples will not be collected from inside wooden crib frames or from the actual structure because of the health and safety risks involved. In lieu of these samples, the assessment of risk and groundwater impact will rely on data collected from surrounding soil and assume that the structures and interiors are at least as contaminated as this soil. For this reason, one or more of the shallow DPTs should be installed adjacent to the structure, as near as safety allows.

If the waste site location is poorly defined, the shallow soil investigation will follow protocol described previously for shallow, subsurface contamination using area-wide grid or composite sampling strategy to locate contaminated soil. Once located, soil samples will be collected from two to three DPTs for analysis as described for focused sampling.

E3.4.2.2 Intermediate and Deep Sites, Deep Vadose Zone Contamination (>4.6 m [>15 ft] bgs)

One deep borehole will be installed within the waste site footprint in the area of highest known or expected contamination. For trenches, this is typically next to the discharge pipe, and for cribs, this is usually just outside the wooden crib frame that received the highest contamination or most liquid volume based on waste site history. Soil samples will be collected to determine maximum contaminant concentrations and lowest vertical extent of contamination. In addition to chemical analyses, physical properties will be assessed on a minimum of three soil samples from each deep borehole. These data will be used to support vadose zone modeling.

The zones anticipated to contain the highest levels of contamination correspond to the following:

- Regions within, adjacent to, and immediately beneath the waste site footprint (e.g., the bottom of the cribs and trenches)
- Lithologic changes such as contacts associated with grain size increases or decreases, silt layers, and clay layers
- Intervals of elevated (above background) moisture contents
- Intervals of elevated (above background) gamma activities

For intermediate waste sites where contamination is not expected below the Cold Creek unit (CCU), a DPT may be attempted for borehole installation and sample collection. The DPT will be extended either to clean soil or to refusal. If refusal is encountered before the vertical extent of contamination has been reached, a drill rig will be needed to complete the investigation. Due to the density of the CCU, it is expected that a drill rig will be needed for the deep waste sites to allow sample collection of the entire soil profile extending through the CCU to groundwater.

For most of the intermediate waste sites and some deep waste sites, limited information is available regarding the quantity of contaminants discharged to the site, or the depth and degree of contamination. As a result, radiological levels will not be known until soil cores are opened, potentially exposing field personnel to health and safety risks. Under these conditions, a “twin borehole” strategy may be advantageous.

With twin boreholes, two separate DPTs are pushed to depth at a given waste site. The initial DPT is advanced to a designated depth based on site knowledge or professional judgment, without collecting samples. (Lacking any information regarding depth, the FTL may choose to push the borehole open 15.2 m [50 ft] at a time and drop a logging tool down through the casing to determine if radiological contamination is present and additional depth is warranted.) Once open, the borehole is geophysically logged for both gamma activity and neutron moisture. Following logging, an electrode may be installed for electrical resistivity characterization (ERT) at waste sites that received large volumes of relatively mobile contaminants. ERT can characterize areas of high electrical conductivity and may be useful in evaluating the horizontal extent of deep vadose zone contamination.

Once the geophysical data have been reviewed and appropriate health and safety precautions taken, a second DPT borehole is advanced in the immediate vicinity of the first. Based on data obtained from the first push, appropriate sample depths (e.g., lithologic transitions) can be targeted for soil sampling.

E3.4.3 Sites with Structures

Samples for “nonsoil-like” physical structures will be collected using several approaches, depending on the structure.

Concrete Slabs, Foundations, and Vaults: Concrete slabs, foundations, and vaults will be characterized using a phased approach that will include the following steps:

1. Perform a characterization scoping survey to provide an overall assessment of contamination and hazards. Survey areas will be delineated based on contamination potential, considering historical information and current radiological postings. The survey may include radiological surveys, facility walkdowns, and any other survey needed to characterize contamination levels in the facility.
2. Conduct radiation surveys of accessible surfaces of the structure.

3. Collect surficial samples, if warranted, based on screening results. Information from the scoping surveys will be used to determine whether sampling is needed to meet project objectives and to select sample locations.

4. Collect volumetric samples if the potential exists that contamination may have migrated into the concrete. For example, volumetric samples may be collected in areas that have a history of repeated spills of contaminated liquids. The samples will be collected from worst-case locations. A statistical sampling design may be developed if a worst-case location cannot be reliably determined. When characterization sampling is needed, a SAP amendment with sample design information (number of samples, locations, analyses, statistical design) may be required.

