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Field Sampling and Analysis Plan for Soil Samples in Support of an Interim Barrier at S Farm

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Abstract: This Field Sampling and Analysis Plan (FSAP) for S Farm has been prepared to collect information regarding the geographic extent of subsurface mobile contaminant plumes to address design requirements for an interim surface barrier and to characterize the nature and extent of the contamination release to establish site cleanup and closure decisions.

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FIELD SAMPLING AND ANALYSIS PLAN FOR SOIL SAMPLES IN SUPPORT OF AN INTERIM BARRIER AT S FARM

C. L. Tabor
Washington River Protection Solutions, LLC

Date Published
April 2011

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Office of River Protection

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Abbreviations and Acronyms

ATL	Advanced Technologies and Laboratories International, Inc.
bgs	below ground surface
CFR	*Code of Federal Regulations*
CHPRC	CH2M HILL Plateau Remediation Company
DOE	U.S. Department of Energy
DOECAP	U.S. Department of Energy Consolidated Audit Program
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FEAD	Format for Electronic Analytical Data
FSAP	Field Sampling and Analysis Plan
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Documents*
HEIS	Hanford Environmental Information System
ICP/AES	inductively coupled plasma/atomic emission spectroscopy
ICP/MS	inductively coupled plasma/mass spectroscopy
IDMS	Integrated Document Management System
LCS	laboratory control sample
ORP	U.S. Department of Energy, Office of River Protection
QA	quality assurance
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
REDOX	Reduction Oxidation (Plant)
RL	U.S. Department of Energy, Richland Operations Office
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SGE	surface geophysical exploration
SOW	statement of work
SST	single-shell tank
WAC	*Washington Administrative Code*
WMA	Waste Management Area
WRPS	Washington River Protection Solutions LLC

Units

°C	degrees Celsius
Ci	curies
ft	feet
g	gram
L	liter
m	meters
mg/kg	milligram per kilogram
mL	milliliter
pCi/g	picocuries per gram

1.0 SAMPLING AND ANALYSIS OBJECTIVES

1.1 PURPOSE

The 241-S Tank Farm (S Farm) has near surface soil contamination of hazardous constituents from past waste releases. It is postulated that an interim surface barrier placed over S Farm will reduce moisture infiltration rate into the soil, thereby reducing the migration of soluble contaminants to the groundwater. To address design requirements for an interim surface barrier and to characterize the nature and extent of the contamination release, the geographic extent of subsurface mobile contaminant plumes must be understood. Furthermore, vadose zone characterization is necessary to establish site cleanup and closure decisions. This Field Sampling and Analysis Plan (FSAP) for S Farm has been prepared to collect information to meet both of these objectives. The requirements to meet these objectives are based on:

- RPP-ENV-49131, *Data Requirements for Characterization Supporting Near-Term Interim Barrier in S Farm*
- RPP-43551, *Tank Farm Interim Barrier Data Quality Objectives*
- RPP-RPT-38152, *Data Quality Objectives Report Phase 2 Characterization for Waste Management Area C RCRA Field Investigation/Corrective Measures Study*, applied opportunistically in support of the *Resource Conservation and Recovery Act of 1976* (RCRA) requirements and characterization efforts.

In regards to S Farm, a meeting was held on January 13, 2011 with representatives from the Washington State Department of Ecology (Ecology), U.S. Department of Energy (DOE) Office of River Protection (ORP), and Washington River Protection Solutions, LLC (WRPS). During this meeting, waste release characterization information about S Farm was presented to further the understanding on the need of an interim barrier (refer to Appendix A for meeting minutes, Figure 11 of RPP-RPT-30976, *Surface Geophysical Exploration of S Tank Farm at the Hanford Site*, and Figure E-4 of GJO-97-31-TARA/GJO-HAN-17, *Hanford Tank Farms Vadose Zone: Addendum to the S Tank Farm Report*). Specifically, it was identified that the waste release from tank 241-S-104 (S-104) was probably larger than previously determined, surface geophysical exploration (SGE) results suggest a large plume (plus one or more smaller plumes in the tank S-104 area), and drywell logging indicates plumes near the surface. Additionally it was noted that performing direct push in S Farm, with some emphasis in the region of the tank S-104 leak, should firm up the waste release conceptual model and support an informed decision on whether an interim surface barrier is warranted in this area.

It should be noted that there has been extensive characterization work conducted in Waste Management Area (WMA) S-SX, specifically in 241-SX Tank Farm (SX Farm) and the area between SX and S Farms. Information gathered during that characterization effort indicates that SX Farm contaminant transport would likely be reduced by an interim surface barrier and work is underway to design the barrier with construction expected to start in 2011. Gathering additional vadose zone characterization information at S Farm will result in a better understanding of the potential benefit of an interim barrier for reducing the transport of soluble contaminants towards the groundwater in WMA S-SX.

After data from this FSAP is collected and reviewed, determinations will be undertaken to assess how to proceed with characterization efforts in the S Farm. The data should aid in evaluating the S Farm vadose zone (e.g., determine the nature and extent of the plume contaminants). Furthermore, it is probable that data collected through this FSAP will be used to clarify future Phase 2 characterization activities for S Farm. Ecology will be involved in any discussions regarding further use of this data and associated information.

1.2 SCOPE

The characterization activities in S Farm will include direct pushing and logging an initial probe hole, then direct pushing an adjacent probe hole for sampling. Deep electrodes will be placed in each direct push logging hole for geophysical surveys. A multidiscipline team comprised of WRPS personnel, Energy*Solutions* Federal Services, Inc., Northwest Operations, and other supporting subcontractors will implement the field activities.

This FSAP provides the direction and requirements for the field sampling, laboratory analysis, and data reporting for soil sampling for seven direct push locations in S Farm. Information is provided in the following sections:

- Facility description (Section 2.0)
- Sampling requirements (Section 3.0)
- Sample analysis requirements (Section 4.0)
- Quality assurance and quality control (Section 5.0)
- Data reporting (Section 6.0)
- Change control (Section 7.0)
- Documents and records (Section 8.0)
- Project organization (Section 9.0)
- References (Section 10.0).

The quality assurance plan objectives are met through implementation of all sections of this FSAP.

The seven direct push locations in S Farm, along with alternates, were determined in a meeting held on March 24, 2011 and documented by the associated meeting minutes (Appendix B) and by RPP-ENV-49131. Table 1-1 identifies the reasons for selecting the sampling locations.

Table 1-1. Direct Push Location Strategy for 241-S Tank Farm

Location #[a]		Input Factors Associated with Location[b] **Reason for Sampling with Respect to Barrier**
1	**C8393/C8394** (Southeast of Tank S-104)	• Tank S-104 designated as a leaker (~24,000 gals) • Tank S-104 filled above spare inlet (Location near spare inlet area) • Nearby drywell (40-04-05) has detectable Cs-137 concentrations at depth (Figure 10[c]) **Further Assess the Path and Inventory of Tank S-104 Release**
2	**C8395/C8396** (Between Tanks S-104 and S-105 – South of Diversion Box)	• Diversion Box and many pipelines nearby • Tanks S-101 and S-105 associated with pipeline failure • Higher conductivity area based on resistivity information (Figure 12[c]) • Tank S-104 confirmed leaker (~24,000 gals) **Further Assess the nature and depth of migration of releases near Tanks S-102 and S-105 and potentially to Further Assess the path and inventory of Tank S-104 Release**
3	**C8397/C8398** (Northeast of Tank S-102)	• Transfer line leak between S-103 and S-102 • Nearby drywell (40-02-03) has detectable Cs-137 concentrations at depth (Figure 9[c]) • Nearby spare inlet **Confirm Previous Results: Gather additional data to assist in determining nature and extent of contamination (i.e., Tc-99) and to Further Assess the nature and extent of releases near Tanks S-102 and S-103**
4	**C8399/C8400** (Southeast of Tank S-103)	• Transfer line leak between S-103 and S-102 • Tank S-103 associated with pipeline failure • Higher conductivity area based on resistivity information (Figure 12[c]) • Nearby spare inlet **Further Assess the nature and extent of releases near Tanks S-102 and S-103**
5 (Options A, B, or C)	**C8401/C8402** (Southwest of Tank S-105; or Northwest or Northeast of Tank S-109)	• Tanks S-105 and S-106 associated with pipeline failure • Higher conductivity area based on resistivity information (Figure 12[c]) **Gather data to assist in determining nature and extent of contamination (i.e., Tc-99)**
6	**C8403/C8404** (Southeast of Tank S-107)	• Tank S-104 designated as a leaker (~24,000 gals) • 1996 water line rupture, 500,000 gals north of S Farm (most water infiltrated along the east side of S Farm) **Gather data to assist in determining nature and extent of contamination (i.e., Tc-99) and to Further Assess the Path and Inventory of Tank S-104 Release and 1996 water line rupture**

Table 1-1. Direct Push Location Strategy for 241-S Tank Farm

Location #[a]		Input Factors Associated with Location[b] / **Reason for Sampling with Respect to Barrier**
7	**C8405/C8406** (Southeast of Tank S-105)	• Tank S-104 designated as a leaker (~24,000 gals) • Tank S-105 associated with pipeline failure **Gather data to assist in determining nature and extent of contamination (i.e., Tc-99) and to Further Assess the Path and Inventory of Tank S-104 Release**

Note: Stratigraphic dip to the south-southeast

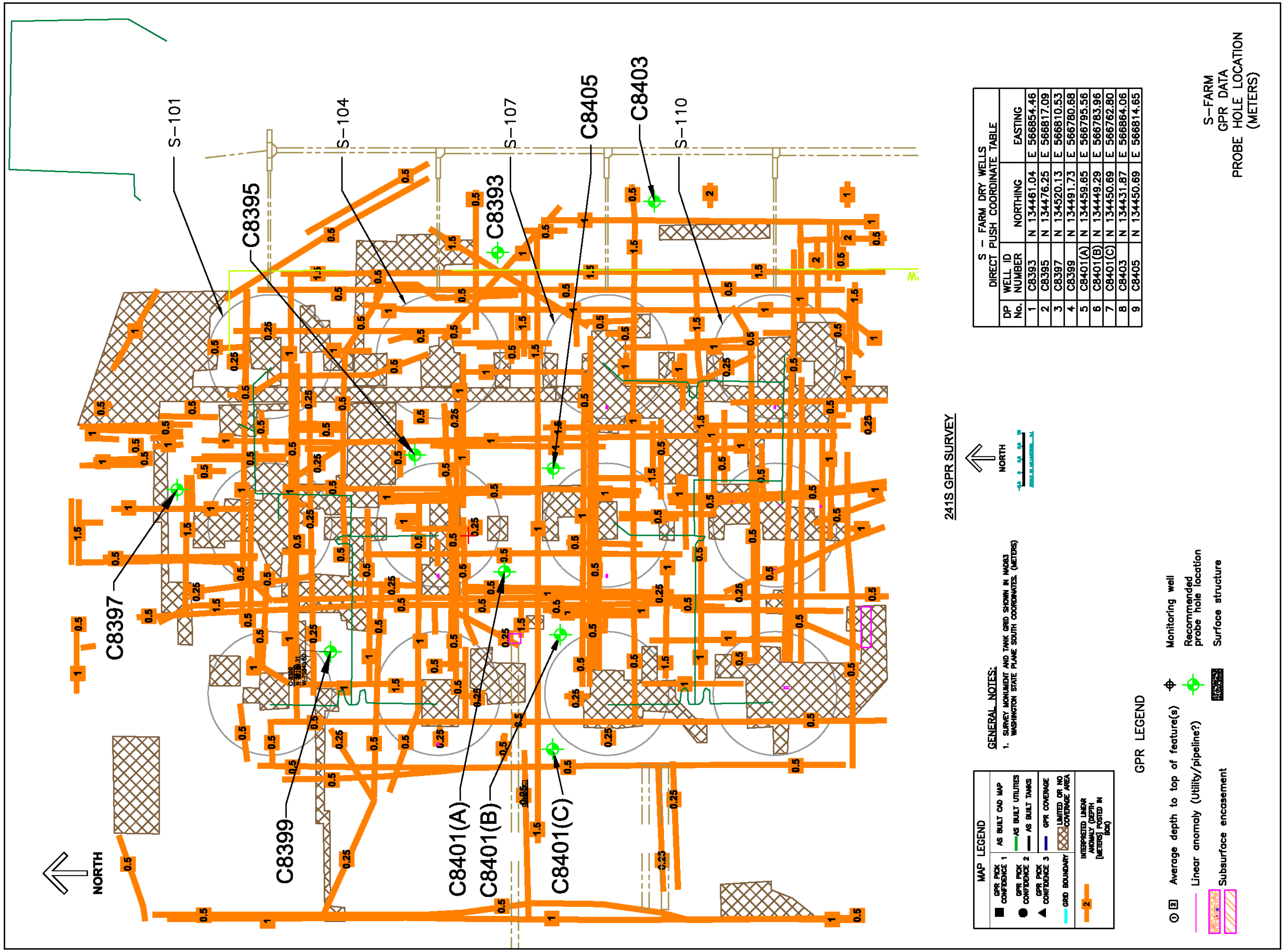
[a] Refer to Appendix B Meeting Minutes. Coordinates for all locations were obtained and locations were staked in the field. During the field walk-down (staking process), optimal option locations were determined based on accessibility and data needs for C8395 and C8405. Location C8401/C8402 will be selected based on quick turn results and field conditions. Final location for C8401/C8402 will be documented in a changed notice to this plan.

