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Tri-Party Agreement

**Change Notice for Modifying Approved Documents/ Workplans**
**In Accordance with the Tri-Party Agreement Action Plan,**
**Section 9.0, *Documentation and Records***

| **Change Number** | **Document Submitted Under Tri-Party Agreement Milestone** | **Date:** |
|---|---|---|
| TPA-CN-521 | _____ | June 26, 2013 |

**Document Number and Title:**
DOE/RL-2001-48, Rev. 3 300 Area Remedial Action Sampling and Analysis Plan
0094750

**Date Document Last Issued:** December 2010

**Originator:** Mark French **Phone:** 373-9863

**Description of Change:** The 618-11 Burial Ground Trenches are being added into the Sampling and Analysis Plan for 300-FF-2. Prior revisions had excluded 618-11 from the scope, pending further investigations of constituents and remediation methods.

M. French (**DOE**) and L. Gadbois (**Lead Regulatory Agency**) agree that the proposed change modifies an approved workplan/document and will be processed in accordance with the Tri-Party Agreement Action Plan, Section 9.0, *Documentation and Records*, and not Chapter 12.0, *Changes to the Agreement.*

**Justification and Impacts of Change:** Documentation reviews have led to the conclusion that the 618-10 and 618-11 Burial Grounds share the same contaminants of concern. As such, the information added for 618-10 in a prior document revision is also applicable to 618-11. Changes include adding a description of the 618-11 Burial Ground and then adding "618-11" to areas of the SAP where the 618-10 and 618-11 information is the same. In addition, site UPR-600-22 is being moved from Table 1-2, "Candidate Waste Sites" to Table 1-3, "RTD Waste Sites", based on sampling conducted in 2012.

Affected pages are: 1-1, 1-6, 1-7, 1-8, 1-9, 1-10, 1-16, 1-20, 1-22, 1-25, 1-26, 1-27, 1-28, 1-29, 2-1, 2-3, 2-14, 2-15, 2-16, 3-3, 3-4, 3-12, 5-5

(Double underline indicates changes)

**Approvals:**

| | | | | |
|---|---|---|---|---|
| Mark French<br>DOE Project Manager | 5/19/13<br>Date | X Approved | __ Disapproved | |
| Larry Gadbois<br>Lead Regulatory Project Manager | 6-26-13<br>Date | X Approved | __ Disapproved | |

Once all the above steps have been completed, the originator sends a copy of the signed change notice to the MSA TPAI organization (H7-28), the Administrative Record (H6-08) (refer to TPA Action Plan, Section 9.3), lead regulatory agency, affected Hanford contractor, DOE Project Manager, project/contractor Document Custodian, and others as appropriate. Maintain the original Change Notice per approved Records Management procedures.

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300-FF-2

# 1.0 INTRODUCTION

This sampling and analysis plan (SAP) presents the rationale and strategy for sampling and analysis activities to support remedial actions at a subset of waste sites in the 300-FF-2 Operable Unit (OU), including the 618-10 and 618-11 Burial Ground trenches and vertical pipe units (VPUs). The 618-11 Burial Ground caissons are ~~is~~ not included in this SAP. Information presented in this SAP with respect to the 300-FF-2 OU waste sites is based on the *Data Quality Objective Summary Report for the 100 Area Burial Grounds and 300-FF-2 Operable Unit Waste Sites* (DQO summary report) (BHI 2001). Information presented in this SAP pertaining to the remediation of the 618-10 and 618-11 Burial Grounds is based on other 300 Area burial grounds outlined in the DQO summary report (BHI 2001), and the data quality objective (DQO) process developed for the nonintrusive and intrusive characterization of the 618-10 Burial Ground trenches (WCH 2010a). Historical document reviews have led to the conclusion that the 618-10 and 618-11 Burial Grounds share the same contaminants of concern.

The purpose of the proposed sampling and analysis activities is two-fold:

- Characterization of co-mingled soil, buried waste, and debris excavated from the sites to support remediation waste characterization and disposal

- Demonstration that post-remediation cleanup objectives have been met for residual soil in pits/trenches, stockpiled soil intended for use as clean backfill material, and residual soil beneath staging pile areas to support site closeout.

The scope of this SAP includes an initial group of waste sites identified in the *Record of Decision for the 300-FF-2 Operable Unit, Hanford Site, Benton County, Washington* (300-FF-2 Record of Decision [ROD]) (EPA 2001). The waste sites include a combination of burial grounds, dump sites, drain fields, french drains, foundation slabs, and test units and are provided in Appendix A of the *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (300 Area RDR/RAWP) (DOE-RL 2009a). This document also provides a sampling and analysis process for the candidate waste sites (also referred to as "remaining sites") identified in the 300-FF-2 ROD (EPA 2001), as well as for newly discovered sites (e.g., soil contamination areas beneath 300 Area facilities that have not yet been recognized) that may be identified in the future.

The 316-4 Crib site is the only liquid waste disposal site included in the scope of this SAP. This site was evaluated through the DQO process with the burial ground sites by presenting its unique features in separate tables or text within the DQO summary report (BHI 2001). The unique elements for the 316-4 Crib, such as the contaminant of potential concern (COPC) list and sampling design, are presented in Appendix A.

Remedial action pertaining to the 618-10 and 618-11 Burial Grounds is addressed in the 300-FF-2 ROD (EPA 2001) and *Explanation of Significant Differences for the 300 FF-2 Operable Unit Record of Decision* (EPA 2004). Remediation work at the 618-10 Burial Ground and the 618-11

618-10 Burial Ground is one of the sites where the land-use scenario was modified from industrial to unrestricted (EPA 2004).

### 1.1.4 618-11 Burial Ground

The 618-11 Burial Ground consists of 3 slope-sided trenches, 3 to 5 large caissons, and 50 VPUs. It was opened in March 1962 and accepted waste into Trench 1 until October 1962, when it was taken out of service. While out of service, Trench 2 and 40 VPUs were added and the burial ground was brought back online in September 1963. Waste was disposed throughout Trench 2 and presumably in all VPUs, but Trench 3 had received waste only in the east and west ends when the site was closed in December 1967.

The trenches are 270 m (900 ft) long by 15 m (50 ft) wide and 7.6 m (25 ft) deep. The VPUs were constructed with five 209 L (55 gal) bottomless drums, like those in the 618-10 Burial Ground. The caissons were constructed of 2.4 m (8 ft-) diameter corrugated metal pipe, 3 m (10 ft) long, with the top of the caisson being 4.6 m (15 ft) below grade, and connected to the surface by an offset 91 cm (36 in.-) diameter pipe with a dome cap lid. These units were buried with about 4.6 m (15 ft) of space between them. The caissons are also open to the soil at the bottom. The number of caissons (three to five) is questionable due to contradictions in site documentation. The burial ground received a minimum of 0.6 m (2 ft) of soil when it was closed. This was in addition to the soil cover used to close the trenches. An additional 0.6 m (2 ft) of topsoil was added to the site for surface stabilization in 1983. Trenches, VPUs and caissons are expected to have the same contaminants of concern. Radiological concentrations drove disposal into the specific units.