Retention Basins: If feasible, the concrete at each retention basin will be characterized by collecting a core sample of the concrete floor for analysis. The core sample will be collected at the location of the deep borehole proposed to characterize vadose zone soil beneath the basin. Of the four retention basins requiring investigation, one is empty but is covered with a plastic liner, two are filled with contaminated soil, and one is filled with high-density grout. For the filled basins, sampling will be completed where contamination is expected based on background information. For the empty basin, site reconnaissance and field screening may also be used to select the deep borehole location (similar to the approach for concrete slabs).

200-W-44 Sand Filter: The contents of the sand filter will not be sampled. Existing inventory, process knowledge, and construction details will be used for risk and remedial alternative evaluations. The characterization approach for sand filters consists of focused soil sampling of the vadose zone adjacent to the French drain to which the filter condensate drains.

241-WR Vault: A records review was conducted to determine if the contents of the tanks and sumps had been removed or if the condition of the vault or tanks was documented at the time the 241-WR Vault was taken out of service. Documentation was found that indicated the pipelines were disconnected, but no definitive documentation was found that indicated the contents were removed or the condition of the tanks and the structure at the time the 241-WR Vault was isolated. Due to uncertainty of the contents, if any, within the tanks and sumps, a separate DQO will be performed to determine if additional data must be obtained for this site, or if process knowledge and historical records can provide sufficient information to perform remedy evaluation and to determine whether contaminants exceed acceptable risk levels for groundwater protection. Additional records searches and staff interviews will be performed in preparation for the DQO process. If additional data needs related to the 241-WR Vault tank and sump contents are identified, a SAP amendment will be prepared.

The 241-WR Vault may require additional work planning and scoping requirements in order to facilitate safe entry into the vault structure to fulfill data needs, if identified by a separate DQO for this site. For initial work planning purposes, reconnaissance would include determining the contents and volumes of each of the nine tanks, any materials remaining in vault sumps, the condition of the tanks and structure, and if feasible, collection of samples of the contents of the tanks and sumps.

Because of the potential for highly hazardous conditions requiring specialized sampling teams and equipment, and the need for in-depth planning and various approvals, a separate scope of work and SAP amendment will be developed and submitted to the regulatory agencies, if the need to enter the vault is established by the DQO process. The timeframe for submittal of the work planning documentation and SAP amendment will be coordinated with U Plant activities to determine if the investigation can be optimized with other ongoing U Plant activities.

Tanks and Pipelines: Tanks and pipelines are common to both the 200-IS-1 and 200-WA-1 OUs. These structures may require characterization of the physical structure and the vadose zone to characterize risk in the RI or to evaluate remedial options in the FS. Currently under development, the 200-IS-1 OU RI/FS work plan will include a characterization approach for tanks and pipelines. Pending completion and approval of the 200-IS-1 work plan, a similar approach for investigation of tanks and pipelines may be incorporated into the 200-WA-1 OU work plan and SAP with EPA acceptance.

E3.4.4 Sites with Contained Waste

For waste sites with physical structures that currently contain liquid or solid waste (tanks, vaults, septic tanks, retention basins, silos, or other vessels), characterization of the waste material may be warranted where process knowledge is insufficient to reliably determine the nature and extent of tank contents. Data are available for some of these waste sites and are of sufficient quantity and quality to meet project objectives. If data are inadequate or insufficient, waste samples will be collected if waste is still present in the vessel.

E3.4.5 Planning Field Activities

Appendix D provides FSPs for each waste site based on available information and using the guidelines presented in the following subsections.

E3.4.5.1 Depth of Investigation and Sampling Strategy

The depth of investigation (surface only, subsurface, intermediate, or deep vadose zone) and sampling strategy (focused, area-wide grid, or composite) proposed for each waste site were based on historical characterizations and recorded estimates of the volume spilled or discharged. For waste sites with known or at least conjectured discharge volumes, the depth of contamination was estimated by converting discharge to pore volume[4]. For waste sites with estimated pore volumes greater than 0.5, contamination was assumed to have the potential for affecting groundwater (deep waste sites), and conversely, if estimated pore volumes were less than 0.5, then it was assumed that contamination did not reach groundwater (intermediate sites). If no estimate of discharge volume was recorded, the proposed depth of contamination and sampling strategy were based on the waste site description, process information, and professional judgment. Most of the waste sites labeled shallow contamination sites fall into this category.

