TRI-PARTY AGREEMENT

Change Notice Number TPA-CN- 357	TPA CHANGE NOTICE FORM	Date: 5/5/2010
Document Number, Title, and Revision: *Sampling and Analysis Plan for the 100-K Decision Unit Remedial Investigation/Feasibility Study,* DOE/RL-2009-41, Rev. 0		Date Document Last Issued: October 23, 2009
Originator: Roger Ovink/Art Lee		Phone: 375-9426/372-1763

Description of Change:

Replace pages 1-2, pages 2-26 through 2-28, page 3-4 through 3-19 and page A-5 with the attached.

- Updated Figure 1-1 to reflect change in sample location for well #9 to behind the 105-KE reactor building.
- The frequency of field transfer blanks and duplicates were reduced to 1 per borehole for soil/sediment samples and retained at one per day for groundwater samples.
- Updated Table 3-1 to increase soil number of sampling intervals in wells drilled within the 100K reactor fence line area (i.e., well numbers 2, 4, 5, 9, R1, R3 and R5). Also, modified sample total depth for boreholes at the trench.
- "Well Drilling and Completion Procedures" in Section 3.5.2.1 modified to identify that well R3 will be constructed with PVC pipe instead of stainless steel.
- Reduced the laboratory standard compound list for gamma energy analysis.

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

Note: Include affected page number(s)

Justification and Impacts of Change:

Unable to obtain tribal concurrence for location of well #9 in culturally sensitive area so alternate location within the KE reactor area was selected. This sample location will provide additional characterization for the KE reactor area and is preferable to relocating well #9 further northeast to outside the culturally sensitive area which may be beyond the extent of the contamination plume.

The additional soil samples for wells 2, 4, 5, 9, R1, R3, and R4 will provide for additional characterization of potential source contamination in the vadose zone to ground water within the 100K reactor area.

Well R3 is anticipated to be decommissioned within 1 year of construction with D&D of the 183.1KE head house. Characterization information to support the RI data needs could be obtained with a borehole drilled at this location and then decommissioned. Construction of the well with PVC pipe is a cost effective alternative to enable ground water samples to be collected prior to decommissioning with D&D of the 183.1KE head house.

Revised GEA reporting list to standardized list in the other RIFS SAPs. The list represents the minimum information necessary for both the groundwater and vadoze zone monitoring efforts and will streamline planning activities and analysis reporting from the laboratories. The majority of the removed isotopes are daughter progeny of isotopes that will be measured. Activities can be calculated for these and the requirement that the labs report all realistic detected isotopes will ensure that no unexpected gamma emitting isotopes are missed.

Approvals:

Signature	Date	
[signature] acting for B. Charboneau DOE Project Manager	6/1/2010	[X] Approved [ ] Disapproved
[signature] EPA Project Manager	6/1/10	[X] Approved [ ] Disapproved
Ecology Project Manager	Date	[ ] Approved [ ] Disapproved

