0076358

Tri-Party Agreement

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

RECEIVED
FEB 27 2008
EDMC

Change Number	**Document Submitted Under Tri-Party Agreement Milestone M-015-38B**	**Date:**
TPA-CN-211		February 20, 2008

Document Number and Title: Sampling and Analysis Plan for Supplemental Remedial Investigation Activities at Model Group 5, Large-Area Ponds, Waste Sites Located Within the 200-CW-1 Operable Unit, DOE/RL-2006-57, Rev 0

Date Document Last Issued: November 20, 2007

Originator: Briant Charbonneau

Phone: 509-376-2663

Description of Change: Changes were made in the following areas:

1) An additional sample location was added to 216-U-10 pond increasing the number of holes to be augured from 3 to 4.
2) Incorporated the commitment to geophysically log 10 existing small diameter probe holes in 216-U-10 Pond, if feasible after field inspection.
3) Clarified the locations proposed for use of the high purity germanium (HPGE) spectral tool and the small diameter scintillation spectral tool.
4) Clarified the number and locations for QC soil samples
5) Minor edits.

Briant Charbonneau, RL, John Price, Ecology and Craig Cameron, EPA (2/26/08) agree that the proposed change modifies an approved workplan/document and will be processed in accordance with the Tri-Party Agreement Action Plan, Section 9.0, *Documentation and Records*, and not Chapter 12.0, *Changes to the Agreement.*

Redline/strikeout changes are found in the attachment to this request. Changes correspond to the five areas noted in the Description of Change.

Justification and Impacts of Change:

1) Implements agreement with EPA to address potential data variability. IMPACT - adds an additional auger hole to scope of the field program
2) Site visit indicated the presence of 10 probes installed in ~1994. Logging tools did not collect calibrated data. IMPACT -logging these probe holes will provide a quantitative estimate of the spread of gamma emitters across the 216-U-10 Pond
3) The need for the HPGE is indicated in only the 216-U-10 Pond based on the potential presence of Uranium at levels that potentially can be identified with the HPGE tool. Scintillation tools can identify Cs-137 at detection levels indicated as needed in the DQO for all other sample locations. This change requires the installation of large diameter probes in 216-U-10 Pond to support the larger diameter logging tool needed to potentially identify uranium and smaller diameter probe holes in the other sites. IMPACT – refined use of installation and logging equipment.
4) QC samples were reduced from 1 per waste site (where sampling is planned) to 2 per 6 sites. IMPACT – reduces over compliance with sampling QC requirements (5% duplicate samples).
5) Clarify wording and figures. IMPACT – minor.

Approvals:

RL Project Manager*	2/26/08 Date	X Approved	__ Disapproved
Lead Regulatory Unit Manager*	2/26/08 Date	✓ Approved	__ Disapproved

*Send approved form to FH TPAI, H8-12, and the Administrative Record, H6-08

Table 1-7. Summary Sampling Design. (2 Pages)

Planned Survey or Analytical Methodology	Key Features of Design*
UPR-200-W-124 (Overflow Area of the 216-S-17 Pond) – CW-2	
Geophysical logging	Specific location/area of concern: Determine nature and extent of contamination emanating from the dike overflow at the southwest corner of the pond by installing two shallow pushes into overflow area soil and geophysically log pushes using high-resolution spectral-gamma instruments.
Soil sampling	None.
216-T-4B Pond – CW-4	
Geophysical logging	Specific location/area of concern: Determine general extent of contamination in the primary pond location and the ditch that fed the pond by installing two shallow pushes into ditch soil and two shallow pushes into pond soil and geophysically log pushes using high-resolution spectral-gamma instruments.
Soil sampling	Collect one soil sample from the worst case location with the highest Cs-137 concentration. Soil samples will be analyzed for contaminants identified in Table 1-2.
216-U-10 Pond – CW-5	
Geophysical logging (gamma and moisture)	Specific location/area of concern: Determine general extent of contamination in the primary pond location, contamination at the pond bottom (i.e., organic mat), and contamination at borehole depth by installing the following: (a) Four shallow pushes into ditch soil (b) One borehole to 42.7 m (140 ft) below ground surface to resolve prior data quality issues (Table 1-2) (c) Three Four augered holes (d) Two deep pushes (one pair) (e) Geophysically log the 10 existing direct push casings, if possible after an initial field evaluation. Geophysically log shallow pushes and borehole using spectral-gamma logging instruments. Additionally log the first push of the pair of deep pushes with slim hole gamma and moisture estimating tools. Based on the geophysical results of the first push of each pair, select up to three depths to collect soil samples from the second push in the pair.
Soil sampling	(a) Collect one soil sample from the worst case location with the highest Cs-137 concentration from the shallow pushes (b) Borehole sampling: Collect one sample at depth, at a minimum. (c) Auger holes: From each augered hole sample at and below the organic mat (pond bottom) for a total of six samples. (d) Collect soil samples from the second push of the deep-push pair at a depth representative of the bottom of the pond and at two depths having elevated moisture levels for a total of six soil samples. Soil samples will be analyzed for contaminants identified in Table 1-2.
216-U-11 Ditch – CW-5	
Geophysical logging (gamma and moisture)	Specific location/area of concern: Determine general extent of contamination in the primary ditch sections and in the shallow overflow area between the ditch sections by installing five shallow pushes in ditch soil and geophysically log pushes using high-resolution spectral-gamma instruments. Install two deep pushes (one pair) in the ditch for a total of two pushes. Additionally log the first push of each pair of deep pushes with a slim hole gamma and moisture estimating tools. Based on the geophysical results of the first push of each pair, select up to three depths to collect soil samples from the second push in the pair.
Soil sampling	Collect soil samples from the second push of the deep-push pair at a depth representative of the bottom of the pond and at two depths having elevated moisture levels for a total of six soil samples. Soil samples will be analyzed for contaminants identified in Table 1-2.

*Number of pushes, samples, augered samples, and boreholes is found in Tables 3-2 and 3-3.

Figure 3-6. Planned Geophysical Logging and Soil Sampling Locations at the 216-U-10 Pond. See Table 3-1 for sample details.