Following site reconnaissance and field screening, the FTL (Section E2.1.1) or designee (e.g., the site geologist) will evaluate whether the sampling depth and strategy for a given waste site requires adjustments and to make changes, as needed, to the site-specific FSP and field instructions. These modifications will require notification of project management in accordance with Section E2.1.6.

To verify the vertical extent of a waste site during the soil investigation, a sample collected from the bottom of the borehole may be submitted for quick-turnaround analyses to confirm absence of contamination. If contamination was detected, additional boring and sample collection could be conducted without the need to remobilize.

E3.4.5.2 Sample Intervals

The site-specific FSPs in Appendix D propose estimated sample intervals for the intermediate and deep waste sites. Intervals include the continuous sampling by 0.6 m (2 ft) cores in the shallow subsurface (0 to 4.6 m [0 to 15 ft] bgs) and a sample interval directly beneath the crib or trench structure, if present. Additional samples to be collected within the deep vadose zone to the bottom of the borehole were estimated using the following sources:

[4] Pore volumes were calculated using the approximate depth to groundwater, area of waste site footprint at base, and assuming a soil porosity of 30 percent.

- Hydrostratigraphic templates in Appendix A of PNNL-14702, *Vadose Zone Hydrogeology Data Package for Hanford Assessments*. At most, two templates were included for each plant area in this document; these were applied to most of the waste sites within the plant area, and sample intervals were defined by significant lithologic transitions.

- Geophysical logs had been completed on boreholes conducted in or near a few waste sites. For these sites, sample intervals were selected at depths with elevated anthropogenic gamma contamination, and/or intervals with elevated (anomalous) neutron moisture, as recorded in the Stoller reports.

- A few of the 200-WA-1 OU waste sites have previously been addressed in SAPs (e.g., DOE/RL-2007-02, Rev. 0, Vol. II). The site stratigraphy and sample collection intervals presented in these FSPs were included in Appendix D.

The individual FSPs in Appendix D reference the source of the sample interval depths proposed. For some waste sites, additional sample intervals were identified to fill gaps in the vertical distribution or to target specific zones of interest.

In the field, sample intervals will be adjusted, as needed, to collect the samples from the zones most likely to have the highest contaminant concentrations. The FTL or designee (e.g., the site geologist) will use the following criteria during borehole drilling to evaluate whether the planned sample depths and intervals identified in Appendix D are appropriate and to make adjustments, as needed, to the depths and quantities of samples to be obtained. These modifications will be considered minor changes in accordance with Section E2.1.6.

- Radiological field screening data
- Visual observation of lithology and moisture conditions
- Visual observation of contamination
- Exploratory geophysical borehole logging
- Changes in drilling rate
- Site geologist professional judgment
- Changes in project requirements (e.g., addition of opportunistic samples for other projects)

These criteria also may be used by other field personnel, as necessary, to assist in determining sample shipping requirements, and to support worker health and safety monitoring.

E3.5 Sampling Methods

Sampling activities for all 200-WA-1 and 200-BC-1 OU waste sites target the most likely zones of contamination for characterization. Surface soil samples will be collected with hand tools and subsurface (0 to 4.6 m [15 ft] bgs) and vadose zone soil samples will be collected using either drive points advanced with DPT equipment or split-spoon samplers advanced with conventional drilling technology. In all cases, excavation permits will be obtained prior to any digging, and precautions taken to minimize dispersing contamination and risks from exposure.

E3.5.1 Surface Soil Sampling

Collection of surface soil samples can be accomplished with tools such as spades, shovels, trowels, and scoops. Surface material is removed to the required depth and a stainless steel or plastic scoop is then used to collect the sample. If present, the stabilization cover should be carefully removed, exposing an area larger than the sample location. Depending on the cover thickness, this may be accomplished with a

hand shovel, backhoe, or other equipment. Remaining gravel and /or debris may be scraped away to reach bare soil with clean stainless steel spade or trowel.

Surface soil is considered the top 30.4 cm (12 in.); however, the thickness and depth of samples for a given waste site should be designed to obtain samples from the most probable zone of contamination. For example, "windblown specks" would likely reside within the top inch of soil, while organic constituents are more likely to be present several inches below the surface. At some sites, a sample consisting of the top 15.2 or 30.4 cm (6 or 12 in.) may provide a more representative sample of the contamination.