[b] Tank leak and pipeline failure information is provided in RPP-RPT-48589, *Hanford 241-S Farm Leak Assessment Report* [Draft].

[c] Referenced figures are provided in RPP-ENV-49131, *Data Requirements for Characterization Supporting Near-Term Interim Barrier in S Farm*.

Underground piping information and accessibility requirements were used to further refine sample locations. See Figure 1-1 for direct push probe locations.

The direct push probe will be driven to depths of ~150 feet (ft) below ground surface (bgs) and soil samples will be collected at an average of three depths from each sample probe hole. Samples will be analyzed for constituents identified in RPP-43551 and RPP-RPT-38152, excluding the organic analyses (see Sections 3.0 and 4.0 for further constituent information). Geophysical logging along with available quick turnaround analysis ("quick turn") of two mobile contaminants (^{99}Tc and nitrate) will be used to aid in determining sample depths. After this information is obtained, meetings will be held with, or e-mails will be sent to, representatives from WRPS, DOE, ORP, DOE Richland Operations Office (RL), and Ecology, to gain a consensus on sample depths.



S – FARM DRY WELLS DIRECT PUSH COORDINATE TABLE			
DP No.	WELL ID NUMBER	NORTHING	EASTING
1	C8393	N 134461.04	E 566854.46
2	C8395	N 134476.25	E 566817.09
3	C8397	N 134520.13	E 566810.53
4	C8399	N 134491.73	E 566780.68
5	C8401(A)	N 134459.65	E 566795.56
6	C8401(B)	N 134449.29	E 566783.96
7	C8401(C)	N 134450.69	E 566762.80
8	C8403	N 134431.87	E 566864.06
9	C8405	N 134450.69	E 566814.65

Figure 1-1. Probe Hole Locations in 241-S Tank Farm

2.0 FACILITY DESCRIPTION

Figure 2-1 shows the layout of WMA S-SX. Note that the WMA boundary identified in Figure 2-1 is associated with groundwater monitoring and is essentially the perimeter fence, which is a security construct. The WMA for closure and corrective measures may include areas beyond the current perimeter fence(s) that have been affected by releases from single shell tanks or ancillary equipment (e.g., pipeline breaks outside the fenceline).

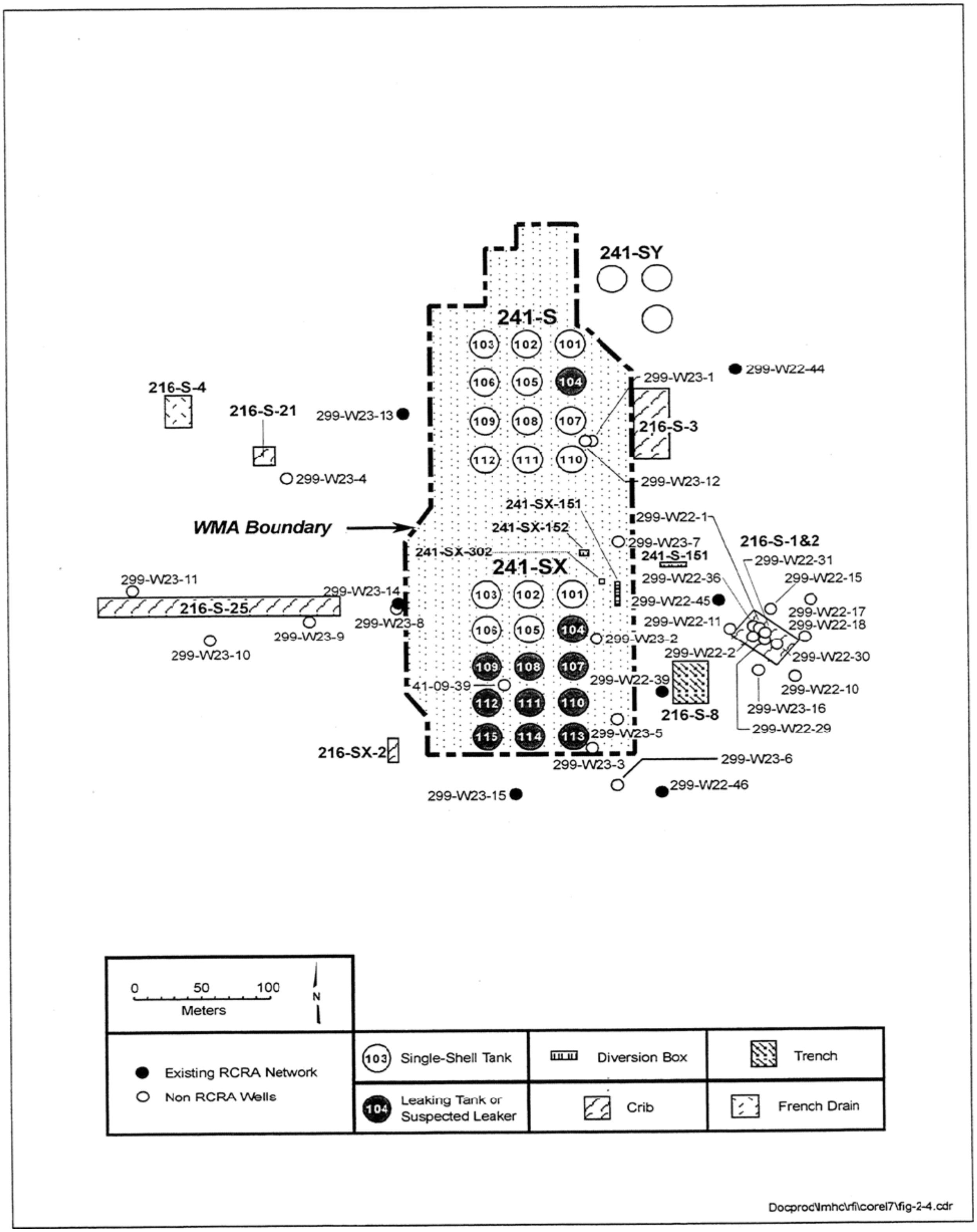
The 241-S Tank Farm was constructed during 1950 and 1951 in the 200 West Area. The farm is comprised of 12 100-series tanks. The tanks each have a capacity of 758,000 gal, a diameter of 75 ft, and an operating depth of 23 ft. The base of the S Farm excavation is about 42 ft bgs, allowing space for footings and other construction requirements.

After startup of the 12 tanks in S Farm in 1951, several types of Reduction Oxidation (REDOX) Plant wastes were received. The tanks were almost filled with liquids by 1953; however, the wastes started to self boil in the summer of 1952 which caused the waste to concentrate. To provide tank space in 1953, surface condensers were installed that concentrated the wastes in the first two cascades by disposing of vapor condensate to the cribs. Liquid levels in the tanks fluctuated for the next 20 years; then the tanks filled with solids when the 242-S Evaporator/ Crystallizer started up and the S Farm tanks were used as receivers for evaporator waste bottoms. The tanks were removed from service in the late 1970s through early 1980s (HNF-SD-WM-ER-352, *Historical Tank Content Estimate for the Southwest Quadrant of the Hanford 200 West Area*).

As indicated, S Farm received primarily REDOX process waste from the REDOX Plant. The REDOX Plant was the first plant to separate both plutonium and uranium using solvent extraction. The waste in S Farm consists mainly of sludge, salt cake, and liquid. Sludge is composed of solid precipitate (hydrous metal oxides) that results from the neutralization of acid waste. The wastes were neutralized before being transferred to the waste tanks. Salt cake is normally composed of sodium salts formed by the caustic neutralization of the process waste and then concentrated through evaporation. Sludge and salt cake form the solids component of the tank waste. Liquids are present as supernate and interstitial liquids contained within the waste solids (RPP-RPT-48589, *Hanford 241-S Farm Leak Assessment Report* [Draft]).

As a means to reduce risk (impact) of a waste being released (leaking) from single-shell tanks (SSTs); the SSTs underwent a stabilization program (designated as interim stabilization) to remove as much of the liquid wastes from all tanks as practical to the double-shell tank system. That information as well as general SST waste content (i.e., liquid and solid volumes) data and some tank monitoring data are summarized monthly in waste tank summary reports (e.g., HNF-EP-0182, *Waste Tank Summary Report for Month Ending March 31, 2010*).

Figure 2-1. Waste Management Area S-SX and Surrounding Facilities



The following are the stratigraphic units recognized in WMA S-SX:

- Recent backfill material
- Hanford formation—gravel-dominated sequence (H1 unit)
- Hanford formation—sand-dominated sequence (H2 unit)
- Plio-Pleistocene unit
- Ringold Formation
- Columbia River Basalt.

The WMA S-SX was constructed in a sequence of sediments that overlie the Columbia River Basalt Group. The sediments include the upper Miocene to Pliocene Ringold Formation, the Plio-Pleistocene unit, Pleistocene cataclysmic flood gravels and slack water sediments of the Hanford formation, and the Holocene eolian deposits. Figure 2-2 presents a generalized cross section of the Hanford Site (GJO-97-31-TAR/GJO-HAN-17, *Hanford Tank Farms Vadose Zone: S Tank Farm Report* and GJO-97-31-TARA/GJO-HAN-17, *Hanford Tank Farms Vadose Zone: Addendum to the S Tank Farm Report*).

The vadose zone beneath WMA S-SX is as much as 65 meters (213 ft) thick and consists of the (HNF-4936, *Subsurface Physical Conditions Description of the S-SX Waste Management Area*):

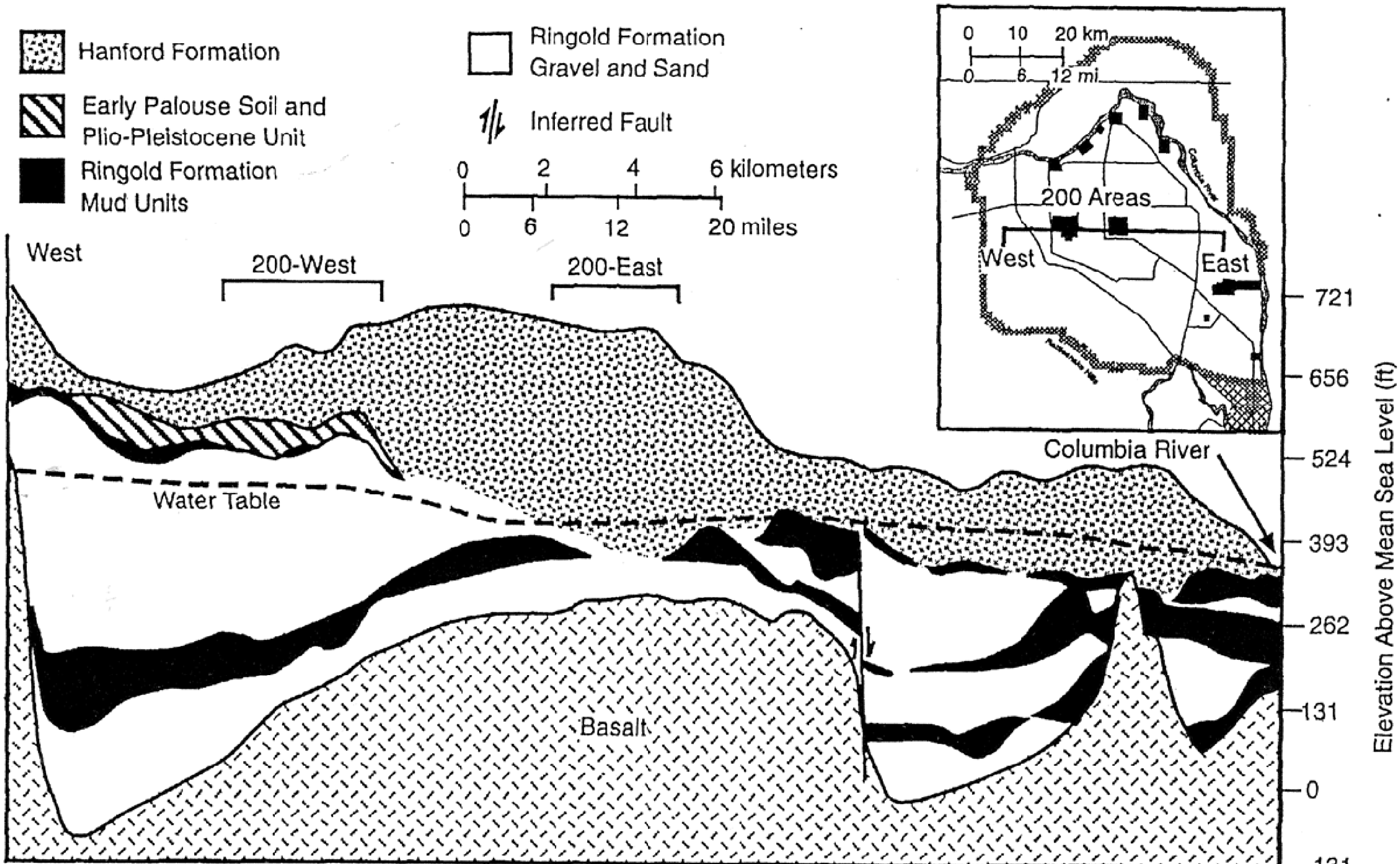
- Pleistocene-aged Hanford formation
- Plio-Pleistocene unit
- Upper part of the Ringold Formation.

