1245345
[0069229H]

DOE/RL-2017-35
Revision 0

CHARACTERIZATION SAMPLING AND ANALYSIS PLAN FOR THE C9617 BOREHOLE AT THE 216-A-29 WASTE SITE

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

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

P.O. Box 1600
Richland, Washington 99352

Approved for Public Release;
Further Dissemination Unlimited

RECEIVED
JUL 18 2017
EDMC

Attached to: 1245344

DOE/RL-2017-35
Revision 0

CHARACTERIZATION SAMPLING AND ANALYSIS PLAN FOR THE C9617 BOREHOLE AT THE 216-A-29 WASTE SITE

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

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

P.O. Box 1600
Richland, Washington 99352

Approved for Public Release;
Further Dissemination Unlimited

DOE/RL-2017-35
Revision 0

CHARACTERIZATION SAMPLING AND ANALYSIS PLAN FOR THE C9617 BOREHOLE AT THE 216-A-29 WASTE SITE

Date Published
June 2017

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

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

P.O. Box 1600
Richland, Washington 99352

APPROVED
By Julia Raymer at 12:29 pm, Jun 15, 2017

Release Approval Date

Approved for Public Release;
Further Dissemination Unlimited

TRADEMARK DISCLAIMER

Reference herein to any specific commercial product, process, or service by tradename, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors.

This report has been reproduced from the best available copy.

Printed in the United States of America

Signature Page

Title: *Characterization Sampling and Analysis Plan for the C9617 Borehole at the 216-A-29 Waste Site*

Michael Cline
Print Name
U.S. Department of Energy,
Richland Operations Office

Signature

6/8/2017
Date

Craig Cameron
Print Name
U.S. Environmental Protection Agency

Signature

6/8/2017
Date

NINA M. MENARD
Print Name
Washington State Department of Ecology

Signature

6/8/17
Date

This page intentionally left blank.

Contents

1 Introduction 1

1.1 Project Scope 1
1.2 Background 1
1.3 Systematic Planning Summary 1
1.3.1 Statement of the Problem 3
1.3.2 Principal Study Questions 4
1.3.3 Data Needs 4
1.4 Target Analytes 4
1.5 Project Schedule 6

2 Quality Assurance Project Plan 6

2.1 Project Management 6
2.1.1 Project/Task Organization 6
2.1.2 Quality Objectives and Criteria 10
2.1.3 Methods-Based Analysis 10
2.1.4 Analytical Priority 10
2.1.5 Special Training/Certification 15
2.1.6 Documents and Records 15
2.2 Data Generation and Acquisition 17
2.2.1 Analytical Methods Requirements 17
2.2.2 Quality Control 18
2.2.3 Measurement Equipment 34
2.2.4 Instrument and Equipment Testing, Inspection, and Maintenance 34
2.2.5 Instrument/Equipment Calibration and Frequency 34
2.2.6 Inspection/Acceptance of Supplies and Consumables 34
2.2.7 Nondirect Measurements 35
2.2.8 Data Management 35
2.3 Assessment and Oversight 35
2.3.1 Assessments and Response Actions 35
2.3.2 Reports to Management 35
2.4 Data Review and Usability 36
2.4.1 Data Review and Verification 36
2.4.2 Data Validation 36
2.4.3 Reconciliation with User Requirements 37

3 Field Sampling 37

3.1 Sampling Design 37

3.2 Sampling Methods 38
3.2.1 Decontamination of Sampling Equipment 41
3.3 Documentation of Field Activities 41
3.3.1 Corrective Actions and Deviations for Sampling Activities 42
3.4 Calibration of Field Equipment 43
3.5 Sample Handling 43
3.5.1 Containers 43
3.5.2 Container Labeling 44
3.5.3 Sample Custody 44
3.5.4 Sample Transportation 45

4 Management of Waste 45

5 Health and Safety 46

6 References 46

Figures

Figure 1. Location of the 216-A-29 Ditch 2
Figure 2. Planned Location of Borehole C9617 and Monitoring Well 299-E25-238 3
Figure 3. Project Organization 7
Figure 4. Summary Geologic Log for Borehole C4996 39
Figure 5. Example of Drill Cuttings from the Sand-Dominated Hanford Formation (H2 Unit) (on the left) and Gravel-Dominated Hanford Formation (H3 Unit) (on the right) from the C4996 Entry Borehole 40

Tables

Table 1. Target Analyte List for Borehole C9617 5
Table 2. Data Quality Indicators 11
Table 3. Change Control for Sampling Projects 15
Table 4. Analytical Performance Requirements for Radionuclides in Soil 19
Table 5. Analytical Performance Requirements for Nonradionuclides in Soil 21
Table 6. QC Sample Requirements 26
Table 7. Laboratory QC and Acceptance Criteria 27
Table 8. Sample Holding-Time Guidelines 33
Table 9. Vadose Zone Soil Sample Collection Summary at Borehole C9617 38

Terms

ASTM	American Society for Testing and Materials
bgs	below ground surface
CAS	Chemical Abstracts Service
CHPRC	CH2M HILL Plateau Remediation Company
CMS	corrective measures study
COPC	contaminant of potential concern
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
DQO	data quality objective
DQI	data quality indicator
DUP	laboratory duplicate
EB	equipment blank
ECO	environmental compliance officer
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FS	feasibility study
FSO	Field Sample Operations
FTB	full trip blank
FWS	field work supervisor
FXR	field transfer blank
GC/MS	gas chromatography/mass spectrometry
GEA	gamma energy analysis
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document* (DOE-RL-96-68)
HEIS	Hanford Environmental Information System
IATA	International Air Transportation Association
IC	ion chromatography

ICP	inductively coupled plasma
ICP/AES	inductively coupled plasma/atomic emission spectrometry
ICP/MS	inductively coupled plasma/mass spectrometry
LCS	laboratory control sample
LSC	liquid scintillation counting
MB	method blank
MDC	minimum detectable concentration
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
NWTPH	Northwest Total Petroleum Hydrocarbons
OU	operable unit
PCB	polychlorinated biphenyl
PQL	practical quantitation limit
PSQ	principal study question
QA	quality assurance
QAPjP	quality assurance project plan
QC	quality control
RBL	risk-based level
RCRA	*Resource Conservation and Recovery Act of 1976*
RFI	RCRA facility investigation
RI	remedial investigation
RPD	relative percent difference
SAF	sample authorization form
SAP	sampling and analysis plan
SMR	Sample Management and Reporting
SPLIT	field split sample
SUR	surrogate
TBD	to be determined

Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989a)
VOA	volatile organic analysis
VOC	volatile organic compound

This page intentionally left blank.

1 Introduction

This sampling and analysis plan (SAP) provides the quality assurance (QA) and field sampling requirements for opportunistic characterization of the 216-A-29 waste site at planned borehole C9617. The borehole will be drilled to support construction of new groundwater monitoring well 299-E25-238 to improve downgradient monitoring coverage along the central portion of the 216-A-29 waste site in accordance with DOE/RL-2016-23, *216-A-29 Ditch Interim Status Groundwater Quality Assessment Monitoring Plan*. The data collected will supplement expected future data collection activities at the 216-A-29 waste site as part of the remedial investigation (RI)/feasibility study (FS) and *Resource Conservation and Recovery Act of 1976* (RCRA) facility investigation (RFI)/corrective measure study (CMS) process for the 200-EA-1 Operable Unit (OU).

1.1 Project Scope

This SAP is limited to characterization of vadose zone soil at borehole C9617. Additional data collection activities to characterize vadose zone soil at the 216-A-29 waste site are planned to be addressed by a future SAP associated with the RI/FS/RFI/CMS work plan for the 200-EA-1 OU. Groundwater monitoring activities at the site are addressed by DOE/RL-2016-23.

1.2 Background

The 216-A-29 Ditch was an unlined, uncovered ditch located northeast of the Plutonium-Uranium Extraction Plant (Figure 1) that transported billions of gallons of the plant's chemical sewer discharge to the 216-B-3 Ditches for subsequent discharge to the 216-B-3 Ponds. The 216-A-29 waste site is currently a nonoperating, interim status treatment, storage, and disposal unit subject to assessment monitoring in accordance with DOE/RL-2016-23. Groundwater monitoring requirements for new well 299-E25-238 will be incorporated into changes or revisions to DOE/RL-2016-23. Figure 2 provides the location of the borehole and planned well.

The general geologic framework at the ditch above the water table consists of Holocene eolian sand underlain by the Hanford formation sand and gravel. Additional background information for the 216-A-29 waste site, including greater detail of the geologic and hydrologic setting, is provided in Appendix C of DOE/RL-2016-23. DOE/RL-2004-17, *Remedial Investigation Report for the 200-CS-1 Chemical Sewer Group Operable Unit*, presents the results of previous vadose zone investigations.

1.3 Systematic Planning Summary

From late 2016 through the first half of 2017, the U.S. Department of Energy (DOE) and the Washington Department of Ecology (Ecology) collaborated in a series of facilitated systematic planning workshops for the 200-EA-1 OU waste sites. The workshops included reviewing available information to determine data needs for decision-making purposes at each waste site in the OU, including the 216-A-29 waste site. The results of this systematic planning process will be documented in the future RI/FS/RFI/CMS work plan for the 200-EA-1 OU. The following subsections address a portion of the identified data needs for the 216-A-29 waste site.

