SAMPLING AND ANALYSIS PLAN FOR PHASE 2 CHARACTERIZATION OF VADOSE ZONE SOIL IN WASTE MANAGEMENT AREA C

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Abstract: This plan specifies requirements for field sampling, laboratory analysis, and data reporting for soil samples to be taken from the vadose zone in and around Waste Management Area C. The data will be used to support a corrective measure study required for closure of the waste management area.

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Abbreviations and Acronyms

3D	three dimensional
AEA	Alpha energy analysis
bgs	below ground surface
CAS	Chemical Abstracts Service
COPC	constituent of potential concern
CVAA	cold vapor atomic absorption
DOE	U.S. Department of Energy
DQO	Data Quality Objective
Ecology	State of Washington Department of Ecology
EPA	U.S. Environmental Protection Agency
FY	fiscal year
GC/ECD	gas chromatography/electron capture detection
GC/FID	gas chromatography/flame ionization detection
GC/MS	gas chromatography/mass spectrometry
GEA	gamma energy analysis
GPC	gas proportional counting
HASQARD	Hanford Analytical Services Quality Assurance Requirements Document
HEIS	Hanford Environmental Information System
IC	ion chromatography
ICP/AES	inductively coupled plasma/atomic emission spectroscopy
ICP/MS	inductively coupled plasma/mass spectrometry
KPA	Kinetic Phosphorescence Absorption

LCS	laboratory control sample
LRDL	laboratory required detection limit
LSC	liquid scintillation counter
MDL	method detection limit
PCB	polychlorinated biphenyl
PUREX	Plutonium Uranium Extraction (Plant)
QA	quality assurance
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
RDL	required detection limit
SAP	sampling and analysis plan
SGE	surface geophysical exploration
SST	single-shell tank
SVOA	semi-volatile organic analysis
SVOC	semi-volatile organic compound
TBD	to be determined
TBP	tributyl phosphate
TDL	target detection limit
TIC	tentatively identified compound
UPR	unplanned release
VOA	volatile organic analysis
WAC	*Washington Administrative Code*
WIDS	Waste Information Data System
WMA	Waste Management Area

1.0 SAMPLING AND ANALYSIS OBJECTIVES

This sampling and analysis plan (SAP) specifies requirements for field sampling, laboratory analysis, and data reporting for soil samples that will be taken in and around Waste Management Area (WMA) C. The requirements are based on objectives developed using a data quality objective (DQO) process. Results of the DQO process are documented in RPP-RPT-38152, *Data Quality Objectives Report Phase 2 Characterization for Waste Management Area C RCRA Field Investigation/Corrective Measures Study*. The State of Washington Department of Ecology (Ecology), the U.S. Department of Energy (DOE), and its contractors participated in the DQO process. This SAP and RPP-PLAN-39114, *Phase 2 RCRA Facility Investigation/ Corrective Measures Study Work Plan for Waste Management Area C* provide information that is consistent with guidelines for contents as described in *Washington Administrative Code* (WAC) 173-340-820, "Sampling and Analysis Plans."

More specifically, this SAP provides overall requirements for soil characterization that will be performed to support development of a *Resource Conservation and Recovery Act of 1976* (RCRA) facility investigation/corrective measures study for WMA C. In addition to information in this SAP, operational details will be needed to perform field sampling and laboratory analysis of the samples. Operational instructions and a summary of requirements will be provided to performing organizations in the forms of sampling and analysis work instructions. These operational documents will meet requirements in this SAP and will be provided to Ecology for information prior to sample collection.

As stated in the DQO, information regarding treatment, management, and disposal of the radioactive source, byproduct material, and/or special nuclear components of mixed waste (as defined by the *Atomic Energy Act of 1954*, as amended) is not provided in this SAP for the purpose of regulating the radiation hazards of such components under the authority of this SAP or the Hazardous Waste Management Act (*Revised Code of Washington* 70.105, "Hazardous Waste Management"), but is provided for informational purposes only.

This SAP addresses only characterization of soil contaminants identified in the DQO process as documented in RPP-RPT-38152. Requirements for collecting biological data (e.g., tissue sample data) for an ecological risk assessment and obtaining other input data for the facility investigation/corrective measures study are provided in RPP-PLAN-39114.

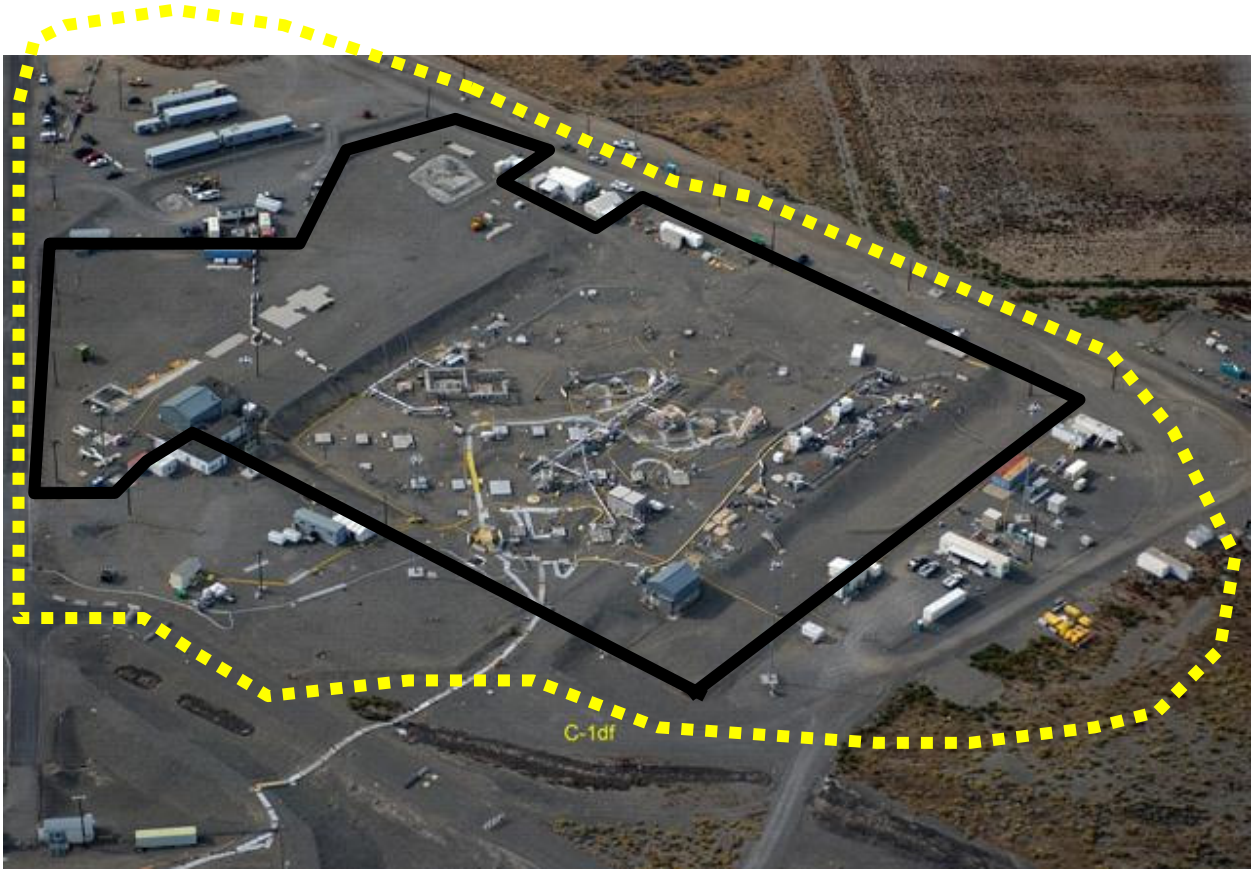
This revision removes the requirements to analyze for volatile organic compounds, gasoline and diesel range organics, polychlorinated biphenyl (PCB) congeners, ethylene glycol, monobutyl/dibutyl phosphate and sulfide as described in Letters 11-TPD-020, "Organic Analyses Optimization for Waste Management Area (WMA) C" and 11-NWP-053, "Re: Organic Analyses Optimization for Waste Management Area (WMA) C." In addition, the analytical tables are consolidated and reformatted to improve clarity and remove redundancies. Sulfide is eliminated as a soil investigation chemical of potential concern based on the removal of sulfide as a constituent associated with single-shell tank (SST) waste. Implementation of these changes will result in more sample volume being available for the constituents of highest concern, allowing for use of lower detection limits and improved quality control.

2.0 FACILITY DESCRIPTION

Waste Management Area C encompasses the 241-C Tank Farm (C Farm) located in the east central portion of the 200 East Area. It includes equipment, soil, and groundwater contaminated by C Farm operations. In general, the WMA C boundary is represented by the fence line surrounding the C Farm tanks. The boundary for vadose zone soil sampling, as defined by the DQO, includes the WMA and the immediate surrounding areas (see Figure 2-1).

A description of the equipment, soil, and groundwater in WMA C is provided in Section 2 of RPP-PLAN-39114. Section 2 also provided information on past unplanned releases (UPRs) of contaminants in this area. In general, the tank waste contaminants in the WMA C vadose zone soil are expected to originate from these releases.

Figure 2-1. Aerial Boundary of Waste Management Area C and Data Quality Objectives Study Area



Study Boundary

Waste Management Area C Fenceline

3.0 SAMPLING REQUIREMENTS

Surface and subsurface soil samples will be taken and analyzed as part of this characterization effort (see Table 3-1). Sample analysis results will be used to evaluate human health and ecological risks. Prior to implementing sampling activities, surface radiation surveys will be conducted to protect the health and safety of workers. Near-surface infrastructure will be mapped using surface geophysical surveys such as ground penetrating radar prior to initiating sampling activities. In addition to soil sampling, surface geophysical exploration (SGE) will be performed. Soil sampling locations will be refined based in part on the results of the SGE surveys. Results from soil samples and SGE will be used to evaluate nature and extent of contaminants. Detailed descriptions of and requirements for these survey techniques are provided in Section 4 of RPP-PLAN-39114.

3.1 SUBSURFACE SAMPLING

3.1.1 Sampling Technique

After completion of geophysical survey(s), identified sites will be investigated by the use of small diameter direct push pipe which will be advanced to the target depth or refusal. The subsequent hole will be geophysically logged with bismuth germanium oxide or sodium iodine, and gamma and neutron-neutron moisture instrumentation. The logging data will be reviewed by qualified technical personnel to determine sample collection points. At each sample location, an initial exploratory push will be performed. The resulting exploratory borehole will be decommissioned per applicable requirements of WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells" (e.g., filled with bentonite or bentonite/cement grout as required). An average of seven sample depths per location is planned: three in the top 15 ft (not including a surface sample) and four below 15 ft. After the depths of individual samples are selected, a second push at approximately the same location will be performed. Soil samples will be collected from the pre-determined depths and sent to laboratories where the samples will be analyzed as described in Section 4.0. Direct push sampling techniques are described below.

Single-String Sampling System: The single-string sampling system consists of three stainless steel liners (Shelby tubes) contained within a sampler body that is deployed by small-diameter push rods. The three liners are each 4.22 cm (1.66 in.) outside diameter, 3.89 cm (1.53 in.) inside diameter, and 15.24 cm (6 in.) long. The probe driving equipment is positioned at the appropriate location and the sampler is advanced to the targeted depth. By use of a key release mechanism, the removable tip is released and the open sampler is advanced through the selected sample interval. The entire rod string including the sampler is then retrieved to surface. The sampler is removed from the push tubing and the stainless steel liners are extracted from the sampler mechanism. The sampling push hole is then re-entered with push tubing and decommissioned per WAC 173-160 requirements.

Dual-String Sampling System: The dual-string sampling system consists of inner and outer strings that are deployed by small-diameter push rods. When the targeted sampling depth is achieved, the rods are pulled back and the removable tip is removed from the inner rods.

Table 3-1. Sampling Design (5 sheets)

Sampling Site Designation	Location	Deployment	Number of Sampling Direct Pushes	Average Number of Samples per Direct Push[a]	Number of Surface Samples	Known or Suspected Event	Objective	Access Availability	Sampling Status as of November 2011
A	Spare inlet 241-C-101	Direct push, slant	1-2	7	1 sample plus 1 collocated duplicate	Tank over fill. Loss through spare inlet	Characterize C-101 release and refine conceptual models 1, 2, and 4	Fair	Sampled in fiscal year (FY) 2011
B	241-C-101, south side	Direct push, vertical or slant	1	7	1 sample plus 1 collocated duplicate	Tank release	Characterize C-101 release and refine conceptual models 1 and 2	Good	Sampled in FY2011
C	241-C-203 and 200-UPR-E-137	(1) Direct push, slant (2) 4 adjacent vertical direct pushes at Sites C and D combined to support placement of deep electrodes for 3D SGE; (3) Direct push slant, depending on SGE results[b]	1 or more, based on SGE results	7	1 sample plus 1 collocated duplicate	Tank leak and/or tank over fill. Loss through spare inlet	Determine if C-200s actually leaked and refine conceptual models 1, 2, and 4; determine if any C-200 tank leaked during retrieval	Fair	One slant direct push was logged in FY2011; its companion slant direct push was sampled in FY2012; SGE planned in 2013; additional sampling dependent on SGE results
D	241-C-201 241-C-202 241-C-204	(1) 4 adjacent vertical direct pushes at Sites C and D combined to support placement of deep electrodes for 3D SGE; (2) Direct push, slant, depending on SGE results[b]	TBD based on SGE results	TBD	TBD	200 series tank leaks	Determine if C-200s actually leaked and refine conceptual models 1, 2, and 4; determine if any C-200 tank leaked during retrieval	Fair	SGE planned in 2013; sampling dependent on SGE results

Table 3-1. Sampling Design (5 sheets)

Sampling Site Designation	Location	Deployment	Number of Sampling Direct Pushes	Average Number of Samples per Direct Push[a]	Number of Surface Samples	Known or Suspected Event	Objective	Access Availability	Sampling Status as of November 2011
E	Between 241-C-106 and 200-C-109	Direct push, vertical	1	7	1 sample plus 1 collocated duplicate	Suspected release	Assess ^{60}Co and refine conceptual models 1, 2, and 4	Fair	Sampled in FY2010
F	Bldg C-801 chemical drain	Direct push, vertical	1	7	1 sample plus 1 collocated duplicate	Suspected release site	Assess release of PUREX waste, ^{137}Cs and ^{99}Tc, and ^{60}Co and refine conceptual models 1, 2, and 4	Good	Sampled in FY2010
G	Between Bldg C-801 and 241-C-103	Direct push, vertical	1	7	1 sample plus 1 collocated duplicate	Suspected transfer line release site	Assess release and ^{60}Co and refine conceptual models 1, 2, and 4	Good	Sampled in FY2009
H	Northeast side of E-91	Direct push, vertical	1	7	1 sample plus 1 collocated duplicate	Surface release	Surface exposures and assess ^{60}Co and surface release conceptual model	Good	Sampled in FY2010
I	Northeast side of E-115	Direct push, vertical or slant	1	7	1 sample plus 1 collocated duplicate	Surface release	Surface exposures and assess ^{60}Co and surface release conceptual model, refine conceptual models 1, 2, and 4	Good	Sampled in FY2010
J	241-C-104	Direct push, slant	1	7	1 sample plus 1 collocated duplicate	Tank release	Assess suspected release and refine conceptual models 1, 2, and 4	Fair	Sampled in FY2011

Table 3-1. Sampling Design (5 sheets)