The 618-11 Burial Ground contains a broad spectrum of low level and potential TRU radioactive waste including fission products, byproduct waste (thorium and uranium), and plutonium, similar to 618-10. It was used for the disposal of 300 Area laboratory solid wastes. Low- to high-activity wastes were received from the 305, 306, 309, 313, 315, 317, 324, 325, 325 A, 325 B, 326, 327, 329, 340 Complex, 1171, 3700, 3706, 3707 C, 3708, 3718, and 3730 facilities. These facilities handled radioactively contaminated, or potentially contaminated, waste from operations or laboratory areas, including hot cells. Moderate- and high activity (remote-handled) wastes were received from the 327 Building (radio metallurgy) hot cells, 325 A hot cells, the 325 B (analytical) hot cells, occasionally from the Plutonium Recycle Test Reactor 309 Building, and later from 324 hot cells.

The low- to moderate-activity wastes described above were disposed to trenches (with some exceptions), and the moderate- to high activity wastes were disposed to VPUs and caissons. The 325 A hot cells disposed of moderate- to high-activity waste to the trenches in concrete lead shielded drums. The 325 B hot cells also used concrete-shielded drums to dispose of hot cell waste, used laboratory containers and glassware, and spent instruments and equipment. Some plutonium residues from various organizations and facilities (including the 308 Building) were encapsulated in concrete and placed in lead and concrete-shielded drums for disposal at the 618-11 Burial Ground.

The 618-11 site had several documented unplanned releases during its operational life. After each release, the ground was either washed down with water or gravel was spread over the contaminated area to prevent the spread of contamination.

## 1.2 SITE PROFILE

Because the scope of this SAP includes sampling for waste characterization and site closeout, two relevant site profiles support the sampling designs. These profiles are described in the following subsections.

### 1.2.1 Waste Characterization Site Profile

The burial grounds contain solid and soft wastes and intermixed contaminated soils. These materials were placed in designated burial grounds with finite boundaries (i.e., excavated pits and trenches). After being filled to capacity or declared inactive, these burial grounds were typically covered with clean soil to a depth of approximately 1 m (3 ft). Thus, the burial grounds exist as discrete units of contaminated materials that are surrounded by, and mixed with, clean soil.

The dump areas and test sites have profiles similar to the burial grounds. This assumption is based on field historical information, observations made during remediation efforts at the 618-4 Burial Ground (BHI 1998a) and 300 Area landfills, and data obtained in *Radiological Characterization of the Retired 100 Areas* (Dorian and Richards 1978) and the *118-B-1 Excavation Treatability Test Plan* (DOE-RL 1994). The dump areas typically consist of surface or near-surface solid waste intermixed with soil. The test sites consist of below-surface contaminated vitrified solids, soil, and cement surrounded by soil.

### 1.2.2 Site Closeout Profile

The site closeout profile reflects the post-remediation condition of the waste sites. It is defined as open pits/trenches from which buried wastes and co-mingled soil have been removed and disposed, leaving near-background concentrations of residual contamination. After the site closeout process is complete, it is expected that the pits and trenches would be backfilled and/or graded to blend with the local terrain.

In general, contaminants associated with burial ground wastes are not expected to have migrated to any significant degree beneath the buried solid wastes. This assumption is based on field historical information; observations made during remediation efforts at the 618-2, 618-3, 618-4, and 618-5 Burial Grounds (WCH 2006a, 2006b; BHI 1998a, 2004a, 2004b) and 300 Area landfills; and data obtained in Dorian and Richards (1978) and the excavation test plan (DOE-RL 1994).

## 1.3 CONTAMINANTS OF POTENTIAL CONCERN

The assignment of contaminants of potential concern (COPCs) is essential for both waste characterization and site closeout. The process for identifying COPCs for the 618-10 Burial Ground trenches and VPUs relied on a search of historical documents and IHE-2009-0006, *Integrated Chemical and Radiological Hazard Evaluation Worksheet – 618 10 Burial Ground/North Burial Ground* (WCH 2009b), while the process used for other waste sites in the 300-FF-2 OU relies on the development of waste form models (WFMs). The identification process of COPCs for the 300-FF-2 OU waste sites and the 618-10 Burial Ground trenches and VPUs are described separately. The process for identifying COPCs for the 618-11 Burial Ground included using the information gathered for 618-10 and from IHE-2011-0006 *Integrated Chemical and Radiological Hazard Evaluation Worksheet – 618-11 Burial Ground/Wye Burial Ground* (WCH 2011).

### 1.3.1 300-FF-2 Operable Unit COPCs

The DQO scoping investigations (i.e., process knowledge and data from burial ground remediation activities) within the 300-FF-2 OU, excluding the 618-10 and 618-11 Burial Grounds, revealed that repetitive waste forms are expected in the 300 Area waste sites. Consequently, WFMs were developed for each class or type of buried waste to support waste characterization and designation. These WFMs are linked with COPC lists as shown in Table 1-5.

The waste designation process considers all available information and is not limited to results from sampling for the COPCs identified in Table 1-5. If reported analytical results, process knowledge, or historical data identify concentrations of other potential contaminants, these contaminants will be considered in the waste profiles developed for the site being evaluated.

A different alignment of COPCs was developed for the site closeout decisions because many of the waste sites served unique purposes and received limited suites of contaminants, while other sites served general purposes and received larger suites of contaminants. Consequently, the alignment of COPCs for site closeout decisions is provided for each waste site in the DQO reports (BHI 2001, 2003) and may be expanded based on research done during sample design work (see Section 1.5). Based on observations of the type/quantity of material removed from the site and associated characterization data that are collected during the excavation process, COPCs may be added to or subtracted from the list provided in the DQO reports. A final list of contaminants of concern (COCs) for site closeout will be identified by the project with concurrence from the U.S. Department of Energy (DOE) and EPA prior to initiating the verification sampling process. Final COCs will be presented in the site-specific cleanup verification packages or remaining sites verification packages (RSVPs), as appropriate.