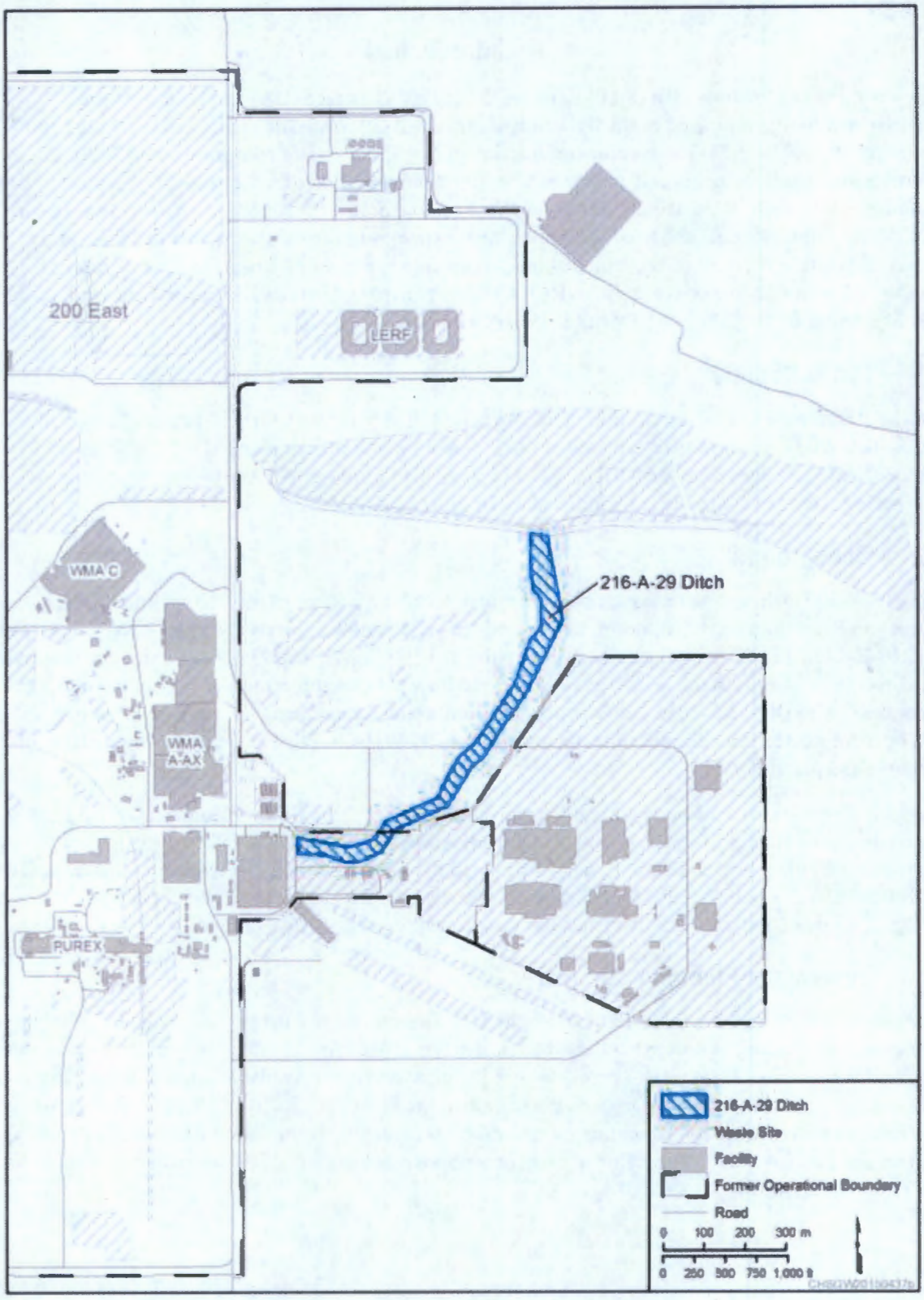


Figure 1. Location of the 216-A-29 Ditch

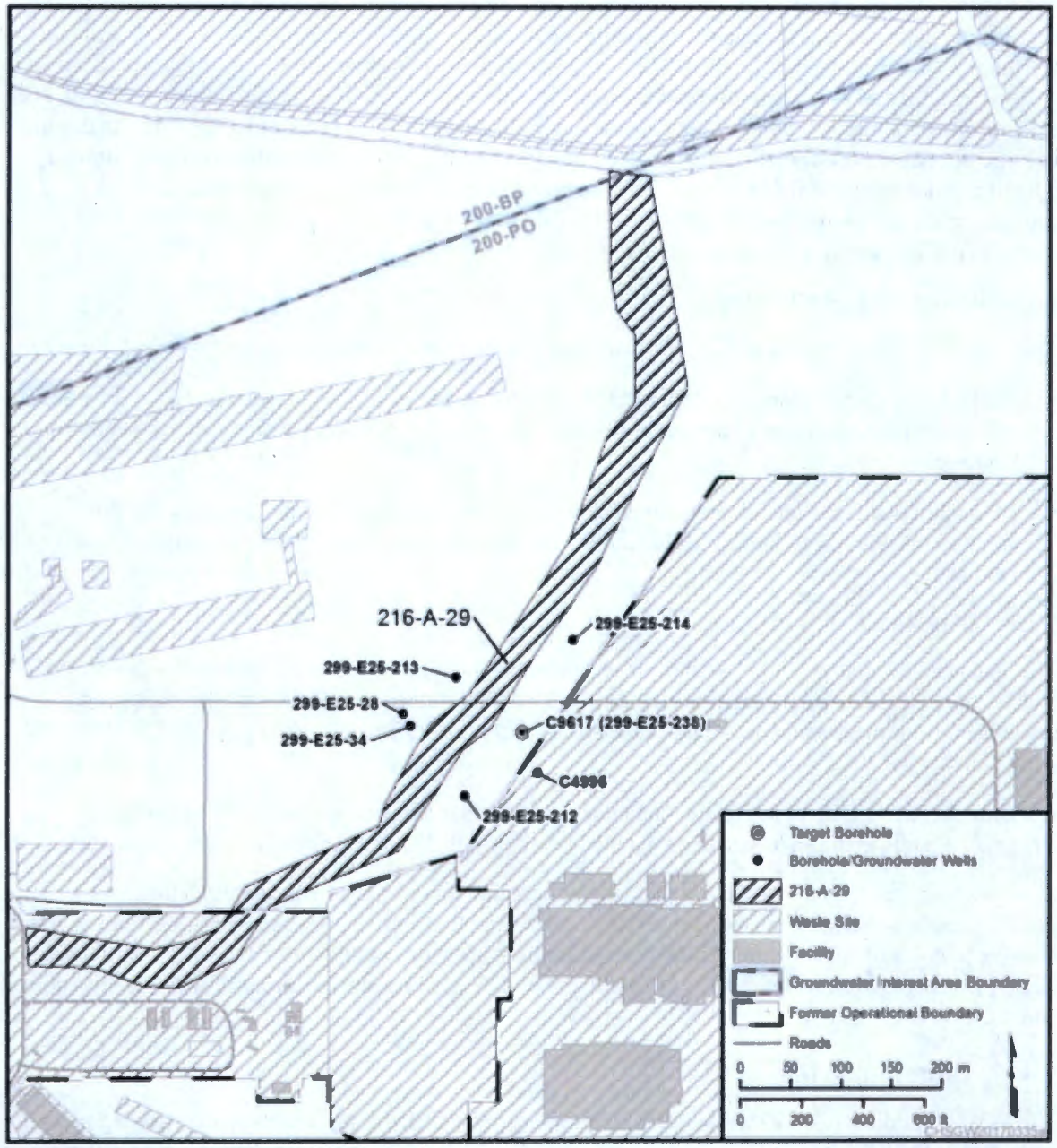


Figure 2. Planned Location of Borehole C9617 and Monitoring Well 299-E25-238

1.3.1 Statement of the Problem

The nature and extent of soil contamination associated with infiltration and lateral migration at the 216-A-29 waste site is uncertain. A sufficient understanding of the nature and extent of contamination is necessary to determine if contaminants of potential concern (COPCs) exist in soil at concentrations posing an unacceptable risk to human health or the environment, as well as to support an evaluation of response scenarios in future FS/CMS efforts.

The 216-A-29 Ditch received discharges of multiple waste streams that included cooling water, steam condensate, and chemical sewage waste. While the ditch was used for effluent transport (not terminal discharge), a large volume of liquid effluent is expected to have infiltrated into soil at the site based on the unlined trench design and general soil characteristics, the operational lifetime and volume received, and existing site data. Earthen berms were constructed in the trench at an undetermined time during the site's late operational or post-operational history to mitigate erosion, which resulted in potential additional retention and subsequent infiltration of discharges and/or precipitation. Chemical and radiological constituents in the waste streams interacted with the underlying soil and groundwater by various mechanisms, and residual contamination may remain in the soil.

1.3.2 Principal Study Questions

The overall principal study questions (PSQs) associated with the 216-A-29 waste site are as follows:

- **PSQ #1:** Do chemical and/or radiological contaminants in the vadose zone at the 216-A-29 waste site pose an unacceptable risk to human health and the environment under current and/or potential future land use?
- **PSQ #2:** What is the lateral and vertical extent of COPCs associated with 216-A-29 that pose an unacceptable risk to human health and the environment under current and/or potential future land use?

1.3.3 Data Needs

The data need addressed by this SAP is presented below. Data collected under this SAP will be used in conjunction with additional data collected for the 216-A-29 waste site. Additional data collection activities for the site are planned to be addressed by a future SAP associated with the RI/FS/RFI/CMS work plan for the 200-EA-1OU.

- **Data Need #1:** Collect sufficient data to determine whether the chemical and/or radiological contaminants in the vadose zone at planned borehole C9617 exceed applicable risk-based values.

A general data need for the 200-EA-1 OU is to collect lithology, hydraulic properties, contaminant mobility, and geochemical information to support fate and transport analysis and FS/CMS remedy design. This data need will not be addressed by characterization activities in this SAP for the C9617 borehole. Geologic and geophysical logging for the borehole will be performed in accordance with the project well construction document.

1.4 Target Analytes

The COPCs for the 216-A-29 waste site were previously identified using a systematic planning process described in DOE/RL-2007-02, *Supplemental Remedial Investigation/Feasibility Study Work Plan for the 200 Areas Central Plateau Operable Units, Volume I: Work Plan and Appendices*. Target analytes for this SAP have been identified based on additional considerations regarding the previous COPC list:

- Radium-228 and thorium-232 are naturally occurring radionuclides that have not been detected above background levels in vadose zone soil in previous site investigations (DOE/RL-2004-17) and will not be considered target analytes.
- Toxicity data are not available for ethanol, 2-propanol (isopropanol), or sulfide; and detections have not been reported in vadose zone soil for these constituents in previous site investigations (DOE/RL-2004-17). Therefore, these constituents will not be considered target analytes.

- Based on a single detection of 1,2-dichloroethane in previous site investigations, 1,1-dichloroethane and 1,2-dichloroethane have been added as target analytes.
- Based on detections of polycylic aromatic hydrocarbons in previous site investigations, benzo(a)pyrene has been added as a target analyte.
- Polychlorinated biphenyls (PCBs) have been identified as site COPCs but are not included as target analytes for this SAP because all samples will be collected in the deep zone (>4.6 m [15 ft] below ground surface) due to the lateral offset of the sampling location from the 216-A-29 trench.

The SAP target analyte list is presented in Table 1. A methods-based analytical approach will be used. The results for constituents beyond those identified as target analytes will be reported for multiconstituent analysis methods.

Table 1. Target Analyte List for Borehole C9617

Radionuclides			
Americium-241	Europium-154	Plutonium-238	Tritium
Cesium-137	Europium-155	Plutonium-239/240	Uranium-233/234
Cobalt-60	Neptunium-237	Strontium-90	Uranium-235
Europium-152	Nickel-63	Technetium-99	Uranium-238
Metals			
Arsenic	Chromium (total)	Mercury	Vanadium
Barium	Chromium(VI)	Nickel	Zinc
Beryllium	Copper	Selenium	
Cadmium	Lead	Silver	
Other Inorganic Constituents			
Ammonia	Cyanide	Nitrate/nitrite	Sulfate
Chloride	Fluoride	Phosphate	
Volatile Organic Constituents			
1,1-Dichloroethane	n-Butyl alcohol	Methyl isobutyl ketone (hexone)	Xylene (total)
1,2-Dichloroethane	Carbon tetrachloride	Methylene chloride (dichloromethane)	
1,1,1-Trichloroethane	Chloroform	Toluene	
1,1,2-Trichloroethane	Methyl ethyl ketone (2-butanone)		
Acetone			
Semivolatile Organic Constituents			
Benzo(a)pyrene	Total petroleum hydrocarbons (diesel to kerosene range)	Tributyl phosphate	

1.5 Project Schedule

Field implementation of this SAP will depend on the schedule for drilling activities for monitoring well 299-E25-238, which are anticipated to begin in July 2017. Additional project schedule elements will be addressed in the RI/FS/RFI/CMS work plan for the 200-EA-1 OU.

2 Quality Assurance Project Plan

This quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection. It includes planning, implementing, and assessing sampling tasks; field measurements, laboratory analysis; and data review. This chapter describes the applicable environmental data collection requirements and controls based on the QA elements found in EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5); and DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD). DoD/DOE QSM, 2013, *Department of Defense (DOD) Department of Energy (DOE) Consolidated Quality System Manual (QSM) for Environmental Laboratories*, is also discussed. Sections 6.5 and 7.8 of Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement Action Plan), require that the QA/quality control (QC) and sampling and analysis activities specify the QA requirements for treatment, storage, and disposal units, as well as for past-practice processes. This QAPjP also describes applicable requirements and controls based on guidance provided in Ecology Publication No. 04-03-030, *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*; and EPA/240/R-02/009, *Guidance for Quality Assurance Project Plans* (EPA QA/G-5). This QAPjP supplements the contractor environmental QA program plan.

This 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

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

2.1.1 Project/Task Organization

The primary contractor, or its approved subcontractor, is responsible for project planning and coordination, sample collection, and sample shipment. The project organization for sampling and characterization activities is described in the following subsections and is shown in Figure 3. The 200-EA-1 OU project manager maintains a list of individuals or organizations as points of contact for each functional element shown in Figure 3. For each functional primary contractor role, there is a corresponding oversight role within DOE.

2.1.1.1 Regulatory Lead

As the lead regulatory agency, Ecology is responsible for regulatory oversight of cleanup projects and activities. Ecology has approval authority for the work being performed under this SAP. Ecology will

work with the DOE Richland Operations Office (DOE-RL) to resolve concerns regarding the work described in this SAP in accordance with Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement). The U.S. Environmental Protection Agency (EPA) also has approval authority for this SAP.

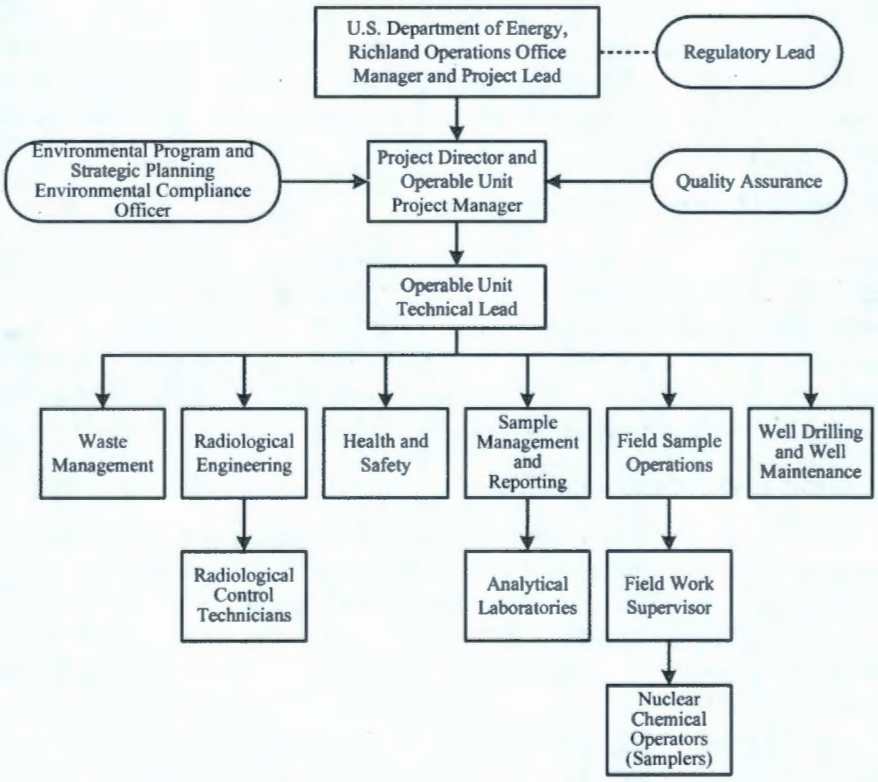


Figure 3. Project Organization

2.1.1.2 DOE-RL Manager

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

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 DOE-RL management.