Sampling Site Designation	Location	Deployment	Number of Sampling Direct Pushes	Average Number of Samples per Direct Push[a]	Number of Surface Samples	Known or Suspected Event	Objective	Access Availability	Sampling Status as of November 2011
K	241-C-108	Direct push, vertical or slant	1	7	1 sample plus 1 collocated duplicate	Transfer line leak, hot drywell (09-02)	Assess suspected release and refine conceptual models 1, 2, and 4	Poor due to retrieval operations	Deleted; replaced with site X to investigate C-105
L	241-C-103 and 241-C-106	Drywell logging and direct push, vertical	2	7	1 sample plus 1 collocated duplicate	Potential transfer line leak and tank over fill	Update logging data for ^{60}Co, ^{137}Cs, uranium, and moisture and assess potential release and refine conceptual models 1, 2, and 4	Fair	Sampled in FY2009 and FY2010
M	241-C-104, 241-C-108, 241-C-109, 241-C-110, 241-C-111, and 241-C-112	Drywell logging	N/A	N/A			Update logging data for ^{60}Co, ^{137}Cs, uranium, and moisture	Fair to good	N/A
N	Unplanned releases (UPR)-86, UPR-82 and UPR-81	SGE	N/A	N/A			Test SGE, define plume at UPR-82 and UPR-86; refine conceptual models 1, 2, and 4	Good	N/A
O	Waste Management Area (WMA) C	SGE	N/A	N/A			3D vision of suspected releases – may lead to supplemental sample locations	Good	N/A
P	UPR-81	Balance of direct pushes to complete characterization	3	7	1 sample plus 1 collocated duplicate	Known release site	Characterize release and refine conceptual models 1, 2, and 4	Good	Sampled in FY2009

Table 3-1. Sampling Design (5 sheets)

Sampling Site Designation	Location	Deployment	Number of Sampling Direct Pushes	Average Number of Samples per Direct Push[a]	Number of Surface Samples	Known or Suspected Event	Objective	Access Availability	Sampling Status as of November 2011
Q	UPR-82	(1) 4 adjacent direct pushes to support placement of strings of deep electrodes for 3D SGE per Map Design. Site N; (2) Direct push through center depending on SGE results[b]	1	7	1 sample plus 1 collocated duplicate	Known release site	Test SGE: resolve depth with deep electrodes; define plume at UPR-82; refine conceptual models 1, 2, and 4	Poor due to shotcrete cover	SGE completed in FY2011; direct push through center deleted
R	241-C-301 Catch Tank	Direct push vertical	1	7	1 sample plus 1 collocated duplicate	Unlined concrete catch tank	Assess potential catch tank release and refine conceptual models 1, 2, and 4	Good	Sampled in FY2010
S	UPR-72 and C-8 Drain	Direct push vertical	1	7	1 sample plus 1 collocated duplicate	Buried radioactive material and French drain from 241 CR Building are in this area	Assess presence of buried material and potential releases to C-8 drain and refine conceptual models 1, 2, and 4	Good	Deleted
T	TBD, based on SGE data for entire WMA	TBD, direct push vertical and/or slant	TBD	TBD	TBD	Previously unknown release sites	TBD	TBD	Sampling dependent on SGE results
U	241-C-110	Direct push, slant or vertical	1	7	1 sample plus 1 collocated duplicate	Tank leak and/or tank over fill. Loss through spare inlet	Characterize C-110 release and conceptual models 1, 2, and 4	Fair	Sampled in FY2010

Table 3-1. Sampling Design (5 sheets)

Sampling Site Designation	Location	Deployment	Number of Sampling Direct Pushes	Average Number of Samples per Direct Push[a]	Number of Surface Samples	Known or Suspected Event	Objective	Access Availability	Sampling Status as of November 2011
V	241-C-111	Direct push vertical	1	7	1 sample plus 1 collocated duplicate	Tank leak and/or tank overfill. Loss through spare inlet	Characterize C-111 release and conceptual models 1, 2, and 4	Good	Deleted
W	299-E27-4 299-E27-12, 299-E27-13, 299-E27-14, 299-E27-15	Log groundwater monitoring wells outside of WMA C	N/A	N/A			Log wells to collect data on U, ^{60}Co, ^{137}Cs, and moisture	Good	N/A
299-E27-20	Well 299-E27-20, adjacent to 299-E27-23	Analysis of archived soil samples	N/A	N/A	N/A	Previously unknown release site	Assess presence of potential release (^{99}Tc) to soil column impacting groundwater and conceptual models 1, 2, and 4	N/A	Planned for FY2013
X	241-C-105	Direct push, slant	1	7	1 sample plus 1 collocated duplicate	Cascade line leak. Possible tank leak and/or tank over fill	Investigate extent of high activity (10^7 pCi/g) ^{137}Cs plume in drywell 30-05-07 near tank C-105 and refine conceptual models 1, 2, and 4	Fair	Planned for 2013

[a]Value excluding surface samples.

[b]Sites D and Q and future work at site C are applicable only to probe holes installed for sampling. Additional probe holes will be placed to support logging/electrode placement.

3D = three dimensional PUREX = Plutonium Uranium Extraction (Plant) SGE = surface geophysical exploration TBD = to be determined

A sampler is attached to the inner string and returned to the bottom of the outer casing/push tubing and positioned against the inner receiver face of the drive shoe. The inner and outer tubing strings are "locked" together by use of a proprietary method, and the entire assembly is advanced through the targeted sample interval.

The sampler body holds three stainless steel liners. The liners are removed from the sampler body and surveyed. Trained sample-handling technicians document recovery, sample condition, and volume recovery percent. They then package and transport the sample under chain-of-custody control to the selected laboratory for analysis. The "dummy" tip is reattached to the inner string and returned to bottom and placed in the casing shoe, and the entire assembly is advanced to the next designated sample depth. This process is repeated until all sample depths are achieved or the tubing meets refusal.

Upon completion of the final sample extraction, or upon meeting refusal, the dummy tip or sampler is removed and the borehole is decommissioned per WAC 173-160 requirements.

3.1.2 Sampling Strategy

There are two ways that direct pushes are performed to support these sampling efforts: vertical pushes and slant (i.e., angle) pushes. This section describes the methodology associated with vertical and slant pushes.

The sampling strategy at each vertical direct push site is summarized below. Note that the specified depths are only approximate and are subject to constraints in the field.

1. At each site, a minimum of two direct push probe hole pushes will be completed. The initial probe hole is logged for both gross gamma and neutron moisture. Following logging, deep electrodes are installed for SGE. The second push is for soil sampling based on the data derived from the first push.

2. The depth of the first direct push will be ~200 ft below ground surface (bgs). This target depth is based on the observation of ^{99}Tc and nitrate at 160 ft bgs at borehole C4297 and ^{60}Co between 150 and 160 ft bgs at well 299-E27-4. Note that the depth at site S is expected to be to 260 ft bgs or refusal based on ^{60}Co detected at nearby well 299-E27-14.

3. In general, strings of depth electrodes are placed starting at the base of the initial probe hole with an electrode every 20 ft to the base of the SSTs. Borehole conditions may necessitate changes from the general rule.

4. For the second direct push hole (i.e., sampling hole), three samples will be collected at depths less than 15 ft bgs: 5, 10 and 14 ft bgs in the vadose zone. These depths are only approximate and were selected such that they are somewhat evenly spaced apart. The purpose of collecting samples in the first 15 ft is to provide data for the direct exposure pathway and to provide initial data for ecological risk.

5. For depths greater than 15 ft bgs, the depth location for sampling individual horizons will be selected by reviewing the gamma and moisture logs of the first direct push and the following information: any leak loss inventory information pertinent to the site, geologic summary of the area, operational history, and historical characterization data at that site. The selection of sampling horizons will be done in an open meeting to which Tank Operation Contract staff, DOE, Ecology, U.S. Environmental Protection Agency (EPA), and other site contractors are invited.

The sampling strategy for the sites with slant probe holes is the same as for vertical probe holes with the following exceptions.

1. The angle of the slant probe hole will be determined after ground penetrating radar survey has been completed.

2. The length of slant direct pushes at the C-100 series tanks will be ~200 ft of pipe run or refusal, while for the C-200 series tanks the length will be ~160 ft of pipe run or refusal. The exact length depends upon the setup location and the angle of the direct push. The goal of the probe holes is to determine if tank fluids were released into the environment.

3. For slant probe holes, three soil samples (direct exposure and ecological risk) will be taken in the upper 15 ft of the vadose zone. The location along the length of these probe holes will be determined by the angle of the probe hole, but samples will be collected at ~5, 10, and 14 ft bgs. Deeper samples will be taken using the method outlined in step 5 of the strategy for vertical probe holes. Additionally, the direct push probe hole placed at the C-200 series tanks will be extended to sample soils beneath the pipelines running between the C-200 series and the C-100 series tanks.

4. One deep electrode will be installed in the initial slant probe hole. If the angle of the slant probe hole permits, a second electrode may be set.

If contamination is found in any of the soil sampling probe holes at their total depth, additional characterization technologies may be deployed upon agreement from Ecology to define the maximum depth of contamination. Sampling below 200 ft bgs may require a drilled borehole. If drilling of the borehole extends all the way into groundwater, Ecology and DOE will meet to determine if a groundwater well will be installed at the location or if the borehole will be decommissioned in accordance with WAC 173-160.

3.2 SURFACE SAMPLING

Surface soil samples will be taken at the sites where direct push samples are planned (see Table 3-1). Soil in the top 12 in. will be collected using spatula, scoop, or miniature core samplers. The samples will be sent to laboratories where they will be analyzed according to a two-step approach as described in Section 4.1. Although every attempt will be made to collect this sample, the gravel surface in tank farms may prevent taking a sample that contains environmentally sensitive media (i.e., soil particles less than 0.08 in. [2 mm] in diameter). If this

is the case, pictures of the sampling site showing the gravelly nature of the land surface and the reason as to why a sample was not taken will be documented in borehole/site completion reports.

3.3 SOIL SAMPLING DESIGN

3.3.1 Sample Number and Locations

A random sampling approach cannot be applied in WMA C because of the extensive amount of interferences caused by buried infrastructure and topographic constraints. Also, significant knowledge exists regarding locations and sources for known and suspected releases in and around WMA C. Therefore, a non-probabilistic (biased) sampling strategy that targets locations where contaminants are most likely to be encountered will be employed. This approach provides the highest potential for confirming and characterizing these known and suspected releases. In addition, an attempt will be made to identify any unknown releases by using SGE across the entire tank farm. Surface geophysical exploration will be used as an alternative technique to random sampling for investigating unknown releases because, regardless of infrastructure interference, the target area is simply too large to permit, in terms of time and resources, a statistically valid random sampling effort.

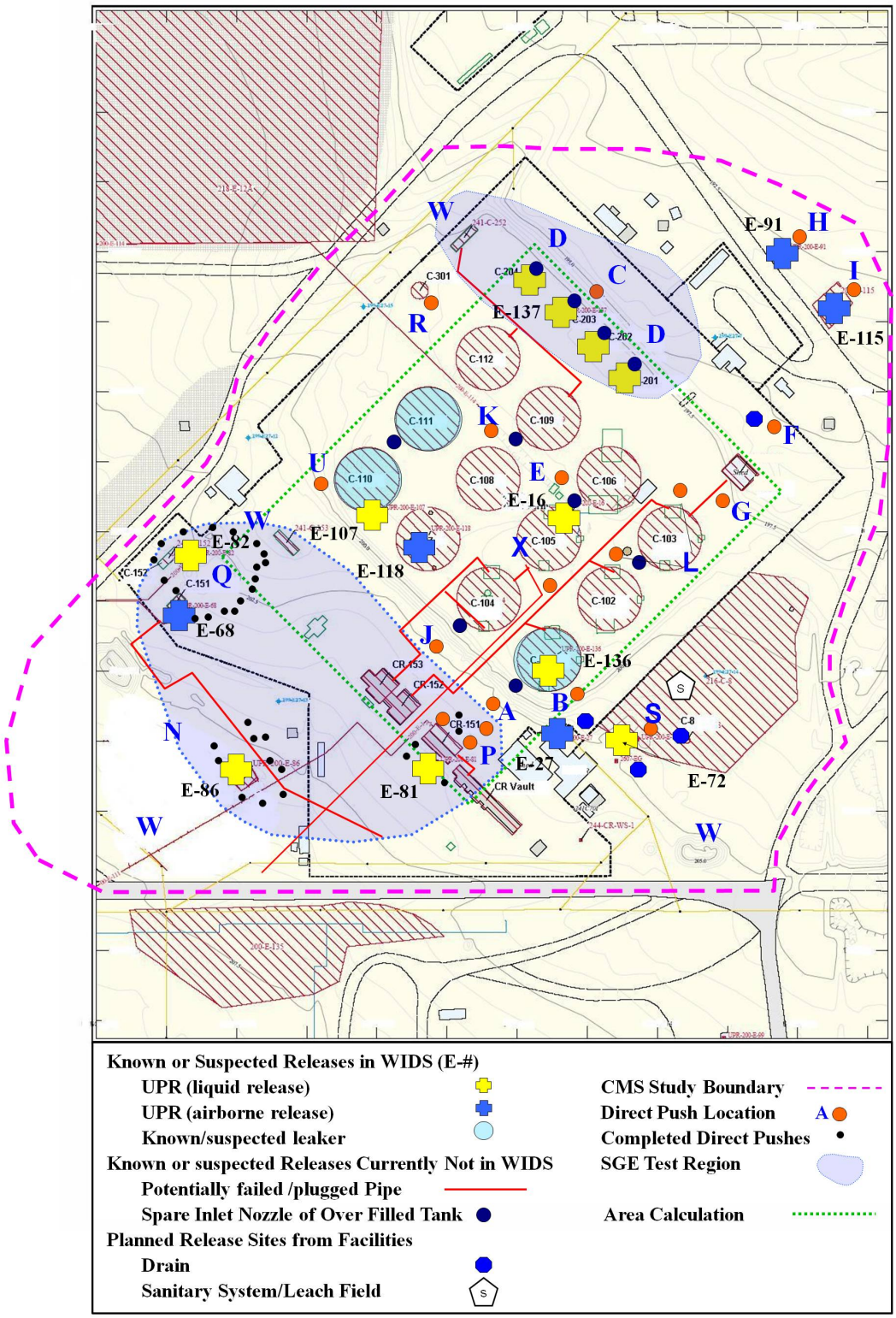
Candidate sample locations are identified in the WMA C DQO (RPP-RPT-38152). Rationale for selecting sample locations is described in detail in Section 4.4 of RPP-PLAN-39114. Figure 3-1 shows the location of known and suspected releases in and around WMA C and the location of the candidate sample sites. Figure 3-2 shows the candidate sample locations in relationship to existing surface features and Figure 3-3 shows the candidate sample locations relative to subsurface interferences. The final sample locations will be established based on collected geophysical data and facility walk downs conducted prior to deployment of the sampling equipment to the sample site. Table 3-1 presents a general description of the candidate sampling locations.

At 241-C-203, one slant direct push will be made and a total of five samples will be collected at depths >15 ft bgs. Additional vertical direct pushes will be placed to optimize conduct of an SGE survey in this region. Additional push sites may be identified from the SGE analysis.