The Ringold Formation is the most extensive suprabasalt sedimentary unit at the Hanford Site. This formation is as much as 600 ft thick south of the 200 West Area and is absent in the north and northeastern portions of the 200 East Area. It is located at a depth of about 142 to 155 ft below S Farm.

The Plio-Pleistocene unit unconformably overlies the Ringold Formation; is laterally discontinuous and pinches out in the northern, eastern, and southern boundaries of 200 West Area; generally dips to the south-southwest; and consists of alluvium deposited by small streams flowing from the surrounding higher elevations. It begins at a depth of about 130 to 135 ft below S Farm and ranges in thickness from about 10 to 35 ft.

Overlying the Plio-Pleistocene unit is the Hanford formation, which is the informal name given to all glaciofluvial cataclysmic flood sediments in the Pleistocene Epoch. It consists of pebble- to boulder-gravel, fine- to coarse-grained sand, silty sand, and silt to clayey-silt. It is thickest in the 200 East and 200 West Areas, where it is as much as 350 ft thick. Beneath S Farm, the formation is 130 to 135 ft thick with the upper 70 ft consisting of sand-dominated facies containing interbeds of the gravel dominated facies (sometimes referred to as the Upper Coarse Unit: H2 unit). The lower 60 ft of the Hanford formation consists of well-stratified sand-dominated facies containing numerous laterally discontinuous silt rich interbeds (sometimes referred to as the Hanford Fine Unit: H1 unit). Clastic dikes, usually consisting of thick alternating vertical to subvertical layers of silt, sand, and granules, are also present in the Hanford formation.

Figure 2-2. Generalized Cross Section of the Hanford Site



The excavation for S Farm tanks was constructed entirely in the Hanford formation sediments. The backfill placed around the completed tanks was the excavated materials that were stockpiled next to the tank farm during tank construction. The base of the excavation is about 42 ft bgs.

At S Farm, the upper portion of the uppermost aquifer is contained in the Ringold Formation. In the vicinity of S Farm, the top of the saturated zone is 211 ft bgs and the base (top of the Columbia River Basalt Group) is about 495 ft bgs. The direction of current groundwater flow is southeasterly (eventually turning east to the river) in the southern portion of the 200 West Area, while it is north and northeast (through Gable Gap) in the northern portion of the 200 West Area.

Vadose zone conditions across the Hanford Site show variations similar to those observed in the uppermost aquifer system. Sediments in the vadose zone vary from open-framework gravels of the gravel-dominated facies and interbedded sand and silt of the silt-dominated facies of the Hanford formation to calcium carbonate rich deposits of the Plio-Pliestocene unit and cemented gravels of the Ringold Formation. These sediments are characterized by numerous lateral discontinuities, such as pinchouts, erosion truncations, and irregular flow patterns. If clastic dikes are present, they may enhance vertical flow patterns. Therefore, there are numerous possible avenues for contamination to migrate through the vadose zone (HNF-4936).

3.0 SAMPLING REQUIREMENTS

All field sampling activities shall be conducted in accordance with this FSAP and the appropriate procedures and work packages. Soil sampling services for this work will be contracted through the CH2M HILL Plateau Remediation Company (CHPRC) or performed by WRPS samplers. The soil samplers shall follow CHPRC or WRPS sampling protocols and procedures, which cover items such as cleaning of sampling devices, chain of custody, etc.

3.1 SOIL SAMPLING TECHNIQUE, STRATEGY, AND DESIGN

3.1.1 Sampling Technique

Sampling at S Farm will be conducted using a hydraulic hammer direct push rig technology using the dual-string sampling system, which 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. 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 ~10% more than the targeted sample interval in order to secure the material in the sampler.

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 requirements of *Washington Administrative Code* (WAC) 173-160, “Minimum Standards for Construction and Maintenance of Wells.”

3.1.2 Sampling Strategy and Design

As indicated in the scope of this effort (Section 1.2), the seven locations were selected for the various reasons identified in Table 1-1. The probe locations will be drilled to approximate depths of 150 ft bgs and soil samples will be collected at three depths from each location. Three depths were chosen to assist in defining the extent of the vertical boundaries of contamination in S Farm. Note that if additional sampling is warranted, more samples (i.e., more than three per location) may be collected.

Sampling strategy at each direct push site is summarized as follows.

a. A minimum of two direct push probe holes will be completed at each location. The initial probe hole is logged for both gross gamma and neutron moisture (i.e., geophysical logging). Following logging, deep electrodes are installed for surface geophysical exploration and the hole is decommissioned per WAC 173-160. The second push is for soil sampling.

b. The depth of the first push will be approximately 150 ft bgs or refusal (whichever comes first).

c. Deep electrodes are placed near the bottom of the initial probe hole and at 20-ft intervals up to approximately 40 ft bgs. Five to nine electrode intervals will be available in each probe hole.

d. 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, historical characterization data at that site, and available "quick turn" (^{99}Tc and nitrate) data. Note that ^{99}Tc and nitrate "quick turn" data may become available from some of the probe holes identified in this plan as the work progresses. As the data becomes available, it may be used to help select sample depths for later probe hole locations. The sampling horizons will be selected in meetings with or via e-mails to WRPS, DOE-ORP, DOE-RL, CHPRC and Ecology.

Note: Depths are subject to constraints in the field and may be modified if necessary.

3.2 SAMPLE COLLECTION, HANDLING, AND SHIPPING

As indicated, the dual-string sampler used to collect soil samples holds three stainless-steel liners and a shoe to collect samples during the direct push. The liners are removed from the sampler body and surveyed. The material in the shoe shall be collected in a 500 mL glass jar. Stainless-steel liner A is the liner closest to the shoe. The next or middle liner is liner B, and the topmost stainless-steel liner is liner C. Each liner needs to be marked for its bottom (labeled B) and top (labeled T) to signify the position of the sample prior to shipping and transport.

Trained samplers document recovery, sample condition, and volume recovery percent. They then package and transport the sample under chain-of-custody control to the laboratory for analysis.

Analysis methods and holding times for radiological and chemical analytes are shown in Table 3-1. Sample preservation and containers are also discussed in Table 3-1 (i.e., table footnotes). Field quality control (QC) samples, specifically equipment rinsates (blanks) and field blanks will be collected to evaluate the potential for cross-contamination and laboratory performance. Sample preservation, containers, and holding times for the field QC samples are shown in Table 3-2.

Table 3-1. Soil Sampling Requirements for 241-S Tank Farm[a] (2 sheets)

Analysis Type	Primary Analysis	Constituent	Holding Time
"Quick Turn"	ICP/MS	Technetium-99	6 months
	9056 Ion chromatography	Nitrate	48 hours after digestion
	9045	pH	24 hours (or as soon as possible)
	9050	Conductivity	28 days
Standard	6010 ICP/AES	Aluminum, Barium, Beryllium, Calcium, Chromium, Cobalt, Copper, Iron, Lithium, Manganese, Magnesium, Molybdenum, Nickel, Phosphorous, Potassium, Sodium, Strontium, Vanadium, Zinc, Boron, Bismuth, Cerium, Europium, Lanthanum, Neodymium, Niobium, Palladium, Praseodymium, Rubidium, Rhodium, Ruthenium, Samarium, Silicon, Tin, Sulfur, Tantalum, Tellurium, Thorium, Titanium, Tungsten, Yttrium, Zirconium	6 months
	6020 ICP/MS	Antimony, Arsenic, Cadmium, Lead, Selenium, Silver, Thallium, Uranium[b]	6 months
	7471 Cold vapor atomic absorption	Mercury	28 days
	9056 Ion chromatography	Fluoride, Nitrite, Nitrate, Chloride, Sulfate, Acetate, Formate, Glycolate, Oxalate, Bromide, Phosphate	28 days/48 hours[c]
	Ion chromatography EPA 300.7	Ammonium	7 days to distillation/28 days for preserved distillate
	9014 Spectrophotometric	Cyanide, Ferrocyanide[d]	14 days
	Gamma energy analysis	Cesium-137, Cobalt-60, Antimony-125, Europium-152, Europium-154, Europium-155, Thorium-228, Thorium-234	6 months
	Low energy gamma counting	Iodine-129	6 months
	ICP/MS	Techenetium-99, Tin-126, Uranium-233, Uranium-234, Uranium-235, Uranium-236, Uranium-238, Neptunium-237, Thorium-230, Thorium-232	6 months

Table 3-1. Soil Sampling Requirements for 241-S Tank Farm[a] (2 sheets)

Analysis Type	Primary Analysis	Constituent	Holding Time
Standard	Liquid scintillation	Carbon-14, Tritium, Nickel-63, Selenium-79	6 months
	Alpha energy analysis	Plutonium-238, Plutonium-239/240, Plutonium-241[d], Americium-241, Curium-242, Curium-243/244	6 months
	Gas proportional counting	Strontium-90	6 months
	Gravimetric	Percent solids	None
	Gravimetric	Percent water	None
	Gravimetric	Bulk density	None

[a] Samplers will place the shoe material in a 500 mL glass bottle. The samples will be cooled to ≤ 6 °C. Available material from the shoe and liners (A, B, and C) are composited by the laboratory and the composited material is used in the “quick turn” and standard analysis.

[b] Uranium analysis will be met through the uranium-238 analysis.

[c] 48 hour hold time time (after preparation) is for nitrate, nitrite, and phosphate.

[d] Ferrocyanide and plutonium-241 will be calculated by modelers.

EPA = U.S. Environmental Protection Agency
ICP/AES = inductively coupled plasma/atomic emission spectroscopy
ICP/MS = inductively coupled plasma/mass spectroscopy

Table 3-2. Field Quality Control Sampling Requirements for 241-S Tank Farm[a] (2 sheets)

Primary Analysis Method	Constituent	Container	Preservative	Holding Time
6010 ICP/AES	Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Lithium, Magnesium, Manganese, Molybdenum, Nickel, Phosphorous, Potassium, Selenium, Silver, Sodium, Strontium, Thallium, Vanadium, Zinc, Boron, Bismuth, Cerium, Europium, Lanthanum, Neodymium, Niobium, Palladium, Praseodymium, Rubidium, Rhodium, Ruthenium, Samarium, Silicon, Tin, Sulfur, Tantalum, Tellurium, Thorium, Titanium, Tungsten, Yttrium, Zirconium, Uranium[b]	Glass/plastic 500 mL	HNO_3 to pH<2	6 months (28 days for Mercury)
ICP/MS	Technetium-99, Tin-126, Uranium-233, Uranium-234, Uranium-235, Uranium-236, Uranium-238, Neptunium-237, Thorium-230, Thorium-232			
7470 Cold vapor atomic absorption	Mercury			
Ion chromatography EPA 300.7	Ammonium	Glass/plastic 250 mL	H_2SO_4 to pH<2/Cool to 6 ºC	7 days
9056 Ion chromatography	Fluoride, Nitrite, Nitrate, Chloride, Sulfate, Acetate, Formate, Glycolate, Oxalate, Bromide, Phosphate	Glass/plastic 500 mL	Cool to 6 ºC	28 days/48 hours[c]
9014 Spectrophotometric	Cyanide, Ferrocyanide[d]	Glass/plastic 60 mL	NaOH to pH≥12/Cool to 6 ºC	14 days

Table 3-2. Field Quality Control Sampling Requirements for 241-S Tank Farm[a] (2 sheets)

Primary Analysis Method	Constituent	Container	Preservative	Holding Time
Gamma energy analysis	Cesium-137, Cobalt-60, Antimony-125, Europium-152, Europium-154, Europium-155, Thorium-228, Thorium-234	Glass/plastic 2x1000 mL	HNO_3 to pH<2	6 months
Alpha energy analysis	Plutonium-238, Plutonium-239/240, Plutonium-241[d], Americium-241, Curium-242, Curium-243/244			
Liquid scintillation	Nickel-63, Selenium-79			
Gas proportional counting	Strontium-90			
Liquid scintillation	Carbon-14, Tritium	Glass/plastic 1000 mL	None	6 months
Low energy gamma counting	Iodine-129			

[a] Percent moisture, percent solids, conductivity, pH, and bulk density will not be measured/analyzed on field quality control samples.