2.1.1.4 Project Director

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

2.1.1.5 Operable Unit Project Manager

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

2.1.1.6 Operable Unit Technical Lead

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

2.1.1.7 Sample Management and Reporting

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

2.1.1.8 Field Sample Operations

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

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

- Objective of the activities
- Individual tasks to be performed
- Hazards associated with the planned tasks
- Controls applied to mitigate hazards

- Environment in which the job will be performed
- Facility where the job will be performed
- Equipment and material required

Samplers collect required field samples, including replicates/duplicates; collect field parameters; and prepare QC samples in accordance with the SAP, corresponding standard methods, and field and sampling instructions. The samplers complete field logbooks, data forms, chain-of-custody forms, and shipping paperwork and ensure delivery of the samples to the analytical laboratory.

2.1.1.9 Quality Assurance

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

2.1.1.10 Environmental Compliance Officer

The ECO provides technical oversight, direction, and acceptance of project and subcontracted environmental work and also develops appropriate mitigation measures with the goal of minimizing adverse environmental impacts. The ECO also reviews plans, protocols, and technical documents to ensure that environmental requirements have been addressed; identifies environmental issues that affect operations and develops cost effective solutions; and responds to environmental/regulatory issues or concerns. The ECO also oversees project implementation for compliance with applicable internal and external environmental requirements.

2.1.1.11 Health and Safety

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

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

2.1.1.12 Radiological Engineering

Radiological Engineering is responsible for the following:

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

2.1.1.13 Waste Management

Waste Management communicates policies and practices and ensures project compliance for storage, transportation, disposal, and waste tracking in a safe and cost-effective manner. Waste Management is

responsible for identifying waste management sampling/characterization requirements to ensure regulatory compliance, interpreting data to determine waste designations and profiles, and preparing and maintaining other documents confirming compliance with waste acceptance criteria.

2.1.1.14 Analytical Laboratories

The analytical laboratories analyze samples in accordance with established procedures and the requirements of this SAP, and provide necessary data packages containing analytical and QC results. Laboratories provide explanations of results to support data review and in response to resolution of analytical issues. Statements of work include quality requirements consistent with HASQARD (DOE/RL-98-68). The laboratories are evaluated under the DOE Consolidated Audit Program in accordance with the requirements of DoD/DOE QSM (2013) and must be accredited by EPA and Ecology for the analyses performed for CH2M HILL Plateau Remediation Company.

2.1.1.15 Well Maintenance

The well maintenance manager is responsible for the following:

- Planning, coordinating, and executing drilling construction
- Performing well maintenance activities
- Coordinating with the OU technical lead regarding field constraints that could affect sampling design

2.1.2 Quality Objectives and Criteria

The QA objective of this plan is to ensure that the generation of analytical data of known and appropriate quality is acceptable and useful for the evaluation requirements stated in the SAP. Data descriptors known as data quality indicators (DQIs) help determine the acceptability and utility of data to the user. For the purposes of this SAP, the principal DQIs (precision, accuracy, representativeness, comparability, completeness, bias, and sensitivity) are defined in Table 2.

Data quality is defined by the degree of rigor in the acceptance criteria assigned to the DQIs. The applicable QC guidelines, DQI acceptance criteria, and levels of effort for assessing data quality are dictated by the intended use of the data and the requirements of the analytical method. DQIs are evaluated during the data quality assessment (DQA) process (Section 2.4). In consultation with the laboratory, the OU manager, and others (as appropriate), SMR identifies the appropriate analytical methods.

2.1.3 Methods-Based Analysis

Laboratory testing and reporting for the analytes described in Section 2.2.2 may include non-target analytes that are part of the analytical method (i.e., methods-based reporting). The non-target analyte result reported by the laboratory as part of the method will be considered with those for the target analyte list (Table 1) and used to supplement expected future data collection activities at the 216-A-29 waste site as part of the RI/FS/RFI/CMS work plan for the 200-EA-1 OU. Analytical performance requirements will be applicable to all analytes resulting from the method-based analysis process including non-detects flagged as such by the laboratory.

2.1.4 Analytical Priority

Analyte groups are listed in order of priority in Section 3.1 and will be analyzed based on the available sample volume. If the sample volume is insufficient to analyze for all analytes listed for a given waste site, analysis will be performed according to analyte priority and available sample volume. Attempts will be made to collect at least every other sample of the lesser priority analytes that are important for supporting waste site decisions. Lowest priority analytes not critical for supporting waste site decisions will be analyzed only if sufficient sample volumes are collected.

Table 2. Data Quality Indicators

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

Table 2. Data Quality Indicators

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

Table 2. Data Quality Indicators

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

Table 2. Data Quality Indicators

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

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

a. Acceptance criteria for QC elements are provided in Table 7.

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

QC = quality control

2.1.5 Special Training/Certification

Workers receive a level of training 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.

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

2.1.6 Documents and Records

The OU project manager (or designee) is responsible for ensuring that the current version of the SAP is being used and providing any updates to field personnel. Version control is maintained by the administrative document control process. Changes to the SAP affecting sampling documents are handled consistent with HASQARD requirements (DOE/RL-96-68) and the Tri-Party Agreement Action Plan (Ecology et al., 1989b). Table 3 defines the types of changes that may impact sampling and the associated approvals, notifications, and documentation requirements. The OU project manager is responsible for tracking all changes and obtaining appropriate reviews by contractor staff. The OU project manager will discuss the change and provide appropriate documentation notifications to DOE-RL.

Table 3. Change Control for Sampling Projects

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

Table 3. Change Control for Sampling Projects

Type of Change[a]	Type of Change[b]	Action	Documentation
Fundamental change: Change has significant effect on the sample or the field analytical result, performance, or cost, and the change does not meet the requirements specified for meeting the data needs in the sampling document.	**Revision necessary:** Lead regulatory agency determines changes to approved plans require revision to document.	If it is anticipated that a fundamental change will require the approval of the lead regulatory agency, the applicable DOE-RL project manager will be notified by the OU project manager and will be involved in the decision prior to implementation of a fundamental change. The lead regulatory agency and EPA determine if the change requires a revision to the document.	Formal revision of the sampling document.

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

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

c. Section 9.3 of the Tri-Party Agreement Action Plan defines the minimum elements of a change notice.

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

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

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

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

- Operational records and logbooks
- Data forms
- Global positioning system data (a copy will be provided to SMR)

- Inspection or assessment reports and corrective action reports
- Field summary reports
- Interim progress reports
- Final reports
- Forms required by WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," and the master drilling contract

The following records are managed and maintained by SMR personnel:

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

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

- Analytical logbooks
- Raw data and QC sample records
- Standard reference material and/or proficiency test sample data
- Sample chain-of-custody and sample storage temperature logs
- Instrument calibration information
- Training records for employees (regarding analytical methods)
- Laboratory state accreditation records
- Laboratory audit records

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

2.2 Data Generation and Acquisition

This section addresses data generation and acquisition to ensure that the project's methods for sample measurement and analysis, data collection or generation, data handling, and QC activities are appropriate and documented. Requirements for instrument calibration and maintenance, supply inspections, and data management are also addressed. Chapter 3 describes the field sampling methods, including corrective actions for sampling activities.

2.2.1 Analytical Methods Requirements

Tables 4 and 5 provide information regarding analytical method requirements for samples collected. In consultation with the laboratory and the OU project manager, SMR can approve changes to analytical

methods, provided the new method is based upon a nationally recognized standard method (e.g., EPA or American Society for Testing and Materials [ASTM]) and if the new method delivers analytical data comparable to those provided by the listed method. The new method shall achieve project data quality objectives (DQOs) as well or better than the replaced method.

Issues that may affect analytical results will be resolved by SMR in coordination with the OU project manager. These analytical methods are controlled in accordance with the laboratory's QA plan and the requirements of this QAPjP.

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

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

2.2.2 Quality Control

The QC requirements specified in the SAP must be followed in the field and analytical laboratory to ensure that reliable data are obtained. Field QC samples will be collected to evaluate the potential for cross-contamination and to provide information pertinent to sampling variability. Laboratory QC samples estimate the precision, bias, and matrix effects of the analytical data. Table 6 summarizes the field and laboratory QC samples, and Table 7 provides the acceptance criteria for laboratory. Data will be qualified and flagged in the HEIS database, 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 4. Analytical Performance Requirements for Radionuclides in Soil

Analyte Name	CAS No.	Preliminary Action Levels[a] (pCi/g)			Hanford Site Background[e] (pCi/g)	Analytical Method[f]	Highest Allowable MDC[g] (pCi/g)
		Outdoor Worker RBL[b]	Ecological Protection[c]	Groundwater Protection[d]			
Americium-241	14596-10-2	61	4,840	0.0014	—	Americium isotopic – AEA	1
Cesium-137	10045-97-3	1.1	924	0.016	1.05	GEA	0.1
Cobalt-60	10198-40-0	0.57	805	4.4	0.00842	GEA	0.1
Europium-152	14683-23-9	0.68	1,740	7.6	—	GEA	0.1
Europium-154	15585-10-1	0.82	1,610	6.2	0.0334	GEA	0.1
Europium-155	14391-16-3	60	33,400	54	0.0539	GEA	0.1
Neptunium-237	13994-20-2	2.4	7,880	0.00022	—	Np-237 – AEA	1
Nickel-63	13981-37-8	59,952	—	15	—	Ni-63 – LSC	10
Plutonium-238	13981-16-3	344	5,980	0.0016	0.00378	Pu isotopic – AEA	1
Plutonium-239/240	PU-239/240[h]	297	6,270	0.0013	0.0248	Pu isotopic – AEA	1
Strontium-90	10098-97-2	119	91	0.0010	0.178	Total radioactive strontium – GPC	2
Technetium-99	14133-76-7	11,705	5,360	0.0011	—	Tc-99 – LSC or GPC	5
Tritium	10028-17-8	1,259	420	—	—	Tritium – LSC	30
Uranium-233/234[i]	U-233/234[h]	220	6,370	0.00028	1.1	U isotopic – AEA or ICP/MS	1
Uranium-235	15117-96-1	3.6	4,360	0.00029	0.109	U isotopic – AEA or ICP/MS	1
Uranium-238	U-238[h]	17	5,150	0.00032	1.06	U isotopic – AEA or ICP/MS	1

Table 4. Analytical Performance Requirements for Radionuclides in Soil

Analyte Name	CAS No.	Preliminary Action Levels[a] (pCi/g)			Hanford Site Background[e] (pCi/g)	Analytical Method[f]	Highest Allowable MDC[g] (pCi/g)
		Outdoor Worker RBL[b]	Ecological Protection[c]	Groundwater Protection[d]			

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

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

c. From CHPRC-00784, *Tier 1 Risk-Based Soil Concentrations Protective of Ecological Receptors at the Hanford Site*.

d. From "Preliminary Remediation Goals (PRGs) Resident Soil to GW Table (TR=1E-6) November 2014" (EPA 2014). Value listed is the lower of the risk-based or maximum contaminant-level based soil screening level.

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

f. Equivalent methods may be substituted, as described in Section 2.2.

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

h. Not a CAS number; the entry is provided to facilitate data management and retrieval in HEIS.