### 1.3.2 618-10 and 618-11 Burial Ground Trench Remediation COPCs and COCs

Table 1-6 lists the COPCs for the 618-10 and 618-11 Burial Ground trench ~~and VPU~~ remediation. The list was developed using historical documents and records for the site,

including the *Integrated Chemical and Radiological Hazard Evaluation Worksheet – 618-10 Burial Ground/North Burial Ground* (WCH 2009b) and *Integrated Chemical and Radiological Hazard Evaluation Worksheet – 618-11 Burial Ground/Wye Burial Ground (WCH, 2011).*

This initial COPC list was screened to develop the COCs list in Table 1-7. ~~Additions to the COC list may be required after completion of the nonintrusive and intrusive characterization efforts for the 618-10 Burial Ground trenches.~~

The following are exclusion criteria used to develop the final list of COCs :

- Radionuclides with half-lives less than 3 years (and no significant "daughters")
- Naturally occurring radionuclides associated with background radiation (e.g., potassium-40, thorium-230, thorium-232, and radium-226)
- A limited number of radionuclides (e.g., plutonium-241) that were removed because they require significant analytical resources, have no analytical method, and/or can be estimated from the other radionuclides that will be reported.
- Essential nutrients for human nutrition (minerals)
- Analytes that have no toxicity values (based on the hierarchy of toxicity values recommended by "Human Health Toxicity Values in Superfund Risk Assessments" (EPA 2003).

Field analyses will be performed to monitor for volatile organic compounds. If detectable levels are noted, sampling for volatile organic compounds shall be included. If an insufficient quantity of sample material is available, a field determination will be made regarding the need to collect additional material. The primary use of asbestos in the 300 Area was for insulation and gasket materials. If suspect materials are encountered, specific asbestos analysis shall be included.

## 1.4 DATA QUALITY OBJECTIVES

The *Guidance for Data Quality Objectives Process* (EPA 1994) was used to support the development of this SAP. The DQO process is a strategic planning approach that provides a systematic method of defining the criteria that a data collection design should satisfy. Using the DQO process ensures that the type, quantity, and quality of environmental data used in decision making will be appropriate for the intended application.

The 618-10 and 618-11 Burial Grounds ~~was~~ were excluded from the DQO summary report (BHI 2001) due to the burial ground containing TRU waste, primarily in VPUs. However, the 618-10 and 618-11 Burial Ground trenches are similar to other 300 Area burial grounds in the respect that they contain buried heterogeneous solid materials both known and anomalous. For this reason, the existing DQO process (BHI 2001) was adopted for the 618-10 and 618-11 Burial

Ground trenches along with DQO processes developed for the nonintrusive characterization and intrusive characterization phases. The DQO process for the intrusive characterization of the 618-10 Burial Ground trenches was documented in *Data Quality Objectives Summary Report for the Intrusive Characterization of 618-10 Burial Ground Trenches* (WCH 2010a). ~~After data evaluation for the nonintrusive and intrusive characterization of the 618-10 Burial Ground trenches is complete, the DQO may be revisited and modified, as necessary, with concurrence of DOE and the EPA.~~

In addition to the DQO process described above, lessons learned from the 118-K-1Burial Ground will also be applied to the remediation of the 618-10 and 618-11 Burial Grounds. The 118-K-1 Burial Ground (also known as the 100-K Burial Ground) is a solid waste site that operated from 1955 to 1973. The 118-K-l Burial Ground consists of numerous trenches and silos, which are similar to but much larger than the VPUs located at the 618-10 and 618-11 Burial Grounds. The 118-K-1 trenches were filled with contaminated reactor wastes (including various fission products such as cesium-137 and activation products such as cobalt-60) and low-level wastes. The silos were used to store radioactive materials until the activity had decayed sufficiently so that it could be disposed of in a trench. As remediation of the 118-K-1 Burial Ground trenches and silos progresses ahead of remediation activities in the 618-10 and 618-11 Burial Grounds, pertinent information and lessons learned will be evaluated and incorporated as applicable.

A summary of essential information based on the DQO summary report (BHI 2001) that is pertinent to this SAP is provided in the following subsections.

### 1.4.1 Statement of the Problem

The waste sites will be remediated in accordance with the RTD selected remedy prescribed by the 300-FF-2 ROD (EPA 2001). The following problem statements were developed for the scope of these remedial actions.

- **Waste characterization:** The problem is to determine if buried solid wastes and co-mingled soils in the 300-FF-2 waste sites are a dangerous, radioactive, and/or mixed waste for proper waste disposition.

- **Site closeout:** The problem is to determine if the 300 Area waste sites are suitable for closeout after remediation and verification sampling. A second part of the problem is to determine if overburden material from the waste sites is suitable for use as backfill.

### 1.4.2 Decision Rules

Based on the inputs from steps 2 through 4 of the DQO process, this section captures the decision rule outputs from step 5 of the DQO process. The decision rules for waste characterization and site closeout are provided in Tables 1-8 and 1-9, respectively.