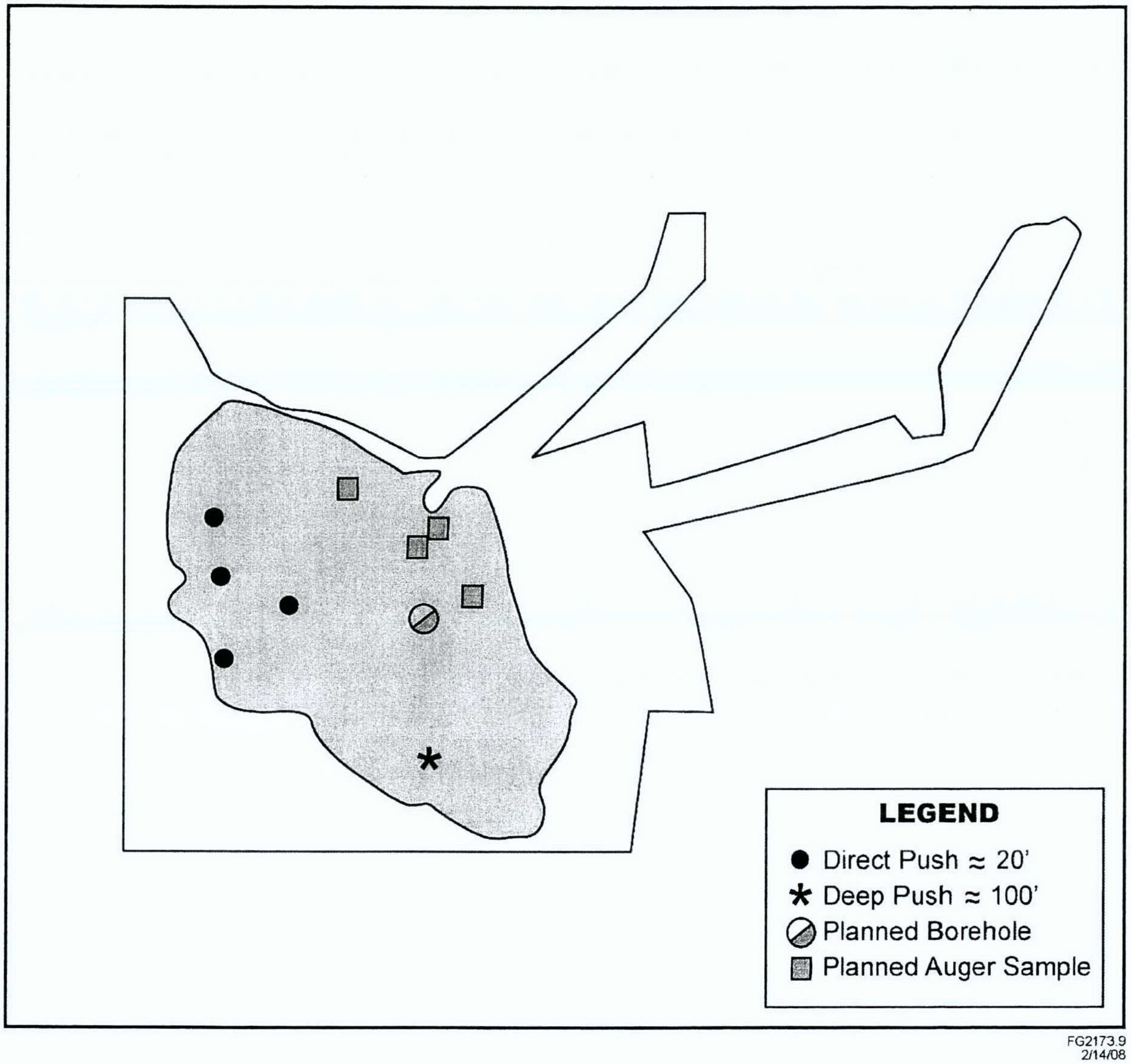

Table 3-1. Key Features of Model Group 5, Large-Area Ponds, Sampling Design. (7 Pages)

Survey or Analytical Methodology	Key Features of Design	Sampling Design Rationale
216-U-10 Pond		
Geophysical logging – shallow push and high-resolution spectral-gamma logging; deep push and slim hole gamma and neutron logging; augered borings with soil sampling; cable tool drilling with high-resolution gamma logging and soil sampling	*Medium*: Soil *Specific Location/Area of Concern*: Nature and extent of contamination in the primary pond location and ditch that fed the pond. *Investigation Method*: This investigation will require installation of shallow-push and deep-push borings, test pits (auger holes), and a borehole as identified in Figure 3-6. Four shallow pushes will be installed to a depth of 6 m (20 ft) as shown in Figure 3-6 and will be logged with a high-resolution gamma tool for Cs-137 and other gamma emitters. One deep push will be installed in the south end of the pond (Figure 3-6) and logged with slim hole gamma and neutron tools. The deep push will be driven to 30 m (100 ft) or refusal, whichever comes first. Three soil samples will be collected: one at the pond bottom and two at levels indicated having high moisture contents. Three Four locations will be sampled by auger and soil samples collected from the historical pond bottom (Figure 3-6). One new borehole approximately 42.7 m (140 ft) deep will be installed in the immediate vicinity of existing Borehole 299-W23-231 (Figure 3-7). The borehole will be geophysically logged and three soil samples collected. The ten existing deep probes will be examined and logged, if feasible, with the small diameter gamma logging systm. *Parameter*: Gamma-emitting contaminants including Cs-137 and elevated moisture levels.	Use gamma activity including Cs-137 and elevated moisture zones for tracking the extent of contamination. Deep soil samples and the proposed borehole will be used to address the significance of contaminants moving through the groundwater pathway. Analysis of augered samples will be used to estimate the level of uranium contamination.
Soil sampling: two samples from each of three augered boreholes; three samples from the borehole, and three samples from the deep push (total of 13 soil samples)	*Augered samples*: At three four separate locations, augered soil samples will be taken to locate and identify the depth and thickness of the organic mat. The mat will be located visually or by use of hand-held radiological survey instruments through the examination of core material removed during augering. Once the organic mat at each test pit is located, take two samples – one of the mat material and one of soil directly below the mat – at each of the three locations for a total of six test-pit samples. *Borehole sample(s)*: Collect one sample at the pond bottom equating to the pond sediment layer (organic mat). Collect one sample at 4.6 m (15 ft) bgs and one sample at depth (approximately 42.7 m or 140 ft bgs). *Shallow-push sample(s)*: One soil sample will be selected based on the results of the geophysical logging of the shallow pushes. *Deep-push samples*: Take one sample at the suspected pond bottom (based on Cs-137 levels) and two additional samples at depths indicated by elevated moisture levels. Samples will be collected using the dual well sampling tool associated with deep pushes. *Contaminants*: Nonradionuclides include antimony, cadmium, manganese, cyanide, selenium, total uranium, silver, thallium, fluoride, and nitrate. [b] Radionuclides include Cs-137, Eu-154, Sr-90, Tc-99, Np-237, Pu-239/240, Am-241, and uranium isotopes.	Augered samples will be used to sample the organic mat at the pond bottom and the location of most contamination because of sorption of contaminants onto organic materials. The borehole will be used to clear up an outstanding data quality issue and to evaluate uranium with depth. Shallow-push samples taken at the Cs-137 hotspots are intended to represent worst-case conditions at the pond and facilitate evaluation of a partial-removal alternative. Deep-push samples will be collected to evaluate risk associated with the groundwater pathway.

Table 3-2. Summary of Model Group 5 Shallow Push and Drilling Sample Collection Requirements. (2 Pages)