[b] Uranium analysis will be met through the uranium-238 analysis.

[c] 48 hour hold time (after preparation) is for nitrate, nitrite, and phosphate.

[d] Ferrocyanide and plutonium-241 will be calculated by modelers.

ICP/AES = inductively coupled plasma/atomic emission spectroscopy
ICP/MS = inductively coupled plasma/mass spectroscopy

Soil samples shall be maintained and shipped at/or below 6 °C as specified in Tables 3-1 and 3-2. 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 may be stored and transported in shielded shipping containers that may not allow the samples to be maintained below 6 °C. Samples not meeting temperature or holding time requirements will be identified as they occur and 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 WRPS personnel.

Radiological control technician(s) will measure the dose rates of each sample container (i.e., jar and liners). The radiological control technician(s) also will measure radiological activity on the outside of the sample container (through the container) and will document the highest contact radiological reading in millirem per hour. This information, along with other data, will be 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” (49 CFR)], and to verify that the sample can be received by the analytical laboratory in accordance with the laboratory’s acceptance criteria.

3.3 SAMPLE IDENTIFICATION

The Hanford Environmental Information System (HEIS) database will be the electronic repository for the laboratory analytical results. The HEIS sample numbers will be issued to the sampling organization for this project in accordance with onsite organizational procedures. Each sample will be identified and labeled with a unique HEIS sample number. The sample location, depth, and corresponding HEIS numbers will be documented in the sampler’s field logbook. Note the shoe material that is put in a 500 mL glass jar and the three liners will each have a unique HEIS number. The composite sample will also have a unique HEIS number.

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

a. Sample identification number
b. Sample collection date and time
c. Name or initials of person collecting the sample
d. Preservation method (if applicable)
e. 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. Section 4.0 identifies the appropriate analyses and additional analysis information (e.g., detection limits).

3.4 SAMPLE CUSTODY

The sampling team shall initiate a chain-of-custody form for each sample. The chain-of-custody form shall accompany each sample. At a minimum, the following sampling information shall be included on the chain-of-custody form:

a. Project name

b. Signature of the collector

c. Date and time of collection

d. Sample type (e.g., soil)

e. Requested analysis or provide a reference for sample analysis

f. Signatures of persons involved in the chain of possession

g. Date and time relinquished to the laboratory

h. Unique HEIS sample identification number assigned to the sample

i. Sample location (direct push hole number and depth of collection)

j. A notation of pertinent sampling information including unusual characteristics or sampling problems

k. A brief description of the sample matrix, such as color or consistency, if possible.

Any pertinent sampling information (recovery, unusual characteristics, or sampling problems) shall be recorded in the sampling logbook. Each sample will be shipped to 222-S Laboratory in an approved shipping container in accordance with approved procedures. Each sample will be sealed with a sample seal to demonstrate that the samples have reached the laboratory without alteration.

4.0 SAMPLE ANALYSIS REQUIREMENTS

Samples are normally received from the field at door 13 of the 222-S Laboratory Multicurie Section. Samples transported in coolers will be stored under refrigeration until they are processed. On receipt, the sample custodian will verify the identification number on each sample container and ensure it matches the sample seal on the sample container and the chain of custody. Laboratory sample identification numbers will be affixed to each container that is retained past initial receipt. Residual sample material remaining after analysis will be maintained in refrigerated storage until directed otherwise by the Primary Laboratory Contact.

After the samples are received at the laboratory, the samples will be prepared and analyzed in accordance with this FSAP. Table 4-1 identifies the following information:

- Constituent (analyte)
- Required detection limit and/or target detection limit
- Primary and alternate analytical method including preparation information
- Quality control acceptance requirements for the various primary methods.

“Quick turn” constituents are bolded in Table 4-1 and secondary constituents are italicized. Secondary constituents will only be reported in the data package if they are detected.

Section 4.1 provides sample handling and preparation requirements and analytical requirements. Direction for addressing insufficient sample recovery is provided in Section 4.2. The laboratory shall use the least possible dilution to obtain the lowest practical detection limits for all requested analytes.

Table 4-1. Analytical Requirements for 241-S Tank Farm (8 sheets)

Constituent	Required Detection Limit (Target Detection Limit)[a, b]	Analytical Method (prep)	Alternate Method (prep)	QC Acceptance Requirements[c, d] LCS % Recovery	Spike % Recovery	% RPD
Aluminum – Al	5 (5)	6010 ICP/AES (acid)	6020 ICP/MS (acid)	80-120%	75-125%	≤30%
Barium – Ba	10.2 (20)					
Beryllium – Be	1 (0.5)					
Calcium[e] – Ca	- (-)					
Chromium – Cr	0.15 (1)					
Cobalt – Co	2 (2)					
Copper – Cu	5 (1)					
Iron – Fe	- (5)					
Lithium[e] – Li	3.5 (-)					
Manganese – Mn	110 (1.9)[f]					
Magnesium[e] – Mg	- (-)					
Molybdenum[e] - Mo	4 (19)[f]					
Nickel – Ni	3 (4)					
Phosphorus[e] – P	- (-)					
Potassium[e] – K	- (-)					
Sodium[e] – Na	- (-)					

Table 4-1. Analytical Requirements for 241-S Tank Farm (8 sheets)

Constituent	Required Detection Limit (Target Detection Limit)[a, b]	Analytical Method (prep)	Alternate Method (prep)	QC Acceptance Requirements[c, d] LCS % Recovery	Spike % Recovery	% RPD
Strontium – Sr	- (1)	6010 ICP/AES (acid)	6020 ICP/MS (acid)	80-120%	75-125%	≤30%
Vanadium – V	0.2 (2.5)					
Zinc – Zn	8.6 (1)					
Boron – B	6 (-)		NA			
Bismuth – Bi	- (-)					
Cerium – Ce	- (-)					
Europium – Eu	- (-)					
Lanthanum – La	- (-)					
Neodymium – Nd	- (-)					
Niobium – Nb	- (-)					
Palladium – Pd	- (-)					
Praseodymium – Pr	- (-)					
Rubidium – Rb	- (-)					
Rhodium – Rh	- (-)					
Ruthenium – Ru	- (-)					

Table 4-1. Analytical Requirements for 241-S Tank Farm (8 sheets)

Constituent	Required Detection Limit (Target Detection Limit)[a, b]	Analytical Method (prep)	Alternate Method (prep)	QC Acceptance Requirements[c, d] LCS % Recovery	Spike % Recovery	% RPD
Samarium – Sm	- (-)	6010 ICP/AES (acid)	6020 ICP/MS (acid)	80-120%	75-125%	≤30%
Silicon – Si	- (-)					
Tin – Sn	6 (-)					
Sulfur – S	- (-)					
Tantalum – Ta	- (-)					
Tellurium – Te	- (-)					
Thorium – Th	- (-)					
Titanium – Ti	- (-)					
Tungsten – W	- (-)					
Yttrium – Y	- (-)					
Zirconium – Zr	- (-)					
Antimony – Sb	0.5 (1)	6020 ICP/MS (acid)	6010 ICP/AES (acid)			
Arsenic[g] – As	0.7 (1)					
Cadmium – Cd	0.4 (0.5)					
Lead – Pb	5 (5)					
Selenium[i] – Se	0.03 (1)					

Table 4-1. Analytical Requirements for 241-S Tank Farm (8 sheets)

Constituent	Required Detection Limit (Target Detection Limit)[a, b]	Analytical Method (prep)	Alternate Method (prep)	QC Acceptance Requirements[c, d]		
				LCS % Recovery	Spike % Recovery	% RPD
Silver – Ag	0.2 (2)	6020 ICP/MS (acid)	6010 ICP/AES (acid)	80-120%	75-125%	≤30%
Thallium – Tl	0.1 (0.5)					
Uranium[j] – U	0.5 (1)					
Mercury – Hg	0.01 (0.2)	7471 Cold vapor atomic absorption (acid)	6020 ICP/MS (acid)	80-120%	75-125%	≤30%
Ammonium – NH_4^+	- (0.5)	Ion Chromotography EPA 300.7 (distillation)	NA	80-120%	75-125%	≤30%
pH	-	9045 (water)	NA	± 0.1 pH units	NA	NA
Fluoride – F^-	20 (5)	Ion Chromotography 9056 (water)	NA	80-120%	75-125%	≤30%
Nitrite – NO_2^-	- (2.5)					
Nitrate – NO_3^-	- (2.5)					
Chloride – Cl^-	- (0.3)[f]					
Sulfate – SO_4^{-2}	- (2.7)[f]					
Acetate[g] – $C_2H_3O_2^-$	- (4.5)[f]					
Formate[g] – CHO_2^-	- (10.0)[f]					
Glycolate[g] – $C_2H_3O_3^-$	- (3.8)[f]					

Table 4-1. Analytical Requirements for 241-S Tank Farm (8 sheets)

Constituent	Required Detection Limit (Target Detection Limit)[a, b]	Analytical Method (prep)	Alternate Method (prep)	QC Acceptance Requirements[c, d]		
				LCS % Recovery	Spike % Recovery	% RPD
Oxalate[g] – $C_2O_4^{-2}$	- (2)[f]	Ion Chromotography 9056 (water)	NA	80-120%	75-125%	≤30%
Bromide[h] – *Br^{-}*[d]	1 (-)					
Phosphate – *PO_4^{-3}*	- (-)					
Cyanide – CN^{-}	- (0.5)	9014 Spectrophotometric (distillation)	9012 Colormetric	80-120%	75-125%	≤30%
Ferrocyanide – $Fe(CN)_6^{-4}$	- (-)	Calculated by Modeler	NA	NA	NA	NA
Cesium-137 – Cs^{137}	2.1 (0.1)	Gamma energy analysis (direct)	NA	80-120%	N/A	≤30%
Cobalt-60 – Co^{60}	69 (0.05)					
Antimony-125 – Sb^{125}	350 (0.3)					
Europium-152 – Eu^{152}	150 (0.1)			NA	NA	≤30%
Europium-154 – Eu^{154}	130 (0.1)					
Europium-155 – Eu^{155}	1,600 (0.1)					
Thorium-228 – Th^{228}	53 (1)			NA	NA	NA
Iodine-129 – I^{129}	570 (2)	Low energy gamma counting (fusion)	NA	80-120%	NA	≤30%
Technetium-99 – Tc^{99}	450 (1)	ICP/MS (water)	Liquid scintillation (water)	80-120%	75-125%	≤30%
Technetium-99 – Tc^{99}	450 (20)	ICP/MS (acid)	Liquid scintillation (acid)	80-120%	75-125%	≤30%
Tin-126 – Sn^{126}	- (-)		NA	80-120%	75-125%	≤30%

Table 4-1. Analytical Requirements for 241-S Tank Farm (8 sheets)

Constituent	Required Detection Limit (Target Detection Limit)[a, b]	Analytical Method (prep)	Alternate Method (prep)	QC Acceptance Requirements[c, d]		
				LCS % Recovery	Spike % Recovery	% RPD
Uranium-233 – U^{233}	480 (1)	ICP/MS (acid)	NA	NA	NA	≤30%
Uranium-234 – U^{234}	510 (1)			NA	NA	≤30%
Uranium-235 – U^{235}	280 (1)			80-120%	75-125%	≤30%
Uranium-236 – U^{236}	- (-)			NA	NA	≤30%
Uranium-238 – U^{238}	160 (1)			80-120%	75-125%	≤30%
Neptunium-237 – Np^{237}	390 (1)		Alpha energy analysis (acid)	80-120%	75-125%	≤30%
Thorium-230 – Th^{230}	1,000 (1)		NA	NA	NA	≤30%
Thorium-232 – Th^{232}	150 (1)			80-120%	75-125%	≤30%
Thorium-234 – Th^{234}	- (-)	Gamma energy analysis (direct)	NA	NA	NA	≤30%
Carbon-14 – C^{14}	480 (1)	Liquid scintillation (water)	NA	80-120%	75-125%	≤30%
Tritium – H^{3}	17,000 (30)	Liquid scintillation (water)	NA	80-120%	75-125%	≤30%
Nickel-63 – Ni^{63}	4.67E7 (30)	Liquid scintillation (acid)	NA	80-120%	NA	≤30%
Selenium-79 – Se^{79}	- (10)			Not performed	NA	≤30%
Plutonium-238 – Pu^{238}	530 (1)	Alpha energy analysis (acid)	ICP/MS (acid)	NA	NA	≤30%
Plutonium-239/240 – $Pu^{239/240}$	610 (1)			80-120%	NA	≤30%