**Figure 1-1. Location of the 618-10 and 618-11 Burial Grounds.**

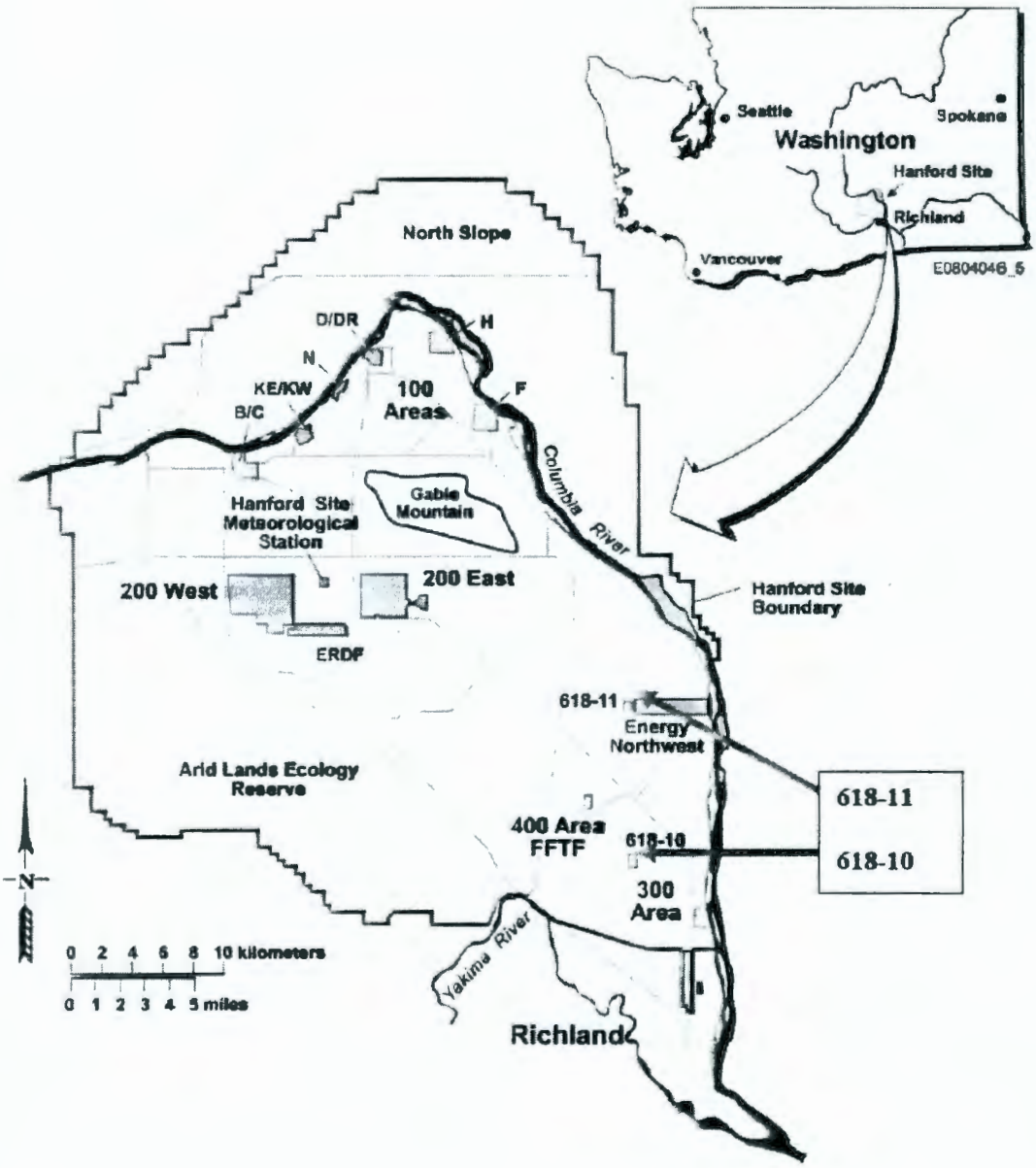

**Table 1-2. Candidate Waste Sites in the 300 Area Sampling and Analysis Plan. (2 Pages)**

| Waste Site Name | Waste Site Description | Location |
|---|---|---|
| UPR-300-1 | Potential soil contamination remaining as a result of a pipeline leak that was partially remediated near the 340 Complex. | 300 Area complex |
| UPR-300-2 | Potential soil contamination remaining as a result of multiple pipeline leaks that were partially remediated near the 340 Complex. | 300 Area complex |
| UPR-300-5 | Possible additional soil contamination remains after an unplanned release cleanup was performed near the 309 Building and was subsequently covered over with concrete and asphalt. | 300 Area complex |
| UPR-300-11 | Potential soil contamination remaining as a result of a pipeline leak that was partially remediated near the 340 Complex. | 300 Area complex |
| ~~UPR-600-22~~ | ~~Potential soil contamination associated with an airborne particulate release from the 618-11 Burial Ground.~~ | ~~Outlying site~~ |
| | Total Number of Candidate Waste Sites | ~~24~~23 |

Source: DOE/RL-2001-47, *Remedial Design Report/Remedial Action Work Plan for the 300 Area*, Rev. 3 (DOE-RL 2009a).

NOTE: When waste sites are added to the 300-FF-2 ROD (EPA 2001) through an explanation of significant difference, the site is within the scope of this SAP with no need for SAP revision.

LSLDF = life sciences laboratory drain field
LSLT1 = life sciences laboratory trench 1
LSLT2 = life sciences laboratory trench 2
ROD = record of decision
SAP = sampling and analysis plan
UPR = unplanned release

**Table 1-3. Summary of RTD Waste Sites to be Addressed in the 300 Area Sampling and Analysis Plan. (3 Pages)**

| Waste Site Name | Waste Site Description |
|---|---|
| 300 RLWS | 300 Area Radioactive Liquid Waste Sewer |
| 300 RRLWS | 300 Area Retired Radioactive Liquid Waste Sewer System |
| 300-4 | Uranium-contaminated soil at the DOE 351 Substation |
| 300-5 | Soil at site of former underground gasoline tank |
| 300-6 | Former location of the 366/366A Fuel Oil Bunkers |
| 300-11 | Soil at site of former underground gasoline tank |
| 300-15 | Leakage from corroded process sewer pipe |
| 300-16 | Uranium-contaminated soil near the 314 Building |
| 300-24 | Uranium-contaminated soil at the 314 Building |

**Table 1-3. Summary of RTD Waste Sites to be Addressed in the 300 Area Sampling and Analysis Plan. (3 Pages)**

| Waste Site Name | Waste Site Description |
|---|---|
| UPR-300-12 | Pipeline leak beneath the 325-A Building |
| UPR-300-17 | Uranium release to asphalt area southwest of the 333 Building |
| UPR-300-38 | Unplanned releases to soil beneath the 313 Building |
| UPR-300-39 | Sodium hydroxide leak in the 311 Tank Farm |
| UPR-300-40 | Pipeline leak between the 311 Tank Farm and 303-F Building |
| UPR-33-42 | 300 Area Powerhouse fuel oil spill |
| UPR-300-45 | Uranium-bearing acid spill at the 303-F Building |
| UPR-300-46 | Uranium-contaminated soil north of the 333 Building |
| UPR-300-48 | Drain line leak at the 325 Building basement topsy pit |
| 400-37 | Underground fuel storage tank South of 4732-B |
| 400-38 | Underground fuel storage tank East of 4722-A |
| 600-63 | 300-N Lysimeter Facility |
| 618-10 Burial Ground | 618-10 Burial Ground |
| 618-11 Burial Ground | 618-11 Burial Ground |
| UPR-600-22 | Potential soil contamination associated with an airborne particulate release from the 618-11 Burial Ground. |

Source: DOE/RL-2001-47, *Remedial Design Report/Remedial Action Work Plan for the 300 Area*, Rev. 3 (DOE-RL 2009a)

ESSP = east side storage pad
RLWS = radioactive liquid waste sewer
RRLWS = retired radioactive liquid waste sewer
RTD = remove, treat as necessary, dispose
SA = storage area
UOF = uranium oxide facility
UPR = unplanned release
WSTF = west side tank farm

**Table 1-4. Summary of Remediated (Close Out and Interim Closed Out) RTD Waste Sites Addressed in the 300 Area Sampling and Analysis Plan. (2 Pages)**

| Waste Site Name | Waste Site Description |
|---|---|
| 300 VTS | 300 Area Vitrification Test Site |
| 300-8 | Aluminum recycle storage area |
| 300-18 | Soil and metal shaving surface contamination |
| 300-110 | Building stormwater runoff drain with internal contamination signs |