Site	Number of Shallow Pushes and Boreholes	Sample Collection Methodology	COPCs	Sample Location Information					Analytical Requirements and Parameters [c]	
				Sample Location [a]	Sample Depth (ft bgs)	No. of Samples from Shallow Pushes & Drilling	No. of Field Quality Control Samples ~~Dup/Rinsate~~		Radionuclides	Nonradio-nuclides
216-A-25 Pond	2	Push	Table 3-1	--	≤ ~~15~~ [b]	2	~~1~~ [d]	~~1~~	Table 2-1	Table 2-2
216-B-3 Pond	5	Push	Table 3-1	Footnote a	≤ 15 [b]	1 [e]	0	~~1~~	Table 2-1	Table 2-2
216-S-16 Pond	9	Push	Table 3-1	Footnote a	≤ 15 [b]	1	0	~~1~~	Table 2-1	Table 2-2
216-S-17 Pond	10	Push	Table 3-1	Footnote a	≤ 15 [b]	1	~~2~~ [d] 0	~~1~~	Table 2-1	Table 2-2
UPR-200-W-124	2	N/A	--	--	--	--	--		--	--
216-T-4B Pond	4	Push	Table 3-1	Footnote a	≤ 20 [b]	1	0	~~1~~	Table 2-1	Table 2-2
216-U-10 Pond	~~3~~4	Augered boreholes (~~3~~4)	Table 3-1	Sediment layer and 1 ft below (Fig 3-6)	TBD	2 at each augered borehole (6 total)	~~2~~ [d] 0	~~1~~	Table 2-1	Table 2-2
	1	Borehole (3)		Sediment layer, 15 ft bgs and depth (140 ft bgs) (Fig 3-6)	Sediment layer (TBD), 15 ft and 140 ft	3	2 ~~1~~ [d]	~~1~~	Table 2-1	Table 2-2
	4	Push		TBD (Fig 3-6)	< 20 [b]	1	--	~~1~~	Table 2-1	Table 2-2
216-U-11 Ditch	5	N/A	--	--	--	--	--		--	--
Total number of shallow pushes: 41										
Number of boreholes (drilled and augered): ~~4~~5										
Total number of samples: 16										
Minimum number of field quality control samples: ~~62 duplicate samples and 8 equipment rinsate samples~~										

Table 1-7. Summary Sampling Design. (2 Pages)

Planned Survey or Analytical Methodology	Key Features of Design*
216-A-25 Pond – CW-1	
Geophysical logging	Specific location/area of concern: Determine general extent of contamination at the stabilized, secondary overflow area emanating from the northwest corner of the stabilized primary overflow section by installing two shallow pushes into overflow area soil and geophysically log pushes using high-resolution spectral-gamma instruments.
Soil sampling	Collect one soil sample from each shallow push for a total of two soil samples representing the pond bottom based on geophysical logging results from the shallow pushes. Soil samples will be analyzed for contaminants identified in Table 1-2.
216-B-3 Pond – CW-1	
Geophysical logging	Specific location/area of concern: Determine the nature and extent of contamination emanating radially from the pond inlet by installing shallow pushes into pond soil surrounding the BP-1 Test-Pit hotspot and geophysically log pushes using high-resolution spectral-gamma instruments.
Soil sampling	Sample soil along the transect with the highest Cs-137 concentration, based on geophysical logging results. Soil samples will be analyzed for contaminants identified in Table 1-2.
216-S-16 Pond – CW-2	
Geophysical logging (gamma and moisture)	Specific location/area of concern: Determine the nature and extent of contamination emanating radially from the pond inlet through the inlet channel and all four pond lobes by installing 11 shallow pushes into pond soil, beginning at the pond inlet and geophysically log pushes using high-resolution spectral-gamma instruments. Install two deep pushes (in pairs) in lobes 1 and 2 of the pond for a total of four pushes. Additionally log the first push of each pair with slim hole gamma and moisture estimating tools. Based on the geophysical results of the first push of each pair, select up to three depths to collect soil samples from the second push in the pair. Integrate activities as applicable with 200-UP-1 Groundwater Operable Unit activities.
Soil sampling	(a) Collect a minimum of one soil sample from worst case location and depth, based on geophysical logging results from the shallow pushes (b) Collect soil samples from the second push of each deep-push pair at a depth representative of the bottom of the pond and at two depths having elevated moisture levels for a total of six soil samples. Integrate activities as applicable with 200-UP-1 Groundwater Operable Unit activities. Soil samples will be analyzed for contaminants identified in Table 1-2.
216-S-17 Pond – CW-2	
Geophysical logging (gamma and moisture)	Specific location/area of concern: Determine nature and extent of contamination emanating radially from the pond inlet by installing 10 shallow pushes into pond soil, beginning at the pond inlet and geophysically log pushes using high-resolution spectral-gamma instruments. Install four deep pushes (in two pairs) in the pond for a total of four pushes. Additionally log the first push of each pair of deep pushes with a slim hole gamma and moisture estimating tools. Based on the geophysical results of the first push of each pair, select up to three depths to collect soil samples from the second push in the pair. Integrate activities as applicable with 200-UP-1 Groundwater Operable Unit activities.
Soil sampling	(a) Collect a minimum of one soil sample from worst case location and depth, based on geophysical logging results from the shallow pushes. (b) Collect soil samples from the second push of each deep push pair at a depth representative of the bottom of the pond and at two depths having elevated moisture levels for a total of six soil samples. Integrate activities as applicable with 200-UP-1 Groundwater Operable Unit activities. Soil samples will be analyzed for contaminants identified in Table 1-2.

significant changes in sample locations that do not impact the DQO/SAP will require notification and approval of the Waste Site Remediation Task Lead. Changes to sample locations that could result in impacts to meeting the DQO/SAP will require RL and regulator approval. Significant differences in geophysical or hydrological conditions encountered require regulator notification, and if such differences are determined to result in impacts to meeting to the DQO/SAP, RL and regulator approval is required.

Revisions to the SAP will be evaluated and processed in accordance with Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*, Section 9.3, "Document Revisions."

Minor field changes will be documented in a log in accordance with the Action Plan, Section 12.4, "Minor Field Changes."

Sample design details are presented in Chapter 3.0. The sample design, sample matrixes, parameters, and rationale are presented on a site-specific basis in Table 3-1. The number and types of samples, including location and frequency and data to be collected are identified in Table 3-2 and in the Chapter 3.0 figures.

2.2.3 Geophysical Logging and Soil-Sampling Methods

Boreholes and shallow pushes in 216-U-10 Pond will generally will be logged with a high-resolution spectral gamma-ray logging system to provide capabilities to locate gamma emitters including uranium isotopes. continuous vertical logs of gamma-emitting radionuclides Deep pushes and shallow pushes outside of 216-U-10 Pond will be logged with a scintillation type geophysical logging system (small diameter tools)., The scintillation logging is focused on the detection of Cs-137 though a complete spectra of emissions will be obtained. Deep pushes will additionally be logged with a neutron probe to support the selection of sample locations containing higher levels of moistureand with a neutron moisture-logging system to identify moisture changes. . In addition, existing boreholes may be logged with the spectral gamma and/or moisture-logging systems.

The spectral gamma logging of existing wells in the vicinity of a waste site can be a cost-effective method of providing supplemental data on the vertical and lateral distribution of gamma-emitting radionuclides. The spectral gamma logging system uses instrumentation to identify and quantify gamma-emitting radionuclides in wells as a function of depth. In sites where substantial plutonium contamination is anticipated based on existing information, spectral gamma-ray logging, passive neutron logging, or a combination of both systems may be used to provide additional understanding of the presence and distribution of plutonium. Before logging, the Field Project Manager and Soil & Groundwater Remediation Project Manager will meet with the logging subcontractor(s) to alert them to potential for plutonium and to appropriate plan the best strategy for obtaining plutonium geophysical logging data.

