U.S. Department of Energy
Hanford Site

22-PFD-003969 December 19, 2022

Mr. Craig E. Cameron, Project Manager
Superfund and Emergency Management Division
Site Cleanup Section 4
U.S. Environmental Protection Agency
825 Jadwin Avenue, Suite 210
Richland, Washington 99352

Dear Mr. Cameron:

SAMPLING AND ANALYSIS PLAN FOR THE REMEDIATION OF WASTE SITES IN THE 200-CW-3 OPERABLE UNIT DOE/RL-2007-54, REVISION 1, DRAFT A

This letter transmits the Sampling and Analysis Plan for the Remediation of Waste Sites in the 200-CW-3 Operable Unit, DOE/RL-2007-54, Revision 1 Draft A, for review and comment. Comments are requested within 45 days of receipt. If you have any questions please contact me, or your staff may contact Anders Wiborg, Operations Activities Team Lead, Project and Facilities Division, on (509) 376-9238.

Sincerely,

Kelly Ebert for

Mark S. French, Director
Project and Facilities Division

PFD:PGE

Attachment

cc: See page 2

cc w/attach:
D. J. Alexander, Ecology
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Attachment
22-PFD-003969

Sampling and Analysis Plan for the Remediation of Waste Sites in the
200-CW-3 Operable Unit
DOE/RL-2007-54, Revision 1 Draft A

(77 pages including cover sheet)

DOE/RL-2007-54
Revision 1 Draft A

Sampling and Analysis Plan for the Remediation of Waste Sites in the 200-CW-3 Operable Unit

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

U.S. DEPARTMENT OF ENERGY | Richland Operations Office

P.O. Box 550
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DOE/RL-2007-54
Revision 1 Draft A

Sampling and Analysis Plan for the Remediation of Waste Sites in the 200-CW-3 Operable Unit

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

U.S. DEPARTMENT OF ENERGY | Richland Operations Office
P.O. Box 550
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APPROVED
By Lynn M Ayers at 8:47 am, Nov 28, 2022

Release Approval Date

Signature Sheet

DOE/RL-2007-54, *Sampling and Analysis Plan for the Remediation of Waste Sites in the 200-CW-3 Operable Unit*, Rev. 1

U.S. Department of Energy Richland Operations Office	Date
U.S. Environmental Protection Agency	Date

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Executive Summary

This sampling and analysis plan (SAP) provides information and instructions for conducting the sampling and analysis activities at the 200-CW-3 Operable Unit as authorized by EPA/ROD/R10-99/039.[1] The SAP consists of three main parts: data quality objectives (DQOs), quality assurance project plan (QAPjP), and field sampling plan (FSP).

DQOs (Chapter 1) describe the planning approach for defining the design criteria for data obtained through sampling and analysis, visual inspection, and direct-reading radiological surveys. The DQOs follow the guidelines contained in EPA/240/B-06/001.[2]

The QAPjP (Chapter 2) presents the objectives, functional activities, methods, and quality assurance/quality control processes associated with sample collection, laboratory analyses, visual inspection, and radiological surveys. The QAPjP follows the guidelines contained in EPA/240/B-01/003.[3]

The FSP (Chapter 3) provides the strategy for sample collection, laboratory analyses, visual inspections, and radiological surveys during implementation of the remedial action. Data collection will also support preparation of the waste profile summaries to determine appropriate waste disposition in accordance with ERDF-00011,[4] and/or waste acceptance criteria for other receiving facilities.

Waste management and health and safety controls during sampling are addressed in Chapters 4 and 5, respectively. Sampling strategies are contained in the main body of this document.

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[1] EPA/ROD/R10-99/039, 1999, *EPA Superfund Record of Decision Hanford 200 Area (USDOE) and Hanford 100 Area (USDOE),* U.S. Environmental Protection Agency, Region 10, Washington State Department of Ecology, and U.S. Department of Energy, Olympia, Washington. Available at: https://pdw.hanford.gov/document/0078953H.

[2] EPA/240/B-06/001, 2006, *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4, Office of Environmental Information, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://www.epa.gov/sites/production/files/2015-06/documents/g4-final.pdf.

[3] EPA/240/B-01/003, 2001, *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5, Office of Environmental Information, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://www.epa.gov/sites/production/files/2016-06/documents/r5-final_0.pdf.

[4] ERDF-00011, 2018, *Environmental Restoration Disposal Facility Waste Acceptance Criteria,* Rev. 1, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: https://pdw.hanford.gov/document/AR-01205.

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Contents

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Terms

COPC	contaminant of potential concern
CS/NFA	confirmatory sampling/no further action
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
DOT	U.S. Department of Transportation
DQA	data quality assessment
DQI	data quality indicators
DQO	data quality objective
EB	equipment blank
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
FSO	field sampling operations
FTB	full trip blank
FWS	field work supervisor
FXR	field transfer blank
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document*
HEIS	*Hanford Environmental Information System* database
IATA	International Air Transport Association
LRA	lead regulatory agency
MB	method blank
MS	matrix spike
MSD	matrix spike duplicate
OU	operable unit
QA	quality assurance
QAPjP	quality assurance project plan
QSM	quality systems manual
QC	quality control
RCT	radiological control technician
RD/RA	remedial design/remedial action

RTD	removal, treatment, and disposal
SAP	sampling and analysis plan
SMR	Sample Management and Reporting
SPLIT	field split
SUR	surrogates
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TRU	transuranic
VOC	volatile organic compound
ZPC	zone of potential contamination

1 Introduction

This sampling and analysis plan (SAP) supports implementation of interim remedial actions for the 200-CW-3 Operable Unit (OU) and encompasses waste sites within the Outer Area of the Central Plateau (Figure 1-1).

The revision to the SAP updates Chapter 2 to reflect current quality assurance (QA) standards and analytical performance criteria, and Chapter 3 to address waste sites added to the 200-CW-3 OU using the plug-in approach as described in DOE/RL-2007-55, *Remedial Design/Remedial Action Work Plan for Waste Sites in the 200-CW-3 Operable Unit*, Rev. 1 (hereinafter referred to as the 200-CW-3 remedial design [RD]/remedial action [RA] work plan).

1.1 Project Scope and Objective

This remedial action consists of contaminated soil and debris removal for 200-CW-3 identified sites located in the outer areas. The remedial action will complete interim closure of identified sites until the final record of decision (ROD) issued. The remedial action will reduce the threat to human health and the environment. It involves removal, treatment, and disposal (RTD) activities and confirmatory sampling /no further action (CS/NFA) activities.

The sampling activities in this SAP provide support for the remedial activities documented in the 200-CW-3 RD/RA work plan (DOE/RL-2007-55, Rev. 1), and this SAP is considered part of the 200-CW-3 RD/RA work plan. The objective of this SAP is to provide the characterization necessary for safe removal of radiologically and/or chemically contaminated soils, structures, and debris; compliant disposal of the removed materials; and implementation of the interim remedial action. These objectives were identified using the data quality objective (DQO) process, which is discussed in Section 1.3.

The strategy presented in this SAP will help to obtain additional characterization information for waste sites listed in Appendix A of the 200-CW-3 OU RD/RA work plan (DOE/RL-2007-55, Rev. 1) that will be used for the following purposes:

- Identify the controls necessary to protect workers performing remedial activities
- Support remedial activity planning (i.e., work sequencing)
- Assist with waste management decisions
- Develop waste profiles for waste disposed at the Hanford Site Environmental Restoration Disposal Facility (ERDF) or other approved and appropriate treatment/disposal facilities, if needed
- Support remedial actions

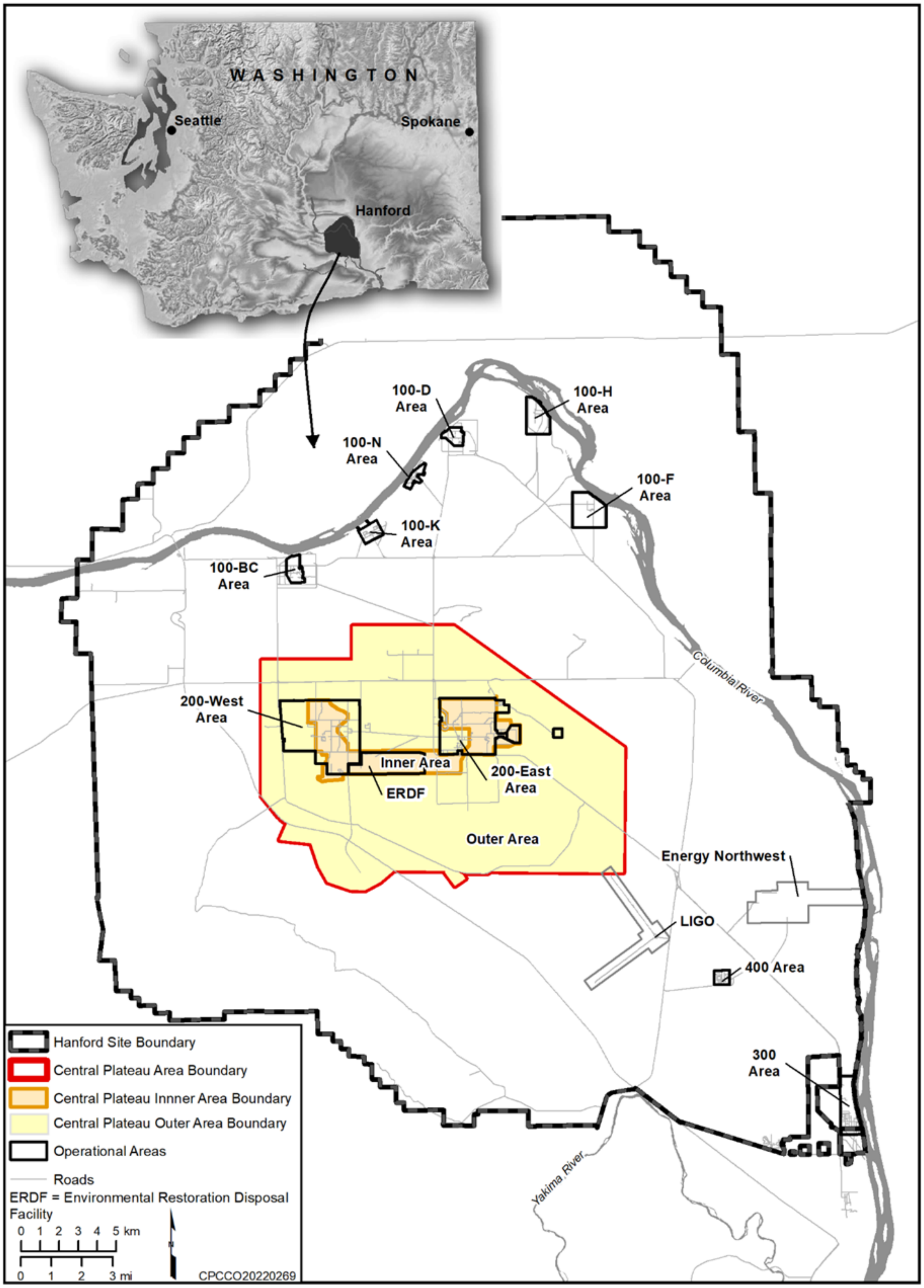

Figure 1-1. Hanford Site

1.2 Background

The Hanford Site is divided into numerically designated areas that served as the location for reactor, chemical separation, and related activities associated with the production and purification of special nuclear materials and other nuclear activities. The reactors and their support facilities were located along the south shore of the Columbia River in the 100 Area to facilitate access to the large quantities of water to dissipate the heat generated during reactor operations. The 200 Area, located about 11 km (7 mi) from the Columbia River, contained facilities used to separate, isolate, store, and ship plutonium. The 300 Area, located adjacent to and north of the city of Richland, contained the reactor fuel manufacturing plants and the research and development laboratories. The 400 Area, located 8 km (5 mi) northwest of the 300 Area, contained the Fast Flux Test Facility designed for testing liquid metal reactor systems. The 1100 Area, located directly south of the 300 Area, contained the Hanford Site maintenance services area as well solid waste disposal. The 600 Area consisted of facilities that served more than one specific area or, in some cases, the entire project.

The 200-CW-3 OU is located within the Outer Area (Figure 1-1). The 200-CW-3 OU was originally a process-based OU for waste sites resulting from the storage or transport of cooling water from the 200 North facilities (212-N, 212-P, and 212-R) and was included in EPA/ROD/R10-99/039, *EPA Superfund Record of Decision Hanford 200 Area (USDOE) and Hanford 100 Area (USDOE)* (hereinafter called the Remaining Sites ROD). These facilities provided lag storage for irradiated fuel rods from reactors in the 100 Area. The fuel storage function, occurring from 1944 to 1952, was the source of the cooling water that was transferred by pipeline to the ponds and trenches for which this OU was created. Over time, other waste sites not directly associated with the cooling water waste stream were added to the OU to support geographic closure goals. The contaminant sources of these waste streams vary and are not process-based. The waste sites in 200-CW-3 OU consist of pipelines, trenches, ponds, septic tanks, debris pits, and unplanned releases.

Other waste sites located in the Outer Area were not associated directly with the nuclear weapons production byproducts or waste streams. These waste sites can have attributes that include either liquid or solid materials. They vary widely in form, design, and materials of construction. For example, due to the highly sensitive nature of the early Hanford mission, security and protection played a very large and active role on the Site. Military and security forces were scattered widely across the Hanford Site, including the Outer Area, and they varied in form and function, from very small manned or unmanned outposts and lone sections of fencing or bunkers to complex encampments. Some of the units, dating from the 1940s, include anti-aircraft artillery sites, radar sites, military camps, gun sites, and ammunition storage sites (igloos). The larger military camps included vehicle and truck garages, fuel storage, shooting ranges, maintenance shops and bays, debris dumps, personnel housing, and personnel support services (e.g., mess halls and barber shops). Most of the super structure components have been demolished, but certain remnants remain (e.g., building foundations; railroad lines, wood, or concrete pads; pits; debris dumps; and infrastructure components such as septic systems, water and energy systems, and communication systems). In addition, coal was used at various powerhouses within the 200 Area, resulting in coal piles as well as coal ash pits. In addition, ramp areas that were used to load coal were washed down, and the water was collected in associated pits.

Various disposal systems also exist in the Outer Area. These include french drains, chemical tile drain fields, retention tanks, brine pits for water treatment systems, and a variety of debris and trash dumps and disposal sites. Atmospheric dispersion modeling towers and meteorological towers used by Pacific Northwest National Laboratory, and lysimeter test sites are located in the Outer Area.

1.3 Data Quality Objectives Summary

The DQO process is a strategic planning approach used to define the data collection design criteria to ensure that the type, quantity, and quality of data are appropriate for the intended application. The DQO process is a seven-step planning approach, as defined in EPA/240/B-06/001, *Guidance on Systematic Planning Using the Data Quality Objectives Process*, used to support the sample design presented in this SAP.

This section summarizes the key outputs resulting from the implementation of the seven-step DQO process. BHI-01249, *Data Quality Objectives Summary Report for 100/300 Area Remaining Sites Analytical Sampling Effort*, provides additional details.