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

AEA	=	alpha energy analysis	HEIS	=	Hanford Environmental Information System
CAS	=	Chemical Abstract Services	ICP/MS	=	inductively coupled plasma/mass spectrometry
CHPRC	=	CH2M HILL Plateau Remediation Company	LSC	=	liquid scintillation counting
GEA	=	gamma energy analysis	MDC	=	minimum detectable concentration
GPC	=	gas proportional counting	RBL	=	risk-based level

20

Table 5. Analytical Performance Requirements for Nonradionuclides in Soil

Analyte Name	CAS No.	Preliminary Action Levels[a] (mg/kg)				Hanford Site Background[f] (mg/kg)	Analytical Method[g]	Highest Allowable PQL[h] (mg/kg)
		Direct Contact, WAC 173-340 Method C Industrial RBL[b]	Outdoor Worker RBL[c]	Ecological Protection[d]	Groundwater Protection[e]			
Metals								
Arsenic	7440-38-2	88	20	105	0.034	6.57	EPA Method 6020 ICP/MS	1
Barium	7440-39-3	700,000	25,900	358	1,650	132	EPA Method 6010 ICP/AES	5
Beryllium	7440-41-7	7,000	259	10	63	1.51	EPA Method 6010 ICP/AES	0.5
Cadmium	7440-43-9	3,500	111	9.8	0.69	0.563	EPA Method 6010 ICP/AES	0.5
Chromium (total)	7440-47-3	5,250,000	195,000	109	2,000	18.5	EPA Method 6010 ICP/AES	1
Chromium(VI)	18540-29-9	TBD	389	109	0.96	—	EPA Method 7196 – colorimetric	0.5
Copper	7440-50-8	140,000	5,190	58	284	22	EPA Method 6010 ICP/AES	2.5
Lead	7439-92-1	1,000[i]	—	15.5	3,000	10.2	EPA Method 6010 ICP/AES	5
Mercury	7439-97-6	560	39	0.3	2.1	0.013	EPA Method 7471	0.2
Nickel	7440-02-0	70,000	2,593	38	130	19.1	EPA Method 6010 ICP/AES	4
Selenium	7782-49-2	17,500	649	1.2	5.2	0.78	EPA Method 6020 ICP/MS	0.5

Table 5. Analytical Performance Requirements for Nonradionuclides in Soil

Analyte Name	CAS No.	Preliminary Action Levels[a] (mg/kg)				Hanford Site Background[f] (mg/kg)	Analytical Method[g]	Highest Allowable PQL[h] (mg/kg)
		Direct Contact, WAC 173-340 Method C Industrial RBL[b]	Outdoor Worker RBL[c]	Ecological Protection[d]	Groundwater Protection[e]			
Silver	7440-22-4	17,500	649	3.0	14	0.167	EPA Method 6010 ICP/AES	1
Vanadium	7440-62-2	17,500	649	16	1,600	85.1	EPA Method 6010 ICP/AES	5
Zinc	7440-66-6	1,050,000	38,930	67	5,970	67.8	EPA Method 6010 ICP/AES	5
Other Inorganic Analytes								
pH (corrosivity)	pH	—	—	—	—	—	—	NA
Ammonia	7664-41-7	—	—	—	—	9.23	EPA Method 350.1	0.5
Chloride	16887-00-6	—	—	—	1,000	100	EPA Method 300.0 – IC	55[j]
Cyanide (total)	57-12-5	2,100	18	20,700	0.97	—	EPA Method 9012	1
Fluoride	16984-48-8	210,000	7,787	556	2,884	2.81	EPA Method 300.0 – IC	25[j]
Nitrate	14797-55-8	24,900,000	921,422	27[k]	180	52	EPA Method 300.0 – IC	12.5[j]
Nitrite	14797-65-0	1,050,000	42,827	27[k]	13	—	EPA Method 300.0 – IC	12.5[j]
Phosphate	14265-44-2	—	—	—	—	0.785	EPA Method 300.0 – IC	5
Sulfate	14808-79-8	—	—	—	1,000	237	EPA Method 300.0 – IC	27.5[j]

22

Table 5. Analytical Performance Requirements for Nonradionuclides in Soil

Analyte Name	CAS No.	Preliminary Action Levels[a] (mg/kg)				Hanford Site Background[f] (mg/kg)	Analytical Method[g]	Highest Allowable PQL[h] (mg/kg)
		Direct Contact, WAC 173-340 Method C Industrial RBL[b]	Outdoor Worker RBL[c]	Ecological Protection[d]	Groundwater Protection[e]			
Volatile Organic Compounds								
1,1-Dichloroethane	75-34-3	23,000	15	83	0.042	—	EPA Method 8260 – GC/MS	0.01
1,2-Dichloroethane	107-06-2	1,440	1.8	84	0.0023	—	EPA Method 8260 – GC/MS	0.005[i]
1,1,1-Trichloroethane	71-55-6	7,000,000	3,820	82	1.6	—	EPA Method 8260 – GC/MS	0.005
1,1,2-Trichloroethane	79-00-5	2,303	0.47	83	0.0043	—	EPA Method 8260 – GC/MS	0.005[i]
Acetone	67-64-1	3,150,000	74,600	—	29	—	EPA Method 8260 – GC/MS	0.02
n-Butyl alcohol	71-36-3	350,000	12,980	7	3.31	—	EPA Method 8260 – GC/MS	0.25
Carbon tetrachloride	56-23-5	1,880	3.1	82	0.0058	—	EPA Method 8260 – GC/MS	0.005
Chloroform	67-66-3	4,230	1.3	82	0.0075	—	EPA Method 8260 – GC/MS	0.005
Methyl ethyl ketone	78-93-3	2,100,000	21,800	312	20	—	EPA Method 8260 – GC/MS	0.02
Methyl isobutyl ketone (hexone)	108-10-1	280,000	13,900	193	2.7	—	EPA Method 8260 – GC/MS	0.02
Methylene chloride	75-09-2	21,000	344	59	0.022	—	EPA Method 8260 – GC/MS	0.005

Table 5. Analytical Performance Requirements for Nonradionuclides in Soil

Analyte Name	CAS No.	Preliminary Action Levels[a] (mg/kg)				Hanford Site Background[f] (mg/kg)	Analytical Method[g]	Highest Allowable PQL[h] (mg/kg)
		Direct Contact, WAC 173-340 Method C Industrial RBL[b]	Outdoor Worker RBL[c]	Ecological Protection[d]	Groundwater Protection[e]			
Toluene	108-88-3	280,000	3,408	195	4.7	—	EPA Method 8260 – GC/MS	0.005
Xylenes (total)	1330-20-7	700,000	149	149	15	—	EPA Method 8260 – GC/MS	0.01
Polycyclic Aromatic Hydrocarbons								
Benzo(a)pyrene	50-32-8	18	0.32	2.4	0.23	—	EPA Method 8270 – GC/MS (SIM)	0.015
Other Semivolatile Organic Compounds								
Tributyl phosphate	126-73-8	14,600	284	—	0.50	—	EPA Method 8270 – GC/MS	0.33
Other Organic Compounds								
Total petroleum hydrocarbons – diesel to oil range (kerosene)	TPH DIESEL, TPH KEROSENE	2,000	—	—	2,000	—	NWTPH-Dx[m]	25

Source: WAC 173-340, "Model Toxics Control Act—Cleanup."

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

b. The direct contact risk-based level is based on an excess lifetime cancer risk of 1 in 100,000 or hazard quotient of 1.0 ECF-HANFORD-10-0453, *Calculation of Standard Method C Direct Contact Soil Cleanup Levels for Industrial Land Use for the 100 Areas and 300 Area Remedial Investigation/Feasibility Study Reports*.

c. The outdoor worker RBL used to determine analytical performance requirements is based on an excess lifetime cancer risk of 1 in 1,000,000 or hazard quotient of 0.1. ECF-HANFORD-16-0134, *Calculation of Soil Nonradiological Preliminary Remedial Goals for the Outdoor Worker Scenario*.

d. From CHPRC-00784, *Tier 1 Risk-Based Soil Concentrations Protective of Ecological Receptors at the Hanford Site*; CHPRC-01311, *Tier 2 Risk-Based Soil Concentrations Protective of Ecological Receptors at the Hanford Site*; ECF-HANFORD-11-0158, *Tier 2 Terrestrial Plant and Invertebrate Preliminary Remediation Goals (PRGs) for Nonradionuclides for Use at the Hanford Site*. Value listed is the lower of the generic soil screening level, Tier 1 risk-based concentration, or Tier 2 PRG.

24

Table 5. Analytical Performance Requirements for Nonradionuclides in Soil

Analyte Name	CAS No.	Preliminary Action Levels[a] (mg/kg)				Hanford Site Background[f] (mg/kg)	Analytical Method[g]	Highest Allowable PQL[h] (mg/kg)
		Direct Contact, WAC 173-340 Method C Industrial RBL[b]	Outdoor Worker RBL[c]	Ecological Protection[d]	Groundwater Protection[e]			

e. From ECF-HANFORD-10-0442, *Calculation of Nonradiological Soil Concentrations Protective of Groundwater Using the Fixed Parameter 3-Phase Equilibrium Partitioning Equation for the 100 Areas and 300 Area*.

f. DOE/RL-92-24, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes*; ECF-HANFORD-11-0038, *Soil Background for Interim Use at the Hanford Site*.

g. For EPA Method 300.0, see EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples*. For EPA Method 3501.1, see EPA-600/4-79-020, *Methods for Chemical Analysis of Water and Wastes*. For four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*. Equivalent methods may be substituted, as described in Section 2.2.

h. Highest allowable PQL values are specified in contracts with analytical laboratories. Actual PQL values vary by laboratory and may be lower. Where project-specific action levels are greater than contract-specified highest allowable PQL values, the contract-specified highest allowable PQL value is given. Where project-specific action levels are less than contract-specified highest allowable PQL values, a highest allowable PQL value that is lower than the action level is given, provided that the lower highest allowable PQL is technically achievable under routine operating conditions by laboratories under contract to CHPRC. Method detection limits are three to five times lower than quantitation limits.

i. From WAC 173-340-900, "Tables," Tables 745-1 (Method A).

j. Dilutions for certain general chemistry IC constituents may be necessary, potentially raising PQLs achieved above the listed limit.

k. The values for nitrate and nitrite are calculated for nitrogen in nitrate plus nitrite.

l. The lowest screening level is greater than the method detection limit but is slightly less than the PQL. If the analyte is found to be a contaminant of concern based on the 200-EA-1 Operable Unit baseline risk assessment, an evaluation will be performed, if necessary, to see if it is technically possible for the PQL for those contaminants to be lowered.

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

CAS	=	Chemical Abstract Services	GC/MS	=	gas chromatography/mass spectrometry
CHPRC	=	CH2M HILL Plateau Remediation Company	NWTPH	=	Northwest Total Petroleum Hydrocarbon
EPA	=	U.S. Environmental Protection Agency	PQL	=	practical quantitation limit
IC	=	ion chromatography	SIM	=	selected ion monitoring
ICP/AES	=	inductively coupled plasma/atomic emission spectrometry	TBD	=	to be determined
ICP/MS	=	inductively coupled plasma/mass spectrometry	RBL	=	risk-based level

Table 6. QC Sample Requirements

Sample Type	Purpose	Frequency
Field QC		
Field duplicate	Estimate precision, including sampling and analytical variability.	One per batch of 20 or fewer samples collected.
Field split	Estimate precision, including sampling, analytical, and interlaboratory variability.	As needed. When needed, the minimum is one for every analytical method, per medium sampled.
Equipment blank	Verify adequacy of sampling equipment decontamination.	As needed.[a] If only disposable equipment is used, then an equipment blank is not required. Otherwise, one per 20 samples, per medium sampled.
Full trip blank	Assess contamination from containers or transportation.	One per 20 samples per medium sampled.
Field transfer blank	Assess contamination from sampling site.	One each day volatile organic compounds are sampled. Not required if no samples are collected for volatile organic compound analysis.
Laboratory QC[b]		
Method blank	Assess response of an entire laboratory analytical system.	At least one per analytical batch[b] or as identified by the method guidance.
Matrix spike	Identify analytical (preparation and analysis) accuracy; possible matrix effect on the analytical method used.	When required by the method guidance, at least one per analytical batch [b] or as identified by the method guidance.
Matrix spike duplicate	Estimate analytical accuracy and precision.	When required by the method guidance, at least one per analytical batch[b] or as identified by the method guidance.
Laboratory control sample	Assess method accuracy.	At least one per analytical batch[b] or as identified by the method guidance.
Laboratory sample duplicates	Laboratory reproducibility and precision.	At least one per batch[b] or as identified by the method guidance.
Surrogates	Recovery/yield.	Added to each sample and QC sample.[c]
Carrier/tracer	Recovery/yield.	Added to each sample and QC sample.[c]

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

a. An equipment blank shall be collected for all nondedicated equipment until it can be shown that less frequent collection of equipment blanks is adequate to monitor the decontamination procedure for the nondedicated equipment.

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

c. Unless not required by or a different frequency is defined in laboratory analysis methods.