The spectral gamma logging system proposed for 216-U-10 Pond uses laboratory-grade high-purity germanium detectors to collect 4096-channel gamma energy spectra at discrete depth increments. Radionuclide identification and assay are based on characteristic gamma emissions associated with decay. At each depth increment, the gamma energy spectrum is analyzed to detect peaks, and to determine net count rate, counting error, and minimum detectable activity for each peak. The energy resolution capability of the detector varies between approximately 2 and 4 keV, depending on energy level and background activity. Net counts from individual gamma energy peaks are processed with the detector calibration function, dead time correction, casing correction, and water correction to determine the bulk concentration, the analytical error, and the minimum detectable level. All quantities are reported in picocuries per gram. For selected radionuclides, specific regions of interest can be 'forced' to determine the minimum detectable activity even when no peak is detected. Thus, the minimum detectable activity and analytical error are calculated on a point-by point basis and shown on the log plot. The minimum detectable activity depends on the intensity (yield) of the characteristic gamma ray, detector efficiency, casing thickness, and background activity level.

A logging system is defined as a unique combination of downhole sonde (detector) and logging system (cable, winch, power supply, control system, and data acquisition system). The spectral gamma logging system describe above and the neutron moisture logging system areis calibrated on an annual basis, or after any significant repairs or modifications to either the sonde or the logging system. Calibration measurements are made at the Hanford Calibration Facility, located near the central weather station, just east of the Hanford Site 200 West Area. Each calibration is documented with a calibration certificate.

The neutron-moisture logging system that measures moisture employs a weak americium beryllium neutron source and neutron detector to provide a direct reading of hydrogen atom distribution in the soil surrounding the borehole. This detector will be used to measure continuous vertical moisture in the vadose zone. The spectral gamma logs will be used to supplement the laboratory radionuclide data to determine the vertical distribution of radionuclides in the vadose zone beneath the units and to aid in geological interpretation of subsurface stratigraphy. The deep hproposed 140 " deep boreholes will be logged through the casing before a new casing string is added and after the well borehole has reached total depth. The spectral gamma logging equipment calibration is conducted annually, and the data acquired during the calibrations are used to derive factors that convert measured peak-area count rate to radionuclide concentrations in picocuries per gram. Corrections are applied to the data to compensate for the gamma ray attenuation by the casing.

Logging runs will be made before the casing sizes are changed and at the total depth of the borehole. The downhole tools and cable will be subject to the same rules as are the drill rig and equipment. The downhole tools and cable will be cleaned between boreholes. The upper part of each borehole will be the most contaminated and will be logged first.

Small-diameter shallow and deep-push holes can will be logged using small-diameter spectral gamma and moisture logging instruments. The small diameter spectral gamma tool will be a scintillation type instrument containing either a sodium-iodide or berellium-germanium-oxide crystal. The minimum detection limit for Cs-137 will be 1 -5 pCi/g. The neutron-moisture logging system used to measure moisture employs a weak americium beryllium neutron source and neutron detector to provide a direct reading of hydrogen atom distribution in the soil surrounding the borehole. This detector will be used to measure continuous vertical moisture in the vadose zone.

3.0 FIELD SAMPLING PLAN

This FSP describes the data-collection objectives, field screening and soil sampling locations and frequency, and sample management.

3.1 SAMPLING OBJECTIVES

Through the DQO process (Section 1.7 and Appendix A), the Tri-Parties agreed that additional data collection is required at the 216-A-25 Pond, 216-B-3 Pond, 216-S-16 Pond, 216-S-17 Pond (and associated UPR-200-W-124), 216-T-4B Pond, 216-U-10 Pond, and 216-U-11 Ditch. This FSP identifies and describes data-collection activities to be performed at these waste sites.

Based on the preliminary conceptual site model, the majority of the contamination is expected to be present in an organic mat that coincides with pond sediment. Soil samples also will be collected to identify areas of elevated moisture potentially containing mobile contaminants at concentrations that could impact groundwater. Because all of these waste sites have been stabilized with cover soils (Table 1-1), intrusive techniques must be employed to collect data and sample material for laboratory analysis to better understand the nature and extent of contamination at the waste sites. A multistep data-collection approach has been developed that generally begins with observational techniques such as geophysical logging, and in some cases is followed up with focused soil sampling. These characterization elements are discussed in the following text and in Table 3-1, and shown in Figures 3-1 through 3-8.

3.1.1 Geophysical Logging of Shallow and Deep Pushes and/or Boreholes

Shallow and deep pushes will be installed at generally predetermined locations. Shallow pushes will be driven to a depth of approximately 4.6 m (15 ft) to 6 m (20 ft) below ground surface (bgs). ~~High-resolution~~Spectral gamma detectors will be lowered the full depth of the pushes, retrieved, and then moved to the next push, until all of the pushed boreholes have been logged. The spectral-gamma logs will be used to supplement the laboratory radionuclide data to determine the vertical distribution of radionuclides in the vadose zone beneath the units and to provide correlation with other data collected from the pushes and/or borehole. The downhole tools and cable will be wiped between use at each push hole. The reference point for logging is the ground surface or the top of the casing. That information will be recorded.

A spectral-gamma logging system will be used to determine the distribution and gross concentrations of Cs-137 via gamma emissions. The pushes will be logged using ~~high-resolution~~ spectral-gamma instruments capable of detecting Cs-137 concentrations to 1 to 5 pCi/g. Geophysical logging will be continuous and thus will include the pond sediment layer as a critical data-collection point, because the highest radiological material activities are expected at this horizon. The results will be used to identify locations for subsequent soil sampling and laboratory analysis described later in this SAP. Shallow pushes and the deep borehole planned for the 216-U-10 Pond will be logged using a high purity germanium spectral logging system. All other shallow and deep pushes will be logged using small diameter logging devices.

In selected ponds, deep pushes will be driven to 30 m (100 ft) bgs or to the point of refusal, whichever occurs first. These deep pushes will be geophysically logged with slim hole gamma and neutron measuring tools. The neutron sonde is used to identify elevated zones of moisture. Up to three locations will be selected for sampling. Generally, a sample will be collected at the pond bottom (elevation selected on gamma measurements). Two additional soil samples will be collected at locations of elevated moisture levels based on the potential for mobile contaminants to move with the moisture front and remain in areas of elevated moisture. The assumption is past discharges of mobile contaminants will be most likely found in moisture-retaining materials.

~~The spectral-gamma data will be used to supplement the laboratory radionuclide data. These data are used to determine the vertical distribution of radionuclides in the vadose zone, to aid in geological interpretation of subsurface stratigraphy, and to provide correlation with other data collected from the borehole. High-resolution spectral-gamma log data are processed in accordance with approved procedures.~~

Soil sampling associated with the shallow pushes will be based on the location with the highest gamma emitters and other information that could be used to indicate the bottom of the pond. It is expected that Cs-137 will be the primary gamma emitter and its location is associated with the bottom of each pond. Soil sampling at the 216-B-3 Pond will occur only if Cs-137 levels are detected above the 'action' level of 24 pCi/g. This level is associated with the level of Cs-137 that will provide a dose of 15 mrem/yr accounting for decay.

The larger diameter (3.5") spectral-gamma logging system uses standard laboratory high-purity germanium detector instrumentation to identify and quantify gamma-emitting radionuclides in boreholes as a function of depth. The high-purity germanium detector is calibrated to National Institute of Standards and Technology requirements and includes corrections for environmental conditions that deviate from the standard calibration condition. Each logging system is calibrated annually, and daily pre-run and post-run verification measurements are made to ensure that system performance is within acceptable limits. The spectral-gamma logging equipment calibration is conducted annually, and the data acquired during the calibrations are used to derive factors that convert measured peak-area count rate to radionuclide concentrations in picocuries per gram. For each measurement, natural and manmade radionuclides are identified from characteristic gamma emissions, and the concentration, uncertainty (counting error), and minimum detectable level are independently calculated from gamma-energy spectra. The detector requires constant cooling with liquid nitrogen and was designed to operate completely submerged in water. Venting of the nitrogen gas to the surface is accomplished with a specially designed logging cable.