1.3.1 Statement of the Problem

Waste sites located in the Outer Area of the Central Plateau are associated with past operations as well as site support activities. Various Hanford Site activities left behind waste sites that continue to pose potential risk to human health and the environment. These waste sites will undergo an interim remedial action consistent with the 200-CW-3 RD/RA work plan (DOE/RL-2007-55, Rev. 1). Sufficient information must be obtained so that remedial actions can be safely performed and waste for disposal can be properly designated.

1.3.2 Decision Statements

The decision statements are developed during the DQO and consolidate key questions that the sampling effort is designed to address. Table 1-1 presents the 200-CW-3 OU decision statements as identified in BHI-01249.

Table 1-1. Operable Unit Decision Statements

No.	Decision Statement
1	Determine if the soils, rubble, and engineered structures within the candidate sites meet the 100/300 Area shallow zone radionuclide RAGs and require no action.
2	Determine if the soils, rubble, and engineered structures within the candidate sites meet the 100/300 Area shallow zone chemical RAGs and require no action.
3	Determine if the soils, rubble, and engineered structures within the candidate sites meet the 100/300 Area deep zone radionuclide RAGs or RAOs and require no action.
4	Determine if the soils, rubble, and engineered structures within the candidate sites meet the 100/300 Area deep zone chemical RAGs or RAOs and require no action.

RAG = remedial action goal

RAO = remedial action objective

1.3.3 Decision Rules

Decision rules are developed during the DQO process and generally are structured as "IF…THEN" statements that indicate the action that would be taken when a prescribed waste site condition is met. Decision rules incorporate the parameters of interest (e.g., contaminants of potential concern [COPCs]), the scale of the decision (waste site boundaries), the action level (risk-based criteria), and the resulting action (remediation needs). The decision rules are summarized in Table 1-2.

Table 1-2. Decision Rules

DR #	Decision Rule
1	**If** process knowledge or the maximum sample concentration for contaminated materials is determined to exceed the ERDF waste acceptance criteria, **then** the materials will be evaluated for storage at the CWC in accordance with DR #2 through DR #8, as applicable. **If** process knowledge or the maximum sample concentration for contaminated materials is determined to not exceed the final action levels, **then** the materials will be evaluated for disposal at ERDF in accordance with DR #2 through DR #8, as applicable.
2 – 8*	**If** process knowledge or the maximum sample concentration for contaminated materials indicates that the materials are to be designated as listed, characteristic, toxic, persistent, PCB, or asbestos-containing material, **then** materials will be evaluated for treatment or disposal at ERDF, or storage at the CWC in accordance with DR #9. **If** process knowledge or the maximum sample concentration for contaminated materials indicates that the materials are not to be designated as listed, characteristic, toxic, persistent, PCB, or asbestos-containing material, **then** materials will be evaluated for being sent to a solid waste landfill in accordance with DR #9.
9	**If** process knowledge or the maximum sample concentration dictate land disposal restriction-imposed treatment, **then** the materials will be treated and disposed of at ERDF or stored at the CWC pending future treatment and final disposal. **If** process knowledge or the maximum sample concentration does not dictate land disposal restriction-imposed treatment of the materials, **then** the materials will be disposed of at ERDF.
10	**If** the maximum sample concentration for soil in the excavations indicates that the soil exceeds the action levels, **then** soil remediation will be performed and a verification sampling plan will be developed in accordance with Chapter 3 of this SAP and implemented. Data will be evaluated against the remedial action goals and objectives. **If** the maximum sample concentration for soil in the excavation indicates that the soil does not exceed the action levels, **then** the results will be documented in a work instruction to confirm that no further remedial action will be required or to conduct further sampling and analysis in support of remedy selection.

*DR #2 through DR #8 support waste designation.

CWC = Central Waste Complex
DR = decision rule
ERDF = Environmental Restoration Disposal Facility
PCB = polychlorinated biphenyl
SAP = sampling and analysis plan

The most restrictive concentration limits or action levels for disposal are used to develop the decision rules. By meeting the analytical requirements for the most restrictive options, the data will be adequate for the less-restrictive options.

For waste characterization, the most restrictive concentration limits are identified from the following documents:

- ERDF-00011, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*
- WAC 173-303, "Dangerous Waste Regulations," as amended
- HNF-EP-0063, *Hanford Site Solid Waste Acceptance Criteria*
- 40 CFR 268.48, "Land Disposal Restrictions," "Universal Treatment Standards"
- HNF-3172, *Liquid Waste Processing Facilities Waste Acceptance Criteria*
- 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste," as amended

Waste that does not meet the land disposal restrictions (WAC 173-303-140, "Land Disposal Restrictions"; 40 CFR 268) must be treated prior to disposal at ERDF, which cannot accept transuranic (TRU) waste, TRU mixed waste, greater-than-Class C waste (as defined by 10 CFR 61), high-level waste, or dangerous waste that does not meet the land disposal restrictions or cannot be treated by ERDF. TRU waste will be sent to and managed at Central Waste Complex until it can be sent to the Waste Isolation Pilot Plant (Carlsbad, New Mexico) for disposal. Liquid waste will either be sent to the Effluent Treatment Facility or treated by adding absorbent to meet acceptance criteria of the receiving facility.

1.3.4 Design Summary

The nature of the 200-CW-3 OU waste sites supports the use of focused sampling for the waste site investigations, as identified in EPA/240/R-02/005, *Guidance on Choosing a Sampling Design for Environmental Data Collection for Use in Developing a Quality Assurance Project Plan* (EPA QA/G-5S). This guidance document defines "focused sampling" as selective sampling of areas where potential or suspected soil contamination can reliably be expected to be found if a release of a hazardous substance has occurred.

These waste sites have attributes such as visible surface debris, known discharge release points in engineered structures such as ponds, or subsurface debris that can be identified by surface geophysics techniques, or have a primary constituent which has a gamma and/or beta emitter that can be identified by surface/near surface radiological surveys. Therefore, sampling in a focused manner will ensure data collection of the area of greatest impact associated with the release for waste characterization purposes. Additional efforts may be needed to determine the worst-case location for the sample collection within these sites, such as driven soil probes and gamma logging, which will provide additional data on gamma-emitting radionuclides to support the focused sampling regime.

Sampling locations will be selected during site walk downs by prime contractor technical staff familiar with the 200-CW-3 OU and the waste sites in question. The primary judgment used in selecting sample locations/materials is field-screening results (e.g., detectable radioactive contamination as defined with field instruments) or suspicious locations/materials based on visual inspection (e.g., stained soil areas or debris known to represent hazardous/dangerous/radioactive waste in the past).

1.3.4.1 Focused Sampling Design

Focused sampling designs are appropriate for waste characterization to ensure compliance with the receiving facilities' waste acceptance criteria, for confirmation of remedy, and for evaluation of preliminary data to determine the need for further sampling and analysis. Statistical sampling designs may be implemented for the verification portion of the sampling effort in accordance with Chapter 3 of this SAP. Samples will be collected from site locations where existing analytical data, process knowledge, and field radiological surveys indicate maximum contamination, or "worst case," concentrations are expected to establish the maximum concentrations of the contamination. The number of samples, the depth of sampling, the types of samples, and their locations would be developed judgmentally based on site knowledge. Details of the focused sampling design are presented in Chapter 3 for field investigation and verification sampling.

1.3.4.2 Specific Media Sampling

As needed, discrete samples of specific media will be collected from biased locations from those waste streams that have been identified as needing additional sampling/analytical data for final disposition. The laboratory data will be used to confirm contamination levels in each of the materials and to establish the waste profile.

1.4 Contaminants of Potential Concern

Table 1-3 includes a comprehensive list of radionuclide, inorganic, and organic COPCs for the 200-CW-3 OU. The COPCs were identified in 200-CW-3 RD/RA work plan (DOE/RL-2007-55, Rev. 1) and through process knowledge. The site-specific list of COPCs and characterization approach will be evaluated and identified during implementation of the activities described in Chapter 3.

Table 1-3. CPOCs for the 200-CW-3 Operable Unit Sampling

General Chemistry		
Chromium (VI)	Nitrate (as nitrogen)	--
Metals		
Antimony	Cobalt	Selenium
Arsenic	Copper	Silver
Barium	Lead	Strontium
Beryllium	Lithium	Tin
Boron	Manganese	Uranium
Cadmium	Mercury	Vanadium
Chromium, total	Nickel	Zinc
Organic Compounds		
Acenaphthene	Dibenz(a,h)anthracene	4,4'-DDE (Dichlorodiphenyldichloroethylene)
Anthracene	Fluoranthene	4,4'-DDT (Dichlorodiphenyltrichloroethane)
Benzo(a)anthracene	Fluorene	Dieldrin
Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene	Polychlorinated biphenyl
Benzo(b)fluoranthene	Naphthalene	TPH – diesel range organics
Benzo(k)fluoranthene	Pyrene	TPH – gasoline range organics
Carbon tetrachloride	Aldrin	TPH – kerosene range
Chrysene	4,4'-DDD (Dichlorodiphenyldichloroethane)	TPH – motor oil
Radionuclides		
Americium-241	Nickel-63	Tritium
Cesium-137	Plutonium-238	Uranium-233/234
Cobalt-60	Plutonium-239/240	Uranium-235
Europium-152	Strontium-90	Uranium-238
Europium-154	Technetium-99	--
Europium-155	Thorium-232	--

1.5 Project Schedule

Remedial activities for the 200-CW-3 OU waste sites will be executed using a phased approach based on funding availability, craft/engineering resources availability, and overall interactive site priorities. The remedial action work is expected to begin following the issuance of the 200-CW-3 RD/RA work plan (DOE/RL-2007-55, Rev. 1), which is anticipated to be September 2022 (Section 7.2 of DOE/RL-2007-55, Rev. 1). Implementation of the remedial action will be performed to support Ecology et al; 1989a, *Hanford Federal Facility Agreement and Consent Order* (hereinafter called the Tri-Party Agreement), Milestone M-016-202, tentatively scheduled for September 30, 2024.

2 Quality Assurance Project Plan

A Quality Assurance Project Plan (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 QA and quality control (QC) elements found in EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5), CPCC-00172, *Central Plateau Cleanup Company Environmental Quality Assurance Program Plan*,[1] and DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD). DoD/DOE, 2021, *Department of Defense (DoD) Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories* (hereinafter referred to as the Quality Systems Manual [QSM]), is also discussed. Section 7.8 of Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan* (hereinafter called the Tri-Party Agreement Action Plan), requires the QA/QC and sampling and analysis activities to specify the QA requirements for past-practice processes. This QAPjP also describes applicable requirements and controls based on guidance in Ecology Publication No. 04-03-030, *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies,* and EPA/240/R-02/009, *Guidance for Quality Assurance Project Plans* (EPA QA/G-5).

The QAPjP references are included in Chapter 6. The QAPjP includes the following sections, which describe the quality requirements and controls applicable to Hanford Site OU sampling activities:

- Section 2.1, “Project Management”
- Section 2.2, “Data Generation and Acquisition”
- Section 2.3, “Assessment and Oversight”
- Section 2.4, “Data Review and Usability”

2.1 Project Management

This section includes project goals, planned management approaches, and planned output documentation.

2.1.1 Project/Task Organization

The U.S. Department of Energy, Richland Operations Office (DOE-RL) is the lead agency for the remedial action presented in this SAP. Implementation of the SAP is performed via direction from DOE-RL to a contractor, or its approved subcontractor, who is responsible for planning, coordinating, and sampling, as well as preparing, packaging, and shipping samples to the laboratory. For sampling and characterization, the project organization is described in the following sections and is shown graphically in Figure 2-1.

2.1.1.1 Regulatory Lead

The lead regulatory agency (LRA) for the remedial action is the U.S. Environmental Protection Agency (EPA). The LRA is responsible for regulatory oversight of cleanup projects and activities. EPA retains approval authority for all SAPs. EPA works with DOE-RL to resolve concerns over the work described in this SAP, in accordance with the Tri-Party Agreement. The LRA is responsible for approval of the SAP authorizing field sampling activities.

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[1] The QA/QC planning and implementing elements described in Chapters 1, 2, and 3 of this SAP are consistent with the associated environmental management plan elements described in CPCC-00172. CPCC-00172 is not a Tri-Party Agreement (Ecology et al., 1989a) primary or secondary document and thus is not subject to LRA review or approval.

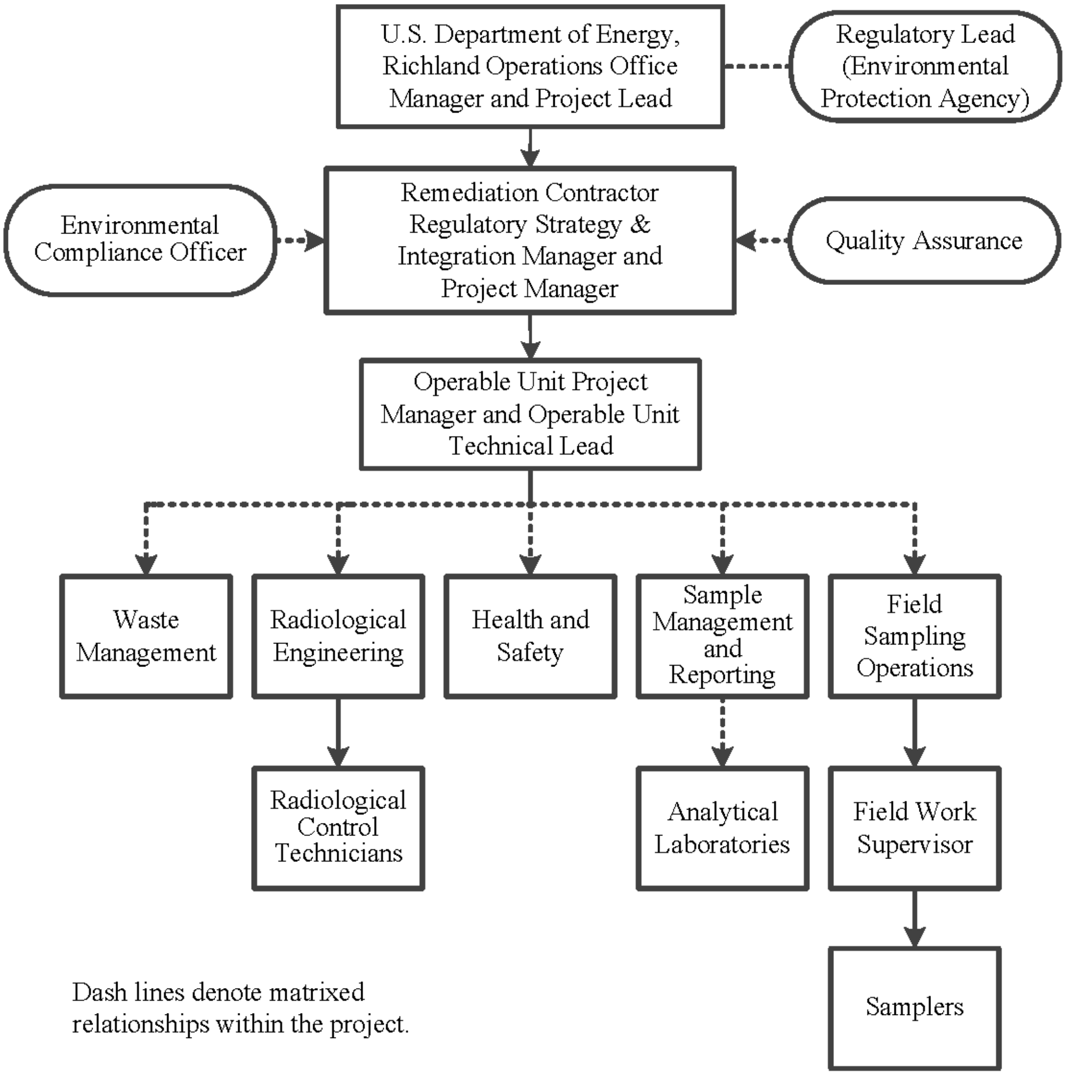

Figure 2-1. Project Organization

2.1.1.2 DOE-RL Manager

Hanford Site cleanup in this remedial action is the responsibility of DOE-RL. The DOE-RL Manager is responsible for authorizing the contractor to perform activities described within this SAP at the Hanford Site under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*; the *Resource Conservation and Recovery Act of 1976*; the *Atomic Energy Act of 1954*; and the Tri-Party Agreement (Ecology et al.,1989a).