EPA = U.S. Environmental Protection Agency

QC = quality control

Table 7. Laboratory QC and Acceptance Criteria

Analysis	QC Element	Acceptance Criteria	Corrective Action
Radiochemical Analyses			
Gamma spectroscopy[a]	MB	<MDC <5% sample activity concentration	Flag with "B"
	LCS	80–120% recovery	Flag with "o"[b]
	DUP	≤30% RPD[c]	Review data[d]
	EB, FTB	< MDC <5% sample activity concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote e	Review data[d]
Alpha energy analysis[a]	MB	<MDC <5% sample activity concentration	Flag with "B"
	LCS	80–120% recovery	Flag with "o"[b]
	DUP	≤30% RPD[c]	Review data[d]
	EB, FTB	< MDC <5% sample activity concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote e	Review data[d]
	Tracer	30-105% recovery	Review data[d]
Liquid scintillation counting[a]	MB	<MDC <5% sample activity concentration	Flag with "B"
	LCS	80–120% recovery	Flag with "o"[b]
	MS	75-125% recovery	Review data[d]
	DUP	≤30% RPD[c]	Review data[d]
	Carrier	40-100%	Review data[d]
	EB, FTB	< MDC <5% sample activity concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote e	Review data[d]
Strontium-90	MB	< MDC <5% sample activity concentration	Flag with "B"
	LCS	80–120% recovery	Flag with "o"[b]
	DUP	≤30% RPD[c]	Review data[d]
	EB, FTB	< MDC <5% sample activity concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote e	Review data[d]

Table 7. Laboratory QC and Acceptance Criteria

Analysis	QC Element	Acceptance Criteria	Corrective Action
	Carrier	40-110% recovery	Review data[d]
	Tracer	30-105% recovery	Review data[d]
General Chemical Analyses			
Cyanide	MB	<MDL <5% sample concentration	Flag with "C"
	LCS	80–120% recovery	Flag with "o"[b]
	MS/MSD	75–125% recovery	Flag with "N"
	DUP[f]/MSD[f]	≤35% RPD[c]	Review data[d]
	EB, FTB	< MDL <5% sample concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote e	Review data[b,d]
Anions by ion chromatography[g]	MB	<MDL <5% sample concentration	Flag with "C"
	LCS	80–120% recovery	Flag with "o"[b]
	MS/MSD	75–125% recovery	Flag with "N"
	DUP[f]/MSD[f]	≤35% RPD[c]	Review data[d]
	EB, FTB	< MDL <5% sample concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote e	Review data[d]
Ammonia	MB	< MDL <5% sample concentration	Flag with "C"
	LCS	80–120% recovery	Flag with "o"[b]
	MS/MSD	75–125% recovery	Flag with "N"
	DUP[f]/MSD[f]	≤35% RPD[c]	Review data[d]
	EB, FTB	< MDL <5% sample concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote e	Review data[d]
Metals			
Metals (ICP/AES and ICP/MS)[f]	MB	< MDL <5% sample concentration	Flag with "C"
	LCS	80–120% recovery	Flag with "o"[b]
	MS/MSD	75–125% recovery	Flag with "N"
	DUP[f]/MSD[f]	≤35% RPD[c]	Review data[d]
	EB, FTB	< MDL <5% sample concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote e	Review data[d]

Table 7. Laboratory QC and Acceptance Criteria

Analysis	QC Element	Acceptance Criteria	Corrective Action
Chromium(VI)	MB	<MDL <5% sample concentration	Flag with "C"
	LCS	80–120% recovery	Flag with "o"[b]
	MS/MSD	75–125% recovery	Flag with "N"
	DUP[f]/MSD[f]	≤35% RPD[c]	Review data[d]
	EB, FTB	< MDL <5% sample concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote e	Review data[d]
Mercury	MB	<MDL <5% sample concentration	Flag with "C"
	LCS	80–120% recovery	Flag with "o"[b]
	MS/MSD	75–125% recovery	Flag with "N"
	DUP[f]/MSD[f]	≤35% RPD[c]	Review data[d]
	EB, FTB	< MDL <5% sample concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote e	Review data[d]
Volatile Organic Compounds			
Volatiles by GC/MS[g]	MB	<MDL[h] <5% sample concentration	Flag with "B"
	LCS	70-130% recovery	Flag with "o"[b]
	MS/MSD	70-130% recovery	Flag with "T"
	DUP[f]/MSD[c,f]	≤20% RPD[c]	Review data[d]
	SUR	% recovery statistically derived[i]	Review data[d]
	EB, FTB, FXR	< MDL[h] <5% sample concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote e	Review data[d]
Semivolatile Organic Compounds			
Semivolatiles by GC/MS[g]	MB	<MDL[h] <5% sample concentration	Flag with "B"
	LCS	70-130% recovery	Flag with "o"[b]
	MS/MSD	% recovery statistically derived[i]	Flag with "T"
	DUP[f]/MSD[f]	<30% RPD[c]	Review data[d]
	SUR	% recovery statistically derived[i]	Review data[d]
	EB, FTB	< MDL[h] <5% sample concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote e	Review data[d]

Table 7. Laboratory QC and Acceptance Criteria

Analysis	QC Element	Acceptance Criteria	Corrective Action
Total petroleum hydrocarbons	MB	<MDL <5% sample concentration	Flagged with "B"
	LCS	70-130% recovery	Flag with "o"[b]
	MS/MSD	70-130% recovery	Flag with "N"
	DUP[f]/MSD[f]	≤ 30% RPD[c]	Review data[d]
	SUR	60-140% recovery	Review data[d]
	EB, FTB	< MDL <5% sample concentration	Flag with "Q"
	Field duplicate/SPLIT	See footnote e	Review data[d]

Notes:

Information in this table does not represent EPA requirements and is intended solely as guidance. The table is consistent with SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*; and DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document*.

This table only applies to laboratory analyses of analytes. QC associated with physical properties is maintained by analytical laboratories.

a. See Table 4 for constituent list.

b. Apply with concurrence from the Sample Management and Reporting organization.

c. Applies when at least one result is greater than the laboratory PQL (chemical analyses) or > 5 times the MDC (radiochemical analyses).

d. After review, corrective actions are determined on a case-by-case basis. Corrective actions may include a laboratory recheck or flagging the data as suspect ("Y" flag) or rejected ("R" flag).

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

f. Either a sample duplicate or an MSD is to be analyzed to determine measurement precision.

g. See Table 5 for constituent list.

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

i. Determined by the laboratory based on historical data or statistically derived control limits. Limits are reported with the data. Where specific acceptance criteria are listed, those acceptance criteria may be used in place of statistically derived acceptance criteria.

DUP = laboratory sample duplicate
EB = equipment blank
EPA = U.S. Environmental Protection Agency
FTB = full trip blank
FXR = field transfer blank
GC/MS = gas chromatography/mass spectrometry
ICP/AES = inductively coupled plasma/atomic emission spectrometry
ICP/MS = inductively coupled plasma/mass spectrometry
LCS = laboratory control sample
MB = method blank
MDC = minimum detectable concentration
MDL = method detection limit
MS = matrix spike
MSD = matrix spike duplicate
PQL = practical quantitation limit
QC = quality control
RPD = relative percent difference
SPLIT = field split
SUR = surrogate

Table 7. Laboratory QC and Acceptance Criteria

Analysis	QC Element	Acceptance Criteria	Corrective Action

Data flags:

B, C = possible laboratory contamination; analyte was detected in the associated MB

N = result may be biased; associated MS result was outside the acceptance limits (except gas chromatography/mass spectrometry)

Q = problem with associated field QC blank; results were out of limits

R = result is rejected

T = result may be biased; associated MS result was outside the acceptance limits (gas chromatograph/mass spectrometry only)

Y = result is suspect

2.2.2.1 Field Quality Control Samples

Field QC samples will be collected to evaluate the potential for cross-contamination and provide information pertinent to field sampling variability and laboratory performance to help ensure that reliable data are obtained. Field QC samples include field duplicates, field split (SPLIT) samples, and three types of field blanks (equipment blanks [EBs], field transfer blanks [FXRs], and full trip [FTBs]). Field blanks are typically prepared using high-purity reagent water[1] or silica sand. The QC sample definitions and their required frequency for collection are described below:

- **Field duplicates:** Independent samples collected as close as possible to the same time and same location as the scheduled sample and intended to be identical. Field duplicates are placed in separate sample containers and analyzed independently. Field duplicates are used to determine precision for both sampling and laboratory measurements.

  Soil duplicates will be collected and homogenized before dividing into two separate samples in the field. Volatile organic compound (VOC) analysis soil duplicates are not to be homogenized or split and will be collected as collocated samples. Duplicates will be stored and transported together and analyzed for the same constituents by the same laboratory. The duplicates will be used to determine precision for both sampling heterogeneity and laboratory manipulation.

- **Field splits (SPLITs):** Two samples collected as close as possible to the same time and same location and intended to be identical. SPLITs will be stored in separate containers and analyzed by different laboratories for the same analytes. SPLITs are interlaboratory comparison samples used to evaluate comparability between laboratories.

- **Equipment blanks (EBs):** High-purity water or silica sand passed through or poured over decontaminated sampling equipment identical to the sample set collected and placed in sample containers, as identified on the SAF. EB sample bottles are placed in the storage containers with samples from the associated sampling event and are analyzed for the same constituents as samples from the sampling event. EBs are used to evaluate decontamination process effectiveness; these samples are not required for disposable sampling equipment.

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

- **Field transfer blanks (FXRs):** Preserved volatile organic analysis (VOA) sample vials filled with high-purity water at the sample collection site where VOC samples are collected. FXR samples are prepared during sampling to evaluate potential contamination attributed to field conditions. After collection, FXR sample vials are sealed and placed into the same storage containers with samples collected the same day for the associated sampling event. FXR samples are analyzed for VOCs only.

- **Full trip blanks (FTBs):** Bottles prepared by the sampling team before travel to the sampling site. The preserved bottle set is either for VOA only or identical to the set to be collected in the field. The bottles are filled with high-purity water or silica sand and then sealed and transported (unopened) to the field in the same storage containers used for samples collected that day. Collected FTBs are typically analyzed for the same constituents as the samples from the associated sampling event. FTBs are used to evaluate potential sample contamination from the sample bottles, preservative, handling, storage, and transportation.

2.2.2.2 Laboratory Quality Control Samples

Internal QA/QC programs are maintained by laboratories used by the project. Laboratory QA includes a comprehensive QC program that uses laboratory control samples (LCSs), laboratory sample duplicates (DUPs), matrix spikes (MSs), matrix spike duplicates (MSDs), method blanks (MBs), surrogates (SURs), tracers, and carriers. These QC analyses are required by EPA methods (e.g., those in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*), 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 DQAs (if performed). Table 6 lists the laboratory QC checks and their typical frequencies, and Table 7 identifies the acceptance criteria. For organic analyses, QC acceptance criteria are typically statistically derived from historical data at the laboratories in accordance with SW-846.

- **Laboratory control sample (LCS):** A control matrix (e.g., reagent water) spiked with analytes representing the target analytes or certified reference material used to evaluate laboratory accuracy.

- **Laboratory sample duplicate (DUP):** An intralaboratory replicate sample used to evaluate the precision of a method in a given sample matrix.

- **Matrix spike (MS):** An aliquot of a sample spiked with a known concentration of the target analyte(s). The MS is used to assess the bias of a method in a given sample matrix. Spiking occurs prior to sample preparation and analysis.

- **Matrix spike duplicate (MSD):** A replicate spiked aliquot of a sample subjected to the entire sample preparation and analytical process. MSD results are used to determine the bias and precision of a method in a given sample matrix.

- **Method blank (MB):** An analyte-free matrix to which the same reagents are added in the same volumes or proportions as used in the sample processing. The MB is carried through the sample preparation and analytical procedure and is used to quantify contamination resulting from the analytical process.

- **Surrogate (SUR):** A compound added to every sample in the analysis batch (field samples and QC samples) prior to preparation. SURs are typically similar in chemical composition to the analyte being determined but they are not normally encountered. SURs are expected to respond to the preparation and measurement systems similar to the analytes of interest. Because SURs are added to every standard, sample, and QC sample, they are used to evaluate overall method performance in a given matrix. SURs are used only in organic analyses.

- **Tracer:** A known quantity of radioactive isotope different from that of the isotope of interest but expected to behave similarly and is added to an aliquot of sample. Sample results are generally corrected based on tracer recovery.
- **Carrier:** Typically nonradioactive (e.g., natural strontium) substances added in known quantities to samples to determine the overall chemical yield for the analytical preparation steps. As with a tracer, carrier recovery is a measure of the amount of analyte lost in performing the method.

Laboratories are required to analyze samples within the holding times specified in Table 8. In some instances, constituents in the samples not analyzed within the holding times may be compromised by volatilization, decomposition, or by other chemical changes. If holding times are exceeded, the effects of the holding-time exceedance on the results will be evaluated on a case-by-case basis. Data from samples analyzed outside of the holding times are flagged in the HEIS database with an "H."