E3.5.1.1 Surficial Sampling

Surficial samples will be collected, if warranted, based on screening results. Information from the scoping surveys will be used to determine whether sampling is needed to meet project objectives and to select sample locations. Surficial sampling is used to sample for contamination on nonsoil surfaces (for example, a concrete foundation). Chip sampling can be used to test for surficial contamination to test for non-volatile contamination on porous surfaces (cement, brick, and wood).

E3.5.2 Direct Push Technology

DPT uses pushing methods, such as a diesel hammer, hydraulic hammer, cone penetrometer, or GeoProbe,[5] to penetrate the vadose zone to collect soil samples and/or to obtain downhole geophysical data. These methods generally are limited in the depth of penetration and in sample volume, compared to conventional borehole drilling, and very dense stratigraphy, cobbles, or boulders will cause refusal. However, they are also generally less expensive than drilling. Table E-13 includes descriptions of various DPT technologies that may be employed to collect samples specified in this SAP.

Table E-13. 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)	2.7 cm (1.08 in.) diameter, 55.9 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

[5] GeoProbe is a registered trademark of GeoProbe systems, Salina, Kansas.

Table E-13. Direct Push Technologies

Technology	Penetration Depth	Sample Size	State of Development	Comments	Relative Cost
GeoProbe®	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	Low to Medium

® GeoProbe is a registered trademark of GeoProbe Systems, Salina, Kansas.

Soil samples are collected from the direct-push 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. Because of the limited sample size using DPT methods, focused analysis or analysis priorities may be necessary (Section E2.1.5.1). Table E-13 lists the anticipated maximum depths for these technologies.

Samples will be collected in accordance with the details of this SAP. For waste sites with single boreholes, the borehole will be geophysically logged for both gamma activity and neutron moisture following sample collection. When logging is complete, at least one deep electrode will be installed to support surface geophysical exploration. Nominally, the electrode will be placed near the bottom of the hole. This borehole will then be decommissioned.

E3.5.3 Test Pits and Trenching

Test pitting, trenching, or augering may be appropriate for investigation of some shallow, subsurface waste sites, particularly extensive disposal sites. These methods will be used only at sites that have been confirmed to be low risk based on reliable process knowledge and thorough field screening. Generally, test pits and trenches will be excavated by backhoe, with soil samples collected directly from the bucket. Soil cuttings should be replaced in the excavation at the completion of the investigation, if appropriate.

E3.5.4 Borehole Drilling

Borehole drilling can be conducted using a variety of equipment, depending on data needs. For application to the 200-WA-1 and 200-BC-1 OU characterization, drilling commonly uses a cable tool rig or a similar type of rig with the following attributes:

- Enables control of contaminated cuttings
- Permits spectral gamma, neutron moisture, and other types of downhole geophysical logging
- Provides adequate soil return to support soil sampling, either through a split-spoon sampler or through a grab sample

Table E-14 includes descriptions of various conventional borehole drilling technologies that may be employed to collect samples specified in this SAP.

Table E-14. Conventional Drilling Technologies

Technology	Penetration Depth	Sample Size	State of Development	Comments	Relative Cost
Cable Tool	Deep (152.4+ m [500+ ft])	6.4 to 12.7 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	6.4 to 12.7 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 Types of Drive Casing)	Medium (<61.0 m [200 ft], depending on geology)	6.4 to 12.7 cm (2.5 to 5 in.) diameter split spoon	Commercial – widely available and routinely used		Medium
Sonic	Medium (<91.4 m [300 ft], depending on geology)	6.4 to 12.7 cm (2.5 to 5 in.) diameter split spoon	Commercial – widely available	Stratigraphy in split spoon may not be representative; can heat formation and sample to high temperatures.	Medium
Hollow-Stem Auger	Shallow (<50 ft) (15.24 m)	6.4 to 12.7 cm (2.5 to 5 in.) diameter split spoon	Commercial – widely available	Brings soil to surface, so not for use in radiological areas.	Low
Directional Drilling	Deep	Unknown	Commercial – widely available	Requires a drilling mud, which could mobilize contamination. Only demonstrated at Hanford Site.	High

All drilling will be done using a method approved by the project and will conform to site-specific technical specifications for environmental drilling services. Drill rigs for deep boreholes will generally require a gravel pad and, in some cases, a gravel access road. Decontamination will be performed in accordance with this SAP (Section E3.5.7).