2.1.1.3 DOE-RL Project Lead

The DOE-RL Project Lead is responsible for providing day-to-day oversight of the contractor's performance of the work scope, working with the contractor to identify and work through issues, and providing technical input to the DOE-RL Remedial Action Manager. The DOE-RL Project Lead is also responsible for obtaining EPA approval of the SAP authorizing field sampling activities.

2.1.1.4 Remedial Action Project Manager

The contractor Remedial Action Project Manager is responsible and accountable for project-related activities and coordinates with DOE-RL, regulators, and contractor management in support of sampling activities. The Remedial Action Project Manager is also responsible for the following tasks:

- Managing sampling documents and requirements, field activities, and subcontracted tasks and ensuring that the project file is properly maintained
- Ensuring that the project personnel are working to the current version of the SAP
- Ensuring that the field sampling instructions comply with the sampling design requirement as specified in this SAP
- Ensuring that appropriate support organizations (Environmental, QA, Sample Management and Reporting [SMR], Nuclear Safety, Waste Management, Radiological Operation, Health and Safety, and Operations) are involved in planning, approving, and implementing the work scope
- Maintaining a list of key project team member names, their roles and responsibilities, and their respective organizations

2.1.1.5 Operable Unit Technical Lead

The OU Technical Lead is responsible for developing specific sampling designs, analytical requirements, and QC requirements. The OU Technical Lead ensures that sampling and analysis activities, as delegated by the Remedial Action Project Manager, are carried out in accordance with the SAP and works closely with the Environmental Compliance Officer, QA, Health and Safety, the field work supervisor (FWS), and the SMR group to integrate these and other technical disciplines in planning and implementing the work scope.

2.1.1.6 Sample Management and Reporting

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

2.1.1.7 Field Sampling Operations

FSO is responsible for planning and coordinating field sampling resources. The FWS directs the samplers, who collect samples in accordance with this sampling plan and corresponding standard methods and work packages. The FWS ensures that deviations from field sampling documents or issues encountered in the field are documented appropriately (e.g., in the field logbook). The FWS ensures that samplers are appropriately trained and available. Samplers collect samples in accordance with sampling requirements. Samplers also complete field logbooks, data forms, and chain of custody forms, including any shipping paperwork, and enable delivery of the samples to the analytical laboratory.

Prejob briefings are conducted by FSO, in accordance with work management and work release requirements, to evaluate activities and associated hazards by considering the following factors:

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

2.1.1.8 Quality Assurance

The QA point of contact provides independent oversight and is responsible for addressing QA issues on the project, 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.

2.1.1.9 Environmental Compliance Officer

The Environmental Compliance Officer provides technical oversight, direction, and acceptance of project and subcontracted environmental work and also develops appropriate mitigation measures with the goal of minimizing adverse environmental impacts.

2.1.1.10 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 regulation or internal primary contractor work requirements.

2.1.1.11 Radiological Engineering

Radiological Engineering is responsible for the following:

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

2.1.1.12 Waste Management

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

2.1.1.13 Analytical Laboratories

The analytical laboratories accept, manage, prepare, and analyze samples in accordance with established methods and the requirements of their subcontract, and provide necessary data packages containing analytical and QC results. Laboratories provide explanations of results to support data review and in response to resolution of analytical issues. Laboratory quality requirements are consistent with HASQARD (DOE/RL-96-68). The laboratories are evaluated under the DOE Consolidated Audit Program-Accreditation Program (DOE/CAP-AP) or its successor programs to DoD/DOE, 2021 QSM requirements. HASQARD requirements, beyond those within the QSM, are also evaluated under the DOE/CAP-AP. Laboratories are accredited by Washington State Department of Ecology for the analyses performed under this SAP.

2.1.2 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 in order to meet the evaluation requirements stated in the sampling plan. Data descriptors, known as data quality indicators (DQIs), help determine the acceptability and usefulness of data to the user. The principal DQIs (precision, accuracy, representativeness, comparability, completeness, bias, and sensitivity) are defined for the purposes of this document in Table 2-1.

Data quality is defined by the degree of rigor in the acceptance criteria assigned to DQIs. Acceptance criteria for field and laboratory QC are identified in Section 2.2.3. 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 a process to assess data usability (Section 2.4.3).

Table 2-1. Data Quality Indicators

Data Quality Indicator (QC Element)	Definition[a]	Determination Methodologies	Corrective Actions
Precision (field duplicates, laboratory sample duplicates, and matrix spike duplicates)	Precision measures the agreement among a set of replicate measurements. Field precision is assessed through the collection and analysis of field duplicates. Analytical precision is estimated by duplicate/replicate analyses, usually on laboratory control samples, spiked samples and/or field samples. The most commonly used estimates of precision are the relative standard deviation and, when only two samples are available, the relative percent difference.	Use the same analytical instrument to make repeated analyses on the same sample. Use the same method to make repeated measurements of the same sample within a single laboratory. Acquire replicate field samples for information on sample acquisition, handling, shipping, storage, preparation, and analytical processes and measurements.	If duplicate data do not meet objective: • Evaluate apparent cause (e.g., sample heterogeneity). • Request reanalysis or remeasurement. • Qualify the data before use.

Table 2-1. Data Quality Indicators

Data Quality Indicator (QC Element)	Definition[a]	Determination Methodologies	Corrective Actions
Accuracy (laboratory control samples, matrix spikes, surrogates, carriers, and tracers)	Accuracy is the closeness of a measured result to an accepted reference value. Accuracy is usually measured as a percent recovery. QC analyses used to measure accuracy include standard recoveries, laboratory control samples, spiked samples, and surrogates.	Analyze a reference material or reanalyze a sample to which a material of known concentration or amount of pollutant has been added (a spiked sample).	If recovery does not meet objective: • Qualify the data before use. • Request reanalysis or remeasurement.
Representativeness (field duplicates)	Sample representativeness expresses the degree to which data accurately and precisely represents 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 are collected in such a manner that the resulting data appropriately reflect the environment or condition being measured or studied.	If results are not representative of the system sampled: • Identify the reason for results not being representative. • Flag for further review. • Review data for usability. • If data are usable, qualify the data for limited use and define the portion of the system that the data represent. • Redefine sampling and measurement requirements and protocols. • Resample and reanalyze, as appropriate.
Comparability (field duplicate, field splits, laboratory control samples, matrix spikes, and matrix spike duplicates)	Comparability expresses the degree of confidence with which one dataset 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 datasets: • Identify appropriate changes to data collection and/or analysis methods • Identify quantifiable bias, if applicable. • Qualify the data as appropriate. • Resample and/or reanalyze if needed. • Revise sampling/analysis protocols to ensure future comparability.
Completeness (no QC element; addressed in data verification and validation)	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	Compare the number of valid measurements completed (samples collected or samples analyzed) with those established by the project's quality criteria (data quality	If dataset does not meet completeness objective: • Identify appropriate changes to data collection and/or analysis methods. • Identify quantifiable bias, if applicable.

Table 2-1. Data Quality Indicators

Data Quality Indicator (QC Element)	Definition[a]	Determination Methodologies	Corrective Actions
	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.	objectives or performance/ acceptance criteria).	• Resample and/or reanalyze if needed. • Revise sampling/analysis protocols to ensure future comparability.
Bias (equipment blanks, field transfer blanks, full trip blanks, laboratory control samples, matrix spikes, and method blanks)	Bias is the systematic or persistent distortion of a measurement process that causes error in one direction (e.g., the sample measurement is consistently lower than the sample's true value). Bias can be introduced during sampling, analysis, and data evaluation. Analytical bias refers to deviation in one direction (i.e., high, low, or unknown) of the measured value from a known spiked amount.	Sampling bias may be revealed by analysis of replicate samples. Analytical bias may be assessed by comparing a measured value in a sample of known concentration to an accepted reference value or by determining the recovery of a known amount of contaminant spiked into a sample (matrix spike).	For sampling bias: • Properly select and use sampling tools. • Institute correct sampling and subsampling 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 laboratories for analysis.

Table 2-1. Data Quality Indicators

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

a. Source: SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Compendium*.

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

QA = quality assurance

QC = quality control

2.1.3 Methods-Based Analysis

Laboratory testing for analytes described in Sections 2.1.6 and 2.2.1 may include nontarget analytes that are part of the analytical method (i.e., methods-based reporting). The additional constituents that are part of the method and reported by the laboratory are for informational purposes. Analytical performance requirements will be applicable only to the analytes specific to this SAP. Poor QC related to nontarget analyte results would not result in any required corrective action by the laboratory, except for the application of proper result qualification flags.

2.1.4 Analytical Priority

If sample volume is insufficient to analyze for all analytes listed for a given sampling area, the highest priority analytes critical for supporting remedial action decisions are required to be analyzed. While insufficient sample volume is not expected to be a concern, priority is normally given first to volatile organic compounds (VOCs), second to chemicals that may be immediately dangerous to life or health, and third to substances that are readily mobile in the immediate environment. Attempts will be made to collect at least every other sample of the lesser priority analytes that are important for supporting remedial action decisions. Lowest priority analytes not critical for supporting remedial action decisions will be analyzed only if sufficient sample volumes are collected.

2.1.5 Special Training/Certification

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

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

Personnel shall be trained and qualified to ensure that they are capable of performing assigned work. Personnel shall maintain job proficiency through continuing training. A combination of general and job-specific safety and operational training is provided to prepare employees to operate and maintain project activities in a safe, effective, efficient, and environmentally sound manner. A training coordinator is assigned to ensure that project personnel receive the required training and maintain their qualification.

Sampling personnel are required to have training in U.S. Department of Transportation (DOT) hazardous material general awareness, and hazardous material driver's training as directed by management. Personnel are required to follow a Dangerous Waste Training Plan (DWTP) to meet the requirements of WAC 173-303-330, "Dangerous Waste Regulations," "Personnel Training."

Training records are maintained for each employee in an electronic training record database. The contractor's training organization maintains the training records system. Line management confirms an employee's training is appropriate and up to date prior to performing assigned tasks under this SAP.

2.1.6 Documents and Records

The Remedial Action Project Manager (or designee) is responsible for ensuring that the current version of the SAP is being used and provides any updates to field personnel. Version control is maintained by the administrative document control process. Table 2-2 defines the types of changes that may impact the sampling design and the associated approvals, notifications, and documentation requirements.

Table 2-2. Change Control for Sampling Projects

Type of Change[a]	Action	Documentation
Minor Field Change: Changes that have no adverse effect on the technical adequacy of the sampling activity or the work schedule.	The field personnel recognizing the need for a field change will consult with the Remedial Action Project Manager prior to implementing the field change.	Minor field changes will be documented in the field logbook. The logbook entry will include the field change, the reason for the field change, and the names and titles of those approving the field change.
Minor Change: Changes to approved plans that do not affect the overall intent of the plan or schedule.	The Remedial Action Project Manager will inform DOE-RL and the Regulatory Lead of the change. EPA determines that there is no need to revise the document.	Documentation of this change approval would be in the Project Managers' Meeting minutes or comparable Tri-Party Agreement Change Notice.[b]
Revision necessary: Lead regulatory agency determines that changes to approved plans require revision to document.	If it is anticipated that a revision is necessary, the Remedial Action Project Manager will inform DOE-RL and the Regulatory Lead. EPA determines the change requires a revision to the document.	Formal revision of the sampling document.

References: DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Documents*.
Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order*.
Ecology et al, 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*.
a. Consistent with DOE/RL-96-68 and Sections 9.3 and 12.4 of Ecology et al., 1989b.
b. The Tri-Party Agreement Action Plan, Section 9.3, defines the minimum elements of a change notice.

DOE-RL	=	U.S. Department of Energy, Richland Operations Office
EPA	=	U.S. Environmental Protection Agency
Tri-Party Agreement	=	*Hanford Federal Facility Agreement and Consent Order*

Logbooks and data forms are required for field activities. The logbook must be identified with a unique project name and number. Only authorized individuals may make entries into the logbooks. Logbooks will be controlled in accordance with internal work requirements and processes. Information recorded on data forms must follow the same requirements as those for logbooks.

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

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

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

The following records are managed and maintained by SMR personnel:

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

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

2.2 Data Generation and Acquisition

This section addresses 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. Requirements for instrument calibration and maintenance, supply inspections, and data management are also addressed. The sampling design is presented in the field sampling plan in Chapter 3.

2.2.1 Analytical Methods Requirements

Analytical method requirements for solid and liquid samples collected are presented in Table 2-3. These analytical methods were identified based upon the radionuclides and chemicals listed in Section 1.4. Updated EPA methods and nationally recognized standard methods may be substituted for the analytical methods identified in Table 2-3. The new method will achieve project DQOs as well as or better than the replaced method and may be required due to the nature of the sample (e.g., high radioactivity). Deviations from the analytical methods must be approved in accordance with HASQARD (DOE/RL-96-68).

2.2.2 Field Analytical Methods

Field measurements are acquired as described in field screening and field analytical procedures. Field screening and survey data shall comply with the requirements in Volume 3 of HASQARD (DOE/RL-96-68). Field analytical methods are performed in accordance with the manufacturer manuals. Table 2-3 provides paraments (if any) for field measurements. Section 3.3 further discusses field measurements.