Table 8. Sample Holding-Time Guidelines

Analytes[a]	Preservation[b]	Holding Time
Radionuclides		
Radionuclides by gamma spectroscopy	None	6 months
Radionuclides by alpha energy analysis	None	6 months
Radionuclides by liquid scintillation counting		
Strontium-90	None	6 months
Chemicals		
Cyanide	Store ≤6°C	14 days
Anions by ion chromatography	Store ≤6°C	28 days/48 hours[c]
Ammonia	None	28 days after extraction
Metals by ICP/AES and ICP/MS	None	6 months
Chromium(VI)	Store ≤6°C	30 days before extraction 7 days after extraction
Mercury	None	28 days
Volatiles by GC/MS	Methanol; store ≤6°C	14 days
Semivolatiles by GC/MS	Store ≤6°C	14 days before extraction 40 days after extraction
Polyclic aromatic hydrocarbons by GC/MS (SIM)	Store ≤6°C	14 days before extraction 40 days after extraction
Total petroleum hydrocarbons – diesel to oil range (kerosene)	Store ≤6°C	14 days before extraction 40 days after extraction

Table 8. Sample Holding-Time Guidelines

Analytes[a]	Preservation[b]	Holding Time

a. See Section 1.4 for constituent lists.

b. For preservation identified as "store ≤6°C." the sample should be protected against freezing unless it is known that freezing will not impact the sample integrity

c. The EPA Method 300.0 nitrate, nitrite, and phosphate holding time is 48 hours after sample extraction preparation. The holding time of 28 days applies to all other anions quantified by EPA Method 300.0.

EPA = U.S. Environmental Protection Agency
GC/MS = gas chromatography/mass spectrometry
ICP/AES = inductively coupled plasma/atomic emission spectrometry
ICP/MS = inductively coupled plasma/mass spectrometry
SIM = selected ion monitoring

2.2.3 Measurement Equipment

Each user of measuring equipment is responsible for ensuring that the equipment is functioning as expected, properly handled, and properly calibrated at required frequencies 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 manufacturer's specifications and other approved methods.

2.2.4 Instrument and Equipment Testing, Inspection, and Maintenance

Collection, measurement, and testing equipment should meet applicable standards (e.g., ASTM International [formerly the American Society for Testing and Materials]) or be acceptable and valid in accordance with instrument-specific methods, requirements, and specifications. Software applications will be acceptance tested prior to use in the field.

Measurement and testing equipment used in the field or laboratory will be subject to preventive maintenance measures to minimize downtime. Laboratories must maintain and calibrate their equipment. Maintenance requirements (e.g., documentation of routine maintenance) will be included in the individual laboratory and onsite organization's QA plan or operating protocols, as appropriate. Maintenance of laboratory instruments will be performed in a manner consistent with applicable Hanford Site requirements.

2.2.5 Instrument/Equipment Calibration and Frequency

Field equipment calibration is discussed in Section 3.4. Analytical laboratory instruments are calibrated in accordance with the laboratory's QA plan and applicable Hanford Site requirements.

2.2.6 Inspection/Acceptance of Supplies and Consumables

Consumables, supplies, and reagents will be reviewed in accordance with internal work requirements and processes described in the contractor's acquisition system and will be appropriate for their use. Responsibilities and interfaces necessary to ensure that items procured/acquired for the contractor meet the specific technical and quality requirements must be in place. The procurement system ensures that purchased items comply with applicable procurement specifications. Supplies and consumables are checked and accepted prior to use.

2.2.7 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.

2.2.8 Data Management

SMR, in coordination with the OU project manager, is responsible for ensuring that analytical data are appropriately reviewed, managed, and stored in accordance with applicable programmatic requirements governing data management methods.

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

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

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 QAPjP, methods, and regulatory requirements. Deficiencies identified by these assessments will be reported in accordance with existing programmatic requirements. The project line management chain coordinates corrective actions/deficiency resolutions in accordance with the QA program, corrective action management program, and associated methods implementing these programs. When appropriate, corrective actions will be taken by the OU project manager (or designee).

A DQA will be performed for the identified SAP activities. The DQA results will be provided to the OU project manager. No other planned assessments have been identified. If circumstances arise in the field dictating the need for additional assessments, then additional assessments will be performed.

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

2.3.2 Reports to Management

Program and project management (as appropriate) will be made aware of deficiencies identified by self-assessments, corrective actions from ECOs, and findings from QA assessments and surveillances. Issues reported by the laboratories are communicated to SMR, which then initiates a sample issue resolution form. This process is used to document analytical or sample issues and to establish resolution with the OU project manager.

These assessments are internal and are not subject to environmental regulations. If an assessment finding results in sampling issues that affect a regulatory requirement, DOE will 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 data conform to the specified criteria, thus satisfying 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, as well as reviewing sample collection dates and sample preparation and analysis dates to assess whether holding times (if any) have been met. The QC data review is also used to determine whether analyses have met the data quality requirements specified in the SAP.

The criteria for verification include, but are not limited to, review for contractual compliance (samples were analyzed as requested), use of the correct analytical method, transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight, and correct application of conversion factors. Field QA/QC results will be reviewed to ensure usability.

Any errors identified by the laboratories are reported to the SMR project coordinator, who will initiate a sample issue resolution form. This process is used to document analytical errors and establish resolution with the OU technical lead.

Relative to analytical data in sample media, physical data and/or field screening results are of lesser importance in making inferences regarding risk. Physical data and field QA/QC results will be reviewed to ensure the usability of physical property data and/or field screening results.

The OU technical lead will perform data reviews to help determine if observed changes reflect potential data errors, which may result in submitting a request for data review for questionable data. The laboratory may be asked to check calculations or reanalyze the sample. The results of the request for data review process are used to flag the data appropriately in the HEIS database and/or to add comments.

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 upon method blanks, recovery of various internal standards, correctness of uncertainty calculations, correctness of identification and quantification of analytes, and the effect of quality deficiencies on data reliability. The contractor follows the data validation process described in EPA-540-R-2017-001, *National Functional Guidelines for Inorganic Superfund 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 data set). Data validation will be performed to Level C, which is a review of the QC data. Level C validation consists of a review of the QC data and specifically requires verification of deliverables; requested versus reported analytes; and qualification of the results based on evaluation of analytical holding times, method blank results, MS/MSD results, surrogate recoveries, and duplicate sample results. Level C data validation

is generally equivalent to Level 2A in EPA 540-R-08-005, *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use*. Level C data validation will be performed on at least 5% of the data by matrix and analyte group under the direction of SMR. Analyte group refers to categories such as radionuclides, volatile chemicals, semivolatiles, metals, and anions. The goal is to include each of the various analyte groups and matrices during the data validation process. The DOE-RL Project Lead or OU Project Manager may specify a higher percentage of data to be validated or that data validation be performed at higher levels. Due to the sampling design, 100% data validation will be conducted.

2.4.3 Reconciliation with User Requirements

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

3 Field Sampling

The objective of this section is to identify project sampling and analysis activities that will be performed specific to vadose zone soil sampling during borehole installation of well 299-E25-238 (C9617). This section uses the sampling design identified during the systematic planning process and includes defining the number of sample locations, sampling methods, field documentation, field equipment calibration requirements, and information on data collection technologies.

3.1 Sampling Design

Judgmental soil sampling targeting expected zones with a higher percentage of fine-grained material will be used to address Data Need #1. Neutron logs and geologic borehole logs were evaluated from the surrounding area and wells to determine the target sampling depths for zones with higher percentages of fine-grained material. Proximal boreholes 299-E25-212, 299-E25-213, and 299-E25-214 were drilled to a maximum depth of 12.2 m (40 ft) and did not provide adequate information to evaluate the target fine-grained material strata. Target sample depths were based primarily on the geologic log for the C4996 borehole described in PNNL-16407, *Geology of the Waste Treatment Plant Seismic Boreholes*, which provides high-quality geologic descriptions and borehole logs from wells 299-E25-28 and 299-E25-34. The locations of these proximal boreholes and monitoring wells are shown on Figure 2. The sample locations listed in Table 9 are estimates only. If the designated sample depth does not contain fine-grained material (e.g., silt or sandy silt), an additional split-spoon sample will be collected at the next depth interval prior to borehole advancement to ensure that appropriate material is collected. If sufficient appropriate sample material is not recovered in these two split-spoon sample intervals, no sample will be collected at the target interval.

Table 9. Vadose Zone Soil Sample Collection Summary at Borehole C9617

Sample Location (ft bgs) [a,b]	Analyte List[c]	Sampling Method	Intended Sample Unit/ Comments
35 – 37.5	Anions Cyanide Ammonia Gamma energy analysis Alpha energy analysis Tritium Volatile organic analysis Semivolatile organic analysis Polycyclic aromatic hydrocarbons Total petroleum hydrocarbon Metals Mercury Hexavalent chromium Technetium-99 Nickel-63 Strontium-90	Split spoon	Fine-grained zone
42 – 44.5			Fine-grained zone
65 – 67.5			Fine-grained zone
80 – 82.5			Fine-grained zone
102.5 – 105			Fine-grained zone
120 – 122.5			Fine-grained zone
140 – 142.5			Fine-grained zone
160 – 162.5			Base of the sand-dominated Hanford formation H2 unit
215 – 217.5			Sand lens within the gravel-dominated Hanford formation H3 unit
252.5 – 255			Expected contact between the Hanford and Cold Creek formations; decreased basalt content
260 – 265			Approximate location of historic high water table

Note: The requirements for field quality control are described in Section 2.2.2.1.

a. If insufficient material for all planned analyses is recovered at the intended sample interval, a second split-spoon sample will be collected prior to borehole advancement.

b. If fine-grained material is not identified in the intended sample interval, a second split-spoon sample will be collected prior to borehole advancement. If insufficient fine-grained material is identified in the second split-spoon sample for sample collection, no sample will be collected for the target interval.

c. Analytical methods are listed in descending order of priority. If insufficient sample volume is available for all planned analyses, analysis will be requested based on priority and available volume. Attempts will be made to collect at least every other sample of lower priority analytical groups.

bgs = below ground surface

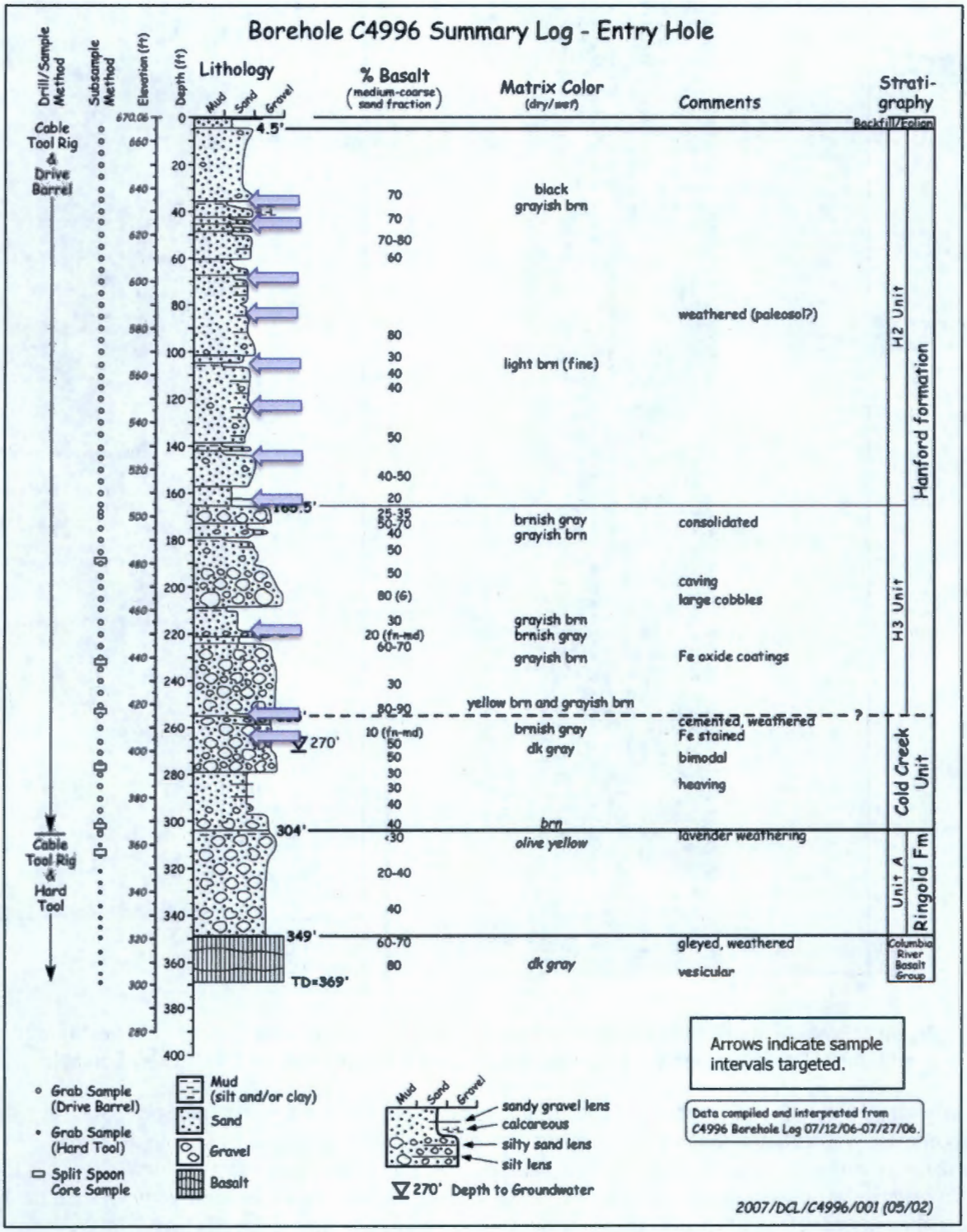
Figure 4 identifies the geologic zone targeted for sampling. Figure 5 shows typical borehole cuttings from several of the targeted sample zones.