3.4 SAMPLE HANDLING AND SHIPPING

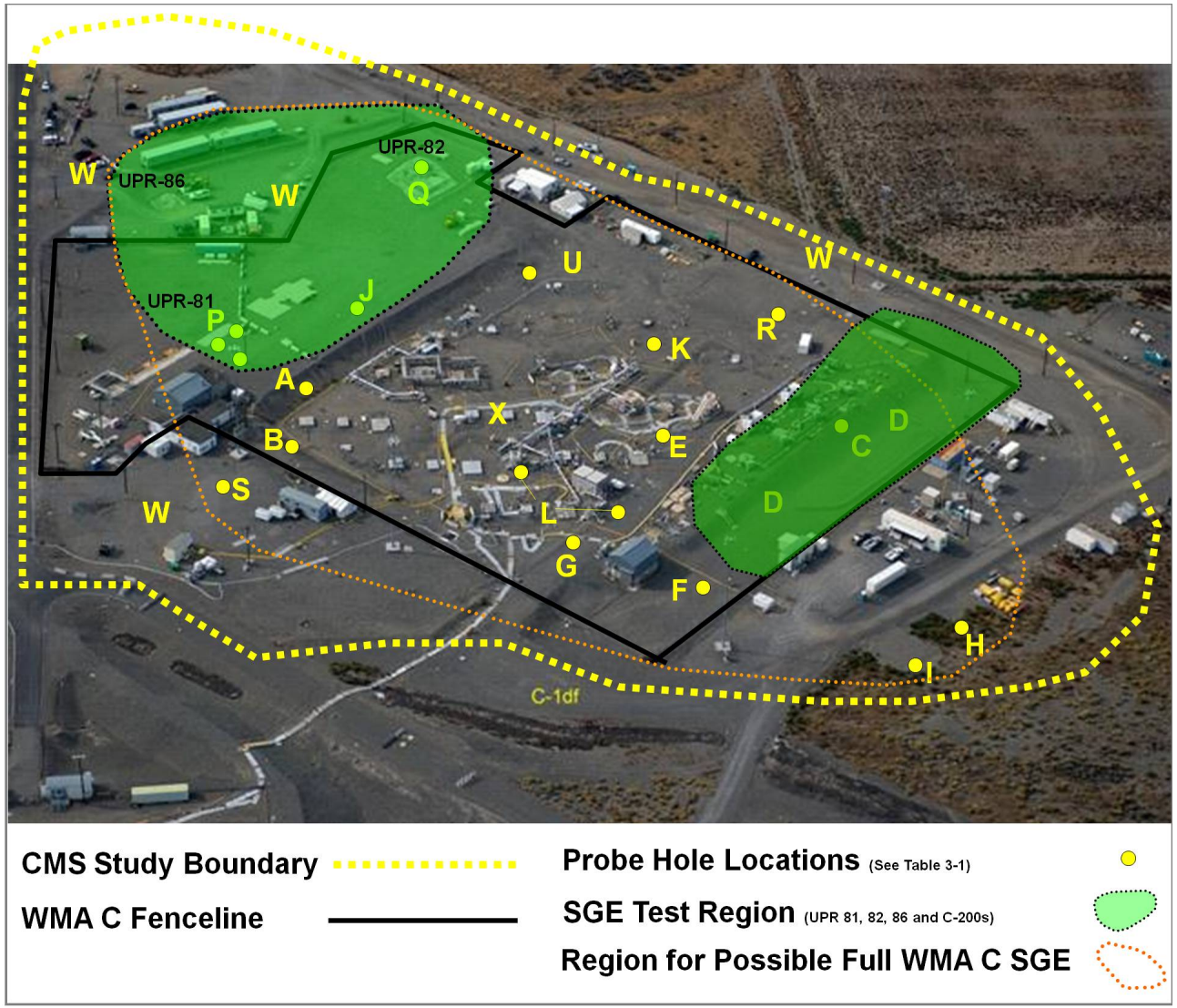
Whenever possible, soil samples shall be cooled to, maintained and shipped at ≤6 °Celsius. The samples shall be shipped to the laboratory as soon as possible to meet applicable holding times. However, it is recognized that some samples may have elevated levels of radioactivity. These samples must be stored and transported in shielded shipping containers that may not allow the samples to be maintained at ≤6 °Celsius. Also, fewer samples may be shipped to the laboratory in a shipment. The additional shipments may jeopardize sample holding times recommended in SW-846, *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods*. To minimize impact on sample integrity, these highly radioactive samples shall not be exposed to high temperatures and they will be shipped to the laboratory for analysis as soon as possible. Samples

Figure 3-1. Candidate Sample Locations and Surface Geophysical Exploration Interrogation Areas



CMS = Corrective Measures Study
SGE = surface geophysical exploration
UPR = unplanned release
WIDS = Waste Information Data System

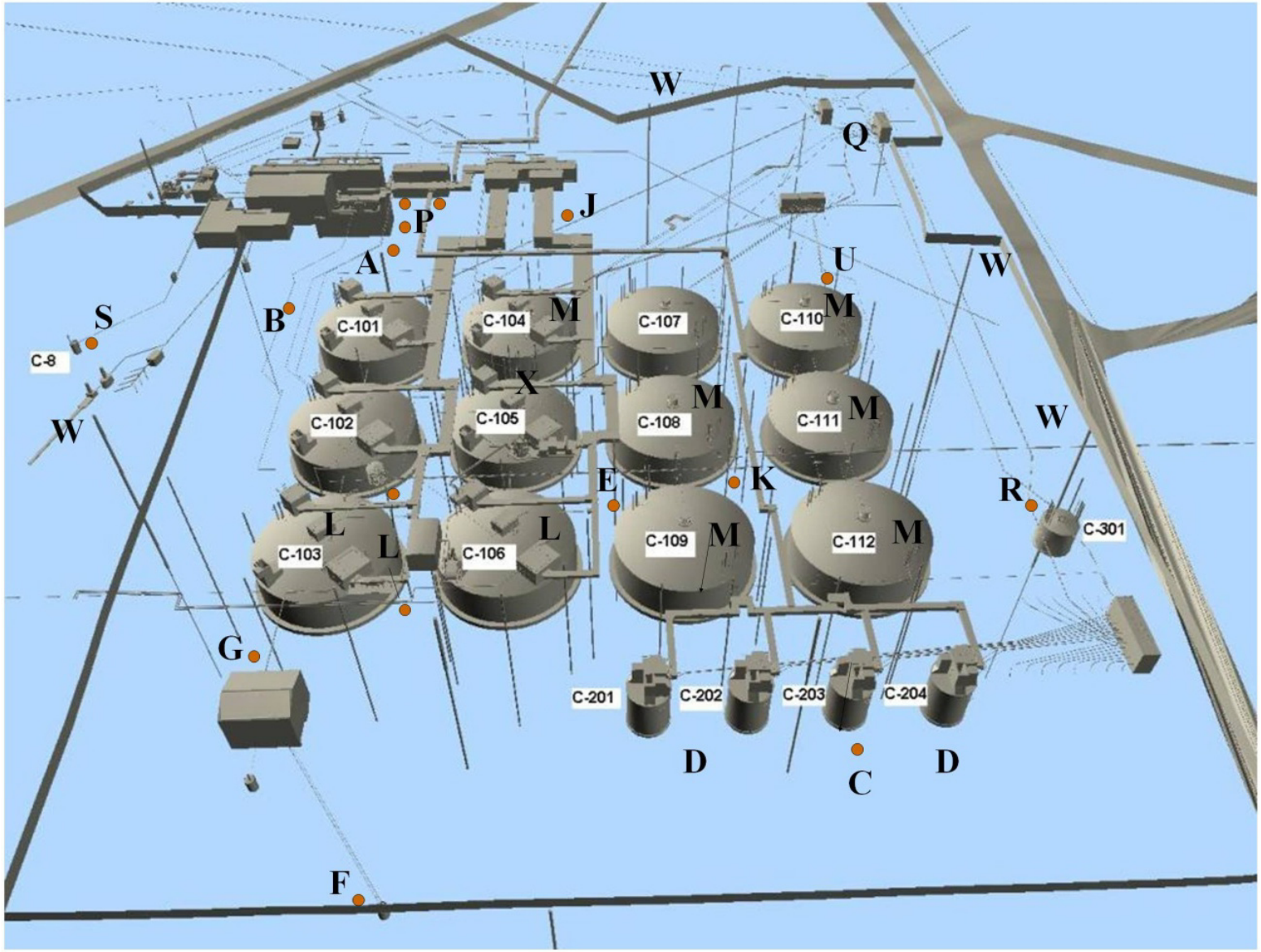
Figure 3-2. Aerial Map of Candidate Sample Locations and Surface Geophysical Exploration Interrogation Areas on Aerial Map



SGE = surface geophysical exploration

WMA = Waste Management Area

Figure 3-3. Candidate Sample Locations and Infrastructure Constraints



not meeting temperature or holding time requirements shall be discussed in the laboratory data report. The impact on subsequent use or interpretation of these data will be evaluated on a case-by-case basis by the Tank Operation Contractor.

Radiological control technician(s) measure contamination levels on the outside of each sample jar and dose rates on each sample jar. The radiological control technician(s) also measure radiological activity on the outside of the sample container (through the container) and document the highest contact radiological reading in millirem per hour. This information, along with other data, is used to select proper packaging, marking, labeling, and shipping paperwork in accordance with U.S. Department of Transportation regulations (Title 49, *Code of Federal Regulations*, "Transportation") and to verify that the sample can be received by the analytical laboratory in accordance with the laboratory's acceptance criteria.

3.5 SAMPLE IDENTIFICATION

A sample and data-tracking database is used to track the samples from the point of collection through laboratory analysis process. The Hanford Environmental Information System (HEIS) database will be the repository for the laboratory analytical results. Sample numbers from HEIS are issued to the sampling organization for this project in accordance with onsite organizational procedures. Each radiological/nonradiological and physical properties sample is identified and labeled with a unique HEIS sample number. The sample location, depth, and corresponding HEIS numbers are documented in the sampler's field logbook.

Each sample container is labeled with the following information using a waterproof marker on firmly affixed water-resistant labels:

- Sample identification number
- Sample collection date and time
- Name or initials of person collecting the sample
- Preservation method (if applicable)
- Sample location (direct push hole number and depth of collection).

A list of sample analyses is not required for sample labels because the list could be quite large. The laboratory will consult the sampling and analysis work instruction document(s) for appropriate analyses and additional guidance for preparing the sample for analysis.

3.6 SAMPLE CUSTODY

A chain-of-custody form is used for each sample and accompanies each sample from sampling through analysis. At a minimum, the following sampling information is included on the chain-of-custody form:

- Project name
- Signature of the collector
- Date and time of collection
- Sample type (e.g., soil)
- Requested analysis or provide a reference for sample analysis
- Signatures of persons involved in the chain of possession
- Date and time relinquished to the laboratory
- Unique sample identification number assigned to the sample
- Sample location (direct push hole number and depth of collection)
- A notation of pertinent sampling information including unusual characteristics or sampling problems
- A brief description of the sample matrix such as color or consistency if possible.

Each sample is shipped to the laboratories in an approved shipping container per approved procedure. A custody seal is affixed to the lid of each sample container.

4.0 SAMPLE ANALYSIS REQUIREMENTS

Note that in this SAP, the specified EPA SW-846 analytical methods are shown without suffices indicating method revisions. For these methods, the most recent revisions are preferred. Table 4-1 identifies the constituents of potential concern (COPCs) and associated analytical requirements. The laboratory required detection limit (LRDL) is one of the analytical requirements listed in Table 4-1. The LRDL is determined by using the required detection limit (RDL) or the target detection limit (TDL), whichever is lowest. When neither an RDL nor a TDL is defined in RPP-PLAN-38777, the typical laboratory achievable detection limit is used as the LRDL.

4.1 OPTIMIZATION OF SAMPLE ANALYSIS

Based on Phase 1 soil sampling results, it is expected that many of the soil samples that will be collected in Phase 2 are not contaminated. The DQO, RPP-RPT-38152, allows the use of a two-step approach to sample analysis wherein samples are analyzed for a limited suite of analytes to determine if additional characterization is required. If the initial analysis results exceed the threshold values listed, the full suite of analytes is required. This two-step process will not be implemented in this SAP; instead full characterization is performed on the samples. Completing the limited suite of analyses first would result in missed holding times for the other required constituents or required resampling. Therefore, the full suite of analyses is performed at the time of sampling to alleviate the risks to data quality (holding times) and cost (resampling).

In addition, organic contaminants are not expected to be present in the WMA C vadose zone soil samples in significant amounts. Organic analyses will be performed on samples to be collected from five sites. Results will be used to determine if certain organic analytes should be removed from the list of COPCs. The organics optimization approach is described in Section 4.1.1. A flow diagram for the overall optimization of sample analyses is provided in Figure 4-1.

4.1.1 Organic Analyses Optimization

Five of the 27 sites identified for characterization have been selected to evaluate potential for organic contamination. The five candidate direct push sites are associated with UPR-81 (three locations) (site P) and on the northwest and northeast side of SST 241-C-103 (two locations) (site L).

At these five locations, following the spectral gamma and neutron logging, samples will be collected and analyzed for the entire suite of analytes. Tributyl phosphate (TBP) will be used as the indicator organic for the occurrence of any organic contamination associated with tank waste. Tributyl phosphate is a known tank waste contaminant because it was used extensively as a solvent in the reprocessing of spent nuclear fuel. Tributyl phosphate was chosen because it has the highest probability of being found. It is the only organic constituent other than acetone and 2-Butanone found above detection limits in all tank residual samples and it is found at higher concentrations, 75 to 73,000 µg/g (mg/kg), which is 10 to 100,000 times higher than all other organics including PCBs. It was presented during the DQO process that if TBP is not found then

Table 4-1. Constituents of Potential Concern (6 sheets)

Constituent	Chemical Abstracts Service #	Primary/ Secondary Analyte	Method	Alternative Method(s)	Holding Time[a]	Laboratory Required Detection Limit (mg/kg, unless otherwise noted)
Inorganic Constituents						
Metals						
Aluminum	7429-90-5	P	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	5
Antimony	7440-36-0	P	6020 (ICP/MS)	200.8 (ICP/MS) or 6010 (ICP/AES)	6 Months	0.5
Arsenic	7440-38-2	P	6020 (ICP/MS)	200.8 (ICP/MS) or 6010 (ICP/AES)	6 Months	0.7
Barium	7440-39-3	P	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	10.2
Beryllium	7440-41-7	P	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	0.5
Bismuth	7440-69-9	S	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Boron	7440-42-8	S	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	6
Cadmium	7440-43-9	P	6020 (ICP/MS)	200.8 (ICP/MS) or 6010 (ICP/AES)	6 Months	0.4
Calcium[g]	7440-70-2	P	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Cerium	7440-45-1	S	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Chromium	7440-47-3	P	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	0.15
Cobalt	7440-48-4	P	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	2
Copper	7440-50-8	P	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	1
Europium	7440-53-1	S	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Iron	7439-89-6	P	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	5
Lanthanum	7439-91-0	S	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Lead	7439-92-1	P	6020 (ICP/MS)	200.8 (ICP/MS) or 6010 (ICP/AES)	6 Months	5
Lithium[g]	7439-93-2	P	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	3.5
Magnesium[g]	7439-95-4	P	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Manganese	7439-96-5	P	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	1.9
Mercury	7439-97-6	P	7470 (CVAA)	7471 (CVAA), 6020 or 200.8 (ICP/MS)	28 Days	0.01
Molybdenum[g]	7439-98-7	P	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	4
Neodymium	7440-00-8	S	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Nickel	7440-02-0	P	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	3
Niobium	7440-03-1	S	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Palladium	7440-05-3	S	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Phosphorus[g]	7723-14-0	P	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Potassium[g]	7440-09-7	P	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Praseodymium	7440-10-0	S	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Rhodium	7440-16-6	S	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Rubidium	7440-17-7	S	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Ruthenium	7440-18-8	S	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Samarium	7440-19-9	S	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Selenium	7782-49-2	P	6020 (ICP/MS)	200.8 (ICP/MS) or 6010 (ICP/AES)	6 Months	0.03

Table 4-1. Constituents of Potential Concern (6 sheets)