Table 2-3. Performance Requirements for Sample Analysis

Constituent	CAS Number[a]	Cleanup Levels (mg/kg or pCi/g)[b]		Analytical Method[c]	Required PQL for Water (µg/L or pCi/L)[d]	Required PQL for Soil/Other (mg/kg or pCi/g)[d]
		Shallow Zone <4.6 m (15 ft)	Deep Zone >4.6 m (15 ft)			
General Chemical Parameters						
Chromium (VI)	18540-29-9	2.1	2.0	7196	10.5	0.5
Nitrate (as nitrogen)	14797-55-8	128,000	1,000	300 or 9056	525	12.5
Metals						
Antimony	7440-36-0	6.0	6.0	6020	5.25	0.5
Arsenic	7440-38-2	20	20	6020	10.5	1.0
Barium	7440-39-3	5,600	5,600	6020	5.25	2.0
Beryllium	7440-41-7	10.4	1.51	6020	1.05	0.2
Boron	7440-42-8	7,200	320	6010	105	5.0
Cadmium	7440-43-9	80	N/A	6020	2.1	0.2
Chromium, total	7440-47-3	80,000	18.5	6020	10.5	1.0
Cobalt	7440-48-4	24	15.7	6020	5.25	0.4
Copper	7440-50-8	2,960	22.0	6020	10	1.0
Lead	7439-92-1	353	10.2	6020	3.15	0.3

Table 2-3. Performance Requirements for Sample Analysis

Constituent	CAS Number[a]	Cleanup Levels (mg/kg or pCi/g)[b]		Analytical Method[c]	Required PQL for Water (µg/L or pCi/L)[d]	Required PQL for Soil/Other (mg/kg or pCi/g)[d]
		Shallow Zone <4.6 m (15 ft)	Deep Zone >4.6 m (15 ft)			
Lithium	7439-93-2	160	33.5	6010	52.5	5.0
Manganese	7439-96-5	3,760	512	6020	10.5	1.0
Mercury	7439-97-6	24	0.33	7470 or 7471	0.5	0.2
Nickel	7440-02-0	1,600	19.1	6020	21	0.5
Selenium	7782-49-2	400	1	6020	10.5	0.5
Silver	7440-22-4	400	0.73	6020	5.25	0.2
Strontium	7440-24-6	48,000	960	6020	10.5	0.5
Tin	7440-31-5	48,000	960	6020	10.5	0.5
Uranium	7440-61-1	240	3.21	6020	1.05	0.15
Vanadium	7440-62-2	560	85.1	6010	52.5	1.0
Zinc	7440-66-6	24,000	67.8	6010	21	5.0
Organic Compounds						
Acenaphthene	83-32-9	4,800	96	8270 (SIM)	0.105	0.0105
Anthracene	120-12-7	24,000	240	8270 (SIM)	10	0.05
Benzo(a)anthracene	56-55-3	1.37	0.015	8270 (SIM)	0.3	0.015
Benzo(a)pyrene	50-32-8	0.137	0.015	8270 (SIM)	0.5	0.015
Benzo(b)fluoranthene	205-99-2	1.37	0.015	8270 (SIM)	0.5	0.015
Benzo(k)fluoranthene	207-08-9	1.37	0.015	8270 (SIM)	0.5	0.15
Carbon tetrachloride	56-23-5	7.69	0.0337	8260	3	0.005
Chrysene	218-01-9	13.7	0.04	8270 (SIM)	3	0.040
Dibenzo(a,h)anthracene	53-70-3	1.37	0.03	8270 (SIM)	1	0.030
Fluoranthene	206-44-0	3,200	18.0	8270 (SIM)	5	0.040
Fluorene	86-73-7	3,200	64	8270 (SIM)	3	0.030
Indeno(1,2,3-cd)pyrene	193-39-5	1.37	0.03	8270 (SIM)	0.3	0.030
Naphthalene	91-20-3	1,600	16.0	8270 (SIM)	10	0.040
Pyrene	129-00-0	2,400	48	8270 (SIM)	5	0.040
Aldrin[e]	309-00-2	0.0588	0.0017	8081	0.0525	0.0017

Table 2-3. Performance Requirements for Sample Analysis

Constituent	CAS Number[a]	Cleanup Levels (mg/kg or pCi/g)[b] Shallow Zone <4.6 m (15 ft)	Deep Zone >4.6 m (15 ft)	Analytical Method[c]	Required PQL for Water (µg/L or pCi/L)[d]	Required PQL for Soil/Other (mg/kg or pCi/g)[d]
4,4'-DDD (Dichlorodiphenyldichloroethane)[e]	72-54-8	4.17	0.0033	8081	0.1	0.0033
4,4'-DDE (Dichlorodiphenyldichloroethylene)[e]	72-55-9	2.94	0.0033	8081	0.1	0.0033
4,4'-DDT (Dichlorodiphenyltrichloroethane)[e]	50-29-3	2.94	0.0033	8081	0.1	0.0033
Dieldrin[e]	60-57-1	0.0625	0.0017	8081	0.0525	0.0017
Polychlorinated biphenyl	N/A	0.5	0.017	8082	1.05	0.033
TPH – diesel range	TPHDIESEL	2,000	2,000	NWTPH	1120.35	25.0
TPH – gasoline range	TPHGASOLINE	100	100	NWTPH	500	5.0
TPH – kerosene range	TPHKEROSENE	2,000	2,000	NWTPH	500	25.0
TPH – motor oil	TPH/OILH	2,000	2,000	NWTPH	500	25.0
Radionuclides (pCi/L)						
Americium-241	14596-10-2	32.1	N/A	AEA	1	1
Cesium-137	10045-97-3	6.2	1,465	GEA	15	0.1
Cobalt-60	10198-40-0	1.4	13.900	GEA	25	0.1
Europium-152	14683-23-9	3.33	N/A	GEA	50	0.1
Europium-154	15585-10-1	3.0	N/A	GEA	50	0.1
Europium-155	14391-16-3	125	N/A	GEA	50	0.1
Nickel-63	13981-37-8	4,013	83	LSC	50	10
Plutonium-238	13981-16-3	38.8	N/A	AEA	1	1
Plutonium-239/240	PU-239/240	35.1	N/A	AEA	1	1
Strontium-90	10098-97-2	4.5	27.6	LSC	2	2
Technetium-99	14133-76-7	5.8	0.46	GPC, LSC	50	5
Thorium-232	TH-232	1.3	N/A	AEA	1	1
Tritium	10028-17-8	459	12.6	LSC	700	30
Uranium-233/234	U-233/234	1.1	1.1	AEA	1	1

Table 2-3. Performance Requirements for Sample Analysis

Constituent	CAS Number[a]	Cleanup Levels (mg/kg or pCi/g)[b] Shallow Zone <4.6 m (15 ft)	Deep Zone >4.6 m (15 ft)	Analytical Method[c]	Required PQL for Water (µg/L or pCi/L)[d]	Required PQL for Soil/Other (mg/kg or pCi/g)[d]
Uranium-235	15117-96-1	0.61	0.5	AEA	1	1
Uranium-238	U-238	1.1	1.1	AEA	1	1

Notes: Complete reference citations are provided in Chapter 6.

Analytical methods and practical quantitation limits provided in this table do not represent EPA requirements but are intended solely as guidance.

a. Value in this column is either the CAS number or the constituent identifier if no CAS number exists.

b. Cleanup levels from Table 2-3 in DOE/RL-2007-55, *Remedial Design/Remedial Action Work Plan for Waste Sites in the 200-CW-3 Operable Unit*, Rev. 1.

c. For EPA Method 300.0, see EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples*. For four-digit EPA methods, see the SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Compendium*. For Standard Methods, see APHA/AWWA/WEF, 2017, *Standard Methods for the Examination of Water and Wastewater*. Equivalent methods may be substituted.

d. Required PQLs are specified in contracts with analytical laboratories. Actual PQLs vary by laboratory and may be lower. Method detection limits are three to five times lower than quantitation limits. For radionuclides, values in this column are the required minimum detectable concentrations in pCi/L for water and pCi/g for soil/other media.

e. Analysis may be included based on process knowledge and field observations for specific waste sites.

AEA	=	alpha energy analysis	LSC	=	liquid scintillation counting
CAS	=	Chemical Abstracts Service	N/A	=	not applicable
EPA	=	U.S. Environmental Protection Agency	NWTPH	=	Northwest Washington total petroleum hydrocarbon
GEA	=	gamma energy analysis	PQL	=	practical quantitation limit
GPC	=	gas flow proportional counting	SIM	=	selective ion monitoring

2.2.3 Quality Control

The QC protocol specified in the SAP must be followed in the field and analytical laboratory to ensure that reliable data are obtained. Field QC samples will be collected to evaluate the potential for cross-contamination and to provide information pertinent to field sampling variability. Laboratory QC samples estimate the precision, bias, and matrix effects of the analytical data. Field and laboratory QC samples are summarized in Table 2-4. Acceptance criteria for field and laboratory QC are shown in Table 2-5. Data will be qualified and flagged in HEIS, as appropriate.

Additional QC measures include laboratory audits and participation in nationally based performance evaluation studies. The contract laboratories participate in national studies such as the EPA-sanctioned Water Pollution and Water Supply Performance Evaluation studies.

Table 2-4. Field and Laboratory Quality Control Protocol

Sample Type	Primary Characteristics Evaluated	Frequency
Field Quality Control		
Equipment blank	Bias due to contamination from nondedicated sampling equipment.	1 in 20 samples when nondedicated equipment is used[a,b]
Full trip blank	Bias due to contamination from containers, preservative reagents, storage, or transportation.	1 in 20 sampling events, depending on analytical requirements[a,c]
Field transfer blank	Bias due to contamination from sampling site for VOCs.	1 each day VOCs are sampled; additional field transfer blanks are collected if VOC samples are acquired on the same day for multiple laboratories; analyzed for VOCs only
Field duplicate samples	For water samples, Representativeness regarding the homogeneity of the sample matrix and the precision of the sampling and analysis processes. The degree of confidence in the comparability of sampling and analytical methods to allow comparison of one dataset to another. The precision of the sampling and analysis processes. For soil/miscellaneous material, not applicable.	Water samples: 1 in 20 samples[a] Soil/miscellaneous material samples: Not recommended for soil/miscellaneous material because of possible matrix heterogeneity effects
Field split samples	Inter-laboratory comparability and the degree of confidence in the comparability of analytical methods to allow comparison of one dataset to another.	As needed (e.g., verification of sample results; SMR requests)
Laboratory Batch Quality Control		
Laboratory control samples	Laboratory accuracy, the degree of confidence in the comparability of analytical methods to allow comparison of one dataset to another, and bias due to laboratory analysis.	1 per analytical batch[d]
Laboratory control sample duplicate	Precision of analysis processes and the degree of confidence in the comparability of analytical methods to allow comparison of one dataset to another.	1 per analytical batch if sample restrictions exist and as directed by SMR[d,e]
Laboratory sample duplicate	Precision of analysis processes.	1 per analytical batch[d,e]
Matrix spikes	Laboratory accuracy, the degree of confidence in the comparability of analytical methods to allow comparison of one dataset to another, and bias due to laboratory analysis or matrix effects.	1 per analytical batch[d,e]
Matrix spike duplicate	Precision of analysis processes: the degree of confidence in the comparability of analytical methods to allow comparison of one dataset to another.	1 per analytical batch[d,e]

Table 2-4. Field and Laboratory Quality Control Protocol

Sample Type	Primary Characteristics Evaluated	Frequency
Method blanks	Precision of analysis processes: the degree of confidence in the comparability of analytical methods to allow comparison of one dataset to another.	1 per analytical batch[d,e]
Surrogates	Laboratory accuracy for organic compounds.	Added to each sample and quality control sample for organic analysis[e]
Carrier	Laboratory accuracy for radioanalytes.	Added to each radioanalyte sample and quality control sample[e]
Tracers	Laboratory accuracy for radioanalytes.	Added to each radioanalyte sample and quality control sample[e]

Note: The information in this table does not represent U.S. Environmental Protection Agency or Washington State Department of Ecology requirements; it is intended solely as guidance.

a. For soil or miscellaneous material samples, a sample is the media (e.g., soil, resin, powder) collected at a specific location or depth interval (e.g., during drilling).

b. Whenever a new type of nondedicated equipment is used, an equipment blank shall be collected every time sampling occurs until it can be shown that less frequent collection of equipment blanks is adequate to monitor the decontamination procedure for the nondedicated equipment. Vendor-provided borehole equipment is considered dedicated equipment and equipment blanks are not typically acquired in this instance.

c. Full trip blank is not recommended for metals analyses, due to possible low-level metal content in the blank media.

d. A batch is a group of up to 20 samples that behave similarly with respect to the sampling or testing procedures being employed and which are processed as a unit. Batching across projects is allowed for similar matrices (e.g., Hanford Site groundwater, Hanford Site soil).

e. Unless not required by, or different frequency is called out, in laboratory analysis method.

VOC = volatile organic compound

SMR = Sample Management and Reporting

Table 2-5. Field and Laboratory QC Elements and Acceptance Criteria

Analyte or Method	QC Element	Acceptance Criteria[a]		Corrective Action
		Water	Soil	
General Chemistry Parameters and Anions				
Anions by IC	MB	<MDL <5% Sample concentration		Flag with “C”
	LCS	80% to 120% Recovery		Flag with “O”[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	≤35% RPD	Review data[e]
	MS/MSD[d]	75% to 125% Recovery		Flag with “N”
	EB, FTB	<MDL <5% Sample concentration		Flag with “Q”
	Field duplicate[c]	≤20% RPD	—[f]	Review data[e]

Table 2-5. Field and Laboratory QC Elements and Acceptance Criteria

Analyte or Method	QC Element	Acceptance Criteria[a]		Corrective Action
		Water	Soil	
Chromium (VI)	MB	<MDL <5% Sample concentration		<MDL <5% sample concentration
	LCS	80% to 120% Recovery		Flag with "O"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	≤35% RPD	Review data[e]
	MS/MSD[d]	75% to 125% Recovery		Flag with "N"
	EB, FTB	<MDL <5% Sample concentration		Flag with "Q"
	Field duplicate[c]	≤20% RPD	—[f]	Review data[e]
Metals				
ICP/AES and ICP/MS metals	MB	<MDL <5% Sample concentration		Flag with "C"
	LCS	80% to 120% Recovery		Flag with "O"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	≤35% RPD	Review data[e]
	MS/MSD[d]	75% to 125% Recovery		Flag with "N"
	EB, FTB	<MDL <5% Sample concentration		Flag with "Q"
	Field duplicate[c]	≤20% RPD	—[f]	Review data[e]
Mercury by cold-vapor atomic absorption	MB	<MDL <5% Sample concentration		Flag with "C"
	LCS	80% to 120% Recovery		Flag with "O"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	≤35% RPD	Review data[e]
	MS/MSD[d]	75% to 125% Recovery		Flag with "N"
	EB, FTB	<MDL <5% Sample concentration		Flag with "Q"
	Field duplicate[c]	≤20% RPD	—[f]	Review data[e]