Multiple casing strings may be used by telescoping to reach the proposed total depth for the borehole and to minimize transport of contaminants through the vadose zone during drilling operations. The casing sizes will be planned and designed to accommodate split-spoon samplers to the bottom of the borehole.

E3.5.4.1 Split-Spoon Sampling and Analysis

The split-spoon samplers will be equipped with four separate liners, generally stainless steel or LEXAN[6] Site personnel will not overdrive the sampling device. With the exception of the VOA subsamples, soil will be transferred to a clean, stainless-steel mixing bowl, homogenized, and containerized in accordance with details in this SAP (Section E3.5.6). VOA samples will be collected first from the undisturbed cores, directly into glass jars (Table E-15).

E3.5.4.2 Grab Sampling and Analysis

To gain a better understanding of the distribution of mobile contaminants (e.g., technetium-99, uranium, nitrate, and chromium), grab samples may be collected from the drill cuttings. The purpose of the grab samples is to analyze for mobile contaminants for field screening information between split-spoon samples. Grab samples will be analyzed in accordance with methods specified in Tables E-6 and E-7. Grab samples will be collected at uniform sampling intervals, typically 3.1 m (10 ft). Grab samples will be collected into jars directly from the drive barrel and temporarily stored for possible analysis. Initially, based on review of available and newly acquired borehole data (e.g., borehole geophysical logs, split-spoon samples, and geologic logs, consistent with the field sampling strategy [Section E3.4]), analyses will be run on a subset of the grab samples. These results will be reviewed, and additional analyses may be requested on the intermediate sample intervals to refine the understanding of contaminant distribution.

E3.5.4.3 Physical Properties Sampling and Analysis

Samples for physical property determinations will be conducted on a minimum of three samples from deep boreholes to provide site-specific values to support modeling efforts. General soil properties of interest are pH, moisture content, grain-size distribution, and soil density. Samples for soil density generally should be collected with a split-spoon sampler equipped with four stainless steel or LEXAN liners. Physical property samples will be analyzed in accordance with methods specified in Table E-7. The physical properties samples will generally be collected from lithologies that represent the major facies in the vadose zone. The samples will be collected coincident with radiological and nonradiological split-spoon sample intervals, where possible. This ensures that the physical properties can be related back to the depth of the chemical sample results. Additional physical properties of interest may be added (e.g., distribution coefficient and porosity).

E3.5.4.4 Concrete Coring

Concrete core samples may be collected from structures (foundations, retention basins). Hand held coring equipment may be appropriate for collecting samples from shallow depths. Drilling-rig-mounted coring drills may be required to collect subsurface samples.

E3.5.5 Geophysical Logging

The drilled 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 and/or process history indicates the likely presence of plutonium contamination. The boreholes will be logged before the casing is telescoped and before the borehole is decommissioned. The starting point for logging will be recorded; this is usually at the ground surface or the top of the casing. Boreholes will be decommissioned with DOE-RL and EPA approval, in accordance with WAC 173-160, “Minimum Standards for Construction and Maintenance of Wells,” after geophysical logging and all sampling are completed.

[6] LEXAN is a registered trademark of General Electric Company, New York, New York.

The 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 and/or process history indicates the likely presence of plutonium contamination.

E3.5.6 Sample Collection/Preservation/Holding Time

Sample collection at each site will be performed in accordance with individual FSPs in Appendix D. Sample preservation, containers, and holding times are presented in Table E-15.

Table E-15. Sample Preservation, Container, and Holding Time Guidelines

Analytes*	Matrix	Bottle		Amount[a,b]		Preservation	Packing Requirements	Holding Time[d]
		Number	Type	Minimum	Optimal			
Radionuclides								
Americium-241	Soil	1	G/P	8 g	20 g	None	None	6 months
Cesium-137	Soil	1	G/P	60 g	500 g	None	None	6 months
Europium-154	Soil							
Neptunium-237	Soil	1	G/P	8 g	20 g	None	None	6 months
Plutonium-239/240	Soil	1	G/P	8 g	20 g	None	None	6 months
Strontium-90	Soil	1	G/P	5 g	10 g	None	None	6 months
Technetium-99	Soil	1	G/P	18 g	30 g	None	None	6 months
Uranium-238	Soil	1	G/P	5 g	10 g	None	None	6 months
Chemicals								
IC Anions – EPA Method 300.0	Soil	1	G/P	30 g	60 g	Cool ≤6°C	Cool ≤6°C	28 days/ 48 hours[c]
Metals by ICP, ICP-MS	Soil	1	G/P	10 g	20 g	Cool ≤6°C	Cool ≤6°C	6 months
Hexavalent Chromium – Method 7196	Soil	1	aG	60 g	120 g	Cool ≤6°C	Cool ≤6°C	30 days
Mercury – Method 7471 – (Cold Vapor Atomic Absorption)	Soil	1	G	2 g	5 g	Cool ≤6°C	Cool ≤6°C	28 days
Total Cyanide – 9010	Soil	1	G	10 g	20 g	Cool ≤6°C	Cool ≤6°C	14 days
Semivolatile Organic Analyte – Method 8270A	Soil	1	aG	120 g	250 g	Cool ≤6°C	Cool ≤6°C	14/40 days[d]
Volatile Organic Analyte Low Level Method 5035A/8260	Soil	5	aG	5 g		Freeze -7°C to -20°C	Freeze -7°C to -20°C	14 days