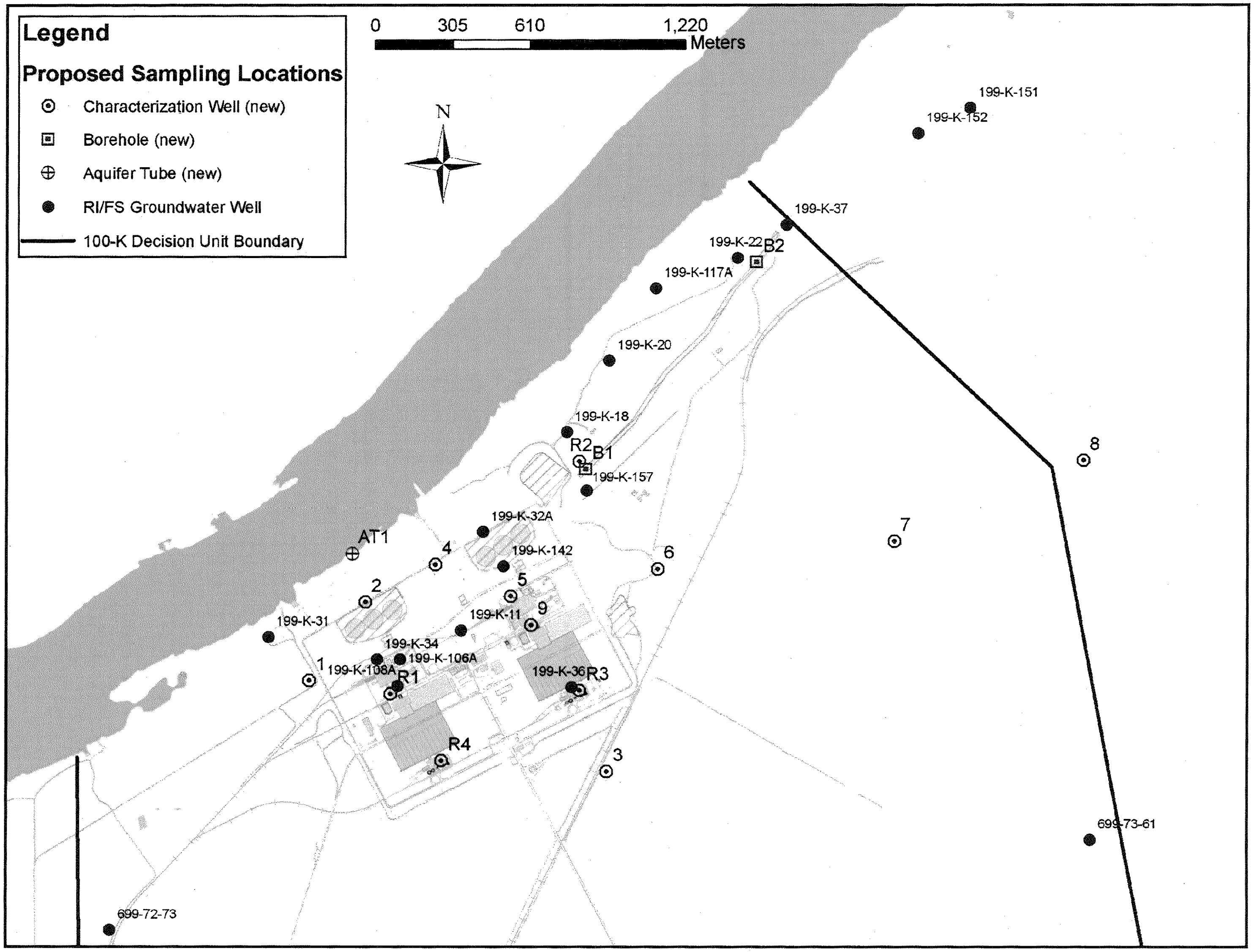

Figure 1-1. 100-K Decision Unit Planned and Existing Sampling Locations

actions. Issues affecting analytical results are to be resolved by Sample Management and Reporting in coordination with the project lead.

Batch leach contacting tests will be performed on select soil and aquifer sediment samples. Standardized batch leach tests are done using a leach procedure based on ASTM D-3987-06, *Standard Test Method for Shake Extraction of Solid Waste with Water*. The procedure recommends using soil screened through 9.5mm (3/8-inch) mesh. Demineralized water~~, pH adjusted according to EPA's West Coast recommendation,~~ will be used as the leaching liquid. Selected soil samples will be leached at soil to water weight ratios of 1 to 1, 1 to 2.5, and 1 to 5 with one test in each series duplicated. Soil/water mixtures are placed in clean water-tight sample containers (extraction vessels) and rotated end-over-end through the vessel centerline at a rate of about 30 rotations per minute for 18 hours. Following 18 hours of mixing, the soil/water slurry is filtered using a 0.45-µm filter. The leachate will be analyzed for pH, conductivity, and metals or other contaminants of interest. Details of the test will be discussed with the laboratory personnel before analysis.

Desorption distribution coefficient determinations using reagent water extract aliquots and results of soil analysis from EPA SW-846 Methods 6010, 6020, 7196, 7470, or 200.8 metals as applicable will support modeling needs. Details of the test will be discussed with the laboratory personnel before analysis.

Grain-size (sieve) analysis may be performed as a field procedure or in the laboratory based on ASTM D422-63, *Standard Test Method for Particle-Size Analysis of Soils*. Field grain size analysis may be used to select well screens for groundwater wells.

2.2.5. Quality Control

The QC procedures must be followed in the field and laboratory to ensure that reliable data are obtained. Field personnel will collect QC samples to evaluate the potential for cross-contamination and to provide information pertinent to field variability. Field QC for sampling will require the collection of field duplicates, trip or field transfer blanks, equipment blanks, and field split samples. Laboratory QC samples estimate the precision and bias of the analytical data. Table 2-6 summarizes field and laboratory QC samples. Additional QC samples may be collected if conditions arise.

Table 2-6. Project Quality Control Checks

QC Sample Type	Purpose	Frequency
	Field Quality Control	
Full trip blank	Assess contamination from containers or transportation	One per 20 samples per media sampled.
Field transfer blank	Assess contamination from sampling site	One per day when volatile organic compounds are sampled ~~per media sampled~~for groundwater monitoring activities. A minimum of one field transfer blank will be collected at each borehole *per media sampled* where the sample will undergo volatile organic analysis.
Equipment rinsate	Verify adequacy of sampling equipment decontamination	As needed.[a] If only disposable equipment is used or equipment is dedicated to a particular well, then an equipment rinsate blank is not required. Otherwise, 1 per 20 samples per media sampled.

Table 2-6. Project Quality Control Checks

QC Sample Type	Purpose	Frequency
Field duplicates	Estimate precision, including sampling and analytical variability	One per batch,[b] 20 samples maximum, for groundwater monitoring activities. A minimum of one field duplicate will be collected at each borehole *per media sampled*.
Field split	Estimate precision, including sampling, analytical, and inter-laboratory variability	At a minimum, one per analytical method, per media for analyses performed where detection limit and precision and accuracy criteria have been defined in the Performance Requirements Tables.
	Laboratory Quality Control[b]	
Method blank	Assess response of an entire laboratory analytical system	One per batch,[b] 20 samples maximum, or as ~~identified~~ required by the method guidance *per media sampled.*
Matrix spike	Identify analytical (preparation and analysis) bias; possible matrix affect on the analytical method used	When required by the method guidance, one per batch,[b] 20 samples maximum, or as identified by the method guidance, *per media sampled.*
Matrix duplicate or matrix spike duplicate	Estimate analytical bias and precision	~~When required by the method guidance,~~ O~~o~~ne per batch,[b] 20 samples maximum, or as ~~identified~~ required by the method guidance, *per media sampled.*
Laboratory control samples	Assess method accuracy	One per batch,[b] 20 samples maximum, or as ~~identified~~ required by the method guidance *per media sampled.*
Surrogates	Estimate recovery/yield	When required by the method guidance, as ~~identified~~ required by the method guidance.

a. Whenever a new type of non-dedicated equipment is used, an equipment blank will be collected every time sampling occurs until it can be shown less frequent collection of equipment blanks is adequate to monitor the decontamination procedure for the non-dedicated equipment.

b. Batching across projects is allowed for similar matrices (e.g., Hanford Site groundwater).

2.2.5.1. Field QC Samples

The field QC sample types are discussed within this section.

Full trip blanks are samples prepared by the sampling team before traveling to the sampling site. The preserved bottle set is identical to the set collected in the field, but it is filled with reagent water or silica sand, as appropriate to the primary sample media. The bottles are sealed and transported, unopened, to the field in the same storage container used for samples collected the same day. Full trip blanks are typically analyzed for the same constituents as the samples from the associated sampling event. However, the analytical list for full trip blanks on soil may be limited to volatile organic analysis, semivolatile organic analysis, and total petroleum hydrocarbons, depending on resolution/determination of the target analyte list. Full trip blanks are not required on aquifer sediments being analyzed for metals, mercury, and hexavalent chromium.