**Table 1-5. Waste Form Models and Contaminants of Potential Concern. (2 Pages)**

| # | Waste Form Model | Known or Suspected Source of Contamination | Type of Contamination (General) | COPCs (Specific) |
|---|---|---|---|---|
| 9 | Unknown media and waste forms | Uncontainerized unknown media, discolored process soil, containerized liquids or solids | Unknown | Unknown, but may include all possible COPCs |
| 10[b] | Suspect TRU waste | Various transuranic contaminated materials | Radiological contamination | Pu-239/240 |
| 11[b] | Suspect spent nuclear fuel | Spent nuclear fuel rods and reactor components | Radiological contamination | Am-241, Co-60, Cs-137, Pu-238, Pu-239/240, Ru-106, Sr-90, U |

[a] Process soil is soil that remains after removal of anomalous materials and large debris.
[b] Applied only to the 618-10 and 618-11 Burial Ground remediation.
COPC = contaminant of potential concern
ISV = in situ vitrification
PCB = polychlorinated biphenyl
PPE = personal protective equipment
SVOA = semivolatile organic analyte
VOA = volatile organic analyte

**Table 1-6. 618-10 and 618-11 Burial Ground Trenches: Contaminants of Potential Concern List. (4 Pages)**

| Contaminants of Potential Concern | |
|---|---|
| ***Radiological Constituents*** | |
| **Radionuclides** | **Half-Life** |
| Am-241 | 432.2 years |
| Ba-137m | 2.552 minutes |
| C-14 | 5,730 years |
| Cd-113m | 13.7 years |
| Cm-242 | 163.2 days |
| Cm-243 | 28.5 years |
| Cm-244 | 18.11 years |
| Cs-134 | 2,062 years |
| Cs-135 | 2,300,000 years |

**Table 1-6. 618-10 and 618-11 Burial Ground Trenches: Contaminants of Potential Concern List. (4 Pages)**

| Contaminants of Potential Concern | |
|---|---|
| Cs-137 | 30.17 years |
| Co-60 | 5.271 years |
| Eu-152 | 13.6 years |
| Eu-154 | 8.8 years |
| Eu-155 | 4.96 years |
| H-3 | 12.33 years |
| I-129 | 15,700,000 years |
| Kr-85 | 10.72 years |
| Nb-93m | 14.6 years |
| Np-237 | 2,140,000 years |
| Pa-231 | 32760 years |
| Pa-234 | 6.7 hours |
| Pa-234m | 1.17 minutes |
| Pd-107 | 6,500,000 years |
| Pm-147 | 2.62 years |
| Pu-238 | 87.75 years |
| Pu-239 | 24,131 years |
| Pu-240 | 6,537 years |
| Pu-241 | 14.4 years |
| Pu-242 | 375,800 years |
| Ra-226 | 1,600 years |
| Sb-125 | 2.77 years |
| Sb-126 | 12.4 days |
| Sb-126m | 19 minutes |
| Sm-151 | 90 years |
| Sn-121m | 55 years |
| Sn-126 | 100,000 years |
| Sr-90 | 28.6 years |
| Te-125m | 58 days |
| Tc-99 | 213,000 years |
| Th-231 | 25.52 hours |

**Table 1-6. 618-10 and 618-11 Burial Ground Trenches: Contaminants of Potential Concern List. (4 Pages)**

| Contaminants of Potential Concern | |
|---|---|
| Th-232 | 14,050,000,000 years |
| Th-234 | 24.1 days |
| U-233 | 159200 years |
| U-234 | 244,500 years |
| U-235 | 703,800,000 years |
| U-238 | 4,468,000,000 years |
| Y-90 | 64.1 hours |
| Zr-93 | 1,530,000 years |
| ***Nonradiological Constituents – Metals*** | |
| Aluminum | Mercury |
| Arsenic | Nickel |
| Barium | Potassium |
| Beryllium | Selenium |
| Cadmium | Silver |
| Chromium | Sodium |
| Chromium (VI) | Potassium |
| Copper | Zinc |
| Lead | Zirconium |
| The "Other" section of IHE-2009-0006 (WCH 2009b) and IHE-2011-0006 (WCH, 2011) contains an extensive discussion on the diverse and complex nature of 300 Area activities that may have used the 618-10 and 618-11 Burial Ground. The nature of some of these activities makes an accurate inventory of all potential ~~unlikely~~ *metals* unlikely (fundamental and applied research with analytical laboratory services, many of which were considered classified activities at the time). The final COC list will include primary toxic metals and others with a high potential for presence. Other "exotic" metals were used in small quantities and are thus unlikely to be present in sufficient quantities to impact disposal decisions. | |
| ***Nonradiological Constituents – General Inorganics*** | |
| Asbestos | Nitrite |
| Chloride | Sulfate |
| Cyanide | Sulfide |
| Nitrate | |

**Table 1-6. 618-10 and 618-11 Burial Ground Trenches: Contaminants of Potential Concern List. (4 Pages)**

| Contaminants of Potential Concern | |
|---|---|
| ***Nonradiological Constituents – Organics*** | |
| Paraffin hydrocarbons – Total petroleum hydrocarbons (TPH) | Tributyl phosphate (TBP) and other semivolatile organics (SVOAs) |
| Polychlorinated biphenyls (PCBs) | Volatile organics (VOAs) |
| The "Other" section of IHE-2009-0006 (WCH 2009b) and IHE-2011-0006 (WCH, 2011) contains an extensive discussion on the diverse and complex nature of 300 Area activities that may have used the 618-10 and 618-11 Burial Grounds. The nature of some of these activities makes an accurate inventory of all potential ~~unlikely~~ *organics* unlikely (fundamental and applied research with analytical laboratory services, much of which were considered classified activities at the time). Routine analytical services will look for a broad spectrum of organics (see additional discussion in Table 1-7). | |

**Table 1-7. 618-10 and 618-11 Burial Ground Trenches: Contaminants of Concern List. (2 Pages)**

| Final Contaminants of Concern | |
|---|---|
| ***Radiological Constituents*** | |
| Am-241 | Pu-238 |
| Cm-244 | Pu-239/240[a] |
| Co-60 | Pu-241 |
| Cs-137 | Sr-90[b] |
| Eu-152 | Tc-99 |
| Eu-154 | Th-232 |
| Eu-155 | U-233/234[a] |
| H-3 | U-235 |
| I-129[a] | U-238 |
| Np-237 | |
| ***Nonradiological Constituents – Metals*** | |
| | Comments |
| Aluminum | Fuel cladding component |
| Arsenic | EPA Toxic alloy component and pesticide |
| Barium | EPA Toxic shielding alloy component. Electrical component |
| Beryllium | Alloys and reactor components |