Table E-15. Sample Preservation, Container, and Holding Time Guidelines

Analytes*	Matrix	Bottle		Amount[a,b]		Preservation	Packing Requirements	Holding Time[d]
		Number	Type	Minimum	Optimal			
Volatile Organic Analyte High Level Method 5035A/8260	Soil	3	aG	5 g		Cool ≤6°C	Cool ≤6°C	14 days

*Four-digit EPA methods are found in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*, as amended. EPA Method 300.0 is found in EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples.*

a. Optimal sample amounts, which may be adjusted downward to accommodate the possibility of retrieval of a small amount of sample. Minimum sample size includes material needed for laboratory batch QC.

b. Mixed soil samples (collocated subsamples that are homogenized to ensure that the minimum sample amount requirements are met) may be obtained and submitted to the analytical laboratory for analyses for specific analytes.

c. 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.

d. The first number shown is the number of days to extract and the second number is the number of days to analyze the extract.

aG = amber glass
EPA = U.S. Environmental Protection Agency
G = glass
IC = ion chromatography
ICP = inductively coupled plasma
ICP-MS = inductively coupled plasma-mass spectrometry
P = plastic
QC = quality control

E3.5.7 Decontamination of Sampling and Drilling Equipment

Sampling equipment shall be decontaminated in accordance with the sampling equipment decontamination methods. To prevent potential contamination of the samples, care should be taken to use decontaminated equipment for each sampling activity.

Special care should be taken to avoid the following common ways in which cross-contamination or background contamination may compromise the samples:

- Improperly storing or transporting sampling equipment and sample containers
- Contaminating the equipment or sample bottles by setting the equipment/sample bottle on or near potential contamination sources (e.g., uncovered ground)
- Handling bottles or equipment with dirty hands or gloves
- Improperly decontaminating equipment before sampling or between sampling events

The drill rig derrick, all downhole equipment, and temporary casing will be field decontaminated (e.g., high pressure and temperature wash), at a minimum, before mobilization and demobilization at each drilling location.

E3.5.8 Radiological Field Data

Alpha and beta/gamma data collection in the field will be used as needed to support sampling and analysis efforts. As a general rule, cuttings from boreholes (excluding slough) will be field screened for evidence of radiological contamination. Radiological screening shall be performed by the RCT or other qualified personnel. The RCT will record field measurements, noting the depth of the sample and the instrument reading. Measurements will be relayed to the field geologist (for borehole, aquifer tubes, and wells) for daily inclusion in the field logbook or operational records, as applicable.

The following information will be distributed to personnel performing work in support of this SAP:

- Instructions to RCTs on the methods required to measure sample activity and media for gamma, alpha, and/or beta emissions, as appropriate.
- Information regarding the portable radiological field instrumentation; including a physical description of the instruments, radiation and energy response characteristics, calibration/maintenance and performance testing descriptions, and the application/operation of the instrument. These instruments are commonly used on the Hanford Site to obtain measurements of removable surface contamination measurements and direct measurements of the total surface contamination.
- Instructions regarding the minimum requirements for documenting radiological controls information in accordance with 10 CFR 835, “Occupational Radiation Protection.”
- Instructions for managing the identification, creation, review, approval, storage, transfer, and retrieval of radiological information.
- The minimum standards and practices necessary for preparing, performing, and retaining radiological-related information.
- The requirements associated with preparing and transporting regulated material.
- Daily reports of radiological surveys and measurements collected during conduct of field investigation activities. Data will be cross-referenced between laboratory analytical data and radiation measurements to facilitate interpreting the investigation results.