Field transfer blanks are preserved volatile organic analysis sample containers filled at the sample collection site with reagent water or silica sand~~, as appropriate to the primary sample media,~~ transported to the field. The samples are prepared during the sampling to evaluate potential contamination caused by field conditions. After collection, field transfer blank bottles are sealed and placed in the same storage container with the samples from the associated sampling event. The field transfer blank samples are analyzed for volatile organic compounds (VOCs) only.

~~A minimum of one field transfer blank will be collected at each borehole where the samples will undergo volatile organic analysis.~~ The field transfer blank will consist of reagent water or silica sand, as appropriate to the primary sample media, added to clean sample containers at the location where the VOC sample was collected. The field transfer blank will be batched with samples for which volatile organic analysis is being requested.

Equipment rinsate blanks are collected for sampling devices reused to assess the adequacy of the decontamination process. Equipment rinsate blanks will consist of silica sand or reagent water poured over the decontaminated sampling equipment and placed in containers, as identified on the project sampling authorization form. If disposable (i.e., single-use) equipment is used, equipment blanks will not be required.

For the field transfer blanks (i.e., full trip blanks, field transfer blanks, and equipment rinsate), results above two times the method detection limit are identified as suspected contamination. However, for common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the limit is five times the method detection limit. For radiological data, blank results are flagged if they are greater than two times the total minimum detectable activity.

Field duplicate samples are used to evaluate sample consistency and the precision of field sampling methods. Field duplicates are independent samples that are collected as close as possible to the same point in space and time. They are two separate samples taken from the same source, stored in separate containers, and analyzed independently.

~~A minimum of one soil and one aquifer sediment field duplicate will be collected for each day of sampling.~~ The duplicate should be collected generally from an area expected to have some contamination so valid comparisons between the samples can be made (e.g., at least some of the constituents will be above the detection limit). When sampling is performed from a split spoon, VOC samples and VOC duplicate samples are collected directly from the sampler. The remaining soil/aquifer sediment is then composited in a stainless steel mixing bowl. The soil/aquifer sediment sample and duplicate sample are collected from this composited material.

Evaluation of the results can provide an indication of intra-laboratory variability. Large relative percent differences can be an indication of laboratory performance problems and should be investigated. Only those field duplicates with at least one result greater than five times the method detection limit or minimum detectable activities are evaluated.

A **field split** is a representative sample~~(s)~~ from a sampling event~~(s)~~ sent to a third-party laboratory (i.e., reference laboratory). Evaluation of the results can provide an indication of inter-laboratory variability. Large relative percent differences can be an indication of laboratory performance problems and should be investigated. Only those results greater than five times the method detection limit or minimum detectable activity at both laboratories are evaluated.

2.2.5.2. Laboratory QC Samples

The laboratory QC samples (e.g., method blanks, laboratory control sample/blank spike, and matrix spike) are defined for three-digit EPA methods (see EPA/600/4-79/020, *Methods for Chemical Analysis of Water and Wastes,* and EPA/600/R-94/111, *Methods for the Determination of Metals in Environmental Samples, Supplement 1*) and ~~for the~~ four-digit EPA methods (see SW-846) and will be run at the frequency specified in respective reference. QC checks outside of control limits will be reflected in the data validation process and during the DQA described in Section 2.4.

2.2.5.3. QC Requirements

If only disposable equipment is used or equipment is dedicated to a particular well, then an equipment rinsate blank is not required. If no VOC samples are collected, then a field transfer blank is not required. ~~Field transfer blanks are not required when simply transferring samples to the field gas chromatograph for analysis.~~

Table 3-1. Sample/Measurement Locations and Depth

Sampling Location	Soil/Aquifer Sediment Sample/Measurement		Water Sample/Measurement	
	Sample Interval Depth (ft bgs)[a]	Properties of Interest	Sample Interval Depth (ft bgs)/frequency	Analyte List
116-K-2 Trench West One borehole to groundwater. Justification: Interim remedial action was successfully completed at this site in 2005 to mitigate impacts from this potential source. Results from this activity indicate the maximum concentration of hexavalent chromium within the trench exceeds the soil concentration for protection of the Columbia River.	25-27.5, 27.5-30, 30-32.5, 32.5-35, 35-37.5, 37.5-40, 40-42.5, 42.5-45, 45-47.5, 47.5-50, 50-52.5, 52.5-55 (55-57.5~~37.5-40~~[b] aquifer sediment sample) by **split spoon** (~~4~~13 samples)	Target analytes, field screening parameters, and batch leach contacting test in accordance with Table 2-2	During drilling ~~37.5-40~~55-57.5 aquifer water sample[b] (1 filtered groundwater sample)	Metals and hexavalent chromium in accordance with Table 2-4
	Major formation and lithology changes by **split spoon** (2 samples)	Physical properties in accordance with Table 2-2		
116-K-2 Trench East One borehole to groundwater. Justification: Interim remedial action was successfully completed at this site in 2005 to mitigate impacts from this potential source. Results from this activity indicate the maximum concentration of hexavalent chromium exceeds the soil concentrations for protection of the Columbia River.	25-27.5, 27.5-30, 30-32.5, 32.5-35, 35-37.5, 37.5-40, 40-42.5, 42.5-45, 45-47.5, (~~45-~~47.5-50[b] aquifer sediment sample) by **split spoon** (~~7~~10 samples)	Target analytes, field screening parameters and batch leach contacting test in accordance with Table 2-2	During drilling ~~45-47.5~~47.5-50 aquifer water sample[b] (1 filtered groundwater sample)	Metals and hexavalent chromium in accordance with Table 2-4
	Major formation and lithology changes by **split spoon** (2 samples)	Physical properties in accordance with Table 2-2		