Table 4-1. Analytical Requirements for 241-S Tank Farm (8 sheets)

Constituent	Required Detection Limit (Target Detection Limit)[a, b]	Analytical Method (prep)	Alternate Method (prep)	QC Acceptance Requirements[c, d]		
				LCS % Recovery	Spike % Recovery	% RPD
Plutonium-241 – Pu^{241}	3.5E8 (-)	Calculated by Modeler	Alpha energy analysis Also Extraction followed by liquid scintillation counting	NA	NA	NA
Americium-241 – Am^{241}	390 (1)	Alpha energy analysis (acid)	ICP/MS (acid)	80-120%	NA	≤30%
Curium-242 – Cm^{242}	210 (1)					
Curium-243/244[k] – $Cm^{243/244}$	410 (1)					
Strontium-90 – Sr^{90}	2.3 (1)	Gas proportional counting (acid)	NA	80-120%	NA	≤30%
Percent water	- (-)	Gravimetric	NA	80-120%	NA	≤30%
Percent solids	- (-)	Gravimetric	NA	NA	NA	NA
Conductivity	- (-)	9050	NA	NA	NA	NA
Bulk density	- (-)	Gravimetric	NA	NA	NA	≤30%

Table 4-1. Analytical Requirements for 241-S Tank Farm (8 sheets)

Constituent	Required Detection Limit (Target Detection Limit)[a, b]	Analytical Method (prep)	Alternate Method (prep)	QC Acceptance Requirements[c, d]		
				LCS % Recovery	Spike % Recovery	% RPD

Note: All analyses are performed on composite samples. Data packages will be provided by the laboratory in Format VI. "Quick turn" analyses (excluding pH and conductivity) will be provided via e-mail to the Characterization Lead but will also be available in the data package for loading into Hanford Environmental Information System.
Bold constituents are "quick turn" constituents.
Italicized constituents are considered secondary constituents per RPP-23403, *Single-Shell Tank Component Closure Data Quality Objectives*.

[a] Detection limits for non-radiological constituents are in mg/kg and detection limits for radiological constituents are in pCi/g.

[b] "–" indicates that there is no required detection limit and/or target detection limit. If there is no required detection limit or target detection limit, then the laboratory will use the associated method detection limit.

[c] Laboratory quality acceptance requirements are based on RPP-43551, *Tank Farm Interim Barrier Data Quality Objectives*, RPP-RPT-38152, *Data Quality Objectives Report Phase 2 Characterization for Waste Management Area C RCRA Field Investigation/Corrective Measures Study*, and ATL-MP-1011, *ATL Quality Assurance Plan for 222-S Laboratory*. The laboratory quality control samples will be analyzed at a frequency of no less than 1 of 20 samples (1 per batch) with the following exceptions:

- Duplicates are not applicable (NA) for Hg analysis.
- Matrix spikes are NA for percent water, percent solids, for constituents analyzed per gamma energy analysis, pH, conductivity, Sr-90, Am-241, isotopic curiums and plutoniums, Ni-63, and Se-79.
- Matrix spike duplicates are NA for all analyses except Hg analysis.
- Blanks are NA for percent water, percent solids, and pH.
- Laboratory control samples are NA for percent water, percent solids analyses, Sn-126, Th-230, U-233, U-236, and Se-79.

[d] Secondary analytes will be reported when detected. All QC failures associated with secondary analytes will be discussed in the report narrative and qualified appropriately in the data package. Note that if there are QC failures associated with secondary analytes, reanalysis will not be required.

[e] With respect to RPP-23403, 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.

[f] Target detection limit for this constituent is not specified in D&D-30262, *Data Quality Objectives Summary Report for the 200-IS-1 Operable Unit Pipelines and Appurtenances*. It is based on detection limits achieved in the analyses of soil samples taken near tank 241-S-102 (RPP-RPT-36439, *Final Report for the Contaminated Soil Samples at Tank 241-S-102 in Support of the Type A Investigation of the Tank Waste Spill*).

[g] The detection limit for arsenic is based on arsenic III (0.7 mg/kg).

[h] The detection limit for bromide is based on bromine (1 mg/kg).

[i] The laboratory is currently unable to meet the required detection limit for Se. At best, they are able to achieve 0.2 µg/g; however, they will continue to try to achieve lower detection limits.

[j] Uranium analysis will be met through the U-238 analysis.

[k] Curium-243/244 detection limit is based on Curium-244.

EPA	= U.S. Environmental Protection Agency	ICP/AES	= inductively coupled plasma/atomic emission spectroscopy		
ICP/MS	= inductively coupled plasma/mass spectroscopy	LCS	= laboratory control sample	NA	= not applicable
QC	= quality control	RPD	= relative percent difference		

4.1 DIRECTION FOR SAMPLE HANDLING AND PREPARATION

The following steps shall be performed on each sample, as soon as the sample from the last interval for each probe hole has been received (batching will be done per probe hole). The steps shall be performed within one borehole in the order in which they were taken.

a. Remove sample material from each liner (Liners A, B and C) and the shoe, then place each in a separate plastic tray. Sample material from the liners may be removed by inserting a push rod in one end of the core tube and forcing the sediment out of the other end onto a flat smooth surface. If the sediment is packed into the core tube too tightly to be extruded in this fashion, use a hydraulic extruder, scoop, or spatula to dislodge the sediment from the tube. Document the samples photographically, immediately after extrusion and before compositing. The photographs are to be recorded and transmitted in the same format. A licensed geologist with Hanford experience will describe the samples. Visual inspection and simple manual manipulations are performed to provide a geologic description of each sample. These descriptions shall provide estimates of the percentage of sand, fine sand, very fine sand, coarse to fine silt and mud content. The sediment descriptions are recorded and used to classify the sediment texture on a modified Folk/Wentworth diagram.

b. Composite the material from Liners A, B and C and the shoe and homogenize.

c. Subsample a representative portion (10 to 15 g) of the composited material and place into a pre-weighed jar on a calibrated balance, as soon as possible after extrusion and compositing. Place the jar with sample in an oven set to 105 °C overnight. Cool the sample and weigh; calculate the percent moisture content by weight. Return the sample to the oven for at least 2 hours of additional heating. Reweigh the sample after cooling and calculate the cumulative weight loss. Repeat this process with additional weighing until a constant weight is achieved (less than 0.01 g change on successive weighing). The cumulative weight loss on drying is used to calculate the moisture content by weight and the percent dry solids by weight.

d. Subsample a sufficient amount of the composited material to perform the required “quick turn” analysis specified in Table 4-1 and contact with an equal portion of deionized water. Initially, assume the amount of moisture in the sediment is 5%, to calculate the amount of water needed to make up a 1:1 ratio of water to dry solids. The assumed leach factors will be mathematically corrected prior to reporting results, once the percent moisture results are complete. Approximately a 3-mL aliquot of the unfiltered 1:1 sediment: water extract supernates will be used for pH measurement.

e. Perform analysis for pH, nitrate, conductivity and ^{99}Tc on the 1:1 water digest. These are the “quick turn” constituents. The nitrate and ^{99}Tc results are to be reported to the Primary Laboratory Contact within an expedited time frame, typically within one week of sample receipt at 222-S Laboratory. If requested by the Primary Laboratory Contact, the data will be provided within 48 hours. Standard laboratory QC requirements are applied to these analyses (i.e., laboratory blank, laboratory control sample, and duplicate). pH and conductivity results will be held and reported in the standard data package. pH was added to the "quick turn" analysis to enable the laboratory to meet the short hold times.

f. Subsample sufficient amount of the composited material to perform all remaining analyses identified in Table 4-1.

The required methods of analysis for analytes are identified in Table 4-1 and are methods included in SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, Third Edition as amended. It will be necessary for the laboratory to contact the Primary Laboratory Contact to deviate from the methods identified in Table 4-1. It is understood that the laboratory analytical procedures may have changes to the SW-846 methods to accommodate analysis of samples that are contaminated with Hanford tank waste and/or to reduce radiological exposure to the analysts. It is also understood that those changes and their effect on method performance will be and have been documented to demonstrate that procedures can provide satisfactory performance for the intended use of the data. The documentation of changes (e.g., substitutions, deviations, or modifications) to the methods shall be in writing, maintained at the laboratory, and available for inspection on request by authorized representatives of regulatory authorities and WRPS. Additional regulatory quality assurance or DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Documents* (HASQARD) requirements for documenting procedure modifications should also be followed.

4.2 INSUFFICIENT RECOVERY OF SAMPLE MATERIAL

If the quantity of sample material is insufficient to perform the analyses requested in this FSAP, the laboratory shall notify the Primary Laboratory Contact within 1 working day. The Primary Laboratory Contact will identify the analyses priority based on available sample material and discussion with project personnel (e.g., Program Manager). Any analyses prescribed by this FSAP, but not performed, shall be identified in the data report and through the change notice process (see Section 7.0).

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5.0 QUALITY ASSURANCE AND QUALITY CONTROL

DOE/RL-96-68 identifies the quality requirements for environmental data collection, including sampling, field measurements, and laboratory analysis and complies with the requirements of:

a. DOE O 414.1C, *Quality Assurance*

b. Title 10, *Code of Federal Regulations*, Part 830.120, "Quality Assurance Requirements" (10 CFR 830.120)

c. EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans EPA QA/R-5*.

Hanford onsite laboratories performing analyses in support of this FSAP 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 DOE Consolidated Audit Program (DOECAP), *Quality Systems for Analytical Services*, or be scheduled for DOECAP certification. Commercial Laboratory off the Hanford Site is subject to WRPS audit and QA Program approval.

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 FSAP. Sampling and analysis activities shall be performed by qualified personnel using properly maintained and calibrated equipment.

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, at a minimum, 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)

- 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 pre-job briefings, on-the-job training, emergency preparedness, plan-of-the-day activities, and facility/worksite orientations.

5.1 QUALITY CONTROL REQUIREMENTS 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 in accordance with 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 requires the collection of field duplicates, equipment rinsate blank, field blanks, and/or trip blank samples, where appropriate. This FSAP requires equipment rinsates and field blanks. Field duplicates (i.e., samples taken at the same location), which are used to evaluate precision of the sampling process, will not be collected as it is not possible to obtain direct pushes exactly at the same location. Trip blanks, which are blank samples that travel with sample containers to the sampling site and return unopened to the laboratory with the samples, usually consist of carbon-free, deionized water. Trip blanks measure contamination during sample transport and are typically only analyzed for volatile organic compounds. Since there are no volatile organic compounds on the sample list (see Tables 3-1 and 4-1), no trip blanks will be collected and analyzed for this FSAP.

5.1.1 Equipment Rinsate Blanks

Samplers from CHPRC or WRPS will prepare the equipment rinsates. Equipment rinsates are usually prepared in the laboratory after cleaning the sampling equipment; they 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 rinsates shall consist of deionized water washed through decontaminated sampling equipment. Equipment rinsates are to be run every 20 samples for the analytes listed in Table 3-2, which also provides the list of the required sample bottles. It is anticipated that two equipment rinsates will be collected and analyzed for this FSAP since at least 21 samples are expected to be collected (7 locations with 3 sample depths at each location).

5.1.2 Field Blanks

Samplers from CHPRC or WRPS will prepare the field blanks. Field blanks are samples prepared in the field at the sample collection site and returned to the laboratory with the samples to be analyzed. They are primarily used to test for contamination from the atmosphere. Field blanks shall consist of deionized water. Field blanks are to be run every 20 samples for the analytes listed in Table 3-2, which also provides the list of the required sample bottles. It is anticipated that two field blanks will be collected and analyzed for this FSAP since at least 21 samples are expected to be collected (7 locations with 3 sample depths at each location).