3.2 Sampling Methods

Depth-discrete soil samples will be collected within the vadose zone, when required, using a split-spoon sampler or core barrel. The sampling device will be equipped with liners generally made of stainless steel or polycarbonate (e.g., LEXAN®).

Site personnel will not overdrive the sampling device. VOA subsamples will be collected first from the undisturbed cores and placed directly into sample containers. Except for the VOA subsamples, soil will be transferred to a clean, stainless-steel mixing bowl and then homogenized and containerized in accordance with this SAP.

® LEXAN is a registered trademark of General Electric Company, New York, New York.



Source: PNNL-16407, *Geology of the Waste Treatment Plant Seismic Boreholes.*

Figure 4. Summary Geologic Log for Borehole C4996

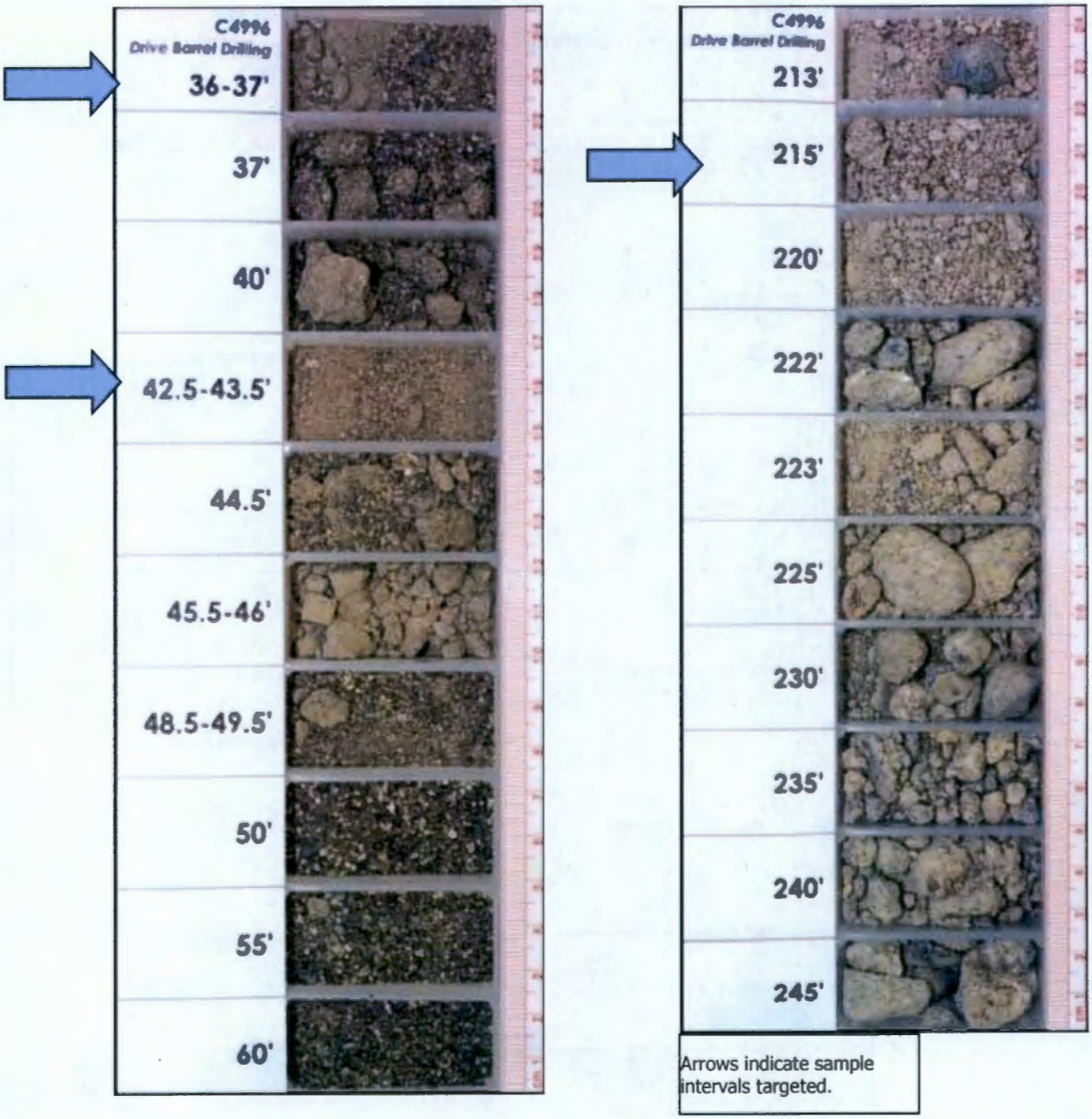


Figure 5. Example of Drill Cuttings from the Sand-Dominated Hanford Formation (H2 Unit) (on the left) and Gravel-Dominated Hanford Formation (H3 Unit) (on the right) from the C4996 Entry Borehole

To ensure the usability of samples and data, sampling associated with this SAP will be performed in accordance with established sampling practices, procedures, and requirements pertaining to sample collection, collection equipment, and sample handling. The OU project manager and contractor management are responsible for ensuring that all field procedures are followed completely and that field sampling personnel are adequately trained to perform sampling activities under this SAP.

Field sampling shall comply with HASQARD requirements (DOE/RL-96-68) for sample collection, collection equipment, sample handling, and sample shipment to the laboratory.

For certain types of samples, preservation is required (as listed in Table 8). Where applicable, preservatives are added to the collection bottles before their use in the field. The container types, preservatives, and volumes will be identified on the SAF and chain-of-custody form. This SAP defines a "sample" as a set of filled sample bottles for the purpose of beginning holding-time restrictions.

Holding time is the maximum period allowed between sample collection and laboratory analysis (as listed in Table 8). Exceeding required holding times could result in changes in constituent concentrations due to volatilization, decomposition, or other chemical alterations. Required holding times depend on the constituent and are listed in analytical method compilations such as APHA/AWWA/WEF, *Standard Methods for the Examination of Water and Wastewater*; and SW-846. Recommended holding times are also provided in HASQARD (DOE/RL-96-68).

3.2.1 Decontamination of Sampling Equipment

Sampling equipment will be decontaminated in accordance with approved sampling equipment decontamination methods. To prevent potential contamination of samples, care should be taken to use decontaminated and/or disposable equipment for each specific sampling activity.

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

- Improperly storing or transporting sampling equipment and sample containers
- Contaminating the equipment or sample bottles by setting them 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 nondisposable 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, stainless-steel or glass equipment is rinsed in 1M nitric acid solution (pH <2). The equipment is then rinsed with high-purity water in three sequential containers (the high-purity water rinses following the acid rinse are 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. Air-dried equipment is loaded into a drying oven set at 50°C (122°F) for items that are not metal or glass or at 100°C (212°F) for metal or glass items. Once reaching temperature, the equipment is baked for 20 minutes and then cooled. The equipment is then removed from the oven using surgeon's gloves and wrapped in clean, unused aluminum foil. The wrapped equipment is stored in a custody-locked, controlled-access area.

The drill rig derrick, all downhole equipment, and temporary casing will be field decontaminated (e.g., high pressure and temperature wash), at a minimum, before mobilization and demobilization at each drilling location. If core barrel equipment is used to collect samples, the drive head will be wiped down between sampling events.

3.3 Documentation of Field Activities

Logbooks or data forms are required for field activities and will be used in accordance with HASQARD requirements (DOE/RL-96-68). A logbook must be identified with a unique project name and number.

The individual(s) responsible for logbooks will be identified in the front of the logbook, and only authorized persons may make entries in logbooks. Logbook entries will be reviewed by the FWS, cognizant scientist/engineer, or other responsible manager; the review will be documented with a 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 on 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.
- Description of site activities in specific detail (e.g., text, maps, and drawings) or by reference to the forms used to record such information (e.g., soil boring log or well completion log). Also include details about any field tests conducted, references to any forms used, other data records, and methods followed when performing the activity.
- Details of any field calibrations and surveys conducted. Reference any forms used, other data records, and the methods followed when performing the calibrations and surveys.
- Details of any samples collected and the preparation (if any) of SPLITS, duplicates, MSs, or MBs. Reference the methods used for sample collection or preparation. List the sample locations, types, labels or tag numbers, identification numbers, containers and volume, preservation methods, packaging, chain-of-custody form numbers, and analytical request form numbers pertinent to each sample or sample set. Note the time and the name of the individual to whom custody of samples was transferred.
- Time, equipment type, serial or identification number, and methods followed for decontaminations and equipment maintenance performed. Reference the page number(s) of any logbook where detailed information is recorded.
- Equipment failures or breakdowns, with a brief description of repairs or replacements.

3.3.1 Corrective Actions and Deviations for Sampling Activities

The OU project manager, FWS, appropriate field crew supervisors, and SMR personnel must document deviations from protocols, issues pertaining to sample collection, chain-of-custody forms, target analytes, contaminants, sample transport, or noncompliant monitoring. Examples of deviations include samples not collected due to field conditions.

As appropriate, such deviations or issues will be documented (e.g., in the field logbook) in accordance with internal corrective action methods. The OU project manager, FWS, field crew supervisors, or SMR personnel are responsible for communicating field corrective action requirements and for ensuring that corrective actions are applied to field activities. Changes in sample activities that require notification, approval, and documentation will be performed as specified in Table 3.

3.4 Calibration of Field Equipment

Onsite environmental instruments are calibrated in accordance with the manufacturer's operating instructions, internal work requirements and processes, and/or field instructions that provide direction for equipment calibration or verification of accuracy by analytical methods. Calibration records shall include raw calibration data, identification of the standards used, associated reports, date of analysis, and the analyst's name or initials. The results from all instrument calibration activities are recorded in accordance with HASQARD requirements (DOE/RL-96-68).

Field instrumentation calibration and QA checks will be performed as follows:

- Prior to initial use of a field analytical measurement system.
- At the frequency recommended by the manufacturer or methods, or as required by regulations.
- Upon failure to meet specified QC criteria.
- Calibration of radiological field instruments on the Hanford Site is performed by the Mission Support Alliance prime contractor, as specified by their calibration program.
- Daily calibration checks will be performed and documented for each instrument used. These checks will be made on standard materials sufficiently similar to the matrix under consideration for direct data comparison. Analysis times will be sufficient to establish detection efficiency and resolution.
- Standards used for calibration will be traceable to a nationally recognized standard agency source or measurement system. Manufacturer's recommendations for storage and handling of standards (if any) will be followed. Expired standards will not be used for calibration.

3.5 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. During the chain-of-custody process, if it is discovered that the custody tape has been tampered with or broken on both the sample bottle and the cooler, the sample may be analyzed but the results will include a flag indicating that custody was broken. If the sample data do not trend with the other data or are not as expected, the data from the sample will be flagged accordingly.

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

3.5.1 Containers

Samples shall be collected, where and when appropriate, in break-resistant containers. The field sample collection record shall indicate the laboratory lot number of the bottles used in sample collection. When commercially pre-cleaned containers are used in the field, the name of the manufacturer, lot identification, and certification 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 reoccurrence. Contaminated sample containers cannot be used for a sampling event. Container sizes may vary depending on laboratory-specific volumes or requirements for meeting

analytical detection limits. Container types and sample amounts/volumes are identified on the chain-of-custody form.

The Radiological Engineering organization will measure the contamination levels and the dose rates associated with the filled sample containers. This information and 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 SMR) can send smaller sample volumes to the laboratory.

3.5.2 Container Labeling

Each sample is identified by affixing a standardized label or tag to the container. This label or tag shall 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 pre-printed or handwritten in indelible or waterproof ink.

3.5.3 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 that sample integrity is maintained.
A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples shipped to any laboratory.

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

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

- Project name
- Collectors' names
- Unique sample identification 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 should note any sample anomalies and inform SMR so special direction for analysis can be provided to the laboratory if necessary.

3.5.4 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 the U.S. Department of Transportation (DOT) as described in 49 CFR 171, "Transportation," "General Information, Regulations, and Definitions," through 177, "Carriage by Public Highway."[2] Carrier-specific requirements defined in the current edition of International Air Transportation Association (IATA) *Dangerous Goods Regulations* shall also be used when preparing sample shipments conveyed by air freight providers.