Constituent	Chemical Abstracts Service #	Primary/ Secondary Analyte	Method	Alternative Method(s)	Holding Time[a]	Laboratory Required Detection Limit (mg/kg, unless otherwise noted)
Silicon	7440-21-3	S	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Silver	7440-22-4	P	6020 (ICP/MS)	200.8 (ICP/MS) or 6010 (ICP/AES)	6 Months	0.2
Sodium[g]	7440-23-5	P	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Strontium	7440-24-6	P	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	1
Sulfur	7704-34-9	S	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Tantalum	7440-25-7	S	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Tellurium	13494-80-9	S	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Thallium	7440-28-0	P	6020 (ICP/MS)	200.8 (ICP/MS) or 6010 (ICP/AES)	6 Months	0.1
Thorium	7440-29-1	S	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Tin	7440-31-5	S	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	6
Titanium	7440-32-6	S	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Tungsten	7440-33-7	S	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Uranium[b]	7440-61-1	P	6020 (ICP/MS)	200.8 (ICP/MS), 6010 (ICP/AES), Kinetic Phosphorescence Absorption (KPA), or Calculated from isotopic results	6 Months	0.5
Vanadium	7440-62-2	P	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	0.2
Yttrium	7440-65-5	S	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Zinc	7440-66-6	P	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	1
Zirconium	7440-67-7	S	6010 (ICP/AES)	6020 or 200.8 (ICP/MS)	6 Months	
Anions						
Acetate	71-50-1	P	9056 (IC)	300.0 (IC)	28 Days	4.5
Bromide	24959-67-9	S	9056 (IC)	300.0 (IC)	28 Days	1
Chloride	16887-00-6	P	9056 (IC)	300.0 (IC)	28 Days	0.3
Cyanide	57-12-5	P	9014 (Spec)	4500E or 335.2, 9010, 9012 (Spec) or ICP/MS	14 Days	0.5
Ferrocyanide	13601-19-9	P	Estimated from Total Cyanide	Estimated from Total Cyanide	N/A	
Fluoride	16984-48-8	P	9056 (IC)	300.0 (IC)	28 Days	5
Formate	FORMATE	P	9056 (IC)	300.0 (IC)	28 Days	10
Glycolate	666-14-8	P	9056 (IC)	300.0 (IC)	28 Days	3.8
Nitrate	14797-55-8	P	9056 (IC)	300.0 (IC)	48 Hours	2.5
Nitrite	14797-65-0	P	9056 (IC)	300.0 (IC)	48 Hours	2.5
Oxalate	338-70-5	P	9056 (IC)	300.0 (IC)	28 Days	2
Phosphate	14265-44-2	S	9056 (IC)	300.0 (IC)	48 Hours	
Sulfate	14808-79-8	P	9056 (IC)	300.0 (IC)	28 Days	2.7

Table 4-1. Constituents of Potential Concern (6 sheets)

Constituent	Chemical Abstracts Service #	Primary/ Secondary Analyte	Method	Alternative Method(s)	Holding Time[a]	Laboratory Required Detection Limit (mg/kg, unless otherwise noted)
Miscellaneous Inorganic Constituents						
Ammonium	14798-03-9	P	300.7 (IC)		7 Days	0.5
Bulk Density			D2937		None	
Percent Solids			Gravimetric		None	
pH			9045 (pH)		24 Hours[c]	
Organic Constituents						
Semivolatile Organic Compounds						
1,1'-Biphenyl	92-52-4	S	8270 (SVOC)		14/40 Days	
1,1-Dimethylhydrazine	57-14-7	S	8270 (SVOC)		14/40 Days	
1,2,4-Trichlorobenzene	120-82-1	P	8270 (SVOC)		14/40 Days	0.33
1,2-Dichlorobenzene	95-50-1	P	8270 (SVOC)		14/40 Days	0.33
1,3-Dichlorobenzene	541-73-1	S	8270 (SVOC)		14/40 Days	
1,4-Dichlorobenzene	106-46-7	S	8270 (SVOC)		14/40 Days	
1,4-Dinitrobenzene	100-25-4	S	8270 (SVOC)		14/40 Days	
2,4,5-Trichlorophenol	95-95-4	P	8270 (SVOC)		14/40 Days	0.33
2,4,6-Trichlorophenol	88-06-2	P	8270 (SVOC)	8041 (GC)	14/40 Days	0.33
2,4-Dinitrotoluene	121-14-2	P	8270 (SVOC)		14/40 Days	0.33
2,6-Bis (tert-butyl)-4-methylphenol	128-37-0	P	8270 (SVOC)		14/40 Days	1.2
2-Chlorophenol	95-57-8	P	8270 (SVOC)		14/40 Days	0.33
2-Ethoxyethanol (Cellosolve solvent)	110-80-5	P	8270 (SVOC)		14/40 Days	
2-Methylphenol (o-cresol)	95-48-7	P	8270 (SVOC)		14/40 Days	0.33
2-Nitrophenol	88-75-5	P	8270 (SVOC)		14/40 Days	0.66
2-sec-Butyl-4,6-dinitrophenol (Dinoseb)	88-85-7	S	8270 (SVOC)		14/40 Days	
3+4 Methylphenol (cresol, m+p)[d]	65794-96-9	P	8270 (SVOC)		14/40 Days	0.33
3-Methyl-2-butanone	563-80-4	S	8270 (SVOC)		14/40 Days	
Acenaphthene	83-32-9	P	8270 (SVOC)		14/40 Days	0.33
Acetophenone	98-86-2	S	8270 (SVOC)		14/40 Days	
Benzo(a)anthracene	56-55-3	P	8270 (SVOC)		14/40 Days	0.33
Benzo(a)pyrene	50-32-8	P	8270 (SVOC)		14/40 Days	0.33
Benzo(b)fluoranthene	205-99-2	P	8270 (SVOC)		14/40 Days	0.33
Benzo(k)fluoranthene	207-08-9	P	8270 (SVOC)		14/40 Days	0.33
Bis(2-ethylhexyl)phthalate	117-81-7	P	8270 (SVOC)		14/40 Days	2.95
Butylbenzylphthalate	85-68-7	P	8270 (SVOC)		14/40 Days	0.33
Chrysene	218-01-9	P	8270 (SVOC)		14/40 Days	0.33
Cresylic acid (cresol, mixed isomers) (Total Cresols)	1319-77-3	P	8270 (SVOC)		14/40 Days	0.5

Table 4-1. Constituents of Potential Concern (6 sheets)

Constituent	Chemical Abstracts Service #	Primary/ Secondary Analyte	Method	Alternative Method(s)	Holding Time[a]	Laboratory Required Detection Limit (mg/kg, unless otherwise noted)
Cyclohexanone	108-94-1	P	8270 (SVOC)		14/40 Days	0.5
Dibenz(a,h)anthracene	53-70-3	P	8270 (SVOC)		14/40 Days	0.33
Di-n-butylphthalate	84-74-2	P	8270 (SVOC)		14/40 Days	0.33
Di-n-octylphthalate	117-84-0	P	8270 (SVOC)		14/40 Days	0.33
Fluoranthene	206-44-0	P	8270 (SVOC)		14/40 Days	0.33
Hexachlorobutadiene	87-68-3	P	8270 (SVOC)		14/40 Days	0.33
Hexachloroethane	67-72-1	P	8270 (SVOC)		14/40 Days	0.33
Hexachloronaphtahlene	1335-87-1	S	8270 (SVOC)		14/40 Days	
Hexafluoroacetone	684-16-2	S	8270 (SVOC)		14/40 Days	
Indeno (1,2,3-cd) pyrene	193-39-5	P	8270 (SVOC)		14/40 Days	0.33
Isodrin	465-73-6	S	8270 (SVOC)		14/40 Days	
m-Cresol (3-Methylphenol)	108-39-4	P	8270 (SVOC)		14/40 Days	
Methylhydrazine	60-34-4	S	8270 (SVOC)		14/40 Days	
N,N-Diphenylamine	122-39-4	S	8270 (SVOC)		14/40 Days	
Naphthalene	91-20-3	P	8270 (SVOC)		14/40 Days	0.33
Nitric acid, propyl ester	627-13-4	S	8270 (SVOC)		14/40 Days	
Nitrobenzene	98-95-3	P	8270 (SVOC)		14/40 Days	0.33
n-Nitrosodi-n-butylamine	924-16-3	S	8270 (SVOC)		14/40 Days	
N-Nitrosodi-n-propylamine	621-64-7	P	8270 (SVOC)		14/40 Days	0.33
n-Nitrosomethylethylamine	10595-95-6	S	8270 (SVOC)		14/40 Days	
n-Nitrosomorpholine	59-89-2	P	8270 (SVOC)		14/40 Days	0.33
N-Nitroso-N,N-dimethylamine	62-75-9	S	8270 (SVOC)		14/40 Days	
Octachloronaphthalene	2234-13-1	S	8270 (SVOC)		14/40 Days	
p-Chloro-m-cresol (4-Chloro-3-methylphenol)	59-50-7	P	8270 (SVOC)		14/40 Days	0.33
Pentachloronaphthalene	1321-64-8	S	8270 (SVOC)		14/40 Days	
Pentachloronitrobenzene (PCNB)	82-68-8	S	8270 (SVOC)		14/40 Days	
Pentachlorophenol	87-86-5	S	8270 (SVOC)		14/40 Days	0.3
Phenol	108-95-2	S	8270 (SVOC)		14/40 Days	
p-Nitrochlorobenzene	100-00-5	S	8270 (SVOC)		14/40 Days	
Pyrene	129-00-0	P	8270 (SVOC)		14/40 Days	0.33
Pyridine	110-86-1	P	8270 (SVOC)		14/40 Days	0.66
Tetrachloronaphthalene	1335-88-2	S	8270 (SVOC)		14/40 Days	
Toxaphene	8001-35-2	S	8270 (SVOC)		14/40 Days	
Tributyl phosphate	126-73-8	P	8270 (SVOC)		14/40 Days	3.3

Table 4-1. Constituents of Potential Concern (6 sheets)

Constituent	Chemical Abstracts Service #	Primary/ Secondary Analyte	Method	Alternative Method(s)	Holding Time[a]	Laboratory Required Detection Limit (mg/kg, unless otherwise noted)
Polychlorinated Biphenyls (PCBs)						
Aroclor 1016	12674-11-2	P	8082 (GC/ECD)		None	0.02
Aroclor 1221	11104-28-2	P	8082 (GC/ECD)		None	0.02
Aroclor 1232	11141-16-5	P	8082 (GC/ECD)		None	0.02
Aroclor 1242	53469-21-9	P	8082 (GC/ECD)		None	0.02
Aroclor 1248	12672-29-6	P	8082 (GC/ECD)		None	0.02
Aroclor 1254	11097-69-1	P	8082 (GC/ECD)		None	0.02
Aroclor 1260	11096-82-5	P	8082 (GC/ECD)		None	0.02
Pesticides						
2,4'-DDD	72-54-8	P	8081 (GC/ECD)	8270 (GC/MS)	14/40 Days	0.075
2,4'-DDE	72-55-9	P	8081 (GC/ECD)	8270 (GC/MS)	14/40 Days	0.075
2,4'-DDT	50-29-3	P	8081 (GC/ECD)	8270 (GC/MS)	14/40 Days	0.075
Aldrin	309-00-2	P	8081 (GC/ECD)	8270 (GC/MS)	14/40 Days	0.01
alpha-BHC	319-84-6	S	8081 (GC/ECD)	8270 (GC/MS)	14/40 Days	
beta-1,2,3,4,5,6-Hexachlorocyclohexane (beta-BHC)	319-85-7	P	8081 (GC/ECD)	8270 (GC/MS)	14/40 Days	
Gamma-BHC (Lindane)	58-89-9	P	8081 (GC/ECD)	8270 (GC/MS)	14/40 Days	0.6
Chlordane	57-74-9	P	8081 (GC/ECD)	8270 (GC/MS)	14/40 Days	0.1
Dieldrin	60-57-1	P	8081 (GC/ECD)	8270 (GC/MS)	14/40 Days	0.007
Endrin	72-20-8	P	8081 (GC/ECD)	8270 (GC/MS)	14/40 Days	0.02
Heptachlor	76-44-8	P	8081 (GC/ECD)	8270 (GC/MS)	14/40 Days	0.04
Heptachlor epoxide	1024-57-3	P	8081 (GC/ECD)	8270 (GC/MS)	14/40 Days	0.04
Hexachlorobenzene	118-74-1	P	8081 (GC/ECD)	8270 (GC/MS)	14/40 Days	1.7
Pentachlorophenol	87-86-5	P	8081 (GC/ECD)	8270 (GC/MS)	14/40 Days	0.3
Radionuclides						
Americium-241	14596-10-2	P	AEA		6 Months	1 pCi/g
Antimony-125	14234-35-6	P	GEA		6 Months	0.3 pCi/g
Carbon-14	14762-75-5	P	LSC		6 Months	1 pCi/g
Cesium-137	10045-97-3	P	GEA		6 Months	0.1 pCi/g
Cobalt-60	10198-40-0	P	GEA		6 Months	0.05 pCi/g
Curium-242	15510-73-3	P	AEA		6 Months	1 pCi/g
Curium-243/244[e]	CM-243/244	P	AEA		6 Months	1 pCi/g
Europium-152	14683-23-9	P	GEA		6 Months	0.1 pCi/g
Europium-154	15585-10-1	P	GEA		6 Months	0.1 pCi/g
Europium-155	14391-16-3	P	GEA		6 Months	0.1 pCi/g
Iodine-129	15046-84-1	P	GEA	ICP/MS	6 Months	2 pCi/g

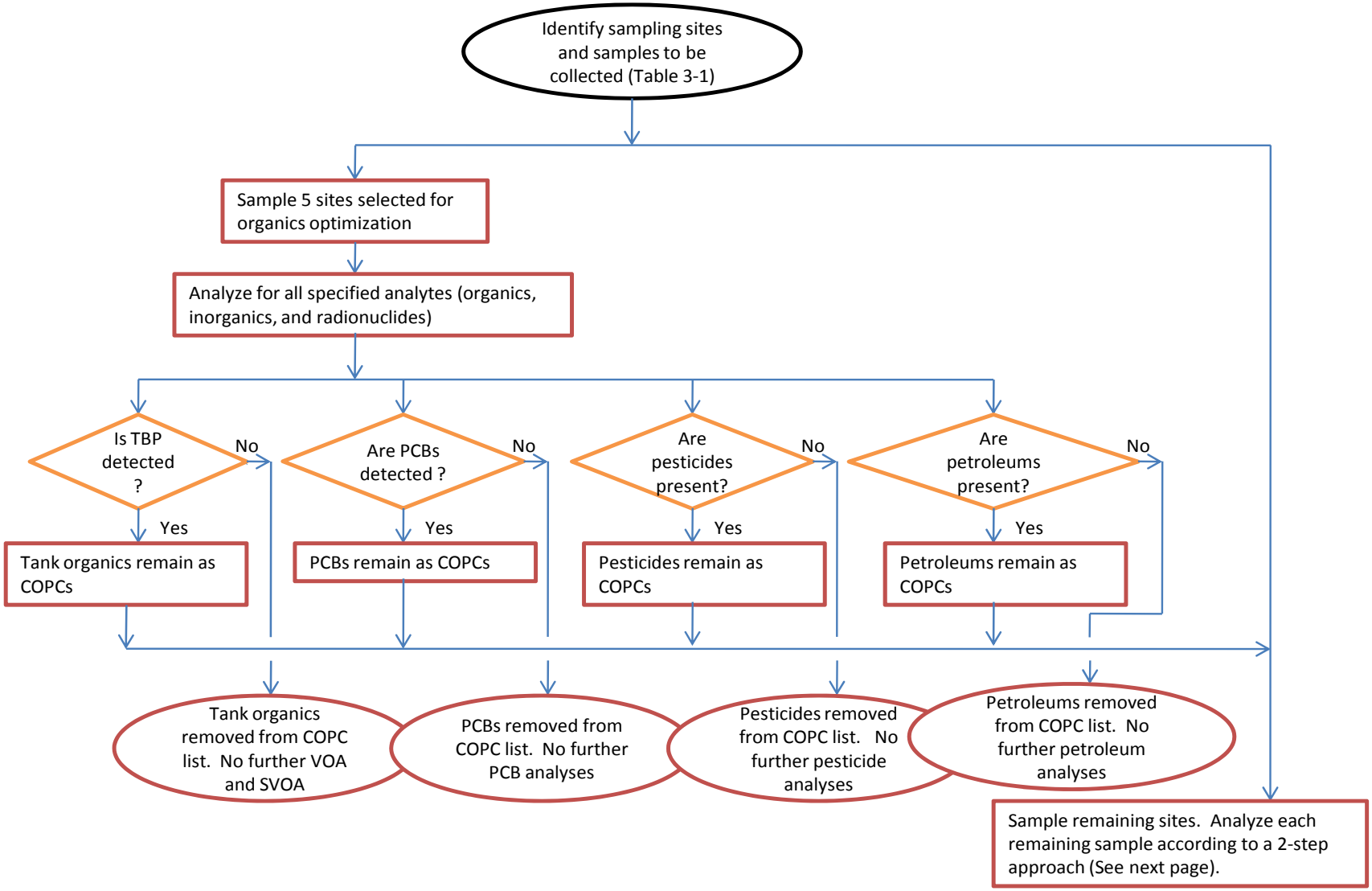
Table 4-1. Constituents of Potential Concern (6 sheets)