5.1.3 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.

a. Improperly storing or transporting sampling equipment and sample containers.

b. Contaminating the equipment or sample bottles by setting them on or near potential contamination sources, such as uncovered ground. Samples should not be collected or stored in the presence of exhaust fumes.

c. Handling bottles or equipment with dirty hands. Sample containers should be filled with care so as to prevent any portion of the collected sample coming in contact with the sampler's gloves.

d. Improperly decontaminating equipment before sampling or between sampling events.

5.2 QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS FOR LABORATORY ANALYSIS

The QA 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. These terms are defined in Table 5-1. 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.

Table 5-1. Data Quality Definitions

Data Quality Term	Definition
Representativeness	Measure of how closely results match actual concentrations
Comparability	Measure of confidence with which one data set can be compared to another
Accuracy	Measure of how close value is to true value
Precision	Measure of the data reproducibility (e.g., duplicate sample)

ATL-MP-1011, *ATL Quality Assurance Project Plan for 222-S Laboratory*, specifies the requirements for ensuring the quality of sample analyses performed by Advanced Technologies and Laboratories International, Inc. (ATL) at the 222-S Laboratory. Analyses performed by ATL shall be governed by ATS-MP-1032, *222-S Laboratory Quality Assurance Plan*, and ATL-MP-1002, *Quality Assurance Program Description*. All analyses shall be performed in accordance with these requirements. Laboratories performing analyses in support of this FSAP shall have approved and implemented QA Plans. These QA plans shall meet HASQARD minimum requirements as the baseline for laboratory quality systems.

The analytical/laboratory QC requirements (duplicates, spikes, etc.) are identified in Table 4-1. The laboratory shall also use calibration and calibration check standards appropriate for the analytical instrumentation being used (see HASQARD for definitions of QC samples and standards). The criteria presented in the tables are goals for demonstrating reliable method performance. The laboratory will use its internal QA system for addressing any QC failures. If the QC failures are systematic and cannot be resolved by the internal protocols, the Quality Assurance Lead shall be consulted to determine the proper action. The laboratory should suggest a course of action at that time. All data not meeting the QC requirements shall be properly noted, and the associated QC failures shall be discussed in the narrative of the data report.

5.2.1 Laboratory Quality Control

The laboratory method blanks, duplicates, laboratory control sample/blank spike, and matrix spikes are defined in Chapter 1 of SW-846 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. 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. Where spike duplicates are required, duplicates do not need to be analyzed and where duplicates are required, spike duplicates are not required. Minimally, a duplicate and spike (or spike duplicate) is required per laboratory batch.

Secondary analytes will be reported when detected. All QC failures associated with secondary analytes will be discussed in the report narrative and qualified appropriately in the data package. Note that if there are QC failures associated with secondary analytes, reanalysis will not be required.

5.2.2 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 specified by 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 QA plan or operating procedures (as appropriate). Calibration of laboratory instruments will be performed in a manner consistent with SW-846 or HASQARD.

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

6.0 DATA REPORTING

This section describes the laboratory reporting requirements for S Farm soil samples. Section 6.1 identifies "quick turn" reporting requirements and Section 6.2 identifies how all the analyses other than the "quick turn" will be reported. Note that "quick turn" constituents are bolded in Table 4-1 and secondary constituents are italicized. Secondary constituents will only be reported in the Format VI data package if they are detected.

It is anticipated that the 222-S Laboratory will perform all of the analyses. If necessary, the laboratory may subcontract certain analyses to another qualified laboratory. The subcontracted laboratory shall meet all QA/QC requirements in this FSAP. The 222-S Laboratory will prepare a statement of work (SOW) authorizing the subcontracted laboratory to perform the analyses. The SOW shall be reviewed and approved by the Primary Laboratory Contact, WRPS QA, and Sample Data Manager prior to commencement of laboratory analysis.

6.1 "QUICK TURN" REPORTING

The "quick turn" ^{99}Tc and nitrate analyses will be reported on an expedited time frame (typically within one week of the last sample receipt batched together; however, upon request it will be reported within 48 hours). The results are transmitted via e-mail to the Primary Laboratory Contact, Characterization Task Lead, and Sample Data Manager. They will also be reported in the standard data package so the information will be available to load into HEIS.

6.2 FORMAT VI REPORTING

Analysis performed at the 222-S Laboratory will be provided in Format VI data packages. Analysis performed at other laboratories will be provided in a format equivalent to a 222-S Laboratory Format VI report.

Format VI Report with QA Verification includes the following.

- 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 final report. Typical QA reviews require a minimum 10% review.

A Format VI data package is subject to internal laboratory QA verification and review including peer review prior to release.

The final data package will be provided to the Primary Laboratory Contact (i.e., .pdf file or copy through Integrated Document Management System [IDMS]). The laboratory shall issue the data package within 120 calendar days following receipt of the last samples. Preliminary results shall be available within 60 days following receipt of the last sample. As indicated in Section 5.0, laboratory changes will be communicated to the Primary Laboratory Contact and documented in the laboratory report(s) narrative.

In addition to this data package, an electronic version of the analytical results, including tentatively identified compounds, shall be uploaded to HEIS within 14 calendar days of release of the data package. The electronic data shall be in the standard electronic format for HEIS [CP-15383, *Common Requirements of the Format for Electronic Analytical Data (FEAD)*].

7.0 CHANGE CONTROL

The Characterization Task Lead is responsible for ensuring the current version of the FSAP is being used and for providing any updates to field personnel. Version control is maintained by the administrative document control process.

Since this plan covers a one-time sampling event (i.e., sampling will not be a routine frequency like quarterly well sampling), all updates to the plan will be made through the change notice process. Formal plan revisions will not be necessary. Table 7-1 provides an example of the types of changes that may be made to the sampling design and the documentation requirements. Field activity and laboratory work scope changes may be required because of unexpected field conditions, new information, health and safety concerns, or other unplanned circumstances. These work scope changes will be documented on the change notice form provided in Appendix C. Laboratory changes will be communicated to the Primary Laboratory Contact and documented in the laboratory report(s) narrative and/or through the change notice process, as applicable.

Table 7-1. Example of Change Control for Sampling Projects

Type of Change	Action	Documentation
Slightly move sample location based on lack of recovery	No plan revision necessary	Field logbooks or operational records
Reduce required analysis due to insufficient sample recovery	Revise plan (can be accomplished with change notice); obtain required approvals; distribute revised plan/change notice	Revised plan or change notice

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8.0 DOCUMENTS AND RECORDS

All information pertinent to field sampling 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 will be followed.

Logbooks are required for field activities. A logbook must be identified with a unique project name and number. The individual(s) responsible for logbooks will be identified in the front of the logbook and only authorized persons may make entries in logbooks. Logbooks will be signed by the field manager, supervisor, cognizant scientist/engineer or other responsible individual. Logbooks will be permanently bound, waterproof, and ruled with sequentially numbered pages. Pages will not be removed from logbooks for any reason. Entries will be made in indelible ink. Corrections will be made by marking through the erroneous entry with a single line, entering the correct information, and initialing and dating the changes.

The Project Manager is responsible for ensuring that a project file is properly maintained. The project file will contain the records or references to their storage locations. The project file will include the following, as appropriate:

- Field logbooks or operational records
- Data Forms
- Chain-of-custody forms
- Sample receipt records.

The laboratory will follow their own procedures with respect to documents and records. Audits will be periodically conducted by WRPS QA to ensure their practices are following requirements. All WRPS records are put into the IDMS, the Hanford Site record repository.

8.1 DATA QUALITY ASSESSMENT

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 is of the correct type and is 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, *Guidance for Data Quality Assessment, Practical Methods for Data Analysis*, *EPA QA/G-9, QA00 Update*.

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9.0 PROJECT ORGANIZATION

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 project organization is described in Table 9-1. Project management and QA may conduct random surveillance and assessments to verify compliance with the requirements outlined in this FSAP, 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 WRPS policy and procedures. Management will be made aware of deficiencies identified by assessments and surveillances and subsequent corrective actions.

Table 9-1. Key Personnel (3 sheets)

Title	Responsibility	Primary Contact	Alternate Contact
Project Manager	• Coordinates the preparation of data quality objectives, data requirements plans, work plans, Sampling and Analysis Plans (SAP), Field Sampling and Analysis Plans (FSAP), as required. • Coordinates with U.S. Department of Energy (DOE) and Washington State Department of Ecology.	Susan Eberlein	Jim Field
Data Management Lead	• Ensures Sample Data Tracking (SDT) system is set up to meet sampling and analysis objectives and ensures paperwork is generated for sampling events. • Oversees all SDT efforts in order to prioritize data management efforts and to ensure that project requirements are achieved. • Coordinates with Primary Laboratory Contact to ensure data verification process is completed and that data is reviewed against existing knowledge and data quality assessment guidelines. • Ensures that data is loaded into Hanford Environmental Information System (HEIS) correctly.	Heather Anastos	Cindy Tabor
Field Team Lead	• Develops information to be included in work packages. • Provides direction to Field Work Supervisor regarding field scope, schedule, and priorities. • Provides direction regarding drilling activities to field personnel including subcontractors. • Prepares work package information for all field activities. • Plans, coordinates, and oversees field drilling activities. • Coordinates with necessary organizations to ensure field drilling activities are conducted safely and correctly. • Communicates with the Characterization Task Lead, Sample Coordinator, Primary Laboratory Contact, and Data Management Lead to identify field constraints that could affect sampling design or that would necessitate a change notice. • Leads the effort of determining sample depth for each probe hole. • Ensures field activities are documented in direct push completion reports.	Harold Sydnor	Cindy Tabor
Characterization Task Lead	• Prepares SAPs and/or FSAPs and documents required changes notices, as necessary. • Coordinates with Field Team Lead to identify reporting schedule requirements. • Coordinates with Sample Coordinator, Primary Laboratory Contact, Data Management Lead, and Quality Assurance Lead to ensure that project requirements are understood. • Determines where quality control samples will be taken to meet plan requirements. • Reviews paperwork to ensure plan requirements are being achieved.	Cindy Tabor	Harold Sydnor

Table 9-1. Key Personnel (3 sheets)

Title	Responsibility	Primary Contact	Alternate Contact
Sample Coordinator	• Plans, coordinates, and oversees field sampling activities including sample collection, packaging, provision of certified clean sampling bottles/containers, documentation of sampling activities in controlled logbooks, chain of custody, and packaging and transporting of samples to laboratory or shipping center. • Reviews field paperwork to ensure that it has been completed correctly. • Directs training, mock-ups, and practice sessions to ensure that the sampling design is understood. • Directs procurement and installation of materials and equipment needed to support sampling activities. • Coordinates with necessary organizations to ensure sampling activities are conducted safely and correctly. • Maintains and coordinates the installation of facilities that support sampler activities and that are used to store sampling equipment and materials. • Identifies resources needed for sampling; develops and revises sampling procedures and training material; and performs training, as necessary. • Procures equipment and materials (e.g., bottles) associated with sampling and ensures that equipment receives preventative maintenance as required.	Andrew Templeton	Cindy Tabor
Field Work Supervisor	• Acts as the key field interface for daily field activities. • Conducts daily briefings and goes over the daily plan. • Ensures work activities are performed in a safe and productive manner and in accordance with all applicable administrative and technical procedures. • Ensures that work does not commence until all personnel involved with the field work understand their roles and responsibilities. • Applies the work planning process, including conducting pre-job briefings and post job reviews. • Oversees personnel performing low/medium risk, self-directed tasks with supervision only on an as-needed basis. • Identifies, recognizes, mitigates, and controls hazards.	William Clark	Greg Simons or Glenda Davis
Quality Assurance Lead	• Provides oversight to ensure data integrity. • Performs assessments and surveillance, as necessary. • Reviews documentation generated through implementation of SAPs and/or FSAPs. • Performs QA review of third party Data Validation results. • Reviews changes to data documents and forms. • Reviews issues identified during data processes for corrective actions. • Identifies QA hold points or best management practices, as needed.	Kathi Dunbar	Mike McElroy

Table 9-1. Key Personnel (3 sheets)

Title	Responsibility	Primary Contact	Alternate Contact
Primary Laboratory Contact	• Acts as the primary laboratory interface. • Selects laboratory to perform the analyses and requests assessments/surveillances of the laboratories. • Communicates to Characterization Task Lead, Data Management Lead, Sample Coordinator, and Quality Assurance Lead any laboratory issue that will impact data quality or necessitate a change notice. • Works with the laboratory to resolve data quality issues and to ensure plan requirements are achieved. • Acts as the Data Verification Lead. • Assists with resolving Data Validation issues and performs technical review of third party Data Validation results. • Assists in laboratory surveillances.	Heather Anastos	Andrew Templeton
Radiological Engineering Contact	• Conducts as low as reasonably achievable reviews, exposure and release modeling, and radiological control optimization. • Identifies that appropriate controls are implemented to maintain worker safety. • Interfaces with health and safety contact. • Plans and directs radiological control technicians that support field activities.	Field Team Lead contacts: Daren Christensen Phone: 373-1986	
Health and Safety Contact	• Coordinates industrial health and safety support within the project as per required health and safety plan, job hazard analyses, and other pertinent safety documents • Provides assistance to ensure compliance with applicable health and safety standards/requirements • Coordinates with radiological engineering to determine personal protective clothing requirements.	Field Team Lead contacts: Mike Powers Phone: 376-5597 Jason Randles Phone: 373-3399	
Waste Management Contact	• Communicates policies and procedures to ensure project compliance with storage, transportation, disposal, and waste tracking requirements.	Field Team Lead contacts: Keith Smith Phone: 372-1322	

10.0 REFERENCES

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APPENDIX A

MEETING NOTES:
FUTURE CHARACTERIZATION SITES FOR POTENTIAL INTERIM BARRIERS

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Meeting Notes:
Future Characterization Sites for Potential Interim Barriers

Meeting Date:	January 13, 2011, 9:00 am
Location:	Ecology Building, room 31
Purpose:	Discuss characterization information related to potential interim surface barriers and set priorities for future barrier site characterization.
Attendees:	Michelle Hendrickson (Ecology), Mike Barnes (Ecology), Joe Caggiano (Ecology), Bob Lober (ORP), Les Fort (WRPS), Cindy Tabor (WRPS), Susan Eberlein (WRPS)

Background:
ORP, Ecology and WRPS met in December 2010 to discuss plans for future interim barriers (per TPA milestone M-45-92). An action was assigned to:

> Set meeting with ORP and Ecology to discuss information obtained since barrier characterization priorities were set and determine if any changes are warranted for the S site. Include consideration of other future characterization priorities.