Table 2-5. Field and Laboratory QC Elements and Acceptance Criteria

Analyte or Method	QC Element	Acceptance Criteria[a]		Corrective Action
		Water	Soil	
Uranium (total) by ICP/MS	MB	<MDL <5% Sample concentration		Flag with “C”
	LCS	80% to 120% Recovery		Flag with “O” [b]
	DUP[c] or MS/MSD[d]	≤20% RPD	≤35% RPD	Review data [e]
	MS/MSD[c]	75% to 125% Recovery		Flag with “N”
	EB, FTB	<MDL <5% Sample concentration		Flag with “Q”
	Field duplicate[c]	≤20% RPD	--[f]	Review data[e]
Volatile Organic Compounds				
Volatile organics by GC-MS	MB	<MDL[g] <5% Sample concentration		Flag with “B”
	LCS	70% to 130% Recovery or % recovery statistically derived[h]		Flag with “O”[b]
	DUP[c] or MS/MSD[d]	≤20% RPD		Review data[e]
	MS/MSD[d]	70% to 130% Recovery		Flag with “T”
	SUR	70% to 130% Recovery	% Recovery statistically derived[h]	Review data[e]
	EB, FTB, FXR	<MDL[g] <5% Sample concentration		Flag with “Q”
	Field duplicate[c]	≤20% RPD	—[f]	Review data[e]
Total petroleum hydrocarbons – gasoline by GC	MB	<MDL <5% Sample concentration		Flag with “B”
	LCS	70% to 130% Recovery or % recovery statistically derived [g]		Flag with “O”[b]
	DUP[c] or MS/MSD [c]	≤20% RPD		Review data [e]
	MS/MSD [c]	70% to 130% Recovery		Flag with “N”
	SUR	60% to 140% Recovery		Review data [e]
	EB, FTB	<MDL <5% Sample concentration		Flag with “Q”
	Field duplicate[c]	≤20% RPD	--[e]	Review data [e]
Semivolatile Organic Compounds and Total Petroleum Hydrocarbons				
Polychlorinated biphenyl by GC-MS	MB	<MDL <5% Sample concentration		Flag with “B”
	LCS	70% to 130% Recovery or % recovery statistically derived[h]		Flag with “O”[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	≤30% RPD	Review data[e]
	MS/MSD[d]	% Recovery statistically derived[h]		Flag with “N”
	SUR	% Recovery statistically derived[h]		Review data[e]
	EB, FTB	<MDL <5% Sample concentration		Flag with “Q”

Table 2-5. Field and Laboratory QC Elements and Acceptance Criteria

Analyte or Method	QC Element	Acceptance Criteria[a]		Corrective Action
		Water	Soil	
	Field duplicate[c]	≤20% RPD	--[f]	Review data[e]
Polycyclic Aromatic Hydrocarbons by GC-MS	MB	<MDL[g] <5% Sample concentration		Flag with “B”
	LCS	70% to 130% Recovery or % recovery statistically derived[h]		Flag with “O”[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	≤30% RPD	Review data[e]
	MS/MSD[d]	% Recovery statistically derived[h]		Flag with “T”
	SUR	% Recovery statistically derived[h]		Review data[e]
	EB, FTB	<MDL[g] <5% Sample concentration		Flag with “Q”
	Field duplicate[c]	≤20% RPD	—[f]	Review data[e]
Pesticides by GC	MB	<MDL <5% Sample concentration		Flag with “B”
	LCS	70% to 130% Recovery or % recovery statistically derived[h]		Flag with “O”[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	≤30% RPD	Review data[e]
	MS/MSD[d]	% Recovery statistically derived[h]		Flag with “N”
	SUR	% Recovery statistically derived[h]		Review data[e]
	EB, FTB	<MDL <5% Sample concentration		Flag with “Q”
	Field duplicate[c]	≤20% RPD	—[f]	Review data[e]
Total petroleum hydrocarbons – diesel or kerosene by GC	MB	<MDL <5% Sample concentration		Flag with “B”
	LCS	70% to 130% Recovery or % recovery statistically derived[h]		Flag with “O”[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	≤30% RPD	Review data[e]
	MS/MSD[d]	70% to 130% Recovery		Flag with “N”
	SUR	60% to 140% Recovery		Review data[e]
	EB, FTB	<MDL <5% Sample concentration		Flag with “Q”
	Field duplicate[c]	≤20% RPD	—[f]	Review data[e]
Radiological Parameters				
AEA	MB	<MDC <5% Sample activity concentration		Flag with “B”
	LCS	80% to 120% Recovery or statistically derived limits[h]		Flag with “O”[b]
	DUP[c]	≤20% RPD	≤30% RPD	Review data[e]
	Tracer	30% to 105% Recovery		Review data[e]
	EB, FTB	<MDC <5% Sample activity concentration		Flag with “Q”

Table 2-5. Field and Laboratory QC Elements and Acceptance Criteria

Analyte or Method	QC Element	Acceptance Criteria[a] Water	Acceptance Criteria[a] Soil	Corrective Action
	Field duplicate[c]	≤20% RPD	—[f]	Review data[e]
GEA	MB	<MDC <5% Sample activity concentration		Flag with “B”
	LCS	80% to 120% Recovery or statistically derived limits[h]		Flag with “O”[b]
	DUP[c]	≤20% RPD	≤30% RPD	Review data[e]
	EB, FTB	<MDC <5% Sample activity concentration		Flag with “Q”
	Field duplicate[c]	≤20% RPD	—[f]	Review data[e]
Nickel-63	MB	<MDC <5% Sample activity concentration		Flag with “B”
	LCS	80% to 120% Recovery or statistically derived limits[h]		Flag with “O”[b]
	DUP[c]	≤20% RPD	≤30% RPD	Review data[e]
	MS	75% to 125% Recovery		Review data[e]
	Carrier	40% to 110% Recovery		Review data[e]
	EB, FTB	<MDC <5% Sample activity concentration		Flag with “Q”
	Field duplicate[c]	≤20% RPD	—[f]	Review data[e]
Strontium-90	MB	<MDC <5% Sample activity concentration		Flag with “B”
	LCS	80% to 120% Recovery or statistically derived limits[h]		Flag with “O”[b]
	DUP[c]	≤20% RPD	≤30% RPD	Review data[e]
	Tracer	30% to 105% Recovery		Review data[e]
	Carrier	40% to 110% Recovery		Review data[e]
	EB, FTB	<MDC <5% Sample activity concentration		Flag with “Q”
	Field duplicate[c]	≤20% RPD	—[f]	Review data[e]
Technetium-99	MB	<MDC <5% Sample activity concentration		Flag with “B”
	LCS	80% to 120% Recovery or statistically derived limits[h]		Flag with “O”[b]
	DUP[c]	≤20% RPD	≤30% RPD	Review data[e]
	MS	75% to 125% Recovery		Flag with “N”
	EB, FTB	<MDC <5% Sample activity concentration		Flag with “Q”
	Field duplicate[c]	≤20% RPD	—[f]	Review data[e]

Table 2-5. Field and Laboratory QC Elements and Acceptance Criteria

Analyte or Method	QC Element	Acceptance Criteria[a]		Corrective Action
		Water	Soil	
Tritium	MB	<MDC <5% Sample activity concentration		Flag with “B”
	LCS	80% to 120% Recovery or statistically derived limits[h]		Flag with “O”[b]
	DUP[c]	≤20% RPD	≤30% RPD	Review data[e]
	MS	75% to 125% Recovery		Flag with “N”
	EB, FTB	<MDC <5% Sample activity concentration		Flag with “Q”
	Field duplicate[c]	≤20% RPD	—[f]	Review data[e]

Notes: The information in this table does not represent U.S. Environmental Protection Agency requirements and is intended solely as guidance.

Table 2-3 provides a list of the constituent and analytical methods.

a. Acceptance criteria listed for analytes/analyte classes and matrix combinations for which sample analyses are required.

b. The reporting laboratory will apply the “O” flag with SMR concurrence.

c. Applies when at least one result is greater than the laboratory practical quantitation limit (chemical analyses) or greater than five times the MDC (radiochemical analyses).

d. Either a DUP or an MS/MSD is to be analyzed to determine measurement precision (if there is insufficient sample volume, an LCS duplicate is analyzed with the acceptance criteria defaulting to the DUP/MSD criteria).

e. After review, corrective actions are determined on a case-by-case basis. Corrective actions may include a laboratory recheck or data flagging.

f. A field duplicate RPD for soils is not recommended because of possible soil matrix heterogeneity effects.

g. For the common laboratory contaminants acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the acceptance criteria are less than five times the MDLs.

h. Laboratory-determined, statistically derived control limits based on historical data are used here. Control limits are reported with the data.

AEA = alpha energy analysis
DUP = laboratory sample duplicate
EB = equipment blank
FTB = full trip blank
FXR = field transfer blank
GC = gas chromatography
GC-MS = gas chromatography/mass spectrometry
GEA = gamma energy analysis
IC = ion chromatography
ICP/AES = inductively coupled plasma/atomic emission spectroscopy
ICP/MS = inductively coupled plasma/mass spectrometry
LCS = laboratory control sample
MB = method blank
MDC = minimum detectable concentration
MDL = method detection limit
MS = matrix spike
MSD = matrix spike duplicate
QC = quality control
RPD = relative percent difference
SUR = surrogate
SMR = Sample Management and Reporting

Data flags:

B, C = Possible laboratory contamination; analyte was detected in the associated MB (laboratory-applied). The “B” flag is used for organic analytes. The “C” flag is used for general chemical and inorganic analytes.
O = Result may be biased; associated LCS result was outside the acceptance limits (laboratory-applied).
N = Result may be biased; associated MS result was outside the acceptance limits (except GC/MS) (laboratory-applied).
T = Result may be biased; associated MS result was outside the acceptance limits (GC/MS only) (laboratory-applied).
Q = Problem with associated field QC blank; results were out of limits (SMR review).

2.2.3.1 Field Quality Control Samples

Field QC samples are collected to evaluate the potential for cross-contamination and provide information pertinent to field sampling variability and laboratory performance to help ensure that reliable data are obtained. Field QC samples include field duplicates, field split (SPLIT) samples, and three types of field blanks (equipment blanks [EBs], field transfer blanks [FXRs], and full trip blanks [FTBs]). Field blanks are typically prepared using silica sand for soil samples and high-purity reagent water[2] for liquids. QC sample definitions and their required frequency for collection are described below:

- **Field duplicates:** Independent samples collected as close as possible to the same time and same location as the scheduled sample and intended to be identical. Field duplicates are placed in separate sample containers and analyzed independently. Field duplicates are used to determine precision for both sampling and laboratory measurements.
- **Field splits (SPLITs):** Two samples collected as close as possible to the same time and same location and intended to be identical. SPLITs will be stored in separate containers and analyzed by different laboratories for the same analytes. SPLITs are inter-laboratory comparison samples used to evaluate comparability between laboratories.
- **Equipment blanks (EBs):** Silica sand or high-purity water will be passed through or poured over decontaminated sampling equipment identical to the sample set collected and placed in sample containers, as identified on the sample authorization form. EB sample bottles are placed in the storage containers with samples from the associated sampling event and are analyzed for the same constituents as samples from the associated sampling event. EBs are used to evaluate the decontamination process effectiveness; these samples are not required for disposable sampling equipment.
- **Field transfer blanks (FXRs):** Preserved volatile organic analysis sample vials filled with silica sand or high-purity water at the sample collection site where VOCs are collected. FXR samples are prepared during sampling to evaluate potential contamination attributable to field conditions. After collection, FXR sample vials are sealed and placed into the same storage containers with samples collected the same day for the associated sampling event. FXR samples are analyzed for VOCs only.
- **Full trip blanks (FTBs):** Bottles prepared by the sampling team before travel to the sampling site. The preserved bottle set is either for VOC analysis only or identical to the set that will be collected in the field. It is filled with high-purity water and the bottles are sealed and transported (unopened) to the field in the same storage containers used for samples collected that day. Collected FTBs are typically analyzed for the same constituents as the samples from the associated sampling event. FTBs are used to evaluate potential contamination from the sample bottles, preservative, handling, storage, and transportation.

For the field blanks (i.e., FTBs, FXRs, and EBs), results greater than 5% sample concentration are identified as suspected contamination. However, for common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the limit is greater than five times the method detection limit. For radiological data, blank results are flagged if they are greater than 5% sample concentration.

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[2] High-purity water is generally defined as water that has been distilled, deionized, or any combination of distillation, deionization, reverse osmosis, activated carbon filtration, ion exchange, particulate filtration, or other polishing techniques (DOE/RL-96-68).

2.2.3.2 Laboratory Quality Control Samples

Internal QA/QC programs are maintained by laboratories used by the project. Laboratory QA includes a comprehensive QC program that includes the use of laboratory control samples (LCSs), laboratory sample duplicates (DUPs), matrix spikes (MSs), matrix spike duplicates (MSDs), method blanks (MBs), surrogates (SURs), carriers, and tracers. These QC analyses are required by EPA methods (e.g., those in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Compendium*) and will be run at the frequency specified in the respective references unless superseded by agreement. QC checks outside of control limits are documented in analytical laboratory reports during data usability assessments, if performed. Laboratory QC checks and their typical frequencies are listed in Table 2-4. Following are descriptions of the various types of laboratory QC samples.

- **Carrier:** A known quantity of nonradioactive isotope that is expected to behave similarly and is added to an aliquot of sample. Sample results are generally corrected based on carrier recovery.
- **Laboratory control sample (LCS):** A control matrix (e.g., reagent water) spiked with analytes representing the target analytes or certified reference material used to evaluate laboratory accuracy.
- **Laboratory sample duplicate (DUP):** An intra-laboratory replicate sample that is used to evaluate the precision of a method in a given sample matrix.
- **Matrix spike (MS):** An aliquot of a sample spiked with a known concentration of target analyte(s). The MS is used to assess the bias of a method in a given sample matrix. Spiking occurs prior to sample preparation and analysis.
- **Matrix spike duplicate (MSD):** A replicate spiked aliquot of a sample that is subjected to the entire sample preparation and analytical process. MSD results are used to determine the bias and precision of a method in a given sample matrix.
- **Method blank (MB):** An analyte-free matrix to which the same reagents are added in the same volumes or proportions as used in the sample processing. The MB is carried through the sample preparations and analytical procedure and is used to quantify contamination resulting from the analytical process.
- **Surrogate (SUR):** A compound added to every sample in the analysis batch (field samples and QC samples) prior to preparation. SURs are typically similar in chemical composition to the analyte being determined, but they are not normally encountered. SURs are expected to respond to the preparation and measurement systems in a manner similar to the analytes of interest. Because SURs are added to every standard, sample, and QC sample, they are used to evaluate overall method performance in a given matrix. SURs are used only in organic analyses.
- **Tracer**: a known quantity of radioactive isotope that is different from that of the isotope of interest but is expected to behave similarly and is generally added to an aliquot of sample prior to the sample preparation step. A tracer does not chemically interfere with the target radioisotope during radiochemical preparation, separation, and counting. Sample results are generally corrected based on tracer recovery.

Laboratories are required to analyze samples within the holding times specified in Table 2-6. In some instances, constituents in the samples not analyzed within the holding times may be compromised by volatilization, decomposition, or by other chemical changes. Data from samples analyzed outside of the holding times are flagged in the HEIS database with an “H.”