Constituent	Chemical Abstracts Service #	Primary/ Secondary Analyte	Method	Alternative Method(s)	Holding Time[a]	Laboratory Required Detection Limit (mg/kg, unless otherwise noted)
Neptunium-237	13994-20-2	P	ICP/MS	AEA	6 Months	1 pCi/g
Nickel-63	13981-37-8	P	LSC		6 Months	30 pCi/g
Plutonium-238	13981-16-3	P	AEA	ICP/MS	6 Months	1 pCi/g
Plutonium-239/240	PU-239/240	P	AEA	ICP/MS	6 Months	1 pCi/g
Plutonium-241	14119-32-5	P	Estimated from Pu-238 and Pu-239/240	AEA or ICP/MS	6 Months	350,000,000 pCi/g
Selenium-79	15758-45-9	P	LSC		6 Months	10 pCi/g
Strontium-89/90[f]	SR-RAD	P	GPC		6 Months	1 pCi/g
Technetium-99	14133-76-7	P	ICP/MS	LSC	6 Months	1 pCi/g
Thorium-228	14274-82-9	P	GEA		6 Months	1 pCi/g
Thorium-230	14269-63-7	P	ICP/MS	AEA	6 Months	1 pCi/g
Thorium-232	TH-232	P	ICP/MS	AEA	6 Months	1 pCi/g
Thorium-234	15065-10-8	P	GEA	ICP/MS	6 Months	
Tin-126	15832-50-5	P	ICP/MS	AEA	6 Months	
Tritium	10028-17-8	P	LSC		6 Months	30 pCi/g
Uranium-233	13968-55-3	P	ICP/MS	AEA	6 Months	1 pCi/g
Uranium-234	13966-29-5	P	ICP/MS	AEA	6 Months	1 pCi/g
Uranium-235	15117-96-1	P	ICP/MS	AEA	6 Months	1 pCi/g
Uranium-236	13982-70-2	P	ICP/MS	AEA	6 Months	
Uranium-238	U-238	P	ICP/MS	AEA	6 Months	1 pCi/g

[a] Holding time listed is for soil samples. Quality control samples will retain the same holding except for the following constituents: Pesticides in Water 7/40 Days.
[b] Isotopic uranium analysis may be substituted for total uranium as long as the required detection limit is met.
[c] Holding time for soil samples is "As Soon As Possible"; 24 hours will be used for vadose samples for tracking purposes.
[d] Sampling and Analysis Plan requires 4-Methylphenol (p-cresol); however, 3&4-Methylphenol are reported together due to analytical method.
[e] Sampling and Analysis Plan requires Curium-243 and Curium-244; however, these isotopes are reported together due to analytical method.
[f] Sampling and Analysis Plan requires Strontium-90; however, many laboratories report Strontium-89/90 due to analytical method. Based on half-live, Strontium-89 is not present in Hanford wastes; therefore, Strontium-89/90 is equivalent to Strontium-90.
[g] Calcium, lithium, molybdenum, magnesium, sodium, phosphorous, and potassium were moved from secondary constituents to primary at the request of Ecology to help in the evaluation of whether or not tank fluids have passed through the sediments.

AEA = alpha energy analysis
AES = atomic emission spectroscopy
CVAA = cold vapor atomic absorption
ECD = electron capture detector
GC = gas chromatography
GEA = gamma energy analysis
GPC = gas proportional counting
IC = ion chromatography
ICP = inductively coupled plasma
LSC = liquid scintillation counter
MS = mass spectroscopy
SVOC = semi-volatile organic compound

Figure 4-1. Optimization of Sample Analyses



COPC = constituent of potential concern
TBP = tributyl phosphate
PCB = polychlorinated biphenyl
VOA = volatile organic analysis
SVOA = semi-volatile organic analysis

it is unlikely that other organic (i.e., volatile organic analysis [VOA], semi-volatile organic analysis [SVOA], diesel range organics/gasoline range organics, PCBs) contaminants related to tank waste would be found. The DQO team agreed to use this compound as an indicator for tank waste organics.

Furthermore, if the data for the organic analytes from the pre-retrieval samples taken at the C-200 tanks is examined, the Best Basis Inventory reports the following organic analytes were found above the method detection limit (MDL) in the pre-retrieval samples: Butylbenzylphthalate, 1-Butanol, Acetone, Aroclor 1254, 2-Butanone, Xylenes (total), Xylene (m & p), Trichloroethene, Xylene (o), Hexone, Methylenechloride, and Toluene. The mean concentrations for Butylbenzylphthalate, 1-Butanol, and Acetone were 66.7 µg/g, 16.8 µg/g, and 1.01 µg/g, respectively. The only PCB above MDL was Aroclor 1254 with a mean concentration of 0.46 µg/g. 2-Butanone had a mean concentration of 0.29 µg/g, with the rest of the non-detected organic analytes having a mean concentration of less than 0.1 µg/g. Tributyl phosphate was found as a tentatively identified compound (TIC) in the pre-retrieval samples from tanks 241-C-203 and 241-C-204 with the highest concentration found at 241-C-204 at greater than 200,000 µg/g. Tributyl phosphate in the post-retrieval samples for these tanks had results ranging from ~5,000 mg/kg (241-C-201) to ~73,000 mg/kg (241-C-204).

Other organic compounds found above detection limits in some, but not all tank residuals, are Butylbenzylphthalate (3.27 mg/kg [241-C-103]), Di-n-butylphthalate (6.11 mg/kg [241-C-103], 6.08 mg/kg [241-C-204]), Hexone (2.27E-02 mg/kg [241-C-202]), and Xylenes (Total) (2.0E-02 mg/kg [241-C-203]).

If TBP is not detected in any of the samples, then organics associated with tank waste will be eliminated from the list of COPCs and samples taken at other locations in WMA C will not be analyzed for organics. If TBP is detected in any of the samples, then organics associated with tank waste will remain on the list of COPCs and these organic compounds will be analyzed as part of the Step 2 suite of analytes if a Step 1 tank waste indicator is met. Tributyl phosphate is selected as a specific tank waste contaminant. Other volatile and semivolatile compounds are rejected as either not being indicators of tank waste or are common laboratory contaminants.

Samples taken from the five sites will be analyzed for pesticides and petroleum compounds. If pesticides are not present in any of the samples from these sites, then pesticides will be eliminated from the list of COPCs and other soil samples that will be taken from WMA C will not be analyzed for these compounds. If a pesticide is present in any of the samples from the five sites, then pesticides will remain on the list of COPCs for Step 1 analyses.

Similarly, if gasoline-range organics and diesel-range organics are not present in any of the samples from the five sites, these petroleum organics will be eliminated from the list of COPCs. If they are present in any of the samples, gasoline-range organics will remain on the list of COPCs for Step 1 analyses of near-surface samples; diesel-range organics will be analyzed by gas chromatography (GC)/flame ionization detection (FID) only if GC/mass spectrometry (MS) indicates that they are present in a sample.

Polychlorinated biphenyls are of specific concern to direct contact and ecological risk and will be analyzed in near-surface samples only. Three vadose zone samples will be collected in the region of 0 to 15 ft bgs at the five direct push locations discussed above (15 samples) and analyzed for Aroclors and congeners. If PCBs are not detected in any of the samples then they will be eliminated from the list of COPCs and will not be analyzed at other locations in WMA C. If PCBs are detected in any of the samples then they will remain on the list of COPCs and will be analyzed as part of the Step 2 suite of analytes following a detection of the Step 1 tank waste trigger constituents. Results from the initial five locations will be used in an attempt to establish a correlation between PCB Aroclors and congeners. The correlation will be used to evaluate whether or not future analysis of PCB congeners is necessary.

The organic sample analysis was initially optimized in fiscal year 2011. Semi-volatile organics, PCB Aroclors, and pesticides continue to be analyzed; however, volatile organics, gasoline and diesel range organics, PCB congeners, ethylene glycol, monobutyl and dibutyl phosphate are discontinued for fiscal year 2011 sampling locations. In addition, the SST closure DQO (RPP-23403, *Single-Shell Tank Component Closure Data Quality Objectives*) was modified to remove sulfide as a constituent associated with tank waste; therefore, sampling for sulfide in WMA C is also discontinued. These changes were documented in DOE's Letter 11-TPD-020 to Ecology and Ecology's response Letter 11-NWP-053. These constituents are not listed in Table 4-1. Additional optimization may be performed if warranted by future results.

Petroleum and pesticide data will be used for an ecological risk assessment. Therefore, only samples taken in the near surface zone (i.e., in the top 15 ft) will be analyzed for these organics.

4.2 INORGANIC ANALYTES

Inorganic chemicals will be analyzed by the methods listed in Table 4-1. The inductively coupled plasma/atomic emission spectroscopy (AES), inductively coupled plasma/MS and ion chromatography (IC) methods are capable of analyzing multiple constituents. Primary and secondary constituents for these methods are also shown in Table 4-1.

Note that chromium and cyanide data will be used as conservative estimates of hexavalent chromium and ferrocyanide, respectively. If the estimates are overly conservative and calculations using the estimates result in unacceptably high risk, analysis for hexavalent chromium and ferrocyanide may be performed.

4.3 ORGANIC ANALYTES

Organic chemicals will be analyzed by the methods shown in Table 4-1. For semi-volatile organic compounds (SVOCs), primary and secondary constituents are also shown in Table 4-1. Analytical strategy for SVOCs is summarized in the following.

The primary constituents will be analyzed to the quality control (QC) requirements specified in this SAP. This means they will be included in the calibration of the gas chromatographs and MDLs will be determined for each constituent.

Detected organic constituents that are not part of the calibration mix (primary constituents), which includes the secondary constituents, are reported as TICs. If a TIC is determined to be real (i.e., not an artifact of analytical methods), it will be evaluated against a gas chromatographic library containing the secondary compounds of interest. This library of compounds (called the "Hanford library") is composed of constituents that have been identified as possibly being present in Hanford Site waste in the Regulatory DQO (PNNL-12040, *Regulatory Data Quality Objectives Supporting Tank Waste Remediation System Privatization Project*) but not identified as primary constituents.

The "Hanford library" was developed by running single standards of the constituents on the laboratory's GC/MS systems. The results of these analyses provide accurate retention time information and mass response factors for these compounds and permit a better evaluation of the TIC. If a TIC is identified in the "Hanford library" of compounds, a semiquantitative estimate (based on an archived one-point calibration) of its concentration is made.

If the TIC is not found in the "Hanford library" of compounds, then the TIC will be evaluated against the standard National Institute of Standards and Technology library of compounds. This library has over 100,000 compounds. However, because they are collected on different instruments from those used for the actual analysis, the retention times and response factors will be different. Before the analyst can name or identify the TIC, the analyst must be confident that the chromatogram and mass spectra match well enough to name the compound. If the analyst cannot confidently name the compound, it is identified as an unknown and no further action is required. When a TIC is identified in the National Institute of Standards and Technology library, then the TIC will be evaluated in a similar manner as a "Hanford library" TIC.

The TICs are identified using the reconstructed ion chromatogram. The reconstructed ion chromatogram is evaluated for TICs by identifying peaks that have not already been identified as target compounds according to the following criteria. The criteria discussed in the following are from Revision 3 of Volume 4 of DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Documents* (HASQARD).

The library match for a TIC should be higher than 75% before this detailed evaluation is initiated. The method-specified tune criteria should be met. The concentration of a TIC should be greater than 10% of the nearest internal standard or estimated 5 nanograms on column injection, whichever is smaller. Early (injection peak) and late eluting peaks (column bleed and coeluting compounds) should have adequate background subtraction to permit use of these TIC criteria. If isotopic patterns are present, the mass ratios should agree with the reference spectrum within 10%. The base mass peak for the sample should be the same as the reference spectrum. If a molecular ion is present in the reference spectrum, the sample should also have a molecular ion mass. Reference spectrum ions greater than 20% should be in the sample spectrum. Sample ions greater than 20% that are not in the reference spectrum need to be evaluated. Major sample

ions (greater than 20%) should match relative intensities to the base peak to those same ratios for the reference spectrum within 10 to 30%.

The TIC evaluation is limited to the 30 largest TICs for the SVOA meeting the criteria discussed here. Only TICs associated with a Chemical Abstracts Service registry number will be reported to HEIS. "Unknown," or unidentified, TICs will be reported in hardcopy only.

A TIC compound may be upgraded to a positively identified compound. This is achieved by obtaining the compound, analyzing it under the same conditions as the initial identification, and matching retention time and mass spectrum. The upgrade will be performed if a TIC is a significant risk contributor.

Polychlorinated biphenyl Aroclors will be measured individually. If necessary, total PCB concentrations would be calculated by summing the concentrations of seven Aroclors (1016, 1221, 1232, 1242, 1248, 1254, and 1260) found in a sample. The total PCBs in a sample are calculated by summing only detected Aroclors. If no Aroclors are detected, the total PCB concentration is considered the detection limit for the single most common Aroclor expected in the sample. Tank results indicate Aroclor 1254 is by far the most common Aroclor in Hanford Site tank waste. The policy of determining total PCB concentrations is the policy of the EPA Manchester Laboratory for determining total PCB concentrations in a sample. In addition, this method was specified by agreement in a meeting with representatives from EPA Region 10, EPA Manchester Laboratory, Ecology, DOE, Pacific Northwest National Laboratory, and the Tank Operation Contract.

Pesticide analytes are shown in Table 4-1. Only samples taken in the top 15 ft will be analyzed for these organics.

4.4 RADIOLOGICAL PARAMETERS

Radionuclides will be analyzed by the methods listed in Table 4-1.

The only truly multiple constituent analytical method for radiochemistry is gamma energy analysis (GEA). Therefore, the secondary constituents are those found in the GEA library. If a constituent in the GEA library is detected, the concentration will be reported.

5.0 QUALITY ASSURANCE AND QUALITY CONTROL REQUIREMENTS

Quality requirements for WMA C soil sampling and analysis are described in DOE/RL-96-68, HASQARD. Hanford onsite laboratories performing analyses in support of this SAP will have approved and implemented quality assurance (QA) plans. As required by TFC-PLN-02, "Quality Assurance Program Description," these QA plans will meet the minimum requirements of DOE/RL-96-68 as the baseline for laboratory quality systems. If subcontracting any portion of the analytical requirements to a commercial laboratory off the Hanford Site, the subcontractor's implementing QA program shall comply with DOECAP, *Consolidated Audit Program Quality Systems for Analytical Services*.