The neutron-moisture logging system that measures moisture employs a weak americium-beryllium neutron source and neutron detector to provide a direct reading of hydrogen atom distribution in the soil surrounding the borehole. This detector will be used to measure continuous vertical moisture in the vadose zone. The system will be calibrated to manufacturer specifications

The small diameter spectral gamma tool will be a scintillation type instrument containing either a sodium-iodide or berellium-germanium-oxide crystal. The minimum detection limit for Cs-137 will be 1 -5 pCi/g. The sytem will be calibrated to manufacturer specifications. The small diameter instruments function in the same manner as the instruments used in larger-diameter boreholes, but they have been adapted to work inside the smaller-diameter casings associated with the deep-push techniques.

The drive-casing hole planned through this SAP at the 216-U-10 Pond will be logged through the casing before casing sizes are changed and at the total depth of the borehole. The downhole tools and cable will be subject to the same rules as the drill rig and equipment. The downhole tools and cable will be decontaminated and surveyed between boreholes. Corrections are applied to the data to compensate for the gamma-ray attenuation by the casing. The site geologist will record the types of geophysical surveys and the depth intervals of initial and repeat runs in the Well Construction Summary Report form.

3.1.2 Shallow- and Direct-Push Soil Sampling and Analysis

Nonradiological and radiological soil samples will be collected from shallow- and deep-push locations for laboratory analysis. Sample collection will follow the plans identified in Table 3-1. Sample depth intervals will be selected to correspond with the highest Cs-137 activity based on the historical pond bottom and on elevated moisture readings that could indicate the presence of mobile contaminants in deeper soil locations.

Sampling will be performed using a split-spoon or similar sampler. Soil will be transferred to a precleaned, stainless-steel mixing bowl, homogenized, and then containerized in accordance with contractor sampling procedures. Samples will be analyzed for COPCs or analytical suites identified in Tables 2-1 and 2-2. Quality control samples will be collected in accordance with the QAPjP. Physical property analyses are not planned for these shallow or deep drive-point samples.

Based on a review of past results and meetings with Ecology, it was determined that organic contamination (toluene) is not to be considered a risk driver and the need for additional analysis for volatile organics is considered unnecessary.

Additional pushes will be collocated to obtain sufficient sample volume if needed. Other field-screening techniques, such as hand-held radiation detectors, can be used in conjunction with the above guidance to determine actual sample depths. Samples also may be collected and analyzed at the discretion of the Waste Site Remediation Task Lead and Field Team Leader (Section 2.1.1), based on field conditions, measurements, or observations.

3.1.3 Borehole Drilling and Sampling and Analysis

A single borehole is planned at the 216-U-10 Pond as a portion of the Model Group 5 supplemental data-collection activity to be drilled in the 216-U-10 Pond as shown in Figure 3-6. Drilling and sampling for this vadose-zone investigation will stop at approximately 42.7 m (140 ft) bgs. Physical property samples are not planned. All drilling will be via a method approved by the project and will conform to site-specific technical specifications for

Table 3-1. Key Features of Model Group 5, Large-Area Ponds, Sampling Design. (7 Pages)

Survey or Analytical Methodology	Key Features of Design	Sampling Design Rationale
B Pond		
Geophysical logging – shallow push and high-resolution spectral-gamma logging tool; soil sampling	*Medium*: Soil *Specific Location/Area of Concern*: Lateral extent of contamination around BP-1 Test Pit in the 216-B-3 Main Pond. No investigation is planned for the B Pond lobes. *Investigation Method*: Three-phased investigation approach: **Phase 1**: Three shallow pushes will be driven into pond soil surrounding the BP-1 Test-Pit hotspot (see Figure 3-2). One shallow push will be placed along each of three transects between the BP-1 Test-Pit location and Test-Pit BP-3, Test-Pit BP-4, and Borehole B8758. One shallow push will be driven approximately 7.6 m (25 ft) away from the BP-1 Test Pit along each transect to a depth of approximately 4.6 m (15 ft) bgs. The pushes will be logged using high-resolutionsmall diameter spectral-gamma instruments. If logging results at a shallow push are below the logging action level for Cs-137, [a] no further investigation will be conducted at the B Pond. **Phase 2** will occur if spectral-gamma logging results, detected at push location(s), exceed the logging action level for Cs-137. Continue installation outward from the first shallow-push location along the same transect and depth using a 7.6 m (25-ft) interval between pushes, until a concentration equal to or less than the logging action level for Cs-137 is reached and the area of elevated contamination is delineated. **Phase 3** will occur when the logging action level for Cs-137 is measured at a push location. Continue shallow-push installation inward from the last push along the same transect at half the distance between the last shallow push and the prior push or the BP-1 Test Pit to refine extent of contamination.	200-CW-1 remedial investigation results in DOE/RL-2000-35 indicate that the BP-1 Test Pit reported the highest concentrations of contaminants, including Cs-137. Use Cs-137 to determine the extent of contamination radiating out from the BP-1 Test-Pit location. This information could be used to evaluate a partial removal alternative under CERCLA. A value of 25.6 represents an activity that is 4 times the Cs-137 action level for unrestricted use and would decay to 6.4 pCi/g (15 mrem/yr) within 50 years.
Soil sampling (one sample, based on Cs-137 activity above the Cs-137 action level)	*Specific Location/Area of Concern*: Collect one soil sample along the transect with the highest Cs-137 concentration based on geophysical logging results. Collect the sample at the edge of the area exceeding the Cs-137 logging action level. *Investigation Method*: Sample the soil at the depth of the maximum Cs-137 radiological contamination (corresponding to the bottom of the pond) based on the results of the shallow push. Other field-screening techniques, such as hand-held radiation detectors, can be used in conjunction with the above guidance to determine sample depths. *Contaminants*: Nonradionuclides include ICP metals and mercury. COPCs are cadmium, lead, and mercury Radionuclides include Cs-137, Eu-154, Sr-90, Tc-99, Np-237, Pu-239/240, Am-241, and uranium isotopes.	Contamination has been previously reported to be associated mainly with the pond bottom, approximately 1.8 m (6 ft) bgs. Use soil sampling to determine the extent of radiological and nonradiological COPC contaminants at 4 times the Cs-137 action levels near the BP-1 Test-Pit.