E3.5.9 Corrective Actions and Deviations for Sampling Activities

The 200-WA-1 and 200-BC-1 OU Project Manager, FWS, appropriate BTR (or designee), and SMR personnel must document deviations from protocols, problems pertaining to sample collection, chain-of-custody forms, target analytes, contaminants, sample transport, or noncompliant monitoring. Examples of deviations include samples not collected because of field conditions, changes in sample locations because of physical obstructions, or additions of sample depth(s).

As appropriate, such deviations or problems will be documented (e.g., in the field logbook or on nonconformance report forms) in accordance with internal corrective action methods. The OU Project Manager, FWS, appropriate BTR (or designee) or SMR personnel will be responsible for communicating field corrective action requirements and for ensuring immediate corrective actions are applied to field activities.

Changes in sample activities require notification, approval, and documentation will be performed as specified in Table E-9.

E3.6 Documentation of Field Activities

Logbooks or data forms are required for field activities. A logbook must be identified with a unique project name and number. The individual(s) responsible for logbooks will be identified in the front of the logbook, and only authorized persons may make entries in logbooks. Logbooks entries will be reviewed by the FWS, cognizant scientist/engineer, or other responsible manager; the review will be documented with signature and date. Logbooks will be permanently bound, waterproof, and ruled with sequentially numbered pages. Pages will not be removed from logbooks for any reason. Entries will be made in indelible ink. Corrections will be made by marking through the erroneous data with a single line, entering the correct data, and initialing and dating the changes.

Data forms may be used to collect field information; however, the information recorded on data forms must follow the same requirements as those for logbooks. The data forms must be referenced in the logbooks.

A summary of information to be recorded in logbooks is as follows:

- Purpose of activity and documentation (e.g., maps, drawings, well completion log)
- Day, date, time the task started, weather conditions
- Names, titles, organizations of personnel performing the task
- Deviations from the QAPjP
- All site activities, including field tests
- Materials quality documentation (e.g., certifications)
- Details of samples collected (e.g., preparation, splits, duplicates, matrix spikes, blanks)
- Location and types of samples
- Sample containers and volume
- Chain-of-custody details and variances relating to chain-of-custody
- Field measurements
- Field calibrations testing, inspections, maintenance, and surveys, and equipment identification numbers, as applicable
- Equipment decontaminated, number of decontaminations, and variations to decontamination methods
- Equipment failures or breakdowns, and descriptions of any corrective actions
- Telephone calls relating to field activities

E3.7 Calibration of Field Equipment

Construction management, the appropriate BTR, or the FWS is responsible for ensuring that field equipment is calibrated appropriately. Onsite environmental instruments are calibrated in accordance with the manufacturer's operating instructions, internal work requirements and processes, and/or field instructions that provide direction for equipment calibration or verification of accuracy by analytical

methods. The results from all instrument calibration activities are recorded in accordance with the HASQARD (DOE/RL-96-68).

Field instrumentation, 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 or 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 to characterize areas under investigation. These checks will be made on standard materials sufficiently like the matrix under consideration for direct comparison of data. Analysis times will be sufficient to establish detection efficiency and resolution.

Standards used for calibration will be traceable to a nationally or internationally recognized standard agency source or measurement system, if available.

E3.8 Sample Handling

Sample handling and transfer shall be in accordance with established methods to preclude loss of identity, damage, deterioration, and loss of sample. Custody seals or custody tape shall be used to verify that sample integrity has been maintained during sample transport. The custody seal will be inscribed with the sampler's initials and date.

A sampling and data tracking database is used to track the samples from the point of collection through the laboratory analysis process.

E3.8.1 Packaging

Pre-cleaned sample containers with certificates of analysis denoting compliance with EPA specification (EPA 540/R-93/051, *Specifications and Guidance for Contaminant-Free Sample Containers*) for the intended analyses will be used for samples collected for chemical analysis. Container sizes may vary depending on laboratory-specific volumes/requirements for meeting analytical detection limits. The Radiological Engineering organization will measure both the contamination levels and dose rates associated with the sample containers. This information, along with other data, will be used to select proper packaging, marking, labeling, and shipping paperwork and to verify that the sample can be received by the analytical laboratory in accordance with the laboratory's acceptance criteria. If the dose rate on the outside of a sample container or the curie content exceeds levels acceptable by an offsite laboratory, the FTL (in consultation with the SMR organization), can send smaller volumes to the laboratory. Preliminary container types and volumes are identified in Table E-15.