All sampling and analysis activities will be performed using approved methods, procedures, and work packages that are written in accordance with approved operational and laboratory QA plans, which are consistent with the requirements of this SAP. Sampling and analysis activities shall be performed by qualified personnel using properly maintained and calibrated equipment.

5.1 QUALITY CONTROL FOR FIELD SAMPLING

Prior to sampling, sampling equipment shall be cleaned using a procedure that is consistent with SW-846 sampling equipment cleaning protocol. Only new (unused) pre-cleaned, quality-assured sample containers or containers cleaned onsite per the SW-846 protocol shall be used for sampling.

Field QC samples shall be collected to evaluate the potential for cross-contamination and laboratory performance. Soil sampling will require the collection of field duplicates, equipment rinsate blanks, and temperature blanks where appropriate. Field QC sample types and frequency for collection are described as follows.

Field Duplicates

Field duplicates (i.e., samples taken at the same location) are used to evaluate precision of the sampling process. However, it is not possible to obtain direct pushes exactly at the same location. Therefore, field duplicates will not be required for direct push samples.

For surface soil samples, collocated samples will be taken. The duplicate samples shall be shipped to the laboratory and analyzed in the same manner as the primary samples.

Equipment Rinsate Blanks

Equipment rinsate blanks are used to verify the adequacy of sampling equipment decontamination procedures and shall be collected for each sampling method or type of equipment used. Equipment blanks shall consist of deionized water washed through decontaminated sampling equipment. Equipment rinsate blanks shall be analyzed using the two-step approach described in Section 4.1.

Trip Blanks

Trip blanks are performed, as required, for volatile organics at a frequency of one per day of sampling during which samples are collected for volatile organic compounds. The organic optimization performed in fiscal year 2011 removed the requirement for volatile organic analysis; therefore, no additional trip blanks will be performed.

Temperature Blanks

A temperature blank, with a water-filled vial or a suitable thermometer, should be included with each cooler of samples designated for transport. Upon sample receipt, the laboratory will use the temperature blank or thermometer to determine the internal temperature of each cooler. Acceptable temperatures are ≤6 °C for refrigerated aqueous and solid samples.

Prevention of Cross-Contamination

Special care should be taken to prevent cross-contamination of soil samples. Particular care will be exercised to avoid the following common ways in which cross-contamination or background contamination may compromise the samples:

- Improperly storing or transporting sampling equipment and sample containers
- Contaminating the equipment or sample bottles by setting them on or near potential contamination sources, such as uncovered ground
- Handling bottles or equipment with dirty hands
- Improperly decontaminating equipment before sampling or between sampling events.

5.2 REQUIRED QUALITY CONTROL FOR ANALYSIS

As applicable, a duplicate analysis, a matrix spike, a laboratory blank, and a laboratory control sample (LCS) are required for each batch of samples. In addition, a matrix spike duplicate is required for SVOA, PCB, and Hg analyses. The matrix spike duplicate is needed due to the high number of "less than" for these analyses. Evaluation criteria for QC analyses are shown in Table 5-1. Where allowed by applicable SW-846 methods, statistical process control limits may be used instead of the specified criteria.

The QC criteria in Table 5-1 are goals for demonstrating reliable method performance. The laboratory's internal QA system will be used to evaluate the analytical data and processes whenever a criterion is exceeded. The laboratory may reanalyze based on the internal evaluation. Otherwise, the data will be further evaluated in accordance with the strategies described in RPP-23403. Primary constituent data not meeting the QC requirements will be noted accordingly and discussed in the narrative of the laboratory data report.

Table 5-1. Quality Control Acceptance Criteria

Constituents of Potential Concern Class	Quality Control Acceptance Criteria		
	Accuracy		Precision
	Laboratory Control Sample Recovery (%)	Spike Recovery (%)	%Relative Percent Difference
Metals	80-120%	75-125%	≤30%
Anions	80-120%	75-125%	≤30%
pH	+ 0.1 pH Units	N/A	N/A
Polychlorinated biphenyls	70-130%	70-130%	≤30%
Semi-volatile organic analysis	70-130%	70-130%	≤30%
Pesticides	70-130%	70-130%	≤30%
% Solids	80-120%	N/A	≤30%
Bulk density	N/A	N/A	≤30%
Radionuclides	80-120%	75-125%	≤30%

5.3 ANALYTICAL DETECTION LIMITS

Required detection limits as specified in the WMA C DQO are shown in Tables 5-2 and 5-3 for waste classification and ecological risk assessment, respectively. Where multiple required detection limits are specified for a single analyte, the laboratory shall meet the lower limit. If a required detection limit is not listed in the WMA C DQO, the COPC will not be listed. Target detection limits are shown in Tables 5-4 and 5-5. Basis for the target detection limits is provided in the DQO. If a target detection limit is not listed in the WMA C DQO, the COPC will not be listed. The laboratories are required to meet the required detection limits and shall strive to meet the target detection limits whenever possible.

Table 5-2. Required Detection Limits for Radionuclides (2 sheets)

Analyte	Source: 10 CFR 61.55 Class C Waste (pCi/g)	Biota Concentration Guide for Terrestrial Animal (pCi/g)	Required Detection Limits (pCi/g)
^{241}Am	9.00E+03	3.9E+03	3.9E+02
^{14}C	5.33E+06	4.8E+03	4.8E+02
^{242}Cm	9.00E+03	2.1E+03	2.1E+02
^{243}Cm	9.00E+03	Not available	9.00E+02
^{244}Cm	9.00E+03	4.1E+03	4.1E+02
^{60}Co	Not available	6.9E+02	6.9E+01
^{137}Cs	3.07E+09	2.1E+01	2.1

Table 5-2. Required Detection Limits for Radionuclides (2 sheets)

Analyte	Source: 10 CFR 61.55 Class C Waste (pCi/g)	Biota Concentration Guide for Terrestrial Animal (pCi/g)	Required Detection Limits (pCi/g)
^{152}Eu	Not available	1.5E+03	1.5E+02
^{154}Eu	Not available	1.3E+03	1.3E+02
^{155}Eu	Not available	1.6E+04	1.6E+03
^{3}H	Not available	1.7E+05	1.7E+04
^{129}I	5.33E+04	5.7E+03	5.7E+02
^{63}Ni	4.67E+08	Not available	4.67E+07
^{237}Np	9.00E+03	3.9E+03	3.9E+02
^{238}Pu	9.00E+03	5.3E+03	5.3E+02
^{239}Pu[1]	9.00E+03 (as $^{239/240}$Pu)	6.1E+03	6.1E+02 (as $^{239/240}$Pu)
^{240}Pu[1]	9.00E+03 (as $^{239/240}$Pu)	Not available	9.00E+02 (as $^{239/240}$Pu)
^{241}Pu	3.50E+09	Not available	3.50E+08
^{125}Sb	Not available	3.5E+03	3.5E+02
^{79}Se	Not available	Not available	Not available
^{90}Sr[2]	4.67E+09	2.3E+01	2.3
^{99}Tc	2.00E+06	4.5E+03	4.5E+02
^{126}Sn	Not available	Not available	Not available
^{228}Th	Not available	5.3E+02	5.3E+01
^{230}Th	Not available	1.0E+04	1.0E+03
^{232}Th	Not available	1.5E+03	1.5E+02
^{233}U[3]	9.00E+03	4.8E+03	4.8E+02
^{234}U[3]	9.00E+03	5.1E+03	5.1E+02
^{235}U[3]	9.00E+03	2.8E+03	2.8E+02
^{236}U[3]	Not available	Not available	Not available
^{238}U[3]	9.00E+03	1.6E+03	1.6E+02

[1] Reported as Pu-239/240.
[2] Reported as Sr-89/90.
[3]Total uranium may be reported by summing the results of the isotopic analysis.

GEA = gamma energy analysis
ICP/MS = inductively coupled plasma/mass spectroscopy
LCS = liquid scintillation counting

Reference: Title 10, *Code of Federal Regulations*, Part 61.55, "Waste Classification."

Table 5-3. Required Detection Limits for Non-Radionuclides[1] (2 sheets)

Analyte	Soil Concentration for Protection of Terrestrial (mg/kg)			Required Detection Limit (mg/kg)
	Plants	Soil Biota	Wildlife	
METALS:				
Aluminum (soluble salts)	50			5
Antimony	5			0.5
Arsenic III[2]			7	0.7
Arsenic V[2]	10	60	132	1
Barium	500		102	10.2
Beryllium	10			1
Boron	0.5			6
Bromine[3]	10			1
Cadmium	4	20	14	0.4
Chromium (total)	42	42	67	0.15
Cobalt	20			2
Copper	100	50	217	5
Fluorine[4]	200			20
Iodine[6]	4			
Lead	50	500	118	5
Lithium	35			3.5
Manganese	1,100		1,500	110
Mercury, inorganic	0.3	0.1	5.5	0.01
Molybdenum	2		7	4
Nickel	30	200	980	3
Selenium	1	70	0.3	0.03
Silver	2			0.2
Technetium[5]	0.2			
Thallium	1			0.1
Tin	50			6
Uranium[6]	5			0.5
Vanadium	2			0.2
Zinc	86	200	360	8.6
OTHER INORGANICS				
Cyanide[7]				0.5

Table 5-3. Required Detection Limits for Non-Radionuclides[1] (2 sheets)

Analyte	Soil Concentration for Protection of Terrestrial (mg/kg)			Required Detection Limit (mg/kg)
	Plants	Soil Biota	Wildlife	
PESTICIDES:[8]				
Aldrin			0.1	0.01
Benzene hexachloride (including lindane)[9]			6	0.6
Chlordane		1	2.7	0.1
DDT/DDD/DDE (total)[10]			0.75	0.075
Dieldrin			0.07	0.007
Endrin			0.2	0.02
Hexachlorobenzene			17	1.7
Heptachlor/heptachlor epoxide (total)[11]			0.4	0.04
Pentachlorophenol	3	6	4.5	0.3
OTHER CHLORINATED ORGANICS:				
1,2,4-Trichlorobenzene		20		2
1,4-Dichlorobenzene		20		
2,4,5-Trichlorophenol	4	9		0.4
2,4,6-Trichlorophenol		10		1
Polychlorinated biphenyl mixtures (total)[12]	40		0.65	0.065
OTHER NONCHLORINATED ORGANICS:				
Acenaphthene	20			2
Benzo(a)pyrene			12	1.2
Di-n-butyl phthalate	200			20
Nitrobenzene		40		4
Phenol	70	30		

[1] Blank cells indicate that no value is available.
[2] Total arsenic is reported.
[3] Bromine is reported as bromide.
[4] Fluorine is reported as fluoride.
[5] Included in the radionuclide analysis, radionuclide will be converted from radioactivity to mass using specific activity.
[6] May be derived from isotopic analysis.
[7] This required detection limit is needed to meet the WAC 173-340, "Model Toxics Control Act – Cleanup" 3-Phase model derived soil concentrations for the protection of groundwater.
[8] In addition to the semi-volatile organic analysis, U.S. Environmental Protection Agency Method 8081 for pesticides will also be performed to meet the reporting requirements for ecological indicator soil concentrations.
[9] Alpha, beta, and gamma-BHC will be reported individually.
[10] DDD, DDE, and DDT will be reported individually.
[11] Heptachlor and heptachlor epoxide will be reported individually.
[12] Polychlorinated biphenyls reported as individual arochlors. Total polychlorinated biphenyls can be calculated by summing the results.
[13] This required detection limit is needed to meet the WAC 173-340 3-Phase model derived soil concentrations for the protection of groundwater.

Table 5-4. Target Detection Limits for Primary Radionuclides

Chemical Abstracts Service # or Constituent Identifier	Analyte	Target Detection Limits (pCi/g)
14234-35-6	Antimony-125	0.3
14596-10-2	Americium-241	1
14762-75-5	Carbon-14	1
10045-97-3	Cesium-137	0.1
10198-40-0	Cobalt-60	0.05
15510-73-3	Curium-242	1.0
15757-87-6	Curium-243[1]	1.0
13981-15-2	Curium-244[1]	1.0
14683-23-9	Europium-152	0.1
15585-10-1	Europium-154	0.1
14391-16-3	Europium-155	0.1
15046-84-1	Iodine 129	2
13994-20-2	Neptunium-237	1
13981-37-8	Nickel-63	30
13981-16-3	Plutonium-238	1
Pu-239/240	Plutonium-239/240	1
15758-85-9	Selenium-79	10
Rad-Sr	Strontium-90	1
14133-76-7	Technetium-99	1
14274-82-9	Thorium-228	1
14269-63-7	Thorium-230	1
Th-232	Thorium-232	1
Th-232	Thorium-234	1
10028-17-8	Tritium	30
13968-55-3	Uranium-233	1
13966-29-5	Uranium-234	1
15117-96-1	Uranium-235	1
U-238	Uranium-238	1

[1] Reported as Curium-243/244.

Table 5-5. Target Detection Limits for Primary Chemicals (3 sheets)

CAS# or Constituent Identifier	Analyte	Target Detection Limits (mg/kg)
7429-90-5	Aluminum	5
7440-36-0	Antimony	0.6
7440-38-2	Arsenic	1
7440-39-3	Barium	20
7440-41-7	Beryllium	0.5
7440-43-9	Cadmium	0.5
7440-47-3	Chromium (III)/chromium (total)	1
7440-48-4	Cobalt	2
7440-50-8	Copper	1
7439-89-6	Iron	5
7439-92-1	Lead	5
7439-96-5	Manganese	1.9
7439-97-6	Mercury	0.2
7439-98-7	Molybdenum	19
7440-02-0	Nickel	4
7782-49-2	Selenium	1
7440-22-4	Silver	2
7440-24-6	Strontium	1
7440-28-0	Thallium	0.5
7440-61-1	Uranium[a]	1
7440-62-2	Vanadium	2.5
7440-66-6	Zinc	1
57-12-5	Cyanide (includes ferrocyanide)	0.5
16984-48-8	Fluoride	5
14797-55-8	Nitrate	2.5
14797-65-0	Nitrite	2.5
16887-00-6	Chloride	0.3
14808-79-8	Sulfate	2.7
71-50-1	Acetate	4.5
64-18-6	Formate	10.0
79-14-1	Glycolate	3.8

Table 5-5. Target Detection Limits for Primary Chemicals (3 sheets)

CAS# or Constituent Identifier	Analyte	Target Detection Limits (mg/kg)
144-62-7	Oxalate	2
18496-25-8	Sulfide	5
NA	Ammonium (NH_4)	0.5
108-94-1	Cyclohexanone	0.5
67-72-1	Hexachloroethane	0.33
83-32-9	Acenaphthene	0.33
117-81-7	Bis(2-ethylhexyl)phthalate	2.95
85-68-7	Butylbenzylphthalate	0.33
95-57-8	Chlorophenol; 2-	0.33
65794-96-9	Cresol; m + p (3+4-Methylphenol)	0.33
95-48-7	Cresol; o- (2-Methylphenol)	0.33
1319-77-3	Total cresols	0.5
84-74-2	Dibutylphthalate (Di-n-butylphthalate)	0.33
117-84-0	Di-n-octylphthalate	0.33
95-50-1	Dichlorobenzene; 1,2- (ortho-)	0.33
121-14-2	Dinitrotoluene; 2,4-	0.33
110-80-5	Ethoxyethanol; 2-(Cellosolve solvent)	0.33
206-44-0	Fluoranthene	0.33
87-68-3	Hexachlorobutadiene	0.33
128-37-0	methylphenol; 2,6-Bis(tert-butyl)-4-	1.2
59-50-7	methylphenol; 4-Chloro-3- (p-Chloro-m-cresol)	0.33
91-20-3	Naphthalene	0.33
98-95-3	Nitrobenzene	0.33
88-75-5	Nitrophenol; o-	0.66
621-64-7	Nitroso-di-n-propylamine	0.33
120-82-1	1,2,4 - Trichlorobenzene	0.33
59-89-2	Nitrosomorpholine; N-	0.33
129-00-0	Pyrene	0.33
110-86-1	Pyridine	0.66
95-95-4	Trichlorophenol; 2,4,5-	0.33

Table 5-5. Target Detection Limits for Primary Chemicals (3 sheets)

CAS# or Constituent Identifier	Analyte	Target Detection Limits (mg/kg)
88-06-2	Trichlorophenol; 2,4,6-	0.33
		0.165
126-73-8	Tributyl phosphate	3.3
56-55-3	Benzo (a) anthracene	0.33
205-99-2	Benzo (b) fluorathene	0.33
207-08-9	Benzo (k) fluorathene	0.33
50-32-8	Benzo (a) pyrene	0.33
218-01-9	Chrysene	0.33
53-70-3	Dibenzo (ab) anthracene	0.33
193-39-5	Indeno (123-cd) pyrene	0.33
2674-11-2	Aroclor 1016	0.02
11104-26-2	Aroclor 1221	0.02
11141-16-5	Aroclor 1232	0.02
53969-21-9	Aroclor 1242	0.02
126572-29-6	Aroclor 1248	0.02
11097-6999-1	Aroclor 1254	0.02
11096-82-5	Aroclor 1260	0.02

[a]Derived from isotopic analysis.