Table 2-6. Holding Time Guidelines for Laboratory Analytes

Analyte or Method	Liquids		Soil and Sediment	
	Preservation[a]	Holding Time	Preservation[a]	Holding Time
General Chemistry Parameters and Anions				
Nitrate (as nitrogen)	Cool ≤6°C	48 hours or 28 days[b]	Cool ≤6°C	28 days/48 hours[c]
Chromium (VI)	Cool ≤6°C	24 hours	Cool ≤6°C	30 days/24 hours[c]
Metals				
6010 or 6020	HNO_3 to pH <2	6 months	None	6 months
Mercury by cold-vapor atomic absorption	HNO_3 to pH <2	28 days	Cool ≤6°C	28 days
Volatile Organic Compounds				
Volatile organics by GC-MS	HCl or H_2SO_4 to pH <2, Cool ≤6°C	7 days/14 days[d]	Cool ≤6°C	14 days
Total petroleum hydrocarbons – gasoline by GC	HCl to pH <2 Cool ≤6°C	7 days/14 days[d]	Cool ≤6°C	14 days
Semivolatile Organic Compounds and Total Petroleum Hydrocarbons				
Polychlorinated biphenyl by GC	Cool ≤6°C	1 year/40 days[c]	Cool ≤6°C	Up to 1 year/40 days[c]
Polycyclic aromatic hydrocarbons by GC-MS	Cool ≤6°C	7 days/40 days[c]	Cool ≤6°C	14 days/40 days[c]
Pesticides by GC	Cool ≤6°C	7 days/40 days[c]	Cool ≤6°C	7 days/40 days[c]
Total petroleum hydrocarbons – diesel or kerosene by GC	HCl to pH ≤2, Cool ≤6°C	14 days/40 days[c]	Cool ≤6°C	14 days/40 days[c]
Radionuclides				
AEA, GEA, GPC, LSC	HNO_3 to pH <2	6 months	None	6 months
Tritium	None	6 months	None	6 months

Notes: Holding times and preservation methods are dependent on the constituent and are consistent with EPA guidance and approved analytical methods.

Container types and volumes will be identified on the chain of custody form.

a. For preservation identified as stored at <6°C, the sample should be protected against freezing unless it is known that freezing will not impact the sample integrity.

b. EPA Method 300.0 or 9056 nitrate, nitrite, and phosphate holding time is 48 hours (after extraction, if a solid sample); holding time of 28 days applies to all other anions by EPA Method 300.0 or 9056.

c. The first number shown is the holding time before extraction; the second number is the holding time after extraction.

d. The first number shown is the holding time if unpreserved; the second number is the holding time preserved.

AEA = alpha energy analysis
EPA = U.S. Environmental Protection Agency
GC = gas chromatography
GC-MS = gas chromatography-mass spectrometry
GEA = gamma energy analysis
GPC = gas proportional counter
LSC = liquid scintillation counting

2.2.4 Measurement Equipment

Each measuring equipment user is responsible to ensure the equipment is functioning as expected, properly handled, and properly calibrated at required frequencies per methods governing control of the equipment. Onsite environmental instrument testing, inspection, calibration, and maintenance will be recorded in accordance with approved methods. Field screening instruments will be used, maintained, and calibrated in accordance with the manufacturers' specifications and other approved methods.

2.2.5 Instrument and Equipment Testing, Inspection, and Maintenance

Collection, measurement, and testing equipment will meet applicable standards (e.g., ASTM International, formerly the American Society for Testing and Materials) or have been evaluated as acceptable and valid in accordance with instrument-specific methods, requirements, and specifications. The FWS, or equivalent, will ensure that the data generated from instructions using a software system are backed up and/or downloaded on a regular basis. Software applications will be acceptance tested before use in the field.

Measurement and testing equipment used in the field or in the laboratory will be subject to preventive maintenance measures to ensure minimization of downtime. Measurement and test equipment used in the field includes, but is not limited to, analytical balances, pH meters, and thermometers. Laboratory equipment will be maintained and calibrated in accordance with the subcontract laboratory's QA plan and in a manner consistent with HASQARD requirements. Maintenance requirements (e.g., documentation of routine maintenance) will be specified in the individual subcontract laboratory and SMR and FSO operating protocols, as appropriate.

2.2.6 Instrument and Equipment Calibration and Frequency

Field equipment calibration is discussed in Section 3.5. Analytical laboratory instruments will be calibrated in accordance with the subcontract laboratory's QA plan and HASQARD requirements.

2.2.7 Inspection and Acceptance of Supplies and Consumables

Consumables, supplies, and reagents will be reviewed in accordance with test methods in SW-846 and will be appropriate for their use. 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.

2.2.8 Nondirect Measurements

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

2.2.9 Data Management

The SMR group, in coordination with the Remedial Action 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.

Electronic data access, when appropriate, will be through a Hanford Site database (e.g., HEIS). Where electronic data are not available, hardcopies will be provided in accordance with Section 9.6 of the Tri-Party Agreement Action Plan (Ecology et al., 1989b).

Laboratory errors are reported to the SMR group through an established process. For reported laboratory errors, a sample issue resolution form will be initiated in accordance with applicable methods. This process is used to document analytical errors and to establish their resolution with the Remedial Action Project Manager. The sample issue resolution forms become a permanent part of the analytical data package for future reference and for records management.

2.3 Assessment and Oversight

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

2.3.1 Assessments and Response Actions

Random surveillances and assessments verify compliance with the requirements outlined in this SAP, project field instructions, the project quality management plan, methods, and regulatory requirements. Assessments may include, but are not limited to, surveillances, management systems reviews, readiness reviews, technical systems audits, performance evaluations, audits of data quality, and reconciliation with user requirements. Assessment processes, roles and responsibilities will be in accordance with existing QA program methods and as directed jointly by the Remedial Action Project Manager and the QA point of contact. If circumstances arise in the field dictating the need for additional assessment activities, then additional assessments will be performed.

Deficiencies identified by these assessments will be reported to the project's line management. The deficiencies will also be entered into an issue management process whereby the project's line management chain will coordinate review of the issue, development of the corrective actions and resolution of the deficiencies. When appropriate, corrective actions will be taken by the Remedial Action Project Manager (or designee).

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

2.3.2 Reports to Management

Program and project management (as appropriate) will be made aware of deficiencies identified by assessments. Issues reported by the laboratories are communicated to SMR, which then initiates a sample issue resolution form. The process is used to document analytical or sample issues and to establish resolution with the Remedial Action Project Manager. If an assessment finding results in sampling issues that affect a regulatory requirement, DOE would be informed and the matter discussed with the regulatory agencies.

2.4 Data Review and Usability

This section addresses QA activities that occur after data collection. Implementation of these activities determines whether the data conform to the specified criteria, thus satisfying the project objectives.

2.4.1 Data Review and Verification

Data review and verification are performed to confirm that sampling and chain-of-custody documentation are complete. This review includes linking sample numbers to specific sampling locations and reviewing sample collection dates and sample preparation and analysis dates to assess whether holding times, if any, have been met. Furthermore, a review of QC data is used to determine whether analyses 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 will be reviewed to ensure they are usable.

The Remedial Action Technical Lead performs data reviews to help determine if observed changes reflect potential data errors, which may result in submitting a request for data review on questionable data. The laboratory may be asked to check calculations or reanalyze the sample. In extreme cases, another sample may be collected. Results of the request for the data review process are used to flag the data appropriately in the HEIS database and/or to add comments.

2.4.2 Data Validation

Data validation is an independent assessment to ensure the reliability of the data. Analytical data validation provides a level of assurance that an analyte is present or absent. Validation may also include:

- Verification of instrument calibrations
- Evaluation of analytical results based on method blanks
- Recovery of various internal standards
- Correctness of uncertainty calculations
- Correctness of identification and quantification of analytes
- The effect of quality deficiencies on data reliability

The contractor follows the data validation process described in EPA/540-R-2017-001, *National Functional Guidelines for Inorganic Superfund Methods Data Review*, and EPA/540-R-2017-002, *National Functional Guidelines for Organic Superfund Methods Data Review*, adjusted for use with SW-846, HASQARD (DOE/RL-96-68), and radiochemistry methods. The criteria for data validation are based on a graded approach, using five levels of validation: Levels A through E. Level A is the lowest level and is the same as verification. Level E is a 100% review of all data (e.g., calibration data and calculations of representative samples from the dataset). Data validation will be performed to Level C, which is a review of the QC data, on the confirmatory and verification samples collected to support whether CS/NFA and RTD actions have met cleanup levels. Level C validation consists of a review of the QC data and specifically requires verification of deliverables; requested versus reported analytes; and qualification of the results based on evaluation of analytical holding times, method blank results, MS/MSD results, surrogate recoveries, and duplicate sample results. Level C data validation is generally equivalent to Level 2A in EPA/540-R-08-005, *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use*. Level C data validation will be performed on at least 5% of the data by matrix and analyte group under the direction of SMR. Analyte group refers to categories such as radionuclides, volatile chemicals, semivolatiles, metals, and anions. The goal is to include each of the various analyte groups and matrices during the data validation process. The DOE-RL Remedial Action Manager or contractor Remedial Action Project Manager may specify a higher percentage of data to be validated or that data validation be performed at higher levels.

2.4.3 Reconciliation with User Requirements

The purpose of reconciliation with user requirements is to determine if quantitative data are of the correct type and are of adequate quality and quantity to meet the project data needs. The data quality assessment (DQA) process is the scientific and statistical evaluation of previously verified and validated data to determine if information obtained from environmental data operations are of the right type, quality, and quantity to support their intended use (usability). If a statistical sampling design was utilized during field sampling activities, then the DQA will be performed following guidance in EPA/240/B-06/003, *Data*

Quality Assessment: Statistical Methods for Practitioners (EPA QA/G-9S). When judgmental (focused) sampling designs are implemented in the field, DQIs such as precision, accuracy, representativeness, comparability, completeness, bias, and sensitivity for the specific datasets (individual data packages) will be evaluated in accordance with EPA/240/R-02/004, *Guidance on Environmental Data Verification and Data Validation* (EPA QA/G-8). Data verification and data validation are integral to both the statistical DQA data evaluation process and the DQI evaluation process. Results of the DQA or DQI processes will be used by the contractor Remedial Action Project Manager to interpret the data and determine if the DQOs for this activity have been met.

3 Field Sampling Plan

The objective of the field sampling plan is to define project sampling and analytical requirements, including sampling methods and analyses that will be performed. The following sections provide field characterization activities, scoping survey strategies, media sampling strategies and sampling analysis activities to be implemented in the field.

Sampling designs specify a variety of sampling requirements, including (but not limited to) sampling locations, sample numbers, sample collection and handling methods, reporting documents, and recordkeeping requirements. The overall sampling strategy is outlined in Table 3-1. Changes to the field sampling plan may be made in the field by the Remedial Action Technical Lead with approval from the Remedial Action Project Manager.

3.1 Sampling Design

To meet project sampling objectives, the sampling strategy outlined in Table 3-1 provides an approach for defining the sample locations, sample intervals, sample processes, target analytes, and analytical methods. The following sections identify the site-specific approach for site investigations.

3.1.1 Observational Approach for Site Investigation

Under the observational approach, the site investigation is streamlined such that site characterization and cleanup verification and/or remedial action alternative confirmation will occur as described below.

1. An initial visual field survey will be performed to document visual observations across the entire site. The visual survey will include descriptions of observed conditions and delineations of the condition that resulted in the original identification of the site (from the Waste Information Data System), as well as any additional observed conditions and/or confirmation of historical conditions. The field survey will also include photo documentation of the site. Radiological surveys will be conducted to identify site health and safety needs and to determine where previous observations have identified potential radioactive contamination. As needed, Geographic Information System coordinate information may be collected for reference. Debris and any stabilization cover, if existing, will be removed as necessary to gain access to soils.

2. Based on the visual survey, the Remedial Action Technical Lead may call for focused field surveys or subsurface ground-penetrating radar surveys to characterize observed conditions. In-process sampling of specific areas, using a focused sampling approach, may be used in order to fully understand the nature of any identified condition or material before contamination removal.

3. The field team will agree on an RTD plan that addresses the observed conditions of the site to a nominal depth of up to 4.6 m (15 ft) below ground surface.

4. During soil/material removal, visual (e.g., extent of staining) and/or radiological indicators will be monitored to guide removal.

5. For CS/NFA sites where contamination is not identified using the observational approach or after all site physical activities, such as after RTD site excavations have concluded, remedial action objective attainment will be demonstrated by surface area sampling. Details of the design will be developed based on site evaluation results to date, the overall size of the site, and any other pertinent site-specific information.

Table 3-1. Sample Summary Table

Zone of Potential Contamination Type[a]	Data Needs	General Sampling Approach	Location and Number of Samples[b]	Sample Analytes
Soil stains	Chemical data for characterization for waste disposal and verification of contaminant removal at RTD sites to below cleanup levels	• Perform initial site evaluation, including site historical document review and visual inspections to identify soil stains for removal. • Perform field survey(s) and document (photographs, field screening reports, etc.) to identify contamination locations requiring removal. Where ZPCs are indicated by inspections and field screening that require sampling: • Perform focused sampling of matrix as specified under the Location and Number of Samples column and document sampling activities, including depth of sample collection, and field activities (photographs, field screening reports, etc.). OR • As needed, excavate indications in 0.3 m (1 ft) depth increments using visual and field screening methods to guide the lateral and vertical extent of the excavation. Sample the excavation bottom to verify that contamination is removed to below cleanup levels.	At each ZPC location (up to 47 m^2 [500 ft^2]), collect at least one focused sample from the bottom of the excavation. Any ZPC greater than 47 m^2 (500 ft^2) may have at least four samples. As needed, use VSP for sampling locations in larger sites.	Based on process knowledge and field observations, where only chemicals are present, analyze for applicable Table 2-3 chemicals, metals, and organics.

Table 3-1. Sample Summary Table

Zone of Potential Contamination Type[a]	Data Needs	General Sampling Approach	Location and Number of Samples[b]	Sample Analytes
Liquid waste	Chemical data for characterization for waste disposal, confirmation of the no further action alternative, and/or verification of contaminant removal at RTD sites to below cleanup levels	Perform field survey(s) and document (photographs, field screening reports, etc.) to identify contamination requiring removal or sampling beneath removed hazardous liquid to confirm contamination is below cleanup levels. • Perform focused sampling of liquid as specified under the Location and Number of Samples column and document sampling activities, including depth of sample collection, and field activities (photographs, field screening reports, etc.) to identify if the liquid is hazardous. AND • As needed, excavate indications in 0.3 m (1 ft) depth increments using visual and field screening methods to guide the lateral and vertical extent of the excavation. Sample the excavation bottom to verify that contamination is removed to below cleanup levels.	At each ZPC location (up to 47 m^2 [500 ft^2]), collect at least one focused sample which can be at the surface where excavation is not indicated or at excavation sites from the bottom of the excavation. Any ZPC greater than 47 m^2 (500 ft^2) may have at least four samples. As needed, use VSP for sampling locations in larger sites.	Based on process knowledge and field observations, where only chemicals are present, analyze for applicable Table 2-3 chemicals, metals, and organics.