**Table 1-7. 618-10 and 618-11 Burial Ground Trenches: Contaminants of Concern List. (2 Pages)**

| Final Contaminants of Concern | |
|---|---|
| Cadmium | EPA Toxic metal used in lead-dipped cladding |
| Chromium | EPA Toxic reactor component |
| Chromium (VI) | EPA Toxic used in reactor cooling and in lab cleaning solutions |
| Copper | Metal used in triple-dip process of cladding and cladding waste stream |
| Lead | EPA Toxic metal used in lead-dipped cladding and cladding waste stream |
| Mercury | EPA Toxic laboratory uses |
| Nickel | Reactor component |
| Selenium | EPA Toxic alloy – electrical component |
| Silver | EPA Toxic miscellaneous laboratory uses |
| Zinc | Reactor component |
| Additional metals may be reported as specified by a comprehensive ICP metals analytical suite. | |
| ***Nonradiological Constituents – General Inorganics*** | |
| Asbestos | Nitrite |
| Chloride | Sulfate |
| Cyanide | Sulfide |
| Nitrate | |
| ***Nonradiological Constituents – Organics*** | |
| Polychlorinated biphenyls (PCBs) | Paraffin hydrocarbons –TPH |
| Volatile organics (VOAs)[c] | Tributyl phosphate (TBP) and other semivoltile organics (SVOAs[c]) |

[a] Generate estimated concentrations based on calculations from the detected isotopes based on reactor fission/activation yields..

[b] Analyzed as total radioactive strontium.

[c] VOA and SVOA analysis are based on GC/MS methods routinely reporting a broad analytical suite including most commonly encountered industrial organics. The methods also screen for the potential presence of >60,000 additional organic compounds reported as TICs. The presence of significant quantities of TICs can be used to guide remediation analytical needs for the 618-10 and 618-11 Burial Ground trenches.

EPA = U.S. Environmental Protection Agency
GC/MS = gas chromatography/mass spectroscopy
SVOA = semivolatile organic analyses
TIC = tentatively identified compound
TPH = total petroleum hydrocarbons
VOA = volatile organic analyses

# 2.0 QUALITY ASSURANCE PROJECT PLAN

This quality assurance project plan (QAPjP) presents the objectives, functional activities, methods, and quality assurance/quality control (QA/QC) procedures associated with waste characterization and site closeout sampling for the 300 Area waste sites. Where appropriate, existing QA/QC guidelines, policies, and programs will be incorporated by reference. This QAPjP follows EPA guidelines contained in *EPA Requirements for Quality Assurance Project Plans* (EPA 1999) and complies with the requirements of *Hanford Analytical Services Quality Assurance Requirements Documents* (HASQARD) (DOE-RL 2007a).

## 2.1 PROJECT MANAGEMENT

### 2.1.1 Project Organization

The project organization is described in Section 3.1, "Project Team," of the 300 Area RDR/RAWP (DOE-RL 2009a). Additional responsibilities are discussed in the "Analytical Standard Operating Procedures" referenced in Appendix C and the *Sampling and Characterization Quality Assurance Program Plan: Volume 1, Administrative Requirements; Volume 2, Sampling Technical Requirements; Volume 3, Field Analytical Technical Requirements* (S&C QAPP) (WCH 2009c).

### 2.1.2 Quality Objectives and Criteria for Measurement Data

As developed from the DQO process, the quality objectives for the various analyses to be performed in support of waste characterization and site closeout are presented in Tables 2-1, 2-2, and 2-3. Table 2-1 covers the laboratory performance requirements for all 300-FF-2 waste sites, Table 2-2 covers the field performance requirements for 300-FF-2 waste sites (excluding the 618-10 and 618-11Burial Ground trenches), and Table 2-3 covers the field performance requirements for the 618-10 and 618-11 Burial Ground trenches. The listed methods were selected during the DQO process based on their ability to meet the quality objectives for the intended data uses (e.g., waste designation and/or site closeout) with respect to the applicable action levels. For candidate sites, an evaluation of the performance requirements of analytical methods for contaminants not presented in Tables 2-1 through 2-3 will be conducted before confirmatory or verification sampling.

### 2.2.4 Sample Handling and Custody Requirements

The sample handling and custody requirements are identified in the FSP in Section 3.0.

### 2.2.5 Analytical Method Requirements

Analytical parameters and methods are listed in Tables 2-1 through 2-2. Laboratory-specific standard operating procedures (SOPs) for the analytical methods are in place or will be prepared, as necessary. A reference list is included in Appendix C. An overview of proposed methods for the 300 Area waste sites and the 618-10/618-11 Burial Ground trenches is presented in the following subsections. Changes to or addition of methods identified in this SAP will be implemented in page changes, addenda, or revisions to this SAP, as appropriate.

**2.2.5.1 Field Screening and Radiological Surveys (General).** Chemical field screening and radiological surveys used to support waste characterization and site closeout activities will be performed in accordance with applicable procedures from HASQARD (DOE-RL 2007a); the S&C QAPP (WCH 2009c); and ENV-1, *Environmental Monitoring & Management*, ENV-1-2.24, "Routine Field Screening."

**2.2.5.2 Field Screening and Radiological Surveys (618-10 and 618-11 Burial Grounds).** The instruments used for initial screening of waste may include gamma radiation rate meters, infrared sensors, and photoionization detectors. Soils and debris will be screened for radiation dose rates with an excavator mounted gamma detector. Further screening of soils and debris exhibiting elevated dose rates may be performed using the Compton Ratio Analysis Testing for Environmental Radioactivity (CRATER™) system. The resident engineer will determine which items will be surveyed with the CRATER™ system. The analytical specifications for the CRATER™ system are documented in *Screening Excavated Soils for Spent Fuel Fragments Using a Compton to Cs-137 Photopeak Ratio Methodology* (WCH 2009d). Drums encountered may be further screened using an Ortec® Detective-EX (high-purity germanium gamma-ray spectrometer) and a shielded passive neutron detector. Metal encountered may be screened using an INNOV-X-Systems© X-ray fluorescence spectrometer. A field portable nondestructive assay (NDA) system may be deployed to determine if TRU waste streams are present, requiring disposition through the Central Waste Complex. The NDA system will be designed to meet the waste acceptance requirements for the Central Waste Complex. In addition to the NDA system, a field portable and/or fixed facility real-time-radiography system may be used to identify liquids and anomalous items contained in concrete and concrete/lead-shielded drums.

**2.2.5.3 Radiological Counting Facility.** Samples submitted to the Radiological Counting Facility will be analyzed in accordance with applicable Washington Closure Hanford (WCH) procedures.

**2.2.5.4 Standard Fixed Laboratory Analyses.** The standard fixed laboratory (SFL) analyses will be used for all verification samples and will be performed in accordance with the reference methods identified in Table 2-1 and the associated laboratory SOPs. The SFL SOPs will also be available prior to analysis as referenced in Appendix C.