CAS = Chemical Abstracts Service
EPA = U.S. Environmental Protection Agency
IC = ion chromatography
PCB = polychlorinated biphenyl

6.0 DATA REPORTING

If soil sample analysis is performed at the 222-S Laboratory, the data report(s) will be in Format VI. A description of a Format VI report is provided below. Additional details of a Format VI report can be found in ATL-MP-1011, *ATL Quality Assurance Project Plan for 222-S Laboratory*.

Format VI Report with Laboratory QA Verification:

- Narrative – contains a description of sample receipt, sample breakdown, and has a section corresponding to each method describing any analytical/QC deviations from the work plan.

- Results Table (Data Summary Report) – printout containing sample and duplicate results, relative percent difference, standard and spike recoveries, blank results, and data qualifiers (flags).

- Sample section that contains sample breakdown diagrams, chains of custody, and geologist's descriptions.

- Section that contains all e-mail correspondence documenting issues that arose during sampling and analysis, and subsequent decisions that affected initial work instructions.

- Laboratory will perform a QA review of the data package. Typical QA reviews require a minimum 10% review.

The data package will also include TICs found in SVOA. A discussion of the TIC evaluation process shall be provided in the narrative. A Format VI data package is subject to internal laboratory QA verification and review including peer review prior to release.

If sample analysis is performed at other laboratories, format for the data reports will be equivalent to a 222-S Laboratory Format VI report.

In addition to the data package(s), an electronic version of the analytical results shall be provided to the HEIS database.

7.0 CHANGE CONTROL

Field activity and laboratory work scope changes may be required because of unexpected field conditions, new information, health and safety concerns, or other circumstances. Changes to work scope may result in modifications to this SAP. Work scope changes that do not result in deviation from the SAP requirements can be made in the field or laboratory with the approval of the project manager or assigned task lead. These work scope changes will be documented in the sampling work package and/or Format VI laboratory report(s). Justification for the changes to work scope shall be provided in sufficient detail to understand the basis for the change. Alternately, if field or laboratory conditions result in substantial work scope changes, the SAP may be revised with DOE and Ecology approval.

Field sampling and survey methods and analytical strategies (e.g., constituent listings and data analysis) may be updated as new technologies or data become available. The impact of these updates to the SAP will be judged as they are identified to determine if revisions to the SAP will be necessary. Ecology, DOE, and its contractors will participate in the SAP update evaluation process and any subsequent revisions to the SAP.

8.0 REFERENCES

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11-NWP-053, 2011, "Re: Organic Analyses Optimization for Waste Management Area (WMA) C" (letter from J. L. Lyon to R. W. Lober, Office of River Protection, U.S. Department of Energy, June 1), Nuclear Waste Program, State of Washington Department of Ecology, Richland, Washington.

11-TPD-020, 2011, "Organic Analyses Optimization for Waste Management Area (WMA) C" (letter from T. W. Fletcher to J. L. Lyon, Nuclear Waste Program, State of Washington Department of Ecology, March 23), Office of River Protection, U.S. Department of Energy, Richland, Washington.

49 CFR, "Transportation," *Code of Federal Regulations*, as amended.

ATL-MP-1011, 2011, *ATL Quality Assurance Project Plan for 222-S Laboratory*, Rev. 10-A, Advanced Technologies and Laboratories International, Inc., Richland, Washington.

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RPP-23403, 2009, *Single-Shell Tank Component Closure Data Quality Objectives*, Rev. 4, Washington River Protection Solutions, LLC, Richland, Washington.

RPP-PLAN-39114, 2011, *Phase 2 RCRA Facility Investigation/Corrective Measures Study Work Plan for Waste Management Area C*, Rev. 1B, Washington River Protection Solutions, LLC, Richland, Washington.

RPP-RPT-38152, 2008, *Data Quality Objectives Report Phase 2 Characterization for Waste Management Area C RCRA Field Investigation/Corrective Measures Study*, Rev. 0, Cenibark International, Inc., Richland, Washington.

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TFC-PLN-02, Rev. G-2, "Quality Assurance Program Description," Washington River Protection Solutions, LLC, Richland, Washington.

WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," *Washington Administrative Codes*, as amended.

WAC 173-340, "Model Toxics Control Act – Cleanup," *Washington Administrative Code*, as amended.

WAC 173-340-820, "Sampling and Analysis Plans," *Washington Administrative Codes*, as amended.

APPENDIX A

QUALITY ASSURANCE PROJECT PLAN FOR PHASE 2 CHARACTERIZATION OF VADOSE ZONE SOIL IN WASTE MANAGEMENT AREA C

LIST OF TERMS

aG	amber glass
ALARA	as low as reasonably achievable
DOE	U.S. Department of Energy
Ecology	State of Washington Department of Ecology
G	glass
G/P	glass or plastic
GEA	gamma energy analysis
PCB	polychlorinated biphenyl
QAPjP	quality assurance project plan
QC	quality control
SAP	sampling and analysis plan
SVOA	semi-volatile organic analysis

QUALITY ASSURANCE PROJECT PLAN FOR PHASE 2 CHARACTERIZATION OF VADOSE ZONE SOIL IN WASTE MANAGEMENT AREA C

The quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection, including sampling, field measurements, and laboratory analysis. The QAPjP complies with the requirements of the following:

- ASME NQA-1, *2004 Quality Assurance Requirements for Nuclear Facility Applications (QA)*
- DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Documents*
- EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5*
- TFC-PLN-02, "Quality Assurance Program Description."

A-1.0 PROJECT MANAGEMENT

This section addresses the basic areas of project management, and it ensures that the project has a defined goal, that the participants understand the goal and approach to be used, and that the planned outputs have been appropriately documented. The QAPjP is organized according to the elements described in EPA/240/B-01/003.

A-1.1 PROJECT/TASK ORGANIZATION

The project organization is described in the subsections that follow and is shown in Figure A-1.

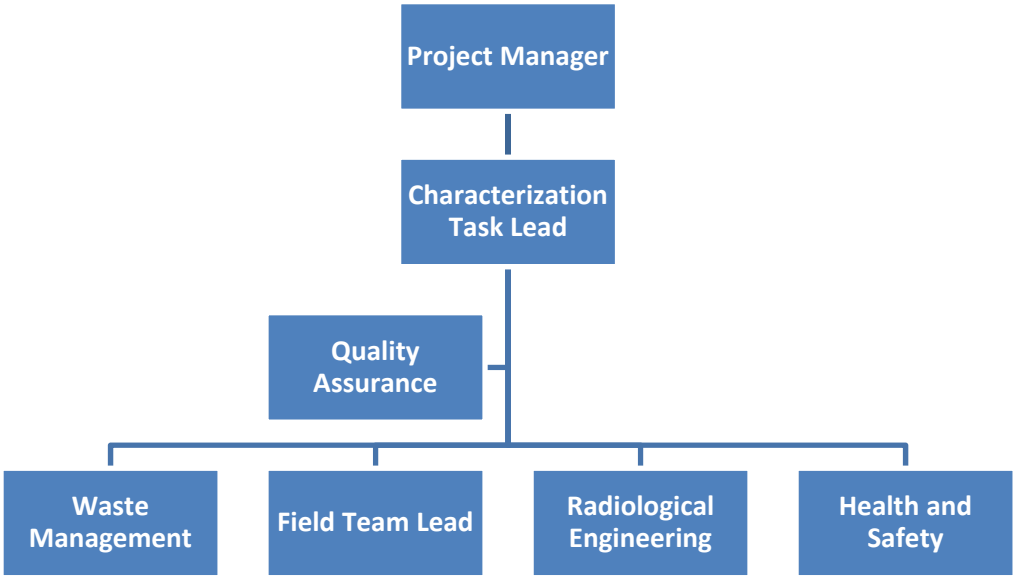
Project Manager

The Project Manager provides oversight for all activities and coordinates with U.S. Department of Energy (DOE) and State of Washington Department of Ecology (Ecology) in support of sampling activities. In addition, support is provided to the task lead to ensure that the work is performed safely and cost-effectively.

Characterization Task Lead

The Characterization Task Lead is responsible for direct management of sampling documents and requirements, field activities, and subcontracted tasks. The task lead ensures that the field team lead, samplers, and others responsible for implementation of this sampling and analysis plan (SAP) and the QAPjP are provided with current copies of this document and any revisions thereto. The task lead works closely with Quality Assurance, Health and Safety, and the field team leader to integrate these and the other lead disciplines in planning and implementing the work scope. The task lead also coordinates with and reports to DOE, Ecology, and the Tank Operation Contractor on all sampling activities.

Figure A-1. Project Organization



The task lead is responsible for selecting the laboratories that perform the analyses and requests assessments/surveillances of the laboratories. The task lead receives the analytical data from the laboratories, and arranges for data entry into the Hanford Environmental Information System database. The task lead is also responsible for a review of sample data against existing knowledge and data quality assessments according to guidelines in EPA/600/R-96/084, *Guidance for Data Quality Assessment, Practical Methods for Data Analysis, EPA QA/G-9, QA00 Update*.

Quality Assurance

Quality Assurance is responsible for quality assurance issues on the project. Responsibilities include oversight of implementation of the project quality assurance requirements; review of project documents, including SAPs (and the QAPjP); and participation in quality assurance assessments and surveillances on sample collection and analysis activities, as appropriate.

Waste Management

The Waste Management lead communicates policies and procedures and ensures project compliance for storage, transportation, disposal, and waste tracking in a safe and cost-effective manner. Other responsibilities include identifying waste management sampling/characterization requirements to ensure regulatory compliance interpretation (e.g., with WAC 173-303, "Dangerous Waste Regulations") of the characterization data to generate waste designations, profiles, and other documents that confirm compliance with waste disposal requirements.

Field Team Leader

The field team leader has the overall responsibility for the planning, coordination, and execution of the field sampling activities. Specific responsibilities include converting the sampling design

requirements into field work plans or task instructions that provide specific direction for field activities. Responsibilities also include directing training, mock-ups, and practice sessions with field personnel to ensure that the sampling design is understood and can be performed as specified. The field team leader communicates with the Characterization Task Lead to identify field constraints that could affect the sampling design. In addition, the field team leader directs the procurement and installation of materials and equipment needed to support the field work.

The field team leader oversees field sampling activities that include sample collection, packaging, provision of certified clean sampling bottles/containers, documentation of sampling activities in controlled logbooks, chain-of-custody documentation, and packaging and transportation of samples to the laboratory or shipping center.

Radiological Engineering

The Radiological Engineering lead is responsible for radiological engineering and health physics support within the project. Specific responsibilities include conducting as low as reasonably achievable (ALARA) reviews, exposure and release modeling, and radiological controls optimization for all work planning. In addition, radiological hazards are identified and appropriate controls are implemented to maintain worker exposures to the hazards at levels ALARA. Radiological Engineering interfaces with the project safety and health representative and plans and directs radiological control technician support for all activities.

Health and Safety

Responsibilities include coordination of industrial safety and health support within the project as carried out through safety and health plans, job hazard analyses, and other pertinent safety documents required by Federal regulation or by internal Tank Operation Contractor work requirements. In addition, assistance is provided to project personnel in complying with applicable health and safety standards and requirements. Personnel protective clothing requirements are coordinated with Radiological Engineering.

A-1.2 PROBLEM DEFINITION/BACKGROUND

See Sections 1.0 and 2.0 of the SAP.

A-1.3 PROJECT/TASK DESCRIPTION

See Sections 3.0 and 4.0 of the SAP.

A-1.4 QUALITY OBJECTIVES AND CRITERIA

See Sections 4.0 and 5.0 of the SAP.

A-1.5 SPECIAL TRAINING/CERTIFICATION

Sampling and laboratory personnel shall complete the necessary training and must receive appropriate certification to perform assigned tasks in support of the characterization project. The environmental safety and health training program provides workers with the knowledge and skills necessary to safely execute assigned duties. Field personnel typically will have completed the following training before starting work:

- Occupational Safety and Health Administration 40-hour hazardous waste worker training and supervised 24-hour hazardous waste site experience
- 8-hour hazardous waste worker refresher training (as required)
- Hanford general employee radiation training
- Radiological worker training.

A graded approach is used to ensure that workers receive a level of training commensurate with their responsibilities that complies with applicable DOE orders and government regulations. Specialized employee training includes prejob briefings, on-the-job training, emergency preparedness, plan-of-the-day activities, and facility/worksite orientations.

A-1.6 DOCUMENTS AND RECORDS

All information pertinent to field sampling and surveying will be recorded in field checklists and bound logbooks in accordance with existing sample collection protocols. The sampling team will be responsible for recording all relevant sampling information. Entries made in the logbook will be dated and signed by the individual who made the entry. Program requirements for managing the generation, identification, transfer, protection, storage, retention, retrieval, and disposition of records within the Tank Operation Contractor will be followed.

Requirements for laboratory data reporting are discussed in Sections 6.0 and 7.0 of the SAP.

A-2.0 DATA GENERATION AND ACQUISITION

A-2.1 SAMPLING PROCESS DESIGN

See Section 3.0 of the SAP.

A-2.2 SAMPLING METHODS

See Section 3.0 of the SAP.

A-2.3 SAMPLE HANDLING AND CUSTODY

See Section 3.0 of the SAP.

A-2.4 ANALYTICAL METHODS

See Table 5-1 of the SAP.

A-2.5 QUALITY CONTROL

Quality control (QC) sample requirements and acceptance criteria for these samples are specified in Section 5.0 of the SAP. Overall quality assurance and QC requirements for characterization are discussed in this section.

A-2.5.1 Quality Assurance Objective

The quality assurance objective of this plan is to develop implementation guidance that will provide data of known and appropriate quality. Data quality is assessed by representativeness, comparability, accuracy, and precision. The applicable QC guidelines, quantitative target limits, and levels of effort for assessing data quality are dictated by the intended use of the data and the nature of the analytical method. Each of these is addressed in the following subsections.

Representativeness

Representativeness is a measure of how closely the results reflect the actual concentration and distribution of the chemical and radiological constituents in the matrix sampled. Sampling design has been developed and sampling techniques have been selected with the goal of optimizing representativeness of the samples.

Comparability

Comparability expresses the confidence with which one data set can be compared to another. Data comparability will be maintained using standard procedures and consistent methods and units.

Accuracy

Accuracy is an assessment of the closeness of the measured value to the true value. Accuracy of chemical test results is assessed by spiking samples with known standards and establishing the average recovery. A matrix spike is the addition to a sample of a known amount of a standard compound similar to the compounds being measured. Sample accuracy is expressed as the percent recovery of a spiked sample. Table 5-1 provides the accuracy criteria for laboratory analyses.