Table 3-1. Key Features of Model Group 5, Large-Area Ponds, Sampling Design. (7 Pages)

Survey or Analytical Methodology	Key Features of Design	Sampling Design Rationale
216-S-16 Pond		
Geophysical logging – shallow push and high-resolution spectral-gamma logging tool; deep push and slim hole gamma and neutron tools; soil sampling	*Medium*: Soil *Specific Location/Area of Concern*: Nature and extent of contamination emanating radially from the pond inlet through the inlet channel and all pond lobes (four). *Investigation Method*: Seven shallow pushes will be driven into lobe 1 of the pond and two shallow pushes will be driven into lobe 4. Shallow pushes will be focused around the inlet and in lobe 4. Each shallow push will be driven approximately 4.6 m (15 ft) deep. The shallow pushes will be logged using high-resolutionsmall diameter spectral-gamma instruments. One shallow soil sample will be collected. One deep push will be driven into lobes 1, 2, and 3, respectively (see Figure 3-3). Each deep push will be driven to 30 m (100 ft) bgs or refusal, whichever occurs first. Each deep push will be logged with a small-diameter gamma detector and neutron detector (for moisture). Soil samples will be collected near the suspected pond bottom (depth based on gamma activity) and at two additional locations of elevated moisture content (based on neutron response). *Parameter*: Cesium-137 activity as determined by high-resolution spectral-gamma tools will be used to select the one shallow soil sample based on logging at the shallow push sites. Gamma activity and elevated moisture levels will be used to select up to three sample locations for each of the deep pushes.	The pond was approximately 1 m (3 ft) deep during operations. After draining, the pond was stabilized with soil from the dikes. The pond bottom is expected at 1 m (3 ft) bgs. Cesium-137 is expected based on discharge information and historical data in the work plan (DOE/RL-99-66). Use Cs-137 and high moisture levels for tracking contamination by geophysical logging. Deep soil samples will be used to address the significance of contaminants moving through the groundwater pathway.
Soil sampling (one sample based on the data gained from the shallow pushes and three soil samples each from two deep pushes (seven soil samples in total)	*Specific Location/Area of Concern*: One soil sample will be collected at the pond bottom based on spectral-gamma readings from the shallow pushes. Up to three soil samples will be collected from each of the deep pushes. Additional samples may be considered based on the results of geophysical logging and field screening. *Investigation Method*: The shallow soil sample will be collected at the depth of the maximum Cs-137 concentration (corresponding to the bottom of the pond) and will use the shallow push tool to collect soil. Samples from the deep push will be collected based on the results from the slim hole gamma and moisture logging. The first sample will be located at the bottom of the pond (based on elevated gamma data and historical information). The remaining two sample elevations will be based on the presence of elevated moisture locations. Soil samples will be collected using a dual wall deep-push sampling tool. Additional pushes can be colocated to obtain sufficient sample volume if needed. Other field-screening techniques, such as hand-held radiation detectors, can be used in conjunction with the above guidance to determine actual sample depths. *Contaminants*: Nonradionuclides include antimony, cadmium, manganese, selenium, total uranium, silver, thallium, fluoride, cyanide, and nitrate. [b] Radionuclides include Cs-137, Eu-154, Sr-90, Tc-99, Np-237, Pu-239/240, Am-241, and uranium isotopes.	Use soil samples to determine other radiological and nonradiological COPC concentrations at selected area(s) of maximum Cs-137 concentrations and higher moisture zones.

Table 3-1. Key Features of Model Group 5, Large-Area Ponds, Sampling Design. (7 Pages)

Survey or Analytical Methodology	Key Features of Design	Sampling Design Rationale
216-S-17 Pond		
Geophysical logging – shallow pushes logged with high-resolution spectral-gamma logging tool; deep pushes logged with slim hole gamma and neutron tools; soil sampling	*Medium*: Soil *Specific Location/Area of Concern*: Nature and extent of contamination emanating radially from the pond inlet, to include a high-radiation area (15 – 450 mR/h) around the perimeter of the pond. *Investigation Method*: Ten shallow pushes will be driven into pond soil beginning at the pond inlet (see Figure 3-4). Shallow pushes will be placed to the edge of the historical maximum-use area of the pond as identified by aerial photographs, markers, other historical information, and/or surface geophysics conducted to support the excavation permit. The pushes will be driven to a depth of approximately 4.6 m (15 ft). The shallow pushes will be logged using high-resolutionsmall diameter spectral-gamma instruments. One soil sample will be collected based on the results of the high-resolution logging of these shallow pushes. Two deep pushes will be installed to investigate potential risk associated with the groundwater pathway. Each deep push will be driven to 30 m (100 ft) bgs or refusal, whichever occurs first. Each push will be logged with a small-diameter gamma detector and neutron detector (for moisture). *Parameter*: Soil sampling locations defined through spectral-gamma activity, gross gamma activity, and moisture levels.	The pond was 0.3 to 0.6 m (1 to 2 ft) deep during operations and was surface stabilized with 1.2 m (4 ft) of soil. Cesium-137 is expected to be present based on discharge information and on historical data in the work plan (DOE/RL-99-66). Use gamma-emitting radionuclides and moisture conditions for tracking contamination using geophysical logging techniques. Deep soil samples will be used to address the potential for contaminants to move through the vadose zone.
Soil sampling (one shallow soil sample and six deep soil samples will be collected using push technologies, seven pushes total)	*Specific Location/Area of Concern*: One soil sample will be collected at the pond bottom based on gamma activity or other radiological contamination. The soil samples will be collected near the suspected pond bottom. Three soil samples will be collected from each of the two deep pushes (total of six samples). The uppermost sample locations will be based on gamma activity or other radiological information to determine the suspected bottom of the pond. Two other soil samples will be collected based on the presence of elevated moisture conditions. Additional samples will be considered based on the results of geophysical logging and field screening. *Investigation Method*: The shallow soil sample will be collected at the location and depth that corresponds to the maximum Cs-137 concentration found using the shallow pushes and corresponding to the bottom of the pond. A shallow push tool will be used to collect the soil sample. Samples from the deep push will be collected based on the results from the slim hole gamma and moisture logging. The first sample will be located at the bottom of the pond (based on elevated gamma data and historical information). The remaining two sample elevations will be based on the depth of elevated moisture. Soil samples will be collected using a dual wall deep-push sampling tool. Additional pushes can be colocated to obtain sufficient sample volume if needed. Other field-screening techniques, such as hand-held radiation detectors, can be used in conjunction with the above guidance to determine actual sample depths. *Contaminants*: Nonradionuclides include antimony, cadmium, manganese, selenium, total uranium, silver, thallium, fluoride, cyanide, and nitrate. [b] Radionuclides include Cs-137, Eu-154, Sr-90, Tc-99, Np-237, Pu-239/240, Am-241, and uranium isotopes.	Use soil sampling to determine other radiological and nonradiological COPC concentrations at selected area(s) of maximum Cs-137 concentrations and higher moisture zones.

Table 3-1. Key Features of Model Group 5, Large-Area Ponds, Sampling Design. (7 Pages)