**Table 2-2. Field Screening Performance Requirements for 300-FF-2 Waste Site (Excluding 618-10/618-11 Burial Ground Trenches).**

| COPCs | Waste Designation Action Levels[a] (mg/kg) | Analytical Method | Soil RDL (mg/kg) | Precision | Accuracy |
|---|---|---|---|---|---|
| ***Field Screening Measurements – Chemical*** | | | | | |
| Arsenic | 100[b] | Field laboratory XRF | 71 | TBD | TBD |
| Barium | 2,000[b] | | 300 | TBD | TBD |
| Cadmium | 20[b] | | 52 | TBD | TBD |
| Chromium (total) | 100[b] | | 282 | TBD | TBD |
| Lead | 100[b] | | 99 | TBD | TBD |
| Selenium | 20[b] | | 190 | TBD | TBD |
| Silver | 100[b] | | 89 | TBD | TBD |
| VOA | Compound-specific | OVA/OVM | Qualitative | N/A | N/A |
| pH | ≤2 or ≥12.5 | Litmus | Qualitative | N/A | N/A |
| ***Radiological Surveys*** | | | | | |
| Uranium | Unlimited | Field survey[c] | 75 pCi/g | ±35% | 70-150% |

[a] The waste designation action level is the regulatory or risk-based value to determine appropriate analytical requirements (e.g., detection limits).
[b] SW-846 Method 1311, TCLP, Section 1.2 (EPA 1997).
[c] From *Survey Method for Radiological Surveys of the 300-FF-1 Operable Unit Soil and Materials* (BHI 1998b).
COPC = contaminant of potential concern
N/A = not applicable
OVA = organic vapor analyzer
OVM = organic vapor meter
RDL = required detection limit
TBD = to be determined
VOA = volatile organic analyte
XRF = x-ray fluorescence

**Table 2-3. Field Analytical Performance Requirements for the 618-10 and 618-11 Burial Ground Trenches. (3 Pages)**

| COPCs | Unrestricted Land-Use Cleanup Level[a] | Waste Designation Action Level[a] | Analytical Method | Detection Limit Goals[b] | Precision Req't[c] (% RPD) | Accuracy Req't[c] (% Recovery) |
|---|---|---|---|---|---|---|
| Cesium-137 | 6.2 | 1.0 | GEA (at RCF) | 0.5 | ±50% | ±50% |
| Cobalt-60 | 1.4 | 1.0 | GEA (at RCF) | 0.5 | ±50% | ±50% |
| Europium-152 | 3.3 | 1.0 | GEA (at RCF) | 1.0 | ±50% | ±50% |

**Table 2-3. Field Analytical Performance Requirements for the 618-10 and 618-11 Burial Ground Trenches. (3 Pages)**

| COPCs | Unrestricted Land-Use Cleanup Level[a] | Waste Designation Action Level[a] | Analytical Method | Detection Limit Goals[b] | Precision Req't[c] (% RPD) | Accuracy Req't[c] (% Recovery) |
|---|---|---|---|---|---|---|
| Europium-154 | 3.0 | 1.0 | GEA (at RCF) | 1.0 | ±50% | ±50% |
| Europium-155 | 125 | 1.0 | GEA (at RCF) | 1.0 | ±50% | ±50% |
| Gamma speciation | NA | NA | Portable HPGe detector and passive neutron detector | NA | NA | NA |
| Gross alpha | NA | NA | Portable contamination detector | 100 dpm/100 $cm^2$ | NA | ±50% |
| Gross beta/gamma | NA | NA | Portable contamination detector | 5,000 dpm/ 100 $cm^2$ | NA | ±50% |
| Metals | NA | NA | XRF[d] | NA | ±50%[d] | ±50%[d] |
| Suspect spent nuclear fuel | NA | NA | CRATER™ (see WCH-305 [WCH 2009d]) | Detect/nondetect | TBD by vender | TBD by vender |
| TRU, Pu isotopes | NA | NA | Mobile nondestructive assay system to meet DOE/ CBFO-01-1005, Rev. 2 (DOE 2009) | Meet CWC and WIPP waste acceptance criteria (see DOE/CBFO-01-1005, Rev. 2 [DOE 2009]) | ≥16% RSD (see DOE/CBFO-01-1005, Rev. 2 [DOE 2009]) | 40%-160% (see DOE/CBFO-01-1005, Rev. 2 [DOE 2009]) |
| VOA | Compound specific | NA | PID | Detect/nondetect | NA | NA |
| Free liquids | NA | NA | Real-time radiography | Detect/nondetect | TBD by vender | TBD by vender |

[a] The waste designation action level is the regulatory or risk-based value to determine appropriate analytical requirements (e.g., detection limits). Units are in pCi/g or mg/kg unless otherwise specified. Land disposal restriction treatment standards for dangerous wastes may be lower than the waste designation action levels shown.

[b] Units are in pCi/g or mg/kg, unless otherwise specified. Detection limits shown are for standard fixed laboratory methods for low contamination soils. Significant levels of contamination may affect achievable detection limits due to the need to reduce sample sizes, increase dilution, or due to interference effects.

[c] Except as additionally noted, the precision criteria shown are for batch laboratory replicate sample RPDs and accuracy criteria shown are for associated batch laboratory control sample percent recoveries.

[d] Normal operation of XRF is used to identify gross levels of metallic contamination. If conditions permit, semiquantitative measurements of a limited number of elements may be achievable. Working detection limits shall be established prior to actual analysis. Normal precision and accuracy expectations will be ±50% in semiquantitative mode.

**Table 2-3. Field Analytical Performance Requirements for the 618-10 and 618-11 Burial Ground Trenches. (3 Pages)**

| COPCs | Unrestricted Land-Use Cleanup Level[a] | Waste Designation Action Level[a] | Analytical Method | Detection Limit Goals[b] | Precision Req't[c] (% RPD) | Accuracy Req't[c] (% Recovery) |
|---|---|---|---|---|---|---|

COPC = contaminants of potential concern
CRATER™ = Compton Ratio Analysis Testing for Environmental Radioactivity
CWC = Central Waste Complex
GEA = gamma energy analysis
HPGe = high-purity germanium
NA = not applicable
PID = photoionization detector
RCF = Radiological Counting Facility
RPD = relative percent difference
RSD = relative standard deviation
TBD = to be determined
TCLP = toxicity characteristic leaching procedure
TRU = transuranic
VOA = volatile organic analysis
WIPP = Waste Isolation Pilot Plan
XRF = X-ray fluorescence analysis

### 3.2.1 Waste Characterization Sampling Objectives

The waste characterization sampling objectives for material unearthed from the 300 Area waste sites and the 618-10/618-11 Burial Ground trenches are to determine the following attributes:

- If soil and debris meets the ERDF waste acceptance criteria (WCH 2010b)
- Applicability of characteristic waste codes (*Washington Administrative Code* [WAC] 173-303-90)
- If the waste meets the definition of a toxic dangerous waste (WAC 173-303-100)
- If the waste meets the definition of a dangerous persistent waste (WAC 173-303-100)
- If the waste is regulated due to polychlorinated biphenyl concentrations (40 CFR 761, WAC 175-303)
- If the waste is regulated due to asbestos content (40 CFR 61 Subpart M)
- If the waste is regulated as TRU (40 CFR 191)
- If the waste is regulated as spent nuclear fuel (40 CFR 191).