Table 3-1. Sample Summary Table

Zone of Potential Contamination Type[a]	Data Needs	General Sampling Approach	Location and Number of Samples[b]	Sample Analytes
Radiological contamination	Radiological data for characterization for waste disposal, confirmation of the no further action alternative, and/or verification of contaminant removal at RTD sites to below cleanup levels	• Perform initial site evaluation, including site historical document review, visual inspections and initial radiation surveys to guide comprehensive radiological field screening. • Perform field radiological survey(s) and document (photographs, field screening reports, etc.) to identify contamination locations requiring removal or sampling to confirm contamination is below cleanup levels. Where ZPCs are indicated by inspections and field screening that require sampling: • Perform focused sampling of matrix as specified under the Location and Number of Samples column and document sampling activities, including depth of sample collection, and field activities (photographs, field screening reports, etc.). OR • As needed, excavate indications in 0.3 m (1 ft) depth increments using visual and field screening methods to guide the lateral and vertical extent of the excavation. Sample the excavation bottom to verify that contamination is removed to below cleanup levels.	Where only radiological contamination is present, post RTD radiological surveys will be used to identify location for focus samples. At each ZPC location (up to 47 m^2 [500 ft^2]), collect at least one focused sample from the bottom of the excavation. Any ZPC greater than 47 m^2 (500 ft^2) may have at least four samples. As needed, use VSP for sampling locations in larger sites.	Based on process knowledge and field observations, where radiological contamination is indicated, analyze samples for Table 2-3 radiological and metal constituents.

Table 3-1. Sample Summary Table

Zone of Potential Contamination Type[a]	Data Needs	General Sampling Approach	Location and Number of Samples[b]	Sample Analytes
Hazardous debris	Chemical data for characterization for waste disposal, confirmation of the no further action alternative, and/or verification of contaminant removal at RTD sites to below cleanup levels	• Perform initial site evaluation, including site historical document review, geophysical review, and visual inspections to identify hazardous debris for removal. • In the absence of staining or other visual indicators for RTD, perform focused sampling of matrix beneath the debris as specified under the Location and Number of Samples column and document sampling activities, including depth of sample collection, and field activities (photographs, field screening reports, etc.). AND • As needed, excavate indications in 0.3 m (1 ft) depth increments using visual and field screening methods to guide the lateral and vertical extent of the excavation. Sample the excavation bottom to verify that contamination is removed to below cleanup levels.	At each ZPC location (up to 47 m^2 [500 ft^2]), collect at least one focused sample which can be at the surface where excavation is not indicated or at excavation sites from the bottom of the excavation. Any ZPC greater than 47 m^2 (500 ft^2) may have at least four samples. As needed, use VSP for sampling locations in larger sites.	Based on process knowledge and field observations, where only chemicals are present, analyze for applicable Table 2-3 chemicals, metals, and organics.

Table 3-1. Sample Summary Table

Zone of Potential Contamination Type[a]	Data Needs	General Sampling Approach	Location and Number of Samples[b]	Sample Analytes
Distressed vegetation	Chemical data for characterization for waste disposal, confirmation of the no further action alternative, and/or verification of contaminant removal at RTD sites to below cleanup levels	• Perform initial site evaluation, including site historical document review and visual inspections to identify potential causes for distressed vegetation. • Perform field survey(s) and document (photographs, field screening reports, etc.) to identify contamination locations requiring removal or sampling to confirm contamination is below cleanup levels. Where ZPCs are indicated by inspections and field screening that require sampling: • Perform focused sampling of matrix as specified under the Location and Number of Samples column and document sampling activities, including depth of sample collection, and field activities (photographs, field screening reports, etc.). OR • As needed, excavate indications in 0.3 m (1 ft) depth increments using visual and field screening methods to guide the lateral and vertical extent of the excavation. Sample the excavation bottom to verify that contamination is removed to below cleanup levels.	At each ZPC location (up to 47 m^2 [500 ft^2]), collect at least one focused sample which can be at the surface where excavation is not indicated or at excavation sites from the bottom of the excavation. Any ZPC greater than 47 m^2 (500 ft^2) may have at least four samples. As needed, use VSP for sampling locations in larger sites.	Based on process knowledge and field observations, where only chemicals are present, analyze for applicable Table 2-3 chemicals, metals, and organics.

Table 3-1. Sample Summary Table

Zone of Potential Contamination Type[a]	Data Needs	General Sampling Approach	Location and Number of Samples[b]	Sample Analytes
Mechanically disturbed soil	Chemical data for characterization for waste disposal, confirmation of the no further action alternative, and/or verification of contaminant removal at RTD sites to below cleanup levels	• Perform initial site evaluation, including site historical document review, geophysical review, and visual inspections to identify potential areas of contamination. • In the absence of staining or other visual indicators for RTD, perform focused sampling of matrix beneath the debris as specified under the Location and Number of Samples column and document sampling activities, including depth of sample collection, and field activities (photographs, field screening reports, etc.). AND • As needed, excavate indications in 0.3 m (1 ft) depth increments using visual and field screening methods to guide the lateral and vertical extent of the excavation. Sample the excavation bottom to verify that contamination is removed to below cleanup levels.	At each ZPC location (up to 47 m^2 [500 ft^2]), collect at least one focused sample which can be at the surface where excavation is not indicated or at excavation sites from the bottom of the excavation. Any ZPC greater than 47 m^2 (500 ft^2) may have at least four samples. As needed, use VSP for sampling locations in larger sites.	Based on process knowledge and field observations, where only chemicals are present, analyze for applicable Table 2-3 chemicals, metals, and organics.
Waste Site with no ZPC	Radiological and chemical data for characterization for waste disposal, confirmation of the no further action alternative, and/or verification of contaminant removal at RTD sites to below cleanup levels	• Perform initial site evaluation, including site historical document review, geophysical review, and visual inspections to identify potential areas of contamination. • Where no ZPC was identified, perform sampling of the waste site to confirm the absence of contamination above cleanup levels. OR • If no ZPC was identified and project documentation exists that supports previous actions taken to eliminate the hazards or hazards did not exist, discuss with EPA the potential to reclassify the waste site as a "rejected" site.	For sampling of waste sites with no ZPC, use statistical sample locations (i.e., VSP), as applicable. If site is reclassified as "rejected", no sampling is required.	Based on process knowledge, where both chemical and radiological contamination is indicated, analyze samples for Table 2-3 constituents applicable to the waste site. Where only chemicals are indicated based on process knowledge and radiological field screening identifies no radionuclide contamination, analyze only for Table 2-3

Table 3-1. Sample Summary Table

Zone of Potential Contamination Type[a]	Data Needs	General Sampling Approach	Location and Number of Samples[b]	Sample Analytes
				chemicals, metals, and organics.
Staging pile area	Radiological and chemical data for characterization for waste disposal, confirmation of the no further action alternative, and/or verification of contaminant removal at RTD sites to below cleanup levels	As required, perform sampling of the staging pile area to confirm the absence of contamination above cleanup levels.	For sampling of the staging pile area, use statistical sample locations (i.e., VSP), as applicable.	Where both chemical and radiological contamination is indicated, analyze samples for Table 2-3 constituents applicable to the waste site. Where only chemicals are present and radiological field screening identifies no radionuclide contamination, analyze only for Table 2-3 chemicals, metals, and organics.

a. More than one ZPC type can be found at any one location within any specific waste site.

b. Quality control sampling will be performed as described in Section 2.2.3.

RTD = removal, treatment, and disposal

VSP = Visual Sample Plan

ZPC = zone of potential contamination

6. The COPCs identified for the waste sites in the scope of the SAP are provided in Table 1-3. The zone of potential contamination (ZPC) specific COPCs to be analyzed for are identified in Table 3-1, on a per-waste-site basis, using process knowledge, existing data, and/or through field screening/sampling described in this SAP.
7. Data will be collected as necessary for waste designation and disposal to ensure compliance with ERDF waste acceptance criteria (ERDF-00011).

The appropriate site reclassification documentation will be generated outside the scope of this SAP in accordance with Section 6.1 of the 200-CW-3 RD/RA work plan (DOE/RL-2007-55, Rev. 1).

3.1.2 Historical Site Assessments

Historical information will be identified, reviewed, summarized, and documented prior to remedial activities. Information reviewed may include the Waste Information Data System and HEIS databases, facility drawings, historical reports, deactivation files (if available), radiation survey reports, and other pertinent sources.

3.1.3 Visual Inspections

Visual inspections will be performed to help guide the locating of site contamination areas for further evaluation. The site surfaces will be inspected for soil staining or discoloration, absence of vegetation, potentially contaminated debris, and any other indications of contamination or visual anomalies. The results of the visual inspection will be documented in field notes.

3.1.4 Field Radiological Surveys

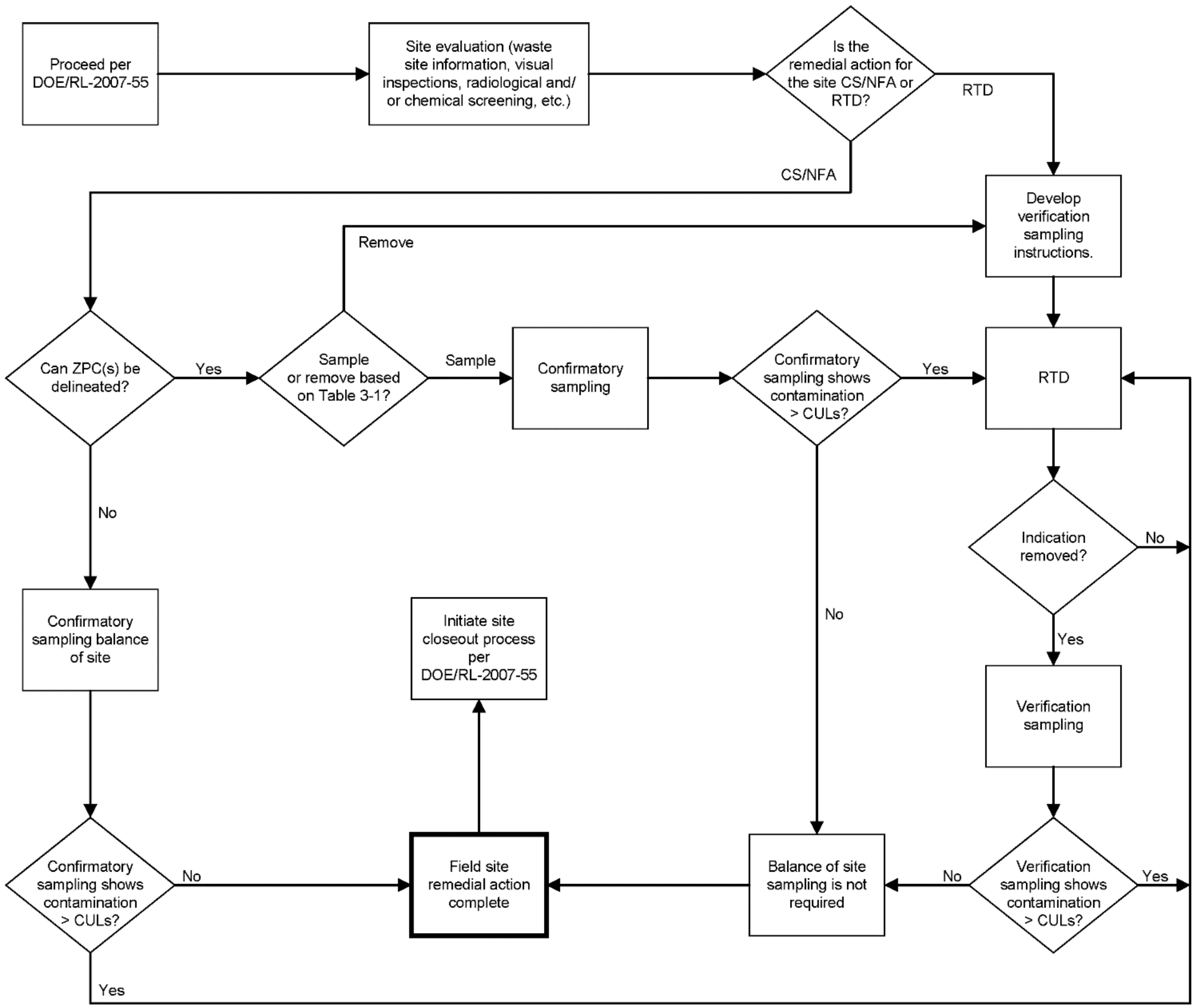
A surface radiological survey may be performed on the soil at a waste site to document existing surface contamination and to support preparation of supporting health and safety documentation. Surface radiological surveys will be conducted by qualified RCTs. Field screening may be used to identify the presence of radiological COPCs to help identify excavation locations for RTD sites and to focus CS/NFA evaluations. A survey report will be prepared documenting the results of each survey.

3.1.5 Soil Sampling

This section describes the general approach for determining the number and type of samples for confirmation and verification purposes. The decision logic for making these determinations is provided in Figure 3-1.

For each site, one or more distinct areas may be identified as a ZPC. A ZPC is an area, within an individual 200-CW-3 OU waste site, that has been identified through background documentation and/or the initial field survey as potentially contaminated. For RTD sites, the ZPC is the area to be excavated. The ZPCs can be a single contamination area or can consist of multiple, discontiguous but proximal and analogous contamination areas.

Where no indication of chemical or radiological contamination was identified during the initial site evaluation, the field team lead in consultation with the DOE-RL Project Lead, as applicable, will determine the need for and extent of sampling necessary to verify the absence of contamination at the site.



CS/NFA = confirmatory sampling/no further action
CUL = cleanup level
RTD = removal, treatment, and disposal
ZPC = zone of potential contamination

Figure 3-1. Decision Logic Diagram

3.1.5.1 General Soil Sampling Design

A statistical approach will be used for the sites where focused sampling is not appropriate, (e.g., when it is not possible to identify worst case sampling locations). The number and location of analytical samples will be determined by the sample design team using visual sample plan (http://dqo.pnl.gov) or other suitable planning tools. Visual sample plan is a site map-based user interface program used to calculate the number of samples given a selected sampling approach and inputs to the associated equation. Statistical designs will be random, based on suspected contaminant variability, or based on a grid system to provide sufficient area coverage based on suspected contaminant distribution. The sampling plan components presented here include how many sampling locations to choose and where within each location to collect samples.

The purpose of the sampling is to compare a site mean value with a fixed threshold. The true mean value is the 95% upper confidence limit of the observed population mean and is the statistical parameter of interest. The fixed threshold for these waste sites is represented by the constituent specific cleanup levels. Therefore, comparison of the true mean with cleanup levels will demonstrate compliance with cleanup criteria. Either a parametric or non-parametric sampling approach could be used, both of which rely on assumptions about the population. Typically, nonparametric equations require fewer assumptions and allow for more uncertainty about the statistical distribution of values at the site. However, fewer samples are required for a parametric approach if the parametric assumptions are valid.

Table 3-2 summarizes a default statistical sampling design for 200-CW-3 OU waste sites and default user input values. The presumed default statistical bias will be visual sample plan sign test, a non-parametric test that determines the minimum number of samples required to compare a population mean to a threshold (e.g., cleanup levels).