Table 3-1. Sample/Measurement Locations and Depth

	Soil/Aquifer Sediment Sample/Measurement		Water Sample/Measurement	
Sampling Location	**Sample Interval Depth (ft bgs)[a]**	**Properties of Interest**	**Sample Interval Depth (ft bgs)/frequency**	**Analyte List**
Well #1 To be drilled and installed in the unconfined aquifer in the 100-K Area Justification: To define the hexavalent chromium upgradient extent of the western extent of the 105-KW Reactor groundwater plume.	During drilling, samples to be **grab** collected every 5 ft or where lithology changes occur, in one pint jar and chip tray from the drill cuttings.[c]	Geologic archive samples	During drilling, samples to be collected at 5-ft intervals throughout unconfined aquifer <u>(12 samples)</u>	Constituents and field screening parameters in accordance with Table 2-4
	During drilling, samples to be collected 15, 10, 5, and 2 ft above water table; at the water table; 5 ft below the water table; and at the bottom of the unconfined aquifer by **split spoon** <u>(7 samples)</u>	In accordance with Table 2-3: • Radiological methods • EPA Methods 7196 and 6010	During drilling, 5 ft below water table[b] <u>(1 filtered groundwater sample)</u>	Filtered groundwater sample for metals and hexavalent chromium in accordance with Table 2-4
	Major formation and lithology changes, and 10 ft and 5 ft above the Hanford Ringold contact, at the Hanford Ringold contact, and 5 ft below the Hanford Ringold contact by **split spoon** <u>(6 samples)</u>	Physical properties in accordance with Table 2-3		

Table 3-1. Sample/Measurement Locations and Depth

Sampling Location	Soil/Aquifer Sediment Sample/Measurement		Water Sample/Measurement	
	Sample Interval Depth (ft bgs)[a]	Properties of Interest	Sample Interval Depth (ft bgs)/frequency	Analyte List
Well #2 To be drilled and installed in the unconfined aquifer in the 100-K Area Justification: To define the extent of hexavalent chromium, carbon-14, TCE, and strontium-90 in groundwater near the 116-KW-3 waste site, 107-KW condensate tanks, and downgradient of 105-KW Reactor area.	During drilling, samples will be **grab** collected every 5 ft or where lithology changes occur in one pint jar and a chip tray from the drill cuttings.[c]	Geologic archive samples	During drilling, samples to be collected at 5-ft intervals throughout unconfined aquifer (12 samples)	Constituents and field screening parameters in accordance with Table 2-4
	During drilling, samples to be collected ~~15, 10, 5, and~~every 5 ft starting 25 ft below ground surface to 2 ft above water table; at the water table; 5 ft below the water table; and at the bottom of the unconfined aquifer by **split spoon** (~~7~~-10 samples)	In accordance with Table 2-3: • Radiological methods • EPA Methods 7196 and 6010	During drilling, 5 ft below water table[b] (1 filtered groundwater sample)	Filtered groundwater sample for metals and hexavalent chromium in accordance with Table 2-4
	Major formation and lithology changes, and 10 ft and 5 ft above the Hanford Ringold contact, at the Hanford Ringold contact, and 5 ft below the Hanford Ringold contact by **split spoon** (6 samples)	Physical properties in accordance with Table 2-3		

Table 3-1. Sample/Measurement Locations and Depth

Sampling Location	Soil/Aquifer Sediment Sample/Measurement		Water Sample/Measurement	
	Sample Interval Depth (ft bgs)[a]	**Properties of Interest**	**Sample Interval Depth (ft bgs)/frequency**	**Analyte List**
Well #3 To be drilled and installed in the unconfined aquifer in the 100-K Area Justification: To define the hexavalent chromium upgradient extent of the 105-KE Reactor plume	During drilling, samples will be **grab** collected every 5 ft or where lithology changes occur in one pint jar and a chip tray from the drill cuttings.[c]	Geologic archive samples	During drilling, samples to be collected at 5-ft intervals throughout unconfined aquifer (12 samples)	Constituents and field screening parameters in accordance with Table 2-4
	During drilling, samples to be collected 15, 10, 5, and 2 ft above water table; at the water table; 5 ft below the water table; and at the bottom of the unconfined aquifer by **split spoon** (7 samples)	In accordance with Table 2-3: • Radiological methods • EPA Methods 7196 and 6010	During drilling, 5 ft below water table[b] (1 filtered groundwater sample)	Filtered groundwater sample for metals and hexavalent chromium in accordance with Table 2-4
	Major formation and lithology changes, and 10 ft and 5 ft above the Hanford Ringold contact, at the Hanford Ringold contact, and 5 ft below the Hanford Ringold contact by **split spoon** (6 samples)	Physical properties in accordance with Table 2-3		

Table 3-1. Sample/Measurement Locations and Depth

Sampling Location	Soil/Aquifer Sediment Sample/Measurement		Water Sample/Measurement	
	Sample Interval Depth (ft bgs)[a]	Properties of Interest	Sample Interval Depth (ft bgs)/frequency	Analyte List
Well #4 To be drilled and installed in the unconfined aquifer in the 100-K Area Justification: To define the extent of a identified "hot" spot of hexavalent chromium and strontium-90 in groundwater . Existing wells are available to define the extent of the hot spot to the east and north. No wells are currently available to define this anomalous hexavalent chromium concentration to the northwest and west.	During drilling, samples will be **grab** collected every 5 ft or where lithology changes occur in one pint jar and a chip tray from the drill cuttings.[c]	Geologic archive samples	During drilling, samples to be collected at 5-ft intervals throughout unconfined aquifer (12 samples)	Constituents and field screening parameters in accordance with Table 2-4
	During drilling, samples to be collected ~~15, 10, 5, and~~every 5 ft starting 14 ft below ground surface to 2 ft above water table; at the water table; 5 ft below the water table; and at the bottom of the unconfined aquifer by **split spoon** (~~7~~11 samples)	In accordance with Table 2-3: • Radiological methods • EPA Methods 7196 and 6010	During drilling, 5 ft below water table[b] (1 filtered groundwater sample)	Filtered groundwater sample for metals and hexavalent chromium in accordance with Table 2-4
	Major formation and lithology changes, and 10 ft and 5 ft above the Hanford Ringold contact, at the Hanford Ringold contact, and 5 ft below the Hanford Ringold contact by **split spoon** (6 samples)	Physical properties in accordance with Table 2-3		