This meeting completes that action.

Topics discussed:

1. The basis for previous potential barrier site characterization priorities was reviewed. Previous locations had used potential reduction of the risk from Tc-99 (as calculated by the Initial Single Shell Tank Performance Assessment) as a basis.

2. New information from leak loss evaluations was discussed. Leak loss evaluations have identified additional probable losses to the soil in several farms, often attributed to pipelines. The current information (based on risk from Tc-99) shows that the two farms with the greatest risk are already being addressed (T and SX). All other farms have significantly less risk based on this parameter.

3. It was noted that the effectiveness of barriers over the long term, and at any depth, is still difficult to assess. Modeling predicts a benefit to depths of up to 150 feet below ground surface. Monitoring indicates that the T farm barrier is having the expected impact near the surface. However, the time frame required to observe impacts at depth is significant.

4. Other criteria that may be used for evaluation of potential barrier priority were discussed. These included:

    a. Release of U, Sr, Nitrate and total inventory
    b. Any available information about the depth of the contaminant plumes
    c. Timing of the completion of retrieval for the farm
    d. Whether there is already an impact on groundwater, and what it is

e. Constructability issues, including potential locations for evapo-transpiration basins

5. Potential characterization in S farm was discussed. The leak loss evaluation showed that the S-104 plume was probably larger than previously thought. Surface Geophysical Exploration (SGE) results also suggest a large plume (plus one or more smaller plumes) in that area. Drywell logging indicates plumes near the surface. The existing body of information would be effectively supplemented by direct push logging, sampling and placement of deep electrodes for future use. Performing direct push work in S-farm, with some emphasis in the region of the S-104 leak, should firm up the conceptual model and support an informed decision on whether an interim surface barrier is warranted in this area.

6. **Decision:** Continue with direct push logging, sampling and placement of deep electrodes in S farm, with emphasis in the region of the S-104 historic leak.

7. Potential options for FY12 characterization (direct push and SGE) were discussed. U farm, BX farm, and TX farm were all considered. All three farms are ranked high in priority due to risk associated with Tc-99. All three farms have Uranium plumes that would benefit from further evaluation.

   a. U farm has an existing array of 10 deep electrodes (at 97 feet) and would be a good candidate for an SGE evaluation using the deep electrodes. U farm was not considered the highest priority previously because of concerns that the large amounts of water in the vadose zone from nearby sources would render a barrier ineffective. There is not complete consensus on this point.
   b. TX farm may also be a candidate for SGE using deep electrodes. Some deep electrodes were previously placed, but not as extensively as in U farm. TX farm may benefit from direct push characterization and placement of more deep electrodes. (Note: it was subsequently determined that BX farm, rather than TX farm, included 4 previously placed deep electrodes.)
   c. BX farm has at least one large plume that has already affected ground water. It does not have deep electrodes in place, but could benefit from further characterization using direct push.

   d. No decision was reached on which characterization options to pursue in FY2012. Instead, it was decided to meet again with additional information on U, BX and TX farms. The additional information will address the criteria noted above (item 4), as well as the number and location of deep electrodes in TX farm. (Note: it was subsequently determined that BX farm, rather than TX farm, included 4 previously placed deep electrodes. Information on these locations will be provided in the next meeting.)

Action required: Set follow on meeting to complete decision for FY12 characterization priorities, once information has been gathered to support a decision of further characterization on the "other criteria" noted in #4 above. (Susan Eberlein)

Meeting Notes:
Future Characterization Sites for Potential Interim Barriers

January 13, 2011

Concurrence:

Jeff Lyon, WA State Department of Ecology — Date: 2/1/11

Bob Lober, US Department of Energy — Date: 2/01/2011

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APPENDIX B

MEETING MINUTES FROM S-FARM INTERIM BARRIER DIRECT PUSH SAMPLE LOCATIONS MARCH 24, 2011 MEETING

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Meeting Minutes from S-Farm Interim Barrier Direct Push Sample Locations March 24, 2011 Meeting

Attendees: Harold Sydnor, Jim Field, Les Fort, Mike Barnes, Joe Caggiano, Bob Lober, Marc Levitt, Dave Myers, Susan Eberlein Brian Cubbage, Kent Reynolds, and Cindy Tabor

Meeting Goal: Select 7 Direct Push Locations

<u>Background Information:</u>

Draft RPP-ENV-49131, Data Requirements for Characterization Supporting Near-Term Interim Barrier in S Farm, provided recommendations for 7 direct pushes and summarized the following leak assessment information:

- Tank S-104 is a designated leaker having an estimated 24,000 gallons of waste released via the tank spare inlet nozzles
- Tanks S-102 and -104 show gamma activity in nearby dry wells (40-02-03 and 40-04-05)
- All Tanks have been filled above their cascade level
- Tanks S-101, -103, -105, and -106 associated with pipeline failures
- Tanks S-103, -104, -110, and -112 filled above or near the level of spare inlet nozzle
- Tanks S-102 and -103 associated with a transfer line leak
- 1996 water line rupture, an estimated 500,000 gals released north of S Farm (most of the water appeared to have infiltrated into the soil along the east side of S Farm)
- SGE indicted S-Farm higher conductivity areas between Tanks S-102 and S-103 (south side); between Tanks S-101 and S-103 (south side); between S-106 and S-105 (south side)

Table 1. Direct Push Location Strategy for S Farm

Location #		Input Factors Associated with Location[a] **Reason for Sampling with Respect to Barrier**
1 (Agreed Upon Location)	**C8393/C8394** (Southeast of Tank S-104)	• Tank S-104 designated as a leaker (~24,000 gals) • Tank S-104 filled above spare inlet (Location near spare inlet area) • Nearby dry well (40-04-05) has detectable Cs-137 concentrations at depth (Figure 10) **Further Assess the Path and Inventory of Tank S-104 Release**
2 (Options A or B)	**C8395/C8396** (Southwest of Tank S-101 and/or Northeast of Tank S-105 – Diversion Box Area)	• Diversion Box and many pipelines nearby • Tanks S-101 and S-105 associated with pipeline failure • Higher conductivity area based on resistivity information (Figure 12) • Tank S-104 confirmed leaker (~24,000 gals) **Further Assess the nature and depth of migration of releases near Tanks S-102 and S-105 and potentially to Further Assess the path and inventory of Tank S-104 Release**

Table 1. Direct Push Location Strategy for S Farm

Location #		Input Factors Associated with Location[a] **Reason for Sampling with Respect to Barrier**
3 (Agreed Upon Location)	**C8397/C8398** (Northeast of Tank S-102)	• Transfer line leak between S-103 and S-102 • Nearby dry well (40-02-03) has detectable Cs-137 concentrations at depth (Figure 9) • Nearby spare inlet **Confirm Previous Results: Gather additional data to assist in determining nature and extent of contamination (i.e., Tc-99) and to Further Assess the nature and extent of releases near Tanks S-102 and S-103**
4 (Agreed Upon Location)	**C8399/C8400** (Southeast of Tank S-103)	• Transfer line leak between S-103 and S-102 • Tank S-103 associated with pipeline failure • Higher conductivity area based on resistivity information (Figure 12) • Nearby spare inlet **Further Assess the nature and extent of releases near Tanks S-102 and S-103**
5 (Options A, B, or C)	**C8401/C8402** (Southwest of Tank S-105 or Northwest of Tank S-109)	• Tanks S-105 and S-106 associated with pipeline failure • Higher conductivity area based on resistivity information (Figure 12) **Gather data to assist in determining nature and extent of contamination (i.e., Tc-99)**
6 (Agreed Upon Location)	**C8403/C8404** (Southeast of Tank S-105)	• Tank S-104 designated as a leaker (~24,000 gals) • 1996 water line rupture, 500,000 gals north of S Farm (most water infiltrated along the east side of S Farm) **Gather data to assist in determining nature and extent of contamination (i.e., Tc-99) and to Further Assess the Path and Inventory of Tank S-104 Release and 1996 water line rupture**
7 (Options A or B)	**C8405/C8406** (Southeast of Tank S-105)	• Tank S-104 designated as a leaker (~24,000 gals) • Tank S-105 associated with pipeline failure **Gather data to assist in determining nature and extent of contamination (i.e., Tc-99) and to Further Assess the Path and Inventory of Tank S-104 Release**

[a]Referenced figures are included in Draft RPP-ENV-49131, Data Requirements for Characterization Supporting Near-Term Interim Barrier in S Farm

Note: Stratigraphic dip to the south-southeast

Final Location Information:

RPP-ENV-49131, Data Requirements for Characterization Supporting Near-Term Interim Barrier in S Farm – Section 1.7.4 "Direct Push Sample Locations" will be updated with the above table (it is Table 2 in the document) and with the following text:

"Coordinates for all locations (including A, B, and C options) will be obtained and then these locations will be staked in the field. During the field walk-down (staking process), optimal option locations will be determined based on accessibility and data needs, except for C8401/C8402. Location C8401/C8402 will be selected based upon quick turn results and field conditions. Final locations will be provided in the field sampling and analysis and/or associated changed notices that will be developed for the S-Farm direct push effort. "

Information Needed:

Please provide comments on DRAFT Data Requirements for Characterization Supporting Near-Term Interim Barrier in S Farm by **COB Monday 3/28/11**