Table 3-2. Summary of Sampling Design and Visual Sample Plan User Inputs

Primary Objective of Design	Compare a Site Mean to a Fixed Threshold
Type of sampling design	Nonparametric
Sample placement (location) in the field	Systematic with a random start location
Working (null) hypothesis	The mean value at the site exceeds the threshold
Formula for calculating number of sampling locations	Sign test – MARSSIM version

Parameter	Value	Basis
S	0.40	Assumed standard deviation value relative to a unit action level
Δ	0.50	User defined conservative value relative to a unit action level
α	5%	False rejection rate
β	20%	False acceptance rate
MARSSIM overage	20%	User-defined sample increase factor

MARSSIM = DOE/EH-0624, *Multi-Agency Radiation Survey and Site Investigation Manual*

3.1.5.2 Focused Soil Sampling

Because these 200-CW-3 OU sites are not process sites and do not represent areas of homogenous contamination, the ZPCs represent worst-case location(s) or potential hot spots. Zone of potential contamination sampling areas will be investigated using either focused sampling or using a systematic sampling approach. Verification sampling of these zones will occur after removal of contaminated or likely contaminated soil.

Focused sampling, which includes in-process sampling, is collecting a single sample or a very limited number of samples at a worst-case location within the ZPC. Focused sampling will be limited to smaller areas of contamination or smaller contamination removal areas. For focused sampling, a default of one sample per 47 m^2 (500 ft^2) will be used. Test pits may be dug for access to subsurface soils where there is evidence of contamination at depth.

A systematic sampling approach using a grid system may be used for confirmatory or verification sampling of larger ZPCs. This approach uses a systematic random-start grid to determine soil sampling locations.

The use of either focused or systematic sampling will be determined on a case-by-case basis and based on the following considerations:

- Site size
- Likelihood of contamination based on known site information
- Significance of not detecting residual contamination

3.1.5.3 Statistical Grid Sampling

Sampling may not be required outside of the ZPC where the ZPC boundaries are clearly and specifically identified and where no likely mechanism exists for distribution of the contamination beyond the ZPC itself. The determination of the extent of sampling, or if any is required, will be based on the following considerations:

- Site specific history and process knowledge
- Observational approach did not provide evidence of contamination
- Potential for analogous, nonreported contamination events
- Justification for sampling only a portion of the remaining area (e.g., within some distance of identified ZPCs)

Where sampling outside of the ZPC is determined to be required, a statistically defined grid-sampling approach will be used. Measured or assumed contaminant variability across the site will be used to determine the required number of samples, if available. Otherwise, default assumptions will be used as described in Section 3.1.5.1. It is likely that most contaminant variability will be unknown because of limited or nonexistent preexisting data. Data from the initial survey may be used. Alternatively, a limited field sampling may be performed to determine contaminant distribution variability. A default presumed variability of 40% relative standard deviation will be used if no data are available. The validity of the default variability will be evaluated as part of a DQA (Section 2.4.3).

3.1.5.4 Waste Designation Sampling Design

A focused sampling approach is used for waste designation determinations. Wastes that require characterization include material/media that cannot be designated without characterization and may require special handling for human-exposure protection or waste acceptance. Uncontainerized, unknown material/media and unknown waste containers have been included in this category because containers may be encountered during cleanup of the 200-CW-3 OU waste sites. The sampling protocols for waste material/media and unknown waste forms will be completed in accordance with site procedures.

3.2 Sampling Locations and Frequency

The observational approach will be used to investigate these sites. Table 3-1 summarizes the sampling approach and minimum number of samples.

3.3 Sampling Methods

To ensure sample and data usability, sampling will be performed in accordance with HASQARD (DOE/RL-96-68) pertaining to sample collection, collection equipment, and sample handling. For some samples, preservatives are required (Table 2-6). Preservatives may be added to the collection bottles before their use in the field, or it is allowable to add the preservatives immediately after sample collection. Potential field sampling methods are as described below.

3.3.1 Field Sampling

Field sampling includes in-process investigation, confirmation, and verification samples. The selection of sampling method and sampling units (i.e., number, location, and/or timing of sample collection) will be determined in accordance with Table 3-1.

As needed, composite samples for characterization are obtained by homogenizing a set of individual samples collected from different locations and/or at different times. The individual samples used to make up a composite sample shall be of equal volume and shall be collected in an identical fashion. Compositing of samples requires the homogenization of a set of individual samples to ensure that a representative composite sample is obtained. These individual samples will be placed in an appropriate mixing container and thoroughly homogenized to form a composite sample that is representative of the group of individual samples that the samples were generated from. True homogenization may be difficult to achieve for the samples collected supporting this project due to expected varying particle size, density, and shape.

Sample compositing will be accomplished as follows:

- Individual grab samples will be collected using an appropriate sampling method.
  - It is important that all grab samples are collected in an identical fashion and consist of approximately equal volumes of sample material.
- Each grab sample, or an equal aliquot of sample from each grab sample, will be placed into a clean stainless steel mixing bowl or appropriate composite container and the contents/aliquots homogenized.

Sample aliquots will be removed from the homogenized composite sample and placed into appropriate sample containers for analysis. Compositing will not be used for confirmation or verification sampling.

3.3.2 Decontamination of Sampling Equipment

Sampling equipment will be decontaminated in accordance with sampling equipment decontamination methods. To prevent potential contamination of samples, care must be taken to use decontaminated equipment for each sampling activity. Only clean or single use sampling equipment is expected to be used for each sample collection activity.

Special care must 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

Decontamination of sampling equipment is performed using high purity water in each step. In general, three rinse cycles are performed to decontaminate sampling equipment: a detergent rinse, an acid rinse, and a water rinse. During the detergent rinse, the equipment is washed in a phosphate-free detergent solution, followed by rinsing with high purity water in three sequential containers. After the third high purity water rinse, equipment that is stainless steel or glass is rinsed in a 1M nitric acid solution (pH less than 2). Equipment is then rinsed with high purity water in three sequential containers (the high purity water rinses following the acid rinse are conducted in separate water containers that are not used for detergent rinse). Following the final high purity water rinse, equipment is rinsed in hexane and then placed on a rack to dry. Dry equipment is loaded into a drying oven. The oven is set at 122°F for items that are not metal or glass or at 212°F for metal or glass. Once reaching temperature, equipment is baked for 20 minutes and then cooled. The equipment is then removed from the oven, and the equipment is wrapped in clean, unused aluminum foil using surgeon’s gloves. The wrapped equipment is stored in a custody locked, controlled access area.

3.3.3 Radiological Field Data

Radiological data collection in the field will be used, as needed, to support sampling and analysis efforts. Radiological screening will be performed by RCTs or other qualified personnel. RCTs will record field measurements, noting the location of the sample and the instrument reading.

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

- Instructions to RCTs on the methods required to measure sample activity, as appropriate
- Information regarding 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
- 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
- Minimum standards and practices necessary for preparing, performing, and retaining radiological related information

- 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)

3.4 Documentation of Field Activities

Logbooks and data forms are required for field sampling activities and will be used in accordance with HASQARD (DOE/RL-96-68) requirements. A logbook must be identified with a unique project name and number. Only authorized persons may make entries in logbooks. Logbook entries will be reviewed by the FWS, Remedial Action Technical Lead, 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, 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 or in the data forms is as follows:

- Day and date; time task started; weather conditions; and names, titles, and organizations of personnel performing the task.
- Purpose of visit to the task area.
- Site activities in specific detail (e.g., maps and drawings) or the forms used to record such information. Also, details of any field tests that were conducted (reference any forms that were used, other data records, and methods followed in conducting the activity).
- Details of any field calibrations and surveys that were conducted. Reference any forms that were used, other data records, and the methods followed in conducting the calibrations and surveys.
- Details of any samples collected and the preparation (if any) of splits, duplicates, MSs, or blanks. Reference the methods followed in sample collection or preparation; list location of sample collected (including global positioning system coordinates), sample type, each label or tag numbers, sample identification, sample containers and volume, preservation method, packaging, chain-of-custody form number, and analytical request form number pertinent to each sample or sample set; and note the time and the name of the individual to whom custody of samples was transferred.
- Time, equipment type, serial or identification number, and methods followed for decontaminations and equipment maintenance performed. Reference the page number(s) of any logbook where detailed information is recorded.
- Any equipment failures or breakdowns that occurred, with a brief description of repairs or replacements.

3.4.1 Corrective Actions and Deviations for Sampling Activities

The Remedial Action Project Manager, FWS, and SMR personnel must document deviations from protocols, issues pertaining to sample collection, chain-of-custody forms, target analytes, contaminants of concern, sample transport, or noncompliant monitoring. Examples of deviations include samples not collected due to field conditions, changes in sample locations due to physical obstructions, or additions of sample depth(s).

As appropriate, such deviations or issues will be documented (e.g., in the field logbook) in accordance with internal corrective action methods. The Remedial Action Project Manager, FWS, or SMR personnel will be responsible for communicating field corrective action requirements and for ensuring corrective actions are applied to field activities as soon as practical.

Changes in sample activities require notification, approval, and documentation as noted in Table 2-2.

3.5 Calibration of Field Equipment

The FWS is responsible for ensuring that field equipment is calibrated appropriately. Onsite environmental instruments are calibrated in accordance with the manufacturers' operating instructions, internal work requirements and processes, and/or field instructions that provide direction for equipment calibration or verification of accuracy by analytical methods. Calibration records will include the raw calibration data, identification of the standards used, associated reports, date of analysis, and analyst's name or initials. The results from all instrument calibration activities are recorded in accordance with HASQARD requirements (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 that is performed by the Hanford Site prime contractors, as specified by their calibration program.
- Daily calibration checks will be performed and documented for each instrument used. 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.
- Using standards for calibration that are traceable to a nationally recognized standard agency source or measurement system. Manufacturer's recommendations for storage and handling of standards (if any) will be followed. Expired standards will not be used for calibration.

3.6 Sample Handling

Sample handling and transfer will be in accordance with established methods to preclude loss of identity, damage, deterioration, and loss of sample. Custody seals or custody tape will 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. If during the chain-of-custody process it is discovered that the custody tape has been tampered with or broken on the sample bottle, the sample will be analyzed but the results will include a flag to indicate that custody was broken. If the custody tape has been tampered with or broken on the cooler, the sample custodian shall note this on the sample receiving documentation.

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

3.6.1 Containers

Samples shall be collected, where and when appropriate, in break-resistant containers. The field sample collection record shall indicate the lot number of the bottles used in sample collection. When commercially pre-cleaned containers are used in the field, lot identification shall be retained for documentation.

Containers shall be capped and stored in an environment that minimizes the possibility of sample container contamination. If contamination of the stored sample containers occurs, corrective actions shall be implemented to prevent reoccurrences. Contaminated sample containers cannot be used for a sampling event. Container sizes may vary depending on laboratory specific volumes/requirements for meeting analytical detection limits. Container types and sample amounts/volumes are identified on the chain-of-custody form.

If required, the Radiological Control organization will measure both the contamination levels and dose rates associated with the filled 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 radioactivity 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 FWS (in consultation with the SMR organization) can send smaller sample volumes to the laboratory.

3.6.2 Container Labeling

Each sample is identified by affixing a standardized label or tag to the container. This label or tag will contain the sample identification number. The label shall identify or provide reference to associate the sample with the date and time of collection, preservative used (if applicable), analysis required, and collector's name or initials. Sample labels may be either preprinted or handwritten in indelible or waterproof ink.

3.6.3 Sample Custody

Sample custody will be maintained in accordance with existing protocols to ensure that sample integrity is maintained throughout the analytical process. Chain-of-custody protocols will be followed throughout sample collection, transfer, analysis, and disposal to ensure sample integrity is maintained. A standard chain-of-custody record will be initiated in the field at the time of sampling and will accompany each sample or set of samples shipped to any laboratory.

Shipping requirements will determine how sample shipping containers are prepped for shipment. The analyses requested for each sample will be indicated on the accompanying chain-of-custody form. Each time the responsibility for the custody of the sample changes, new and previous custodians will sign the record and note the date and time. The field sampling team will make a copy of the signed record before sample shipment and transmit the copy to the SMR group.

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

- Project name
- Collectors' names
- Unique sample number

- Date, time, and location (or traceable reference thereto) of sample collection
- Matrix
- Preservatives
- Chain-of-possession information (i.e., signatures and printed names of each individual involved in the transfer of sample custody and storage locations, and dates/times of receipt and relinquishment)
- Requested analyses (or reference thereto)
- Number of sample containers per unique sample identification number
- Shipped-to information (i.e., analytical laboratory performing the analysis)

Samplers will note any anomalies with the samples. If anomalies are found, samplers will inform the SMR group so special direction for analysis can be provided to the laboratory if deemed necessary.

3.6.4 Sample Transportation

Packaging and transportation instructions shall comply with applicable transportation regulations and DOE requirements. Regulations for classifying, describing, packaging, marking, labeling, and transporting hazardous materials, hazardous substances, and hazardous wastes are enforced by DOT as described in 49 CFR 171, "Transportation," "General Information, Regulations, and Definitions," through 177, "Carriage by Public Highway." Carrier-specific requirements, defined in the current edition of International Air Transport Association (IATA) *Dangerous Goods Regulations* will also be used when preparing sample shipments conveyed by air freight providers.

Samples containing hazardous constituents above regulated amounts 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 will be packaged, marked, labeled, and shipped according to the specific instructions for that material. Appropriate laboratory notifications will be made, if necessary, through the SMR project coordinator.

Materials are classified by DOT/IATA as radioactive when the isotope specific activity concentration and the exempt consignment limits described in 49 CFR 173, "Shippers—General Requirements for Shipments and Packagings," are exceeded. Samples shall be screened, or relevant historical data will be used, to determine if these values are exceeded. When screening or historical data indicate samples are radioactive, they shall be properly classified, described, packaged, marked, labeled, and transported according to DOT/IATA requirements.

Prior to shipping radioactive samples to the laboratory, the organization responsible for shipping shall notify the laboratory of the approximate number of and radiological levels of the samples. The laboratory is responsible for ensuring that the applicable license limits are not exceeded. Prior to sample receipt, the laboratory shall provide SMR with written acceptance for samples with elevated radioactive contamination or dose.

4 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 waste management plan in the 200-CW-3 RD/RA work plan (DOE/RL-2007-55, Rev. 1).

Offsite analytical laboratories are responsible for the disposal of unused sample quantities and wastes from analytical processes.

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5 Health and safety

DOE established the hazardous waste operations safety and health program pursuant to the *Price-Anderson Amendments Act of 1988* to ensure the safety and health of workers involved in mixed waste site activities. The program was developed to comply with the requirements of 10 CFR 851, "Worker Safety and Health Program," which incorporates the standards 29 CFR 1910.120, "Occupational Safety and Health Standards," "Hazardous Waste Operations and Emergency Response"; 10 CFR 830, "Nuclear Safety Management"; and 10 CFR 835. 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. Personnel training, control of industrial safety and radiological hazards, personal protective equipment, site control, and general emergency response to spills, fire, accidents, injury, site visitors, and incident reporting are governed by the health and safety program.

Site-specific health and safety plans may 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.

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