Table 3-1. Sample/Measurement Locations and Depth

Sampling Location	Soil/Aquifer Sediment Sample/Measurement		Water Sample/Measurement	
	Sample Interval Depth (ft bgs)[a]	**Properties of Interest**	**Sample Interval Depth (ft bgs)/frequency**	**Analyte List**
Well #5 To be drilled and installed in the unconfined aquifer in the 100-K Area Justification: A replacement for well 199-K-109A to further monitor and define the extent of strontium-90 hot spot	During drilling, samples will be **grab** collected every 5 ft or where lithology changes occur in one pint jar and a chip tray from the drill cuttings.[c]	Geologic archive samples	During drilling, samples to be collected at 5-ft intervals throughout unconfined aquifer (12 samples)	Constituents and field screening parameters in accordance with Table 2-4
	During drilling, samples to be collected ~~15, 10, 5, and~~every 5 ft from ground surface to 2 ft above water table; at the water table; 5 ft below the water table; and at the bottom of the unconfined aquifer by **split spoon** (~~7~~ 19 samples)	In accordance with Table 2-3: • Radiological methods • EPA Methods 7196 and 6010	During drilling, 5 ft below water table[b] (1 filtered groundwater sample)	Filtered groundwater sample for metals and hexavalent chromium in accordance with Table 2-4
	Major formation and lithology changes, and 10 ft and 5 ft above the Hanford Ringold contact, at the Hanford Ringold contact, and 5 ft below the Hanford Ringold contact by **split spoon** (6 samples)	Physical properties in accordance with Table 2-3		

Table 3-1. Sample/Measurement Locations and Depth

Sampling Location	Soil/Aquifer Sediment Sample/Measurement		Water Sample/Measurement	
	Sample Interval Depth (ft bgs)[a]	**Properties of Interest**	**Sample Interval Depth (ft bgs)/frequency**	**Analyte List**
Well #6 To be drilled and installed in the unconfined aquifer in the 100-K Area Justification: To define the hexavalent chromium upgradient extent of the 116-K-2 Trench plume.	During drilling, samples will be **grab** collected every 5 ft or where lithology changes occur in one pint jar and a chip tray from the drill cuttings.[c]	Geologic archive samples	During drilling, samples to be collected at 5-ft intervals throughout unconfined aquifer (12 samples)	Constituents and field screening parameters in accordance with Table 2-4
	During drilling, samples to be collected 15, 10, 5, and 2 ft above water table; at the water table; 5 ft below the water table; and at the bottom of the unconfined aquifer by **split spoon** (7 samples)	In accordance with Table 2-3: • Radiological methods • EPA Methods 7196 and 6010	During drilling, 5 ft below water table[b] (1 filtered groundwater sample)	Filtered groundwater sample for metals and hexavalent chromium in accordance with Table 2-4
	Major formation and lithology changes, and 10 ft and 5 ft above the Hanford Ringold contact, at the Hanford Ringold contact, and 5 ft below the Hanford Ringold contact by **split spoon** (6 samples)	Physical properties in accordance with Table 2-3		

Table 3-1. Sample/Measurement Locations and Depth

	Soil/Aquifer Sediment Sample/Measurement		Water Sample/Measurement	
Sampling Location	**Sample Interval Depth (ft bgs)[a]**	**Properties of Interest**	**Sample Interval Depth (ft bgs)/frequency**	**Analyte List**
Well #7 To be drilled and installed in the unconfined aquifer in the 100-K Area Justification: To define the hexavalent chromium upgradient extent of the 116-K-2 Trench plume.	During drilling, samples will be **grab** collected every 5 ft or where lithology changes occur in one pint jar and a chip tray from the drill cuttings.[c]	Geologic archive samples	During drilling, samples to be collected at 5-ft intervals throughout unconfined aquifer <u>(12 samples)</u>	Constituents and field screening parameters in accordance with Table 2-4
	During drilling, samples to be collected 15, 10, 5, and 2 ft above water table, at the water table, 5 ft below the water table, and at the bottom of the unconfined aquifer by **split spoon** <u>(7 samples)</u>	In accordance with Table 2-3: • Radiological methods • EPA Methods 7196 and 6010	During drilling, 5 ft below water table[b] <u>(1 filtered groundwater sample)</u>	Filtered groundwater sample for metals and hexavalent chromium in accordance with Table 2-4
	Major formation and lithology changes, and 10 ft and 5 ft above the Hanford Ringold contact, at the Hanford Ringold contact, and 5 ft below the Hanford Ringold contact by **split spoon** <u>(6 samples)</u>	Physical properties in accordance with Table 2-3		

Table 3-1. Sample/Measurement Locations and Depth

Sampling Location	Soil/Aquifer Sediment Sample/Measurement		Water Sample/Measurement	
	Sample Interval Depth (ft bgs)[a]	Properties of Interest	Sample Interval Depth (ft bgs)/frequency	Analyte List
Well #8 To be drilled and installed in the unconfined aquifer in the 100-K Area Justification: To define the hexavalent chromium upgradient extent of the 116-K-2 Trench plume	During drilling, samples will be **grab** collected every 5 ft or where lithology changes occur in one pint jar and a chip tray from the drill cuttings.[c]	Geologic archive samples	During drilling, samples to be collected at 5-ft intervals throughout unconfined aquifer (12 samples)	Constituents and field screening parameters in accordance with Table 2-4
	During drilling, samples to be collected 15, 10, 5, and 2 ft above water table; at the water table; 5 ft below the water table, and at the bottom of the unconfined aquifer by **split spoon** (7 samples)	In accordance with Table 2-3: • Radiological methods • EPA Methods 7196 and 6010	During drilling, 5 ft below water table[b] (1 filtered groundwater sample)	Filtered groundwater sample for metals and hexavalent chromium in accordance with Table 2-4
	Major formation and lithology changes, and 10 ft and 5 ft above the Hanford Ringold contact, at the Hanford Ringold contact, and 5 ft below the Hanford Ringold contact by **split spoon** (6 samples)	Physical properties in accordance with Table 2-3		