E3.8.2 Container Labeling

Each sample container will be labeled with the following preprinted information on firmly affixed, water-resistant labels or handwritten in permanent or waterproof ink:

- SAF
- HEIS number
- Sample collection date and time

- Analysis required
- Preservation method (if applicable)
- Chain-of-custody number
- Bottle type and size
- Laboratory performing the analyses
- Sample location
- Sample identification number

In addition, sample records must include the following information:

- Analysis required
- Source of sample
- Matrix (water, soil, etc.)
- Field data (pH, radiological readings)
- Radiological readings.

Except for VOA samples, a custody seal (i.e., evidence tape) will be affixed to the lid of each sample container. The custody seal will be inscribed with the sampler's initials and the date. Custody seals are not applied directly to VOA bottles collected because of a potential for affecting analytical results and/or fouling of laboratory equipment. Custody seals and any other required labels or documentation can be fixed to the exterior of a plastic bag holding vials in such a manner to detect potential tampering.

E3.8.3 Sample Custody

Sample custody will be maintained in accordance with existing protocols to ensure the maintenance of sample integrity throughout the analytical process. Chain-of-custody protocols will be followed throughout sample collection, transfer, analysis, and disposal to ensure 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 any 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 changes for the custody of the sample, the new and previous custodians will sign the record and note the date and time. The sampler will make a copy of the signed record before sample shipment and will transmit the copy to the SMR organization within 48 hours of shipping.

The following minimum information is required on a completed chain-of-custody form:

- Project name
- Collectors' names
- Unique sample number
- Date and time of collection
- Matrix
- Preservatives
- Chain of possession information (i.e., signatures and printed names of all individuals involved in the transfer of sample custody and storage locations, and dates of receipt and relinquishment)

- Shipped-to information (i.e., analytical laboratory performing the analysis)
- Requested analyses (or reference thereto).

E3.8.4 Sample Transportation

All packaging and transportation instructions shall be in compliance 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 Department of Transportation (DOT) as described in 49 CFR 171, “General Information, Regulations, and Definitions,” through 177, “Carriage by Public Highway.” Carrier specific requirements defined in the International Air Transportation Association Dangerous Goods Regulations (IATA, current edition) shall also be used when preparing sample shipments conveyed by air freight providers.

Samples containing hazardous constituents shall be considered hazardous material in transportation and transported according to DOT/IATA requirements. If the sample material is known or can be identified, then it shall be packaged, marked, labeled, and shipped according to the specific instructions for that material and appropriate laboratory notifications will be made, if necessary, through the SMR project coordinator.

E3.9 Management of Waste

Waste materials are generated during sample collection, processing, and subsampling activities. The method of identification, storage, and disposition of 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 to the extent necessary to meet DOE/RL-2011-41, *Hanford Site Strategy for Management of Investigation Derived Waste* and the waste acceptance criteria for the relevant disposal facility.

Offsite analytical laboratories are responsible for the disposal of unused sample quantities. On a monthly basis, the laboratory will coordinate sample disposal and status with SMR by providing a list of samples more than 90 days post-data delivery for which disposal is requested in the following month. The laboratory will also provide on a monthly basis a list of samples disposed in the preceding month that includes disposal date and method or other relevant information. Signed chain-of-custody forms indicating sample disposal will be retained in laboratory case files pending return of case files to the contractor.

Pursuant to 40 CFR 300.440, “National Oil and Hazardous Substances Pollution Contingency Plan,” “Procedures for Planning and Implementing Off Site Response Actions,” approval from DOE-RL is required before returning unused samples or waste from offsite laboratories.

E4 Health and Safety Plan

The hazardous waste operations safety and health program was established to ensure the safety and health of workers involved in hazardous waste site activities. The program was developed to comply with the requirements of 29 CFR 1910.120, "Occupational Safety and Health Standards," "Hazardous Waste Operations and Emergency Response," and 10 CFR 835, "Occupational Radiation Protection" (Chapter III, “Energy”). The health and safety program defines the chemical, radiological, and physical hazards and specifies the controls and requirements for daily work activities on the overall Hanford Site. Personal 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 prepared to supplement the general health and safety program. Site access and sampling work activities will be controlled in accordance with the site-specific and general health and safety plans.

E5 References

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