Survey or Analytical Methodology	Key Features of Design	Sampling Design Rationale
UPR-200-W-124 (Overflow Area of the 216-S-17 Pond)		
Geophysical logging – shallow push and high-resolution spectral-gamma logging tool	*Medium*: Soil *Specific Location/Area of Concern*: Nature and extent of contamination emanating from the dike overflow at the southwest corner of the pond. The exact location of this unplanned release is indeterminate from records. *Investigation Method:* Two shallow pushes will be driven and logged using a high-resolutionsmall diameter spectral gamma tool (Figure 3-4). The shallow pushes will be driven approximately 4.6 m (15 ft) deep. No sampling is planned for this location. *Parameter*: Gamma emitters.	Use Cs-137 for tracking the contamination extent using geophysical logging techniques. Overflow area contaminants would be the same as 216-S-17 Pond contaminants, at the same or lower concentrations.
Soil sampling	None planned.	
216-T-4B Pond		
Geophysical logging – shallow push and high-resolution spectral-gamma logging tool	*Medium*: Soil *Specific Location/Area of Concern*: Nature and extent of contamination in the primary pond location and the ditch that fed the pond. *Investigation Method*: Two shallow pushes will be driven into the pond soil and two will be driven into the ditch to a depth of approximately 6 m (20 ft), as shown in Figure 3-5. The pushes will be geophysically logged using high-resolutionsmall diameter spectral-gamma instruments. *Parameter*: Gamma-emitting radionuclides, including Cs-137.	The 216-T-4B Pond and the 216-T-4-2 Ditch that fed the pond are both located within the boundary of the 216-W-3AE Burial Ground RCRA treatment, storage, and disposal unit. The pond is considered to have been dry since 1977 (pre-RCRA), although the ditch received waste until 1995. The ditch and pond received steam condensate and evaporator cooling water from the 242-T Evaporator (a RCRA past-practice unit that ceased operations in 1982) and wastewater from the 221-T (T Plant) Canyon Building air conditioning units and floor drains, not known to have been identified as a dangerous waste stream. Extensive contamination is not anticipated.
Sampling (one soil sample)	Collect one soil sample from the worst-case location based on gamma radiation measurements. *Contaminants*: Nonradionuclides include antimony, cadmium, manganese, selenium, total uranium, silver, thallium, fluoride, cyanide, and nitrate. [b] Radionuclides include Cs-137, Eu-154, Sr-90, Tc-99, Np-237, Pu-239/240, Am-241, and uranium isotopes.	Sample information will provide initial baseline contaminant information and possibly could assist with closure of the RCRA treatment, storage, and disposal unit.

Table 3-1. Key Features of Model Group 5, Large-Area Ponds, Sampling Design. (7 Pages)

Survey or Analytical Methodology	Key Features of Design	Sampling Design Rationale
216-U-11 Ditch		
Geophysical logging – shallow push and high-resolution spectral-gamma logging; deep push and slim hole gamma and neutron tools; soil sampling	*Medium*: Soil *Specific Location/Area of Concern*: Nature and extent of contamination in the primary ditch sections and in the shallow overflow area between the ditch sections. *Investigation Method*: Five shallow pushes will be driven into the ditch site soil as shown on Figure 3-8. Each will be advanced approximately 3 m (10 ft) deep and will be geophysically logged using a high-resolutionsmall diameter spectral gamma tool. One deep push will be installed and advanced to 30 m (100 ft) or refusal, whichever occurs first. The deep push will be logged with slim hole gamma and moisture measuring tools. Samples will be collected at the bottom of the pond (based on Cs-137 levels) and at two lower depths where elevated moisture conditions are found. *Parameter*: Spectral gamma will be used to determine levels of gamma-emitting contaminants; gross gamma for locating the pond bottom, and moisture measurements to locate up to two deeper soil sampling locations.	Use Cs-137 to identify the extent of contamination along the ditch length and in the shallow overflow area. This ditch was expected to be approximately 1.8 m (6 ft) deep during operations. Because the horseshoe-shaped ditch was fed by overflow from the 216-U-10 Pond, ditch contaminants are expected to be the same as 216-U-10 Pond contaminants. The ditch is known to have overflowed into the interior portion of the south end of the horseshoe shape.
Soil sampling: total of three soil samples from one location	Deep-push samples: Collect one sample at the suspected pond bottom (based on Cs-137 levels) and two additional samples at levels indicated by elevated moisture levels. Samples will be collected using the dual well sampling tool associated with deep pushes. *Contaminants*: Nonradionuclides include antimony, cadmium, manganese, cyanide, selenium, total uranium, silver, thallium, toluene, fluoride, and nitrate. [b] Radionuclides include Cs-137, Eu-154, Sr-90, Tc-99, Np-237, Pu-239/240, Am-241, and U-238.	Use to evaluate the potential for contaminants to migrate through the vadose zone.

[a] The logging action level for Cs-137 is 24 pCi/g (Section 3.1.1).

[b] This waste site is an analogous waste site to the well-characterized representative waste site 216-U-10 Pond. As a conservative measure because of the absence of data for this analogous waste site, the 200-CW-5 remedial investigation report (DOE/RL-2003-11), Table 6-1, list of 216-U-10 Pond COPCs will be applied and will be expanded to include nitrate (per data quality objectives discussion), U-238 (per WIDS), fluoride and cyanide (identified through STOMP modeling [PNNL-12028]), and Pu-239/240 and Am-241 (identified by earlier 216-U-11 Ditch sampling).

BHI-01133, *216-A-25 Pond Overflow Extension (WIDS Site 600-118) Interim Stabilization Final Report/December 1997.*

Comprehensive Environmental Response, Compensation, and Liability Act of 1980.

DOE/RL-99-66, *Steam Condensate/Cooling Water Waste Group Operable Units RI/FS Work Plan; Includes: 200-CW-5, 200-CW-2, 200-CW-4, and 200-SC-1 Operable Units.*

DOE/RL-2000-35, *200-CW-1 Operable Unit Remedial Investigation Report.*

DOE/RL-2003-11, *Remedial Investigation for the 200-CW-5 U Pond/Z Ditches Cooling Water Group, the 200-CW-2 S Pond and Ditches Cooling Water Group, the 200-CW-4 T Pond and Ditches Cooling Water Group, and the 200-CS-1 Steam Condensate Group Operable Units.*

PNNL-12028, *STOMP Subsurface Transport Over Multiple Phases, Version 2.0, Application Guide.*

Waste Information Data System database.

bgs = below ground surface.
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980.*
COPC = contaminant of potential concern.
ICP = inductively coupled plasma.
RCRA = *Resource Conservation and Recovery Act of 1976.*
STOMP = subsurface transport over multiple phases.
WIDS = *Waste Information Data System* database.

Waste Site Remediation Task Lead are responsible for ensuring that all field procedures are followed completely and that field sampling personnel are adequately trained to perform sampling activities under this SAP. The Waste Site Remediation Lead, or the Field Team Lead at the discretion of the Waste Site Remediation Task Lead, must document all deviations from procedures or other problems pertaining to sample collection, chain of custody, COPCs, sample transport, or noncompliant monitoring. As appropriate, such deviations or problems will be documented in the field logbook or in nonconformance report forms in accordance with internal corrective-action procedures. The Waste Site Remediation Lead, or the Field Team Lead at the discretion of the Waste Site Remediation Task Lead, will be responsible for communicating field corrective action requirements and for ensuring that immediate corrective actions are applied to field activities.

2.2.7.1 Field Duplicates

Field duplicates are independent samples collected as close as possible to the same point in space and time, taken from the same source, stored in separate containers, and analyzed independently. These samples will be homogenized together.

A minimum of oneOne field duplicate will be collected from two of the each waste sites where soil sampling is performed. The duplicate should be collected generally from an interval that is expected to have some contamination, so that valid comparisons between the samples can be made (i.e., at least some of the COPCs will be above detection limit). When sampling is performed with a split spoon, the duplicate sample could be from a separate split spoon, either above or below the main sample, because of sample volume requirements.

2.2.7.2 Field Splits

Field splits of soil samples are not considered necessary to be collected under this SAP. However, during sampling, sample personnel could identify a need to collect a soil split sample to verify the performance of the primary laboratory. If so, the sample medium will be homogenized, split into two separate aliquots in the field, and sent to two independent laboratories. The split sample will be obtained from a sample medium suitable for analysis at an offsite laboratory and will be analyzed for all of the analytes listed in Tables 2-1 and 2-2.