Table 3-1. Sample/Measurement Locations and Depth

Sampling Location	Soil/Aquifer Sediment Sample/Measurement		Water Sample/Measurement	
	Sample Interval Depth (ft bgs)[a]	Properties of Interest	Sample Interval Depth (ft bgs)/frequency	Analyte List
Well #9[d] To be drilled and installed in the unconfined aquifer in the 100-K Area Justification: To define the extent of hexavalent chromium in groundwater.	During drilling, samples will be **grab** collected every 5 ft or where lithology changes occur in one pint jar and a chip tray from the drill cuttings.[c]	Geologic archive samples	During drilling, samples to be collected at 5-ft intervals throughout unconfined aquifer (12 samples)	Constituents and field screening parameters in accordance with Table 2-4
	During drilling, samples to be collected ~~15, 10, 5, and~~every 5 ft from ground surface to 2 ft above water table; at the water table; 5 ft below the water table, and at the bottom of the unconfined aquifer by **split spoon** (~~7~~ 25 samples)	In accordance with Table 2-3: • Radiological methods • EPA Methods 7196 and 6010	During drilling, 5 ft below water table[b] (1 filtered groundwater sample)	Filtered groundwater sample for metals and hexavalent chromium in accordance with Table 2-4
	Major formation and lithology changes, and 10 ft and 5 ft above the Hanford Ringold contact, at the Hanford Ringold contact, and 5 ft below the Hanford Ringold contact by **split spoon** (6 samples)	Physical properties in accordance with Table 2-3		

Table 3-1. Sample/Measurement Locations and Depth

	Soil/Aquifer Sediment Sample/Measurement		Water Sample/Measurement	
Sampling Location	Sample Interval Depth (ft bgs)[a]	Properties of Interest	Sample Interval Depth (ft bgs)/frequency	Analyte List
Well R1 Install borehole reaching a total depth approximately 50 ft within the RUM. Complete the borehole as a well in a water-producing zone within the RUM, if found, in the 100-K Area. Justification: To determine the extent of contamination that may reside in the RUM, physical and hydrologic properties of the RUM, and potential transport of contamination within the RUM.	During drilling, samples will be **grab** collected every 5 ft or where lithology changes occur in one pint jar and a chip tray from the drill cuttings.[c]	Geologic archive samples	During drilling, samples to be collected at 5-ft intervals throughout unconfined aquifer and from water-bearing intervals of the RUM Unit if sufficient water is available (14 samples)	Constituents and field screening parameters in accordance with Table 2-4
	During drilling, samples to be collected ~~15, 10, 5, and~~every 5 ft from ground surface to 2 ft above water table; at the water table, 5 ft below the water table; at the bottom of the unconfined aquifer; and from the top, middle, and bottom of the non-water-bearing units of the RUM Unit by **split spoon** (~~10~~ 28 samples)	In accordance with Table 2-3: • Batch leach contacting test[d] • Radiological methods • EPA Methods 7196 and 6010	During drilling, 5 ft below water table[b] (1 filtered groundwater sample)	Filtered groundwater sample for metals and hexavalent chromium in accordance with Table 2-4
	Major formation and lithology changes, and 10 ft and 5 ft above the Hanford Ringold contact, at the Hanford Ringold contact, and 5 ft below the Hanford Ringold contact by **split spoon** (6 samples)	Physical properties in accordance with Table 2-3		

Table 3-1. Sample/Measurement Locations and Depth

	Soil/Aquifer Sediment Sample/Measurement		Water Sample/Measurement	
Sampling Location	**Sample Interval Depth (ft bgs)[a]**	**Properties of Interest**	**Sample Interval Depth (ft bgs)/frequency**	**Analyte List**
Well R2 Install borehole reaching a total depth approximately 50 ft within the RUM. Complete the borehole as a well in a water-producing zone within the RUM, if found, in the 100-K Area. Justification: To determine the extent of contamination that may reside in the RUM, physical and hydrologic properties of the RUM, and potential transport of contamination within the RUM.	During drilling, samples will be **grab** collected every 5 ft or where lithology changes occur in one pint jar and a chip tray from the drill cuttings.[c]	Geologic archive samples	During drilling, samples to be collected at 5-ft intervals throughout unconfined aquifer and from water-bearing intervals of the RUM unit if sufficient water is available (14 samples)	Constituents and field screening parameters in accordance with Table 2-4
	During drilling, samples to be collected 15, 10, 5, and 2 ft above water table; at the water table; 5 ft below the water table; at the bottom of the unconfined aquifer; and from the top, middle, and bottom of the non-water-bearing units of the RUM unit by **split spoon** (10 samples)	In accordance with Table 2-3: • Radiological methods • EPA Methods 7196 and 6010	During drilling, 5 ft below water table[b] (1 filtered groundwater sample)	Filtered groundwater sample for metals and hexavalent chromium in accordance with Table 2-4
	Major formation and lithology changes, and 10 ft and 5 ft above the Hanford Ringold contact, at the Hanford Ringold contact, and 5 ft below the Hanford Ringold contact by **split spoon** (6 samples)	Physical properties in accordance with Table 2-3		