### 3.2.2 Waste Characterization Sampling Locations and Frequencies

Waste unearthed from the 300 Area waste sites and the 618-10/618-11 Burial Ground may or may not require characterization to support waste designation. As a minimum, radiological surveys will be needed for all waste to verify the waste profile and support U.S. Department of Transportation shipping requirements. The following three categories of waste exist from a designation standpoint:

- Wastes conforming to the WFMs (and/or process soil) that may be designated without additional characterization and that do not require special handling for human exposure or waste acceptance.
- Wastes conforming to the WFMs (and/or process soil) that may be designated without additional characterization but that do require special handling for human exposure or waste acceptance. Waste types in this category include (but are not limited to) lead bricks, cadmium shielding, and friable asbestos-containing materials.
- Wastes that cannot be designated without additional characterization and that may also require special handling for human exposure protection or waste acceptance. Unknown anomalous materials are included in this category.

Project personnel and the Waste Services representative shall determine the category that is appropriate for the various wastes. Specific sampling locations for waste materials that require characterization to support designation will be chosen by project personnel and the Waste

Services representative. Because the locations are not specified, field decisions must be made based on available information. General locations of metallic debris, land disposal restricted waste (e.g., lead bricks), asbestos material, discolored soil, and/or anomalous waste that are characterized for waste designation will be noted so that biased sampling may be performed as a component of excavation guidance. Sampling frequencies are shown in Table 3-1 for the various WFMs that have been identified. Note that the WFMs 10 and 11 listed in Tables 1-4 and 3-1 apply only to the 618-10 and 618-11 Burial Ground remediation.

The specific analyses required for sampling an anomalous waste will be determined by the project on a case-by-case basis. The determination will be made using an anomaly characterization checklist.

Visual observations combined with historical data, process knowledge, and engineering calculations can result in a cost-effective and expeditious waste designation. The observational designation process is based on the assumption that the buried waste did not change after disposal. However, it is recognized that containers of liquids may have leaked, causing dangerous/hazardous materials to come into contact with buried solid wastes, or contaminated soils may have been disposed in the burial grounds. Consequently, field radiological surveys and chemical screening of the co-mingled soil is necessary during excavation as prescribed in Table 3-1.

After the waste sorting process is complete and anomalous waste forms are removed, the co-mingled soil will be referred to as "process soil." Process soil will be sampled for chemicals (metals) and radionuclides at a frequency of one composite laboratory sample per approximately 76 to 153 $m^3$ [100 to 200 $yd^3$]. Samples for metals screening will be delivered to a contract laboratory for metals analysis. Samples for radionuclide screening will be delivered to an onsite counting facility for analysis. An offsite, EPA-approved laboratory may be used for additional analysis if required. Soils outside of burial trenches proper are not considered to be "process soil".

Sampling with organic vapor analyzer (OVA) instrumentation will also be performed to detect organic vapors at sampling sites when soil samples are taken. Monitoring requirements for organic vapors using the OVA are specified by the health and safety plan in consideration of contaminants that are expected at the site. Samples for laboratory analysis are collected as needed to evaluate OVA measurements. If positive OVA results are obtained, a soil sample will be collected from the contaminated location for laboratory analysis or headspace analysis in a gas chromatograph.

In addition to the frequency-based screening (as described above), visual observation of discoloration, leaking containers, hazardous solid materials (e.g., lead bricks), or other anomalous material in the dig face or process soil will be used to conduct field screening. The same techniques (OVA and metals screening) will be used for observational screening. In the absence of obvious worst-case sampling locations (e.g., next to leaking containers), the observational sampling frequency is one laboratory sample/screening per 3.8 $m^3$ (5 $yd^3$) of soil.

**Table 3-1. Waste Characterization Sampling Design. (2 Pages)**

| WFM # | Media | Sample Collection Methodology | Key Features/ Sampling Frequency | Basis for Sampling Design |
|---|---|---|---|---|
| 9 | Uncontainerized unknown media, containerized liquids or solids | Establish requirements with project and waste management representatives. | | |
| | Discolored soil | In situ OVA, metals screen. | One sample per 3.8 $m^3$ (5 $yd^3$) of discolored soil. | Observation based: color changes, leaking containers, radiological surveys, hazardous solid materials (e.g., lead bricks), and other. |
| | | Sampling for offsite analysis. | One sample from location of high field screening results. | Waste designation. Analyses could include total metals, TCLP, or volatile organics suite. Other analyses may be needed. |
| 10[b] | Suspect TRU waste | Onsite NDA | NDA each suspect item | Based on process knowledge |
| 11[b] | Suspect spent nuclear fuel | Onsite gamma spectroscopy | Characterize each suspect item | Based on process knowledge |

[a] Process soil is co-mingled soil after sorting to remove anomalous materials.
[b] Applied only to the 618-10 and 618-11 Burial Ground remediation.
ISV = in situ vitrification
OVA = organic vapor analyzer
PPE = personal protective equipment
TCLP = toxicity characteristic leachate procedure
WFM = waste form model
XRF = x-ray fluorescence

**Table 3-2. Site Closeout Sampling Design. (2 Pages)**

| Sampling Objectives | Number of Samples | Basis |
|---|---|---|
| Excavation guidance – radiological surveys | In situ surveys; no discrete samples. | Excavation continues until radiological levels meet survey criteria; indicates that verification sampling should be satisfied. |
| Excavation guidance – biased sampling | One grab sample beneath locations that had buried liquid wastes, hazardous wastes (e.g., lead bricks), and from areas where waste characterization results showed chemical and/or radiological concentrations above the applicable cleanup levels based anticipated land use for the site. | Excavation continues until chemical and radiological cleanup levels are met; indicates that verification sampling should be satisfied. |

WCH, 2010a, *Data Quality Objectives Summary Report for the Intrusive Characterization of 618-10 Burial Ground Trenches*, WCH-359, Rev. 0, Washington Closure Hanford, Richland, Washington.

WCH, 2010b, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*, WCH-191, Rev. 2, Washington Closure Hanford, Richland, Washington.

WCH, 2011, *Integrated Chemical and Radiological Hazard Evaluation Worksheet – 618-11 Burial Ground / Wye Burial Ground*, IHE-2011-0006, Rev. 2, Washington Closure Hanford, Richland, Washington.