Precision

Precision is a measure of the data reproducibility when more than one measurement has been taken on the same sample. Precision can be expressed as the relative percent difference for duplicate measurements or relative standard deviation for triplicates. Table 5-1 lists the analytical precision criteria for fixed laboratory analyses.

Detection Limits

Detection limits are functions of the analytical method used to provide the data and the quantity of the sample available for analyses. Required and target detection limits for the constituents of potential concern are presented on Tables 5-2 through 5-5.

Laboratory Quality Control

The laboratory method blanks, duplicates, laboratory control sample/blank spike, and matrix spikes are defined in Chapter 1 of SW-846, *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods* and will be run at the frequency specified in Chapter 1 of SW-846. In the event sample material is not sufficient to perform all analyses, sample quantity will be prioritized and allocated to completion of the method analysis. The typical prioritization of analyses is listed in Table A-1 below; however, changes may be made based on specific data needs. Changes to this prioritization will be provided to the laboratory in writing and documented in the data package. If insufficient sample is available for completion of laboratory QC analyses, the laboratory will make note of the condition in the data package narrative and the associated data results will have laboratory qualifiers added as appropriate.

Table A-1. Analytical Prioritization

Constituents	Grams Needed per Analysis	Total (Cumulative) Grams Needed
Technetium-99 (water leach)	35	35
Cyanide	0.6	35.6
Anions	5	40.6
Metals	5	45.6
Radionuclides (gamma)	80	125.6
pH	3	128.6
Ammonia	0.3	128.9
Mercury	0.3	129.2
Strontium-90	10	139.2
Plutonium, Americium, Curium	1.5	140.7
Technetium-99 (acid digest)	5	145.7
Semi-volatile organic analysis	20	165.7
Nickel-63/Selenium-79	4	169.7
Hydrogen-3 (Tritium)	10	179.7
Iodine-129	10	189.7
Antimony, Tin-126	1	190.7
Polychlorinated biphenyls	20	210.7
Pesticides	40	250.7

A-2.5.2 Sample Preservation, Containers, and Holding Times

Sample preservation and containers for radiological and nonradiological analytes for samples and QC are shown in Table A-2. Holding times are found in Table 4-1.

A-2.5.3 Sample Collection Requirements

See Section 3.0.

Table A-2. Sample Preservation and Containers for Analytes

Analytes	Matrices	Bottle		Preservation Requirements
		Type	Lid	
Radionuclides, Anions, Metals, Ammonium, Specific Conductivity, pH, SVOA, PCBs, Pesticides	Soil/sludge/ sediment/scale	G	Teflon®-lined cap	Cool ≤6 °C
SVOA, PCBs	Water	aG	Teflon-lined cap	Cool ≤6 °C
Metals	Water	G/P	Teflon-lined cap	HNO_3 to pH <2
Ammonium	Water	G/P	Teflon-lined cap	H_2SO_4 to pH <2/ Cool ≤6 °C
Anions, pH	Water	G/P	Teflon-lined cap	Cool ≤6 °C
Total Cyanide	Water	G/P	Teflon-lined cap	NaOH to pH >=12 / Cool ≤6 °C
GEA, Am-241, Cm-242/243/244, Ni-63, Se-79, Sr-89/90, Pu-239/240 and Pu-238	Water	G/P	Teflon-lined cap	HNO_3 to pH <2
C-14, H-3, I-129	Water	G/P	Teflon-lined cap	None
Pesticides	Water	aG	Teflon-lined cap	Cool <6 °C

Teflon® is a registered trademark of I. E. du Pont de Nemours and Company, Wilmington, Delaware.

aG = amber glass
G = glass
G/P = glass or plastic
GEA = gamma energy analysis
PCB = polychlorinated biphenyl
SVOA = semi-volatile organic analysis

A-2.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

Measurement and testing equipment used in the field or in the laboratory that directly affects the quality of analytical data will be subject to preventive maintenance measures to ensure minimization of measurement system downtime. Laboratories and onsite measurement organizations must maintain and calibrate their equipment per manufacturer or other applicable guidelines. Maintenance requirements (such as parts lists and documentation of routine maintenance) will be included in the individual laboratory and the onsite organization quality assurance plan or operating procedures (as appropriate). Calibration of laboratory instruments will be performed in a manner consistent with SW-846 as implemented by DOE/RL-96-68.

Consumables, supplies, and reagents will be reviewed in accordance with SW-846 requirements and will be appropriate for their use. Note that contamination is monitored by the QC samples discussed in Section 5.0 of the SAP.

A-2.7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

See Sections 5.2 and A-2.6.

A-2.8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

See Section A-2.6.

A-2.9 NON-DIRECT MEASUREMENTS

See Section 3.0 for a discussion of field survey techniques.

A-2.10 DATA MANAGEMENT

See Section 6.0 for data reporting requirements.

A-3.0 ASSESSMENT AND OVERSIGHT

A-3.1 ASSESSMENT AND RESPONSE ACTIONS

Project management and Quality Assurance may conduct random surveillance and assessments to verify compliance with the requirements outlined in this SAP, project work packages, the project quality management plan, procedures, and regulatory requirements. Deficiencies identified by these assessments shall be reported in accordance with existing programmatic requirements. Corrective actions will be implemented as required by the Tank Operation Contractor policy and procedures.

A-3.2 REPORTS TO MANAGEMENT

Management will be made aware of deficiencies identified by assessments and surveillances and subsequent corrective actions.

A-4.0 DATA VALIDATION AND USABILITY

A-4.1 DATA REVIEW, VERIFICATION, AND VALIDATION

Sample analysis data will be reviewed by laboratory Quality Assurance and chemists prior to issuance. The characterization task lead will be responsible for checking completeness of the data report(s), reviewing results against any existing knowledge, and assessing the data to determine if they are adequate for the intended use. Third-party data validation will be performed on at least 5% of Waste Management Area C soil sample results.

A-4.2 VERIFICATION AND VALIDATION METHOD

See above section (Section A-4.1).

A-4.3 RECONCILIATION WITH USER REQUIREMENTS

The data quality assessment 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 data evaluation is to determine if quantitative data are of the correct type and are of adequate quality and quantity to meet the project data quality objectives. Data quality assessment will be performed according to guidelines in EPA/600/R-96/084.

A-5.0 QUALITY ASSURANCE PROJECT PLAN REFERENCES

ASME NQA-1, 2004, *2004 Quality Assurance Requirements for Nuclear Facility Applications (QA)*, ASME International, New York, New York.

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TFC-PLN-02, Rev. G-2, "Quality Assurance Program Description," Washington River Protection Solutions, LLC, Richland, Washington.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, as amended.

APPENDIX B

OFFICE OF RIVER PROTECTION, STATE OF WASHINGTON DEPARTMENT OF ECOLOGY CHANGE NOTICE (PER HANFORD FEDERAL FACILITY AGREEMENT AND CONSENT ORDER SECTION 9.3)

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
3100 Port of Benton Blvd • Richland, WA 99354 • (509) 372-7950
711 for Washington Relay Service • Persons with a speech disability can call 877-833-6341

May 8, 2012 12-NWP-071

Mr. Christopher Kemp
United States Department of Energy
Office of River Protection
P.O. Box 450, MSIN: H6-60
Richland, Washington 99352

Re: Proposed Changes to RPP-PLAN-39114 and RPP-PLAN-38777

Dear Mr. Kemp:

The Department of Ecology (Ecology) has reviewed the proposed changes for both the *Phase 2 Resource Conservation and Recovery Act (RCRA) Facility Investigation/Corrective Measures Study (RFI/CMS) Work Plan for Waste Management Area C* (RPP-PLAN-39114) and the *Sample and Analysis Plan for Phase 2 Characterization of Vadose Zone in Waste Management Area C* (RPP-PLAN-38777). We approve the proposed changes in both documents. The information obtained from these RFI/CMS activities is important in the completion of the Waste Management Area (WMA) C Performance Assessment.

Ecology appreciates the cooperative and collaborative development for these documents. However, we remain concerned that the United States Department of Energy (USDOE) has suspended the discussions on development of the RFI/CMS Report identified in Milestone M-045-61, which is due 12/31/2014. Continuing that collaboration, to ensure that the agencies are in agreement on content, would provide a more efficient review period. Our hope is to be able to respond and resolve comments in a timely manner so that we can support Hanford Federal Facility Agreement and Consent Order Milestones, M-045-62, "*Submit a Phase 2 Corrective Measures Implementation Plan for WMA-C*", due 06/30/2015 and M-045-82, "Submit a permit modification to support final closure requirements for WMA-C", due 9/30/2015.

Ecology acknowledges that the field work and laboratory analysis work for the RFI/CMS has been stopped and some analytical activities were left incomplete. We want to emphasize the importance of completing the validation, documentation, and evaluation of the field work data (RPP-39114, Section 5). We strongly urge its completion. These efforts will enable all parties to understand the purpose and importance of the remaining work that is planned (RPP-39114, Section 4.5).

Ecology anticipates that the following actions are necessary to support the completion of the RCRA RFI/CMS Study work:

1) USDOE Office of River Protection (ORP) will release a final revision of these two documents as approved
2) Complete work identified in work plan

3) Provide the date for submittal and completion of:
   a) The validation, documentation, and evaluation of the analytical data from FY2010 and FY2011
   b) The following reports:
      i) Tc-99 laboratory interferences
      ii) Evaluation of the organic detects in WMA C groundwater wells
      iii) Latest trending of groundwater contaminants at WMA C groundwater wells
      iv) Evaluation of the Quality Assurance/Quality Control and holding time issues associated with the 222-S shutdown in summer of 2011
4) Submit the revised *Hanford C-Farm Leak Assessment Report* (RPP-ENV-33418)

With the completion of these actions, USDOE-ORP and Ecology can discuss the information and agree to any needed changes or actions to complete the field work, or determine that USDOE-ORP has completed the necessary field work for the work plan. These actions will allow for immediate and final implementation of the work plan when available funding can be obtained to support Milestone M-045-61, which is due 12/31/2014.

If there are any questions, please contact Michael Barnes at 509-372-7927.

Sincerely,

Jeffery J. Lyon
Project Manager
Tank System Operations and Closure

mb/dbm

cc:

Dennis Faulk, EPA	Gabriel Bohnee, NPT
Scott Samuelson, USDOE	Russell Jim, YN
Bruce Sullivan, LMSI	Isabelle Wilder, Wanapum
Jennifer Ollero, MSA	Susan Leckband, HAB
Rob Piippo, MSA	Ken Niles, ODOE
Judy Vance, MSA	John Martell, DOH
Janet Badden, WRPS	Administrative Record: Tank Waste Storage M-45-101
Susan Eberlein, WRPS	Environmental Portal
Steve Killoy, WRPS	USDOE-ORP Correspondence Control
Jeff Luke, WRPS	WRPS Correspondence Control
Stuart Harris, CTUIR	

Office of River Protection, State of Washington Department of Ecology
Change Notice
(Per Hanford Federal Facility Agreement and Consent Order Section 9.3)

1. Document Title and Number: *Sampling And Analysis Plan For Phase 2 Characterization Of Vadose Zone Soil In Waste Management Area C*, RPP-PLAN 3877 Rev.2A		
2. Minor Field Change: (Section 12.4 HFFACO Action Plan) ☐ Yes: (WRPS Signature Only – Attach signed form to Primary Document for record purposes) **x** No: Proceed to Box 3	**3.** Document Issue Date: 2/28/2011 **4.** Document Modification Notice Date: 11/28/2011	**5.** Notice Number: **2011-6**
6. Do proposed changes require schedule changes? (Would this extend completion of retrieval beyond 12 months from date of initiation?) ☐ Yes **x** No	**7.** Do proposed changes include specific additions, deletions, or modification to scope and/or requirements which affect the overall intent of the plan? ☐ Yes **x** No	**8.** (Check only one box) ☐ Significant Modification (Check if the answer to question in either section 6 or 7 is "yes". Significant modifications require revision of the primary document.) Minor Modification Requires modification of the document **x** Can be accomplished with Change Notice.

9. Description and Justification of Change:

Description: : A change is needed to incorporate information gained from the characterization activities already completed in Waste Management Area (WMA) C under this sampling and analysis plan (SAP) and other characterization tasks, and to modify future characterization activities listed in this SAP accordingly. Changes to the governing work plan (RPP-PLAN-39114) are flowed into this revision of the SAP. Text and figures are added with updated information. Proposed changes were discussed and documented in a series of meetings between Office of River Protection and Washington State Department of Ecology, supported by Washington River Protection Solutions. Detailed specific changes and the explanation for the changes are described below.

Explanation:

- P 1-1, objectives are updated to summarize changes based on integration of results to date, derived from the modified work plan
- P 2-1, editorial corrections and clarification of acronyms are added
- P 3-1, text added to clarify sequence of events
- Table 3-1, p 3-3 and following, updates provided to match the completed and planned characterization events as described in RPP-PLAN-39114
- Pp 3-11, 3-12, clarifications to better describe direct push activities, with additional information regarding the performance of slant direct push
- P 3-13, editorial corrections
- P 3-14, revised plan for characterization near C-203 is described, as in the revised work plan
- P 3-14 additional detail is added on the handling of radioactive soil samples
- Figure 3-1 is updated to reflect the revised plan
- Figure 3-2 is updated to reflect the revised plan
- Figure 3-3 is updated to reflect the revised plan
- Pp 3-20, 3-21 editorial changes are made

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- P 4-1, first paragraph clarifies detection limits
- P 4-1, section 4.1, describes current application of optimization approach
- Figure 4-1, optimization approach application is clarified in the figure
- P 4-6, editorial changes and acronyms defined
- P 4-7, changes to analysis resulting from the integration of sample results to date are documented
- Table 4-1 is revised to incorporate additional information on methods, holding time, and detection limits, previously spread across multiple tables. In addition, the analytes previously listed in table 4-2 are incorporated into table 4-1
- Tables 4-2, 4-3, 4-4 and 4-5 are deleted because information has moved into Table 4-1
- P 4-23, reporting of TICs into HEIS is clarified
- Tables 4-6 and 4-7 are deleted because the information has moved into Table 4-1
- Pp 5-1, 5-2 QA requirements are clarified
- Table 5-1, Quality assurance acceptance criteria are described by constituent class, rather than by analytical method
- P 5-5, inclusion of detection limits in Tables 5-2 and 5-2 is better described
- Tables 5-2, 5-3 , 5-4, 5-5 are modified to delete columns that are redundant with Table 4-1, and to update required analytic methods as appropriate
- Page A-8, Table A-1, information is added to show prioritization of analyses
- Table A-2 (formerly A-1) is updated to combine appropriate categories of sample analyses
- Minor editorial corrections, specification of acronyms, and addition of references occur throughout the document

10. Impact of Change:

Change revises remaining field characterization activities and schedule to reflect information needed to develop the Phase 2 RFI/CMS report for Waste Management Area C. Change documents revisions that have been agreed to in a series of meetings among Ecology, ORP and the tank operations contractor.

11. Additional Requirements and/or Provisions[1]:

Approvals

Washington River Protection Solutions, LLC. for Kent Smith via Email	Office of River Protection	State of Wash., Dept. of Ecology
☐ Provisional Approval[2] Date	☐ Provisional Approval[2] Date	☐ Provisional Approval[2] Date
☒ Final Approval Date 12-21-11	☒ Final Approval Date 1/4/12	☒ Final Approval Date 6/6/12

Notes

1 - For use by Ecology to identify any additional information needed to make a decision regarding the change notice. In addition, Ecology will identify actions, if any, regarding the change notice that DOE may take pending Ecology's final decision

2 – Provisional approval allows DOE and its contractors to take specific actions identified in section 10, prior to final approval of this change notice.