Table 3-1. Sample/Measurement Locations and Depth

Sampling Location	Soil/Aquifer Sediment Sample/Measurement		Water Sample/Measurement	
	Sample Interval Depth (ft bgs)[a]	Properties of Interest	Sample Interval Depth (ft bgs)/frequency	Analyte List
Well R3 Install borehole reaching a total depth approximately 50 ft within the RUM. Complete the borehole as a well in a water-producing zone within the RUM, if found, in the 100-K Area. Justification: To determine the extent of contamination that may reside in the RUM, physical and hydrologic properties of the RUM, and potential transport of contamination within the RUM.	During drilling, samples will be **grab** collected every 5 ft or where lithology changes occur in one pint jar and a chip tray from the drill cuttings.[c]	Geologic archive samples	During drilling, samples to be collected at 5-ft intervals throughout unconfined aquifer and from water-bearing intervals of the RUM Unit if sufficient water is available (14 samples)	Constituents and field screening parameters in accordance with Table 2-4
	During drilling, samples to be collected ~~15, 10, 5, and~~every 5 ft from ground surface to 2 ft above water table; at the water table; 5 ft below the water table; at the bottom of the unconfined aquifer; and from the top, middle, and bottom of the non-water-bearing units of the RUM unit by **split spoon** (~~10~~ 27 samples)	In accordance with Table 2-3: • Batch leach contacting test[d] • Radiological methods • EPA Methods 7196 and 6010 • Mercury by EPA 7471	During drilling, 5 ft below water table[b] (1 filtered groundwater sample)	Filtered groundwater sample for metals and hexavalent chromium in accordance with Table 2-4
	Major formation and lithology changes, and 10 ft and 5 ft above the Hanford Ringold contact, at the Hanford Ringold contact, and 5 ft below the Hanford Ringold contact by **split spoon** (6 samples)	Physical properties in accordance with Table 2-3		

Table 3-1. Sample/Measurement Locations and Depth

Sampling Location	Soil/Aquifer Sediment Sample/Measurement: Sample Interval Depth (ft bgs)[a]	Soil/Aquifer Sediment Sample/Measurement: Properties of Interest	Water Sample/Measurement: Sample Interval Depth (ft bgs)/frequency	Water Sample/Measurement: Analyte List
Well R4 Install borehole reaching a total depth approximately 50 ft within the RUM. Complete the borehole as a well in a water-producing zone within the RUM, if found, in the 100-K Area. Justification: To determine the extent of contamination that may reside in the RUM, physical and hydrologic properties of the RUM, and potential transport of contamination within the RUM.	During drilling, samples will be **grab** collected every 5 ft or where lithology changes occur in one pint jar and a chip tray from the drill cuttings.[c]	Geologic archive samples	During drilling, samples to be collected at 5-ft intervals throughout unconfined aquifer and from water-bearing intervals of the RUM unit if sufficient water is available (14 samples)	Constituents and field screening parameters in accordance with Table 2-4
	During drilling, samples to be collected ~~15, 10, 5, and~~every 5 ft from ground surface to 2 ft above water table; at the water table; 5 ft below the water table; at the bottom of the unconfined aquifer; and from the top, middle, and bottom of the non-water-bearing units of the RUM unit by **split spoon** (~~10~~ 22 samples)	In accordance with Table 2-3: • Batch leach contacting test[d] • Radiological methods • EPA Methods 7196 and 6010 • Mercury by EPA 7471	During drilling, 5 ft below water table[b] (1 filtered groundwater sample)	Filtered groundwater sample for metals and hexavalent chromium in accordance with Table 2-4
	Major formation and lithology changes, and 10 ft and 5 ft above the Hanford Ringold contact, at the Hanford Ringold contact, and 5 ft below the Hanford Ringold contact by **split spoon** (6 samples)	Physical properties in accordance with Table 2-3		

Table 3-1. Sample/Measurement Locations and Depth

Sampling Location	Soil/Aquifer Sediment Sample/Measurement: Sample Interval Depth (ft bgs)[a]	Soil/Aquifer Sediment Sample/Measurement: Properties of Interest	Water Sample/Measurement: Sample Interval Depth (ft bgs)/frequency	Water Sample/Measurement: Analyte List
Sample 18 spatial/temporal uncertainty monitoring wells (Table 3-2) Multiple rounds	None	None	Collect one sample per well multiple sampling rounds to support remedial investigation. (18 wells x approximately 3 rounds = 54 samples)	Constituents and field screening parameters in accordance with Table 2-4
Summary				
Number of samples:	Soil/Aquifer sediment chemical: ~~103~~210 Physical property: ~~78~~82 Geologic archive samples: variable		Water samples collected during drilling: 166 Spatial/temporal uncertainty samples: 54 (3 rounds total)	
Minimum number of field quality control samples:	Soil/Aquifer sediment chemical: ~~19~~ 34 (~~6~~ 11 equipment blank, ~~6~~ 11 field blank, ~~6~~ 11 duplicate, 1 split) Physical property: 0 Geologic archive samples: 0		Water samples collected during drilling: 28 (9 equipment blank, 9 field blank, 9 duplicate, 1 split) Spatial/temporal uncertainty samples: 10 (3 equipment blank, 3 field blank, 3 duplicate, 1 split)	
Total number of samples:	Soil/aquifer sediment chemical: ~~122~~244 Physical property: ~~78~~82 Geologic archive samples: variable		Water samples collected during drilling: 194 Spatial/temporal uncertainty samples: 64	

a. Upon visual observation of contamination, a depth discrete sample will be collected for applicable analysis. For example, if hexavalent chromium contamination is observed at any interval other than those stated for sampling, a depth discrete sample would be collected for hexavalent chromium analysis.

b. This sample in intended to be collected from 5 ft into the unconfined aquifer.

c. Archive samples may be omitted at the discretion of the field geologist due to radiological field data.

d. ~~Well #9 is pending approval per Section 106 of the National Historic Preservation Act.~~Batch leach contacting test applies to samples having hexavalent chromium concentrations at levels greater than the EQL in the initial metals analyses

For the four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B.*

bgs = below ground surface

RUM = Ringold upper mud

TCE = trichloroethene

3.5.2. Groundwater Characterization

Groundwater characterization, including well activities, identification of wells to be sampled, well depth and screen placement, and well drilling and completion procedures is discussed in this section.