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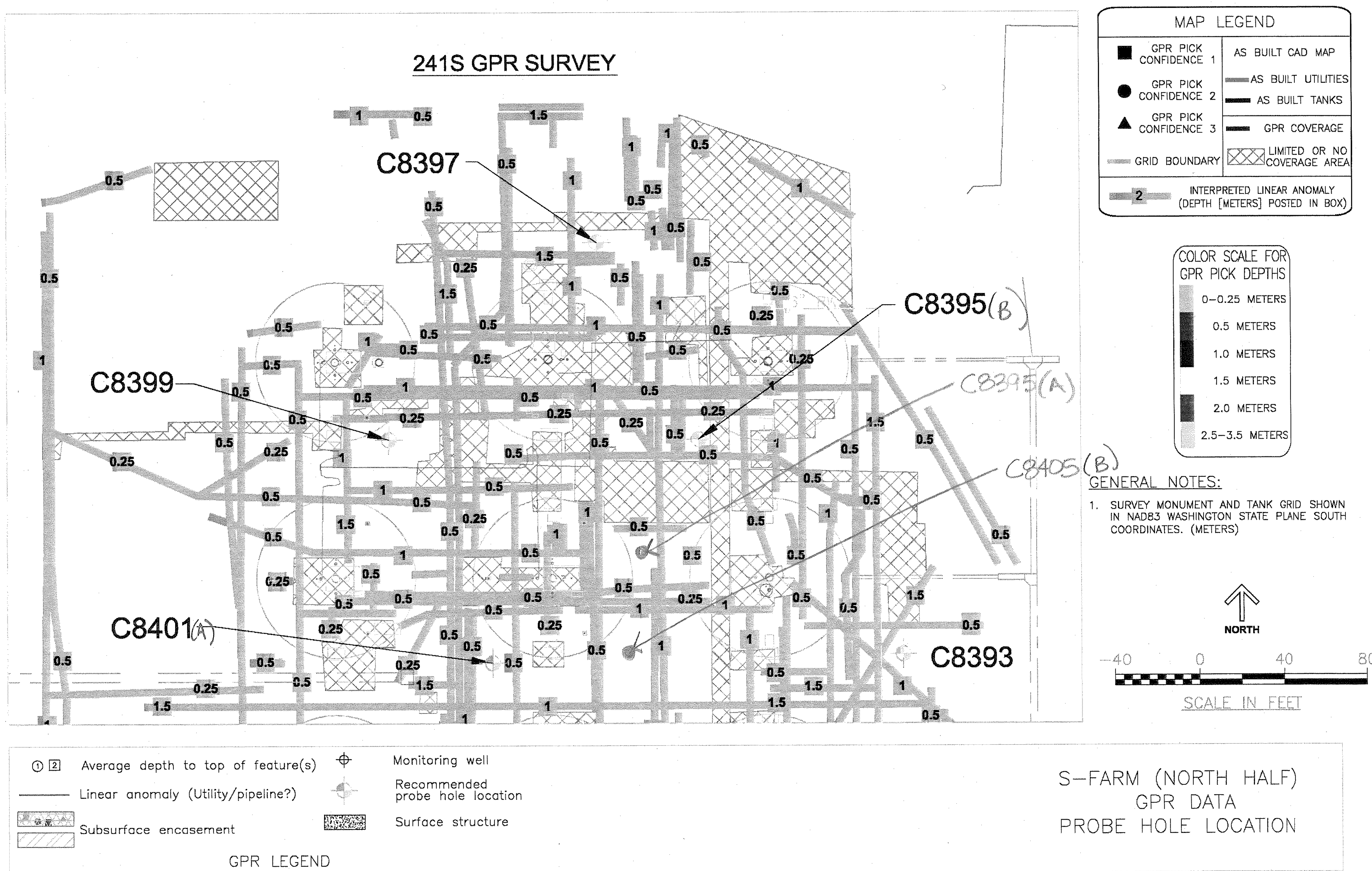
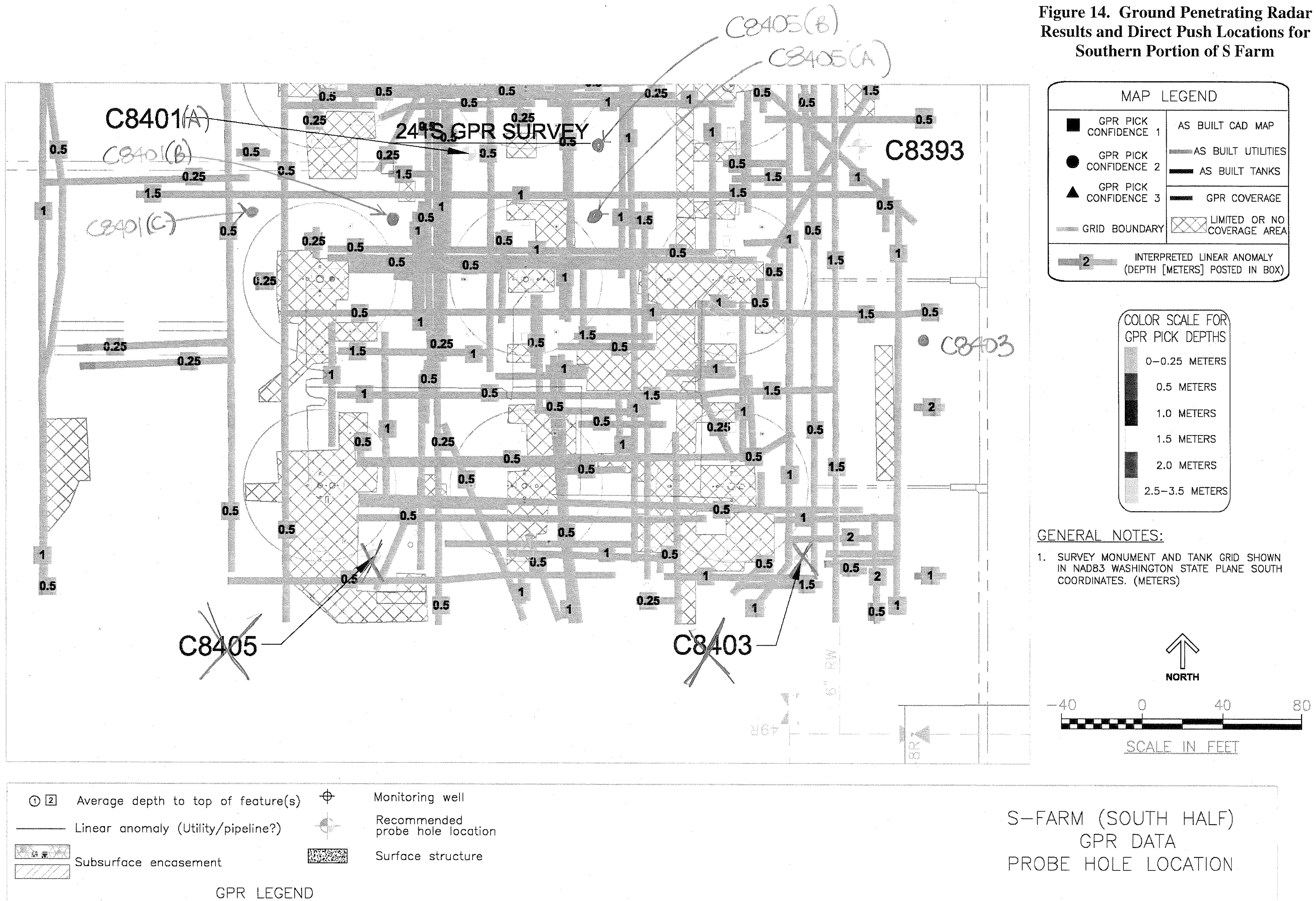
Figure 13. Ground Penetrating Radar Results and Direct Push Locations for Northern Portion of S Farm



RPP-PLAN-49132, Rev. 0

RPP-ENV-49131, Rev. 0

Figure 14. Ground Penetrating Radar Results and Direct Push Locations for Southern Portion of S Farm



APPENDIX C

VADOSE SAMPLING CHANGE NOTICE

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VADOSE SAMPLING
CHANGE NOTICE

Document: ____________ **Change Number:** ____________ **ECN to FSAP Required?** Y / N

Requestor: ______________________________ **Date:** ____________

Original Requirement:

Samples Impacted:

Proposed Change:

Reason for Change:

Date Change Effective: ____________

Schedule Impact:

Authorization:

Vadose Zone Characterization Task Lead (Print/Sign): ______________________________ **Date:** ____________

Vadose Zone Primary Laboratory Contact (Print/Sign): ______________________________ **Date:** ____________

Vadose Zone Quality Assurance (Print/Sign): ______________________________ **Date:** ____________

222-S Project Coordinator (Print/Sign): ______________________________ **Date:** ____________

ATL Project Coordinator (Print/Sign): ______________________________ **Date:** ____________

Other (Optional, Print/Sign): ______________________________ **Date:** ____________

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INFORMATION CLEARANCE REVIEW AND RELEASE APPROVAL

Part I: Background Information

Title: Field Sampling and Analysis Plan for Soil Samples in Support of an Interim Barrier at S Farm	Information Category: ☐ Abstract ☐ Journal Article ☐ Summary ☐ Internet ☐ Visual Aid ☐ Software ☐ Full Paper ☐ Report ☑ Other Field Sampling and Analysis Plan
Publish to OSTI? ☐ Yes ☑ No	
Trademark/Copyright "Right to Use" Information or Permission Documentation	Yes ☐ NA ☑
Document Number: RPP-PLAN-49132 Revision 0	Date: April 2011
Author: Tabor, Cindy L	

Part II: External/Public Presentation Information

Conference Name:

Sponsoring Organization(s): WRPS

Date of Conference:	Conference Location:
Will Material be Handed Out? ☐ Yes ☑ No	Will Information be Published? ☐ Yes ☑ No *(If Yes, attach copy of Conference format instructions/guidance.)*

Part III: WRPS Document Originator Checklist

Description	*Yes*	*N/A*	*Print/Sign/Date*
Information Product meets requirements in TFC-BSM-AD-C-01?	☐	☑	
Document Release Criteria in TFC-ENG-DESIGN-C-25 completed? (Attach checklist)	☐	☑	
If product contains pictures, safety review completed?	☑	☐	Roberts, Sheryl K Approved - IDMS data file att.

Part IV: WRPS Internal Review

Function	*Organization*	*Date*	*Print Name/Signature/Date*
Subject Matter Expert	WRPS	04/14/2020	Tabor, Cindy L Approved - IDMS data file att.
Responsible Manager	WRPS	04/13/2020	Rutland, Paul L Approved - IDMS data file att.
Other:			

Part V: IRM Clearance Services Review

Description	*Yes*	*No*	*Print Name/Signature*
Document Contains Classified Information?	☐	☒	If Answer is "Yes," ADC Approval Required Print Name/Signature/Date
Document Contains Information Restricted by DOE Operational Security Guidelines?	☐	☒	Reviewer Signature: Print Name/Signature/Date
Document is Subject to Release Restrictions? *If the answer is "Yes," please mark category at right and describe limitation or responsible organization below:*	☐	☒	Document contains: ☐ Applied Technology ☐ Protected CRADA ☐ Personal/Private ☐ Export Controlled ☐ Proprietary ☐ Procurement – Sensitive ☐ Patentable Info. ☐ OUO ☐ Predecisional Info. ☐ UCNI ☐ Restricted by Operational Security Guidelines ☐ Other (Specify)
Additional Comments from Information Clearance Specialist Review?	☐	☒	Information Clearance Specialist Approval APPROVED By Sarah Harrison at 8:49 am, Apr 20, 2020 Print Name/Signature/Date

When IRM Clearance Review is Complete – Return to WRPS Originator for Final Signature Routing (Part VI)

INFORMATION CLEARANCE REVIEW AND RELEASE APPROVAL

Part VI: Final Review and Approvals

Description	*Approved for Release*		*Print Name/Signature*
	Yes	*N/A*	
WRPS External Affairs	☒	☐	McKenna, Mark Approved - IDMS data file att.
WRPS Office of Chief Counsel	☒	☐	Peters, Amber D Approved - IDMS data file att.
DOE – ORP Public Affairs/Communications	☒	☐	Levardi, Yvonne M / Tyree, Geoff T Approved - IDMS data file att.
Other: ORP OCC	☒	☐	Zelen, Benjamin J Approved - IDMS data file att.
Other: ORP SME	☒	☐	Blackwell, Becky Approved - IDMS data file att.

Comments Required for WRPS-Indicate Purpose of Document:

This Field Sampling and Analysis Plan for 241-S Tank Farm has been prepared to collect information regarding the geographic extent of subsurface mobile contaminant plumes to address design requirements for an interim surface barrier and to characterize the nature and extent of the contamination release to establish site cleanup and closure decisions.

APPROVED
By Sarah Harrison at 8:49 am, Apr 20, 2020

Approved for Public Release; Further Dissemination Unlimited

Information Release Station

Was/Is Information Product Approved for Release? ☒ Yes ☐ No

If Yes, what is the Level of Releaser? ☑ Public/Unrestricted ☐ Other (Specify) ____________

Date Information Product Stamped/Marked for Release: 04/20/2020

Was/Is Information Product Transferred to OSTI? ☐ Yes ☒ No

Forward Copies of Completed Form to WRPS Originator

- <workflow name="(SEH) Expedite - RPP-PLAN-49132 Rev0" id="260253462">
- <task name="Clearance Process" id="0" date-initiated="20200409T0648" performer="Sarah E Harrison" performer-id="252341659" username="h5635746">
<comments>Due Thursday April 23rd 2020 - COB Please expedite the approval of the Field Sampling and Analysis Plan for Soil Samples in Support of an Interim Barrier at S Farm submitted by Cindy Tabor for public release to Ecology. Thank you, Sarah Harrison Information Clearance</comments>
</task>
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- <task name="ORP Document Reviewer2" id="58" date-due="20200417T0707" date-done="20200415T1031" performer="Yvonne M Levardi" performer-id="185346745" username="h7131303" disposition="Public Release" authentication="true">
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<task name="Doc Owner Reviews ORP Comments" id="61" date-due="20200420T1105" date-done="20200420T0557" performer="Cynthia L Tabor" performer-id="173738849" username="h6436378" disposition="Send On" authentication="true" />

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