Samples containing hazardous constituents above regulated amounts shall be considered hazardous material in transportation and transported in accordance with DOT/IATA requirements. If the sample material is known or can be identified, then it will be packaged, marked, labeled, and shipped according to the specific instructions for that material. Appropriate laboratory notifications will be made, 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, "Transportation," "Shippers—General Requirements for Shipments and Packagings," are exceeded. Samples shall be screened (or relevant historical data will be used) to determine if these values are exceeded. When screening or historical data indicate that samples are radioactive, the samples shall be properly classified, described, packaged, marked, labeled, and transported according to DOT/IATA requirements.

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

4 Management of Waste

Waste materials generated during borehole drilling, sampling activities, and well development will be managed in accordance with DOE/RL-2004-18, *Waste Control Plan for the 200-PO-1 Operable Unit*. Well 299-E25-238 was added to DOE/RL-2004-18 by TPA-CN-0778 (dated April 25, 2017).

Uncontaminated materials will be segregated to minimize radiological waste. Miscellaneous solid waste that has contacted suspect dangerous waste will be managed as dangerous waste. Purgewater and decontamination fluids will be collected and managed in accordance with DOE/RL-2011-41, *Hanford Site Strategy for Management of Investigation Derived Waste*; DOE/RL-2009-39, *Investigation-Derived Waste Purgewater Management Action Memorandum*; and DOE/RL-2009-80, *Investigation Derived Waste Purgewater Management Work Plan*. Waste materials requiring collection will be placed in containers appropriate for the material and the receiving facility in accordance with the applicable requirements document and applicable substantive federal and/or state requirements.

---

[2] Transportation regulations 49 CFR 174, "Carriage by Rail," and 49 CFR 176, "Carriage by Vessel," are not applicable, as these two transportation methods are not used.

Packaging and labeling during waste storage and transportation will meet the requirements of DOT and WAC 173-303, "Dangerous Waste Regulations," as appropriate. Packaging exceptions to DOT requirements may be used for onsite waste shipments if documented as such and if the packaging provides an equivalent degree of safety during transportation.

Offsite analytical laboratories are responsible for the disposal of unused sample quantities.

5 Health and Safety

DOE has established the hazardous waste operations safety and health program pursuant to the *Price-Anderson Amendments Act of 1988* to ensure the safety and health of workers involved in mixed-waste site activities. The program was developed to comply with the requirements of 10 CFR 851, "Worker Safety and Health Program," which incorporates the standards of 29 CFR 1910.120, "Occupational Safety and Health Standards," "Hazardous Waste Operations and Emergency Response"; 10 CFR 830, "Nuclear Safety Management"; and 10 CFR 835, "Occupational Radiation Protection." The health and safety program defines the chemical, radiological, and physical hazards, and it specifies the controls and requirements for daily work activities on the overall Hanford Site. Personnel training; control of industrial safety and radiological hazards; personal protective equipment; site control; and general emergency response to spills, fire, accidents, injury, site visitors, and incident reporting are governed by the health and safety program. Site-specific health and safety plans (i.e., SGW-41472, *Soil and Groundwater Remediation Project Site Specific Health and Safety Plan (HASP)*, Rev. 9, or subsequent revisions) will be used to supplement the general health and safety plan.

6 References

10 CFR 830, "Nuclear Safety Management," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title10-vol4/xml/CFR-2010-title10-vol4-part830.xml.

10 CFR 835, "Occupational Radiation Protection," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title10-vol4/xml/CFR-2010-title10-vol4-part835.xml.

10 CFR 851, "Worker Safety and Health Program," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title10-vol4/xml/CFR-2010-title10-vol4-part851.xml.

29 CFR 1910.120, "Occupational Safety and Health Standards," "Hazardous Waste Operations and Emergency Response," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title29-vol5/xml/CFR-2010-title29-vol5-sec1910-120.xml.

49 CFR, "Transportation," *Code of Federal Regulations*. Available at:
http://www.gpo.gov/fdsys/pkg/CFR-2009-title49-vol1/xml/CFR-2009-title49-vol1.xml.
http://www.gpo.gov/fdsys/pkg/CFR-2009-title49-vol2/xml/CFR-2009-title49-vol2.xml.
http://www.gpo.gov/fdsys/pkg/CFR-2009-title49-vol3/xml/CFR-2009-title49-vol3.xml.
http://www.gpo.gov/fdsys/pkg/CFR-2009-title49-vol4/xml/CFR-2009-title49-vol4.xml.
http://www.gpo.gov/fdsys/pkg/CFR-2009-title49-vol5/xml/CFR-2009-title49-vol5.xml.
http://www.gpo.gov/fdsys/pkg/CFR-2009-title49-vol6/xml/CFR-2009-title49-vol6.xml.
http://www.gpo.gov/fdsys/pkg/CFR-2009-title49-vol7/xml/CFR-2009-title49-vol7.xml.
http://www.gpo.gov/fdsys/pkg/CFR-2010-title49-vol8/xml/CFR-2010-title49-vol8.xml.
http://www.gpo.gov/fdsys/pkg/CFR-2010-title49-vol9/xml/CFR-2010-title49-vol9.xml.

171, "General Information, Regulations, and Definitions."

172, "Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans."

173, "Shippers—General Requirements for Shipments and Packagings."

175, "Carriage by Aircraft."

177, "Carriage by Public Highway."

APHA/AWWA/WEF, 2012, *Standard Methods for the Examination of Water and Wastewater*, 22nd Edition, American Public Health Association, American Water Works Association, and Water Environment Federation, Washington, D.C.

Atomic Energy Act of 1954, as amended, 42 USC 2011, Pub. L. 83-703, 68 Stat. 919. Available at: http://epw.senate.gov/atomic54.pdf.

CHPRC-00784, 2014, *Tier 1 Risk-Based Soil Concentrations Protective of Ecological Receptors at the Hanford Site*, Rev. 1, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0081638H.

CHPRC-01311, 2013, *Tier 2 Risk-Based Soil Concentrations Protective of Ecological Receptors at the Hanford Site*, Rev. 2, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/pdf.cfm?accession=0088115.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. 9601, et seq., Pub. L. 107-377, December 31, 2002. Available at: http://epw.senate.gov/cercla.pdf.

DoD/DOE QSM, 2013, *Department of Defense (DoD) Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories*, U.S. Department of Defense and the U.S. Department of Energy, Washington, D.C. Available at: http://www.denix.osd.mil/edqw/home/what-s-new/unassigned/qsm-version-5-0-final.

DOE/RL-92-24, 2001, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes*, Rev. 4, 2 vols., U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at:
http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0096062.
http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0096061.

DOE/RL-96-12, 1996, *Hanford Site Background: Part 2, Soil Background for Radionuclides*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D1808987.

DOE/RL-96-68, 2014, *Hanford Analytical Services Quality Assurance Requirements Document*, Rev. 4, *Volume 1, Administrative Requirements; Volume 2, Sampling Technical Requirements*; *Volume 3, Field Analytical Technical Requirements*; and *Volume 4, Laboratory Technical Requirements*, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at:
http://www.hanford.gov/files.cfm/DOE-RL-96-68-VOL1-04.pdf.
http://www.hanford.gov/files.cfm/DOE-RL-96-68-VOL2-04.pdf.
http://www.hanford.gov/files.cfm/DOE-RL-96-68-VOL3-04.pdf.
http://www.hanford.gov/files.cfm/DOE-RL-96-68-VOL4-04.pdf.

DOE/RL-2004-17, 2004, *Remedial Investigation Report for the 200-CS-1 Chemical Sewer Group Operable Unit*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at:
http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D7005093.
http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D7005338.
http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D7005561.

DOE/RL-2004-18, 2004, *Waste Control Plan for the 200-PO-1 Operable Unit*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at:
http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0807010321.

TPA-CN-0778, dated April 25, 2017. Available at:
http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0071403H.

DOE/RL-2007-02, 2007, *Supplemental Remedial Investigation/Feasibility Study Work Plan for the 200 Areas Central Plateau Operable Units, Volume I: Work Plan and Appendices*, Rev. 0, Volume I, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0099914.

DOE/RL-2009-80, 2009, *Investigation Derived Waste Purgewater Management Work Plan*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at:
http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0094946.

DOE/RL-2011-41, 2011, *Hanford Site Strategy for Management of Investigation Derived Waste*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at:
http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0093937.

DOE/RL-2016-23, 2016, *216-A-29 Ditch Interim Status Groundwater Quality Assessment Monitoring Plan*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0078183H.

ECF-HANFORD-10-0442, *Calculation of Nonradiological Soil Concentrations Protective of Groundwater Using the Fixed Parameter 3-Phase Equilibrium Partitioning Equation for the 100 Areas and 300 Area*, Rev. 2, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at:
http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0071878H.

ECF-HANFORD-10-0453, *Calculation of Standard Method C Direct Contact Soil Cleanup Levels for Industrial Land Use for the 100 Areas and 300 Area Remedial Investigation/Feasibility Study Reports*, Rev. 1, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0081643H.

ECF-HANFORD-11-0038, 2012, *Soil Background for Interim Use at the Hanford Site*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at:
http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0088381.

ECF-HANFORD-11-0158, 2014, *Tier 2 Terrestrial Plant and Invertebrate Preliminary Remediation Goals (PRGs) for Nonradionuclides for Use at the Hanford Site*, Rev. 1, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at:
http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0081636H.

ECF-HANFORD-16-0133, 2016, *Calculation of Soil Radiological Preliminary Remedial Goals for the Outdoor Worker Scenario*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0071881H.

ECF-HANFORD-16-0134, 2016, *Calculation of Soil Nonradiological Preliminary Remediation Goals for the Outdoor Worker Scenario*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0071879H.

Ecology, EPA, and DOE, 1989a, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington. Available at: http://www.hanford.gov/?page=81.

Ecology, EPA, and DOE, 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington. Available at: http://www.hanford.gov/?page=82.

Ecology Publication ECY 97-602, 1997, *Analytical Methods for Petroleum Hydrocarbons*, Washington State Department of Ecology, Olympia, Washington. Available at: http://www.ecy.wa.gov/pubs/97602.pdf.

Ecology Publication Number 04-03-030, 2004, *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, July 2004, Washington State Department of Ecology. Available at: https://fortress.wa.gov/ecy/publications/documents/0403030.pdf.

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.

EPA/240/R-02/009, 2002, *Guidance for Quality Assurance Project Plans*, EPA QA/G-5, Office of Environmental Information, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://www.epa.gov/sites/production/files/2015-06/documents/g5-final.pdf.

EPA 540-R-08-005, 2009, *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use*, OSWER 9200.1-85, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://semspub.epa.gov/work/HQ/176101.pdf.

EPA-540-R-2017-001, 2017, *National Functional Guidelines for Inorganic Superfund Data Review*, OLEM 9355.0-135, Office of Superfund Remediation and Technology Innovation, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://www.epa.gov/sites/production/files/2017-01/documents/national_functional_guidelines_for_inorganic_superfund_methods_data_review_01302017.pdf.

EPA-540-R-2017-002, 2017, *National Functional Guidelines for Organic Superfund Methods Data Review*, OLEM 9355.0-136, Office of Superfund Remediation and Technology Innovation, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://www.epa.gov/sites/production/files/2017-01/documents/national_functional_guidelines_for_organic_superfund_methods_data_review_013072017.pdf.

EPA/600/4-79/020, 1983, *Methods for Chemical Analysis of Water and Wastes*, Environmental Monitoring and Support Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D196019611.

EPA/600/R-93/100, 1993, *Methods for the Determination of Inorganic Substances in Environmental Samples*, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio. Available at: https://nepis.epa.gov/Exe/ZyPDF.cgi/30002U3P.PDF?Dockey=30002U3P.PDF.

EPA, 2014, "Preliminary Remediation Goals (PRGs) Resident Soil to GW Table (TR=1E-6) November 2014," website, November 2014, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://epa-prgs.ornl.gov/radionuclides/download/ressoil2gw_rprg_table_run_pCi_25NOV14.pdf.

IATA, 2013, *Dangerous Goods Regulations*, current edition, International Air Transport Association, Montreal, Quebec, Canada.

PNNL-16407, 2007, *Geology of the Waste Treatment Plant Seismic Boreholes*, Rev. 1, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-16407rev1.pdf.

Price-Anderson Amendments Act of 1988, Pub. L. 100-408, Aug. 20, 1988, 102 Stat. 1066, 42 USC 2010, et seq. Available at: http://www.gpo.gov/fdsys/pkg/STATUTE-102/pdf/STATUTE-102-Pg1066.pdf.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq. Available at: http://www.epw.senate.gov/rcra.pdf.

SW-846, 2015, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://www.epa.gov/hw-sw846.

SGW-41472, 2014, Soil and Groundwater Remediation Project Site Specific Health and Safety Plan (HASP), Rev. 9, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0082379H.

WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-160.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303.

WAC 173-340, "Model Toxics Control Act—Cleanup," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-340.

340-900, "Tables."