2.2.7.3 Equipment Rinsate Blanks

A minimum of one field rinsate blank will be collected from each waste site where soil sampling is performed. The field geologist may request that additional equipment blanks be taken. Equipment blanks will consist of pure deionized water washed through decontaminated sampling equipment and placed in containers, as identified on the project Sampling Authorization Form. Note that the bottle and preservation requirements for water may differ from the requirements for soil.

Equipment rinsate blanks will be analyzed for the following:

- When characterization analysis is for radionuclides only
  - Gamma emitters
  - Gross alpha

Table 3-2. Summary of Model Group 5 Shallow Push and Drilling Sample Collection Requirements. (2 Pages)

Site	Number of Shallow Pushes and Boreholes	Sample Collection Methodology	COPCs	Sample Location Information					Analytical Requirements and Parameters [c]	
				Sample Location [a]	Sample Depth (ft bgs)	No. of Samples from Shallow Pushes & Drilling	No. of Field Quality Control Samples Dup/Rinsate		Radionuclides	Nonradio-nuclides
216-A-25 Pond	2	Push	Table 3-1	--	≤ 15 [b]	2	~~--~~1 [d]	1	Table 2-1	Table 2-2
216-B-3 Pond	5	Push	Table 3-1	Footnote a	≤ 15 [b]	1 [e]	0	1	Table 2-1	Table 2-2
216-S-16 Pond	9	Push	Table 3-1	Footnote a	≤ 15 [b]	1	0	1	Table 2-1	Table 2-2
216-S-17 Pond	10	Push	Table 3-1	Footnote a	≤ 15 [b]	1	~~2~~ [d] 0	1	Table 2-1	Table 2-2
UPR-200-W-124	2	N/A	--	--	--	--	--		--	--
216-T-4B Pond	4	Push	Table 3-1	Footnote a	≤ 20 [b]	1	0	1	Table 2-1	Table 2-2
216-U-10 Pond	~~3~~4	Augered boreholes (~~3~~4)	Table 3-1	Sediment layer and 1 ft below (Fig 3-6)	TBD	2 at each augered borehole (6 total)	~~2~~ [d] 0	1	Table 2-1	Table 2-2
	1	Borehole (3)		Sediment layer, 15 ft bgs and depth (140 ft bgs) (Fig 3-6)	Sediment layer (TBD), 15 ft and 140 ft	3	~~2~~1 [d]	1	Table 2-1	Table 2-2
	4	Push		TBD (Fig 3-6)	< 20 [b]	1	--	1	Table 2-1	Table 2-2
216-U-11 Ditch	5	N/A	--	--	--	--	--		--	--
Total number of shallow pushes: 41										
Number of boreholes (drilled and augered): 4~~5~~										
Total number of samples: 16										
Minimum number of field quality control samples: ~~6~~2 duplicate samples and 8 equipment rinsate samples										

Table 3-3. Summary of Model Group 5 Deep-Push Sample Collection Requirements.

Site	Number of Deep Pushes with Logging	Number of Deep Pushes with Sampling	Sample Collection Methodology	COPCs	Sample Location Information				Analytical Requirements and Parameters [c]	
					Sample Location [a]	Sample Depth (ft bgs) [b]	No. of Samples from Deep Pushes	No. of Field Quality Control Samples	Radio-nuclides	Nonradio-nuclides
216-A-25 Pond	--	--	--	--	--	--	--	--	--	--
216-B-3 Pond	--	--	--	--	--	--	--	--	--	--
216-S-16 Pond	3	3	Push	Table 3-1	Footnote a	TBD	9	--	Table 2-1	Table 2-2
216-S-17 Pond	2	2	Push	Table 3-1	Footnote a	TBD	6	--	Table 2-1	Table 2-2
UPR-200-W-124	--	--	--	--	--	--	--	--	--	--
216-T 4B Pond	--	--	--	--	--	--	--	--	--	--
216-U-10 Pond	1	1	Push	Table 3-1	Footnote a	TBD	3	2[d]--	Table 2-1	Table 2-2
216-U-11 Ditch	1	1	Push	Table 3-1	Footnote a	TBD	3	--	Table 2-1	Table 2-2
Total number of deep pushes: 14										
Total number of deep-push samples: 21										
Minimum number of field quality control samples: 2										

[a] Sampling at deep-push locations will occur under the conditions described in Table 3-1.
[b] Sample depth will be determined through the use of gamma and moisture logs. One sample will be selected to represent the pond bottom and two lower samples will be selected based on elevated moisture levels.
[c] See Tables 2-1 and 2-2 for detection limits and other analytical parameters.
[d] At a minimum, one duplicate and one equipment blank will be taken at this sampled waste site.

-- = no sampling.
bgs = below ground surface.
COPC = contaminant of potential concern.
TBD = to be determined.

diameter instruments function in the same manner as the instruments used in larger-diameter boreholes, but they have been adapted to work inside the smaller-diameter casings associated with the deep-push techniques.

The drive-casing hole planned through this SAP at the 216-U-10 Pond will be logged through the casing before casing sizes are changed and at the total depth of the borehole. The downhole tools and cable will be subject to the same rules as the drill rig and equipment. The downhole tools and cable will be decontaminated and surveyed between boreholes. Corrections are applied to the data to compensate for the gamma-ray attenuation by the casing. The site geologist will record the types of geophysical surveys and the depth intervals of initial and repeat runs in the Well Construction Summary Report form.

3.1.2 Shallow- and Direct-Push Soil Sampling and Analysis

Nonradiological and radiological soil samples will be collected from shallow- and deep-push locations for laboratory analysis. Sample collection will follow the plans identified in Table 3-1. Sample depth intervals will be selected to correspond with the highest Cs-137 activity based on the historical pond bottom and on elevated moisture readings that could indicate the presence of mobile contaminants in deeper soil locations.

Sampling will be performed using a split-spoon or similar sampler. Soil will be transferred to a precleaned, stainless-steel mixing bowl, homogenized, and then containerized in accordance with contractor sampling procedures. Samples will be analyzed for COPCs or analytical suites identified in Tables 2-1 and 2-2. Quality control samples will be collected in accordance with the QAPjP. Physical property analyses are not planned for these shallow or deep drive-point samples.

Based on a review of past results and meetings with Ecology, it was determined that organic contamination (toluene) is not to be considered a risk driver and the need for additional analysis for volatile organics is considered unnecessary.

Additional pushes will be collocated to obtain sufficient sample volume if needed. Other field-screening techniques, such as hand-held radiation detectors, can be used in conjunction with the above guidance to determine actual sample depths. Samples also may be collected and analyzed at the discretion of the Waste Site Remediation Task Lead and Field Team Leader (Section 2.1.1), based on field conditions, measurements, or observations.

3.1.3 Borehole Drilling and Sampling and Analysis

A single borehole is planned at the 216-U-10 Pond as a portion of the Model Group 5 supplemental data-collection activity to be drilled in the 216-U-10 Pond as shown in Figure 3-6. Drilling and sampling for this vadose-zone investigation will stop at approximately 42.7 m (140 ft) bgs. Physical property samples are not planned. All drilling will be via a method approved by the project and will conform to site-specific technical specifications for

Figure 3-3. Planned Geophysical Logging and Soil Sampling Locations at the 216-S-16 Pond. See Table 3-1 for sample details.