3.5.2.1. New Groundwater Wells

Table 3-1 summarizes groundwater monitoring well activities. From the new wells screened in the Ringold upper mud unit, slug testing and pump testing will be performed to characterize hydraulic conductivity.

Well Depth and Screen Placement

For the nine new groundwater wells in the unconfined aquifer in the 100-K Area, a 6.1 m (20 ft) or longer screen will be installed.

For the four new groundwater wells reaching a total depth approximately 15 m (50 ft) within the Ringold upper mud unit, complete the boreholes as wells in a water-producing zone within the Ringold upper mud unit, if found. Up to a 6.1 m (20-ft) screen will be installed based on ability to produce water in the water-bearing Ringold upper mud unit.

Well Drilling and Completion Procedures

Well drilling will be performed in accordance with WAC 173-160. The wells will be drilled using 25.4 cm (10 in.) diameter (or larger) casing to total depth. The drilling method will be determined based on discussions between the drilling lead and drilling contractor.

The wells, except for well R3, will be constructed as 15.2 cm (6-in.) wells with Schedule 10, Type 304 or 316, stainless steel, V-slot continuous wire wrap screen, atop a 1.5 m (5 ft) long, stainless steel sump with end cap. A Schedule 10 stainless steel riser will be used to extend the permanent well into the vadose zone, with Schedule 10 stainless steel casing through the vadose zone to ground surface. Well R3 will be constructed with PVC pipe instead of stainless steel since this well is anticipated to be decommissioned within 1 year with D&D of the 183.1KE head house. Colorado silica sand will be used for the sand pack; sodium bentonite pellets and/or natural sodium bentonite chunks, crumbles, or powdered bentonite will be used for bentonite sealing material; and Type I/ II Portland cement will be used for cement grout.

Surface construction consisting of protective casing, protective guard posts, and cement pad must be in place before job completion. The protective casing will be a minimum of 5 cm (2 in.) larger in diameter than the permanent casing. Protective casing will rise approximately 0.9 m (3 ft) above the ground surface. Permanent casing will rise to approximately 0.3 m (1 ft) below the top of the protective casing. Protective casing will have a lockable well cap extending approximately 38 cm (15 in.) above the top of the protective casing.

Final well design, including screen placement and length, will be determined by concurrence of the field geologist, drilling lead, and operable unit lead based upon field conditions. If the completion differs from the WAC 173-160 requirements, then variances will be obtained from Ecology.

3.5.2.2. Groundwater Network to Evaluate Spatial and Temporal Uncertainty

Table 3-1 summarizes groundwater monitoring activities to address spatial and temporal uncertainties. Table 3-2 presents the wells to be sampled. Multiple rounds of groundwater samples will be collected for analysis to support the RI in the existing groundwater wells for each contaminant identified in Table 1-3.

Table A-5. Gamma Spectroscopy, Germanium High-Energy Detectors (Gamma Energy Analysis)

CAS #	Constituent	Water EQL (pCi/L)	Soil EQL (pCi/g)	Precision Requirement Water/Soil	Accuracy Requirement Water/Soil
~~14331-83-0~~	~~Actinium-228~~	~~—~~	~~—~~	~~±30%~~	~~70-130%~~
~~14596-10-2~~	~~Americium-241~~	~~50~~	~~1~~	~~±30%~~	~~70-130%~~
~~13981-41-4~~	~~Barium-133~~	~~—~~	~~0.2~~	~~±30%~~	~~70-130%~~
14234-35-6	Antimony-125	50	0.3	≤30%	70-130%
13966-02-4	Beryllium-7	50	0.3	≤30%~~±30%~~	70-130%
~~14913-49-6~~	~~Bismuth-212~~	~~—~~	~~—~~	~~±30%~~	~~70-130%~~
~~14733-03-0~~	~~Bismuth-214~~	~~—~~	~~—~~	~~±30%~~	~~70-130%~~
~~CE/PR-144~~	~~Cerium/Praseodymium-144~~	~~—~~	~~—~~	~~±30%~~	~~70-130%~~
13967-70-9	Cesium-134	15	0.1	≤30%	70-130%
10045-97-3	Cesium-137	15	0.1	≤30%~~±30%~~	70-130%
10198-40-0	Cobalt-60	25	0.05	≤30%~~±30%~~	70-130%
14683-23-9	Europium-152	50	0.1	≤30%~~±30%~~	70-130%
15585-10-1	Europium-154	50	0.1	≤30%~~±30%~~	70-130%
14391-16-3	Europium-155	50	0.1	≤30%~~±30%~~	70-130%
~~15092-94-1~~	~~Lead-212~~	~~—~~	~~—~~	~~±30%~~	~~70-130%~~
~~15067-28-4~~	~~Lead-214~~	~~—~~	~~—~~	~~±30%~~	~~70-130%~~
~~14681-63-1~~	~~Niobium-94~~	~~—~~	~~—~~	~~±30%~~	~~70-130%~~
13966-00-2	Potassium-40	—	—	≤30%~~±30%~~	70-130%
13967-48-1	Ruthenium-106	—	—	≤30%	70-130%
13982-63-3	Radium-226	—	0.1	±30%	70-130%
~~15262-20-1~~	~~Radium-228~~	~~—~~	~~0.2~~	~~±30%~~	~~70-130%~~
~~14274-82-9~~	~~Thorium-228~~	~~—~~	~~—~~	~~±30%~~	~~70-130%~~
~~TH-232~~	~~Thorium-232~~	~~—~~	~~—~~	~~±30%~~	~~70-130%~~
~~15065-10-8~~	~~Thorium-234~~	~~—~~	~~—~~	~~±30%~~	~~70-130%~~
~~15832-50-5~~	~~Tin-126~~	~~—~~	~~—~~	~~±30%~~	~~70-130%~~
~~15117-96-1~~	~~Uranium-235~~	~~50~~	~~0.5~~	~~±30%~~	~~70-130%~~
~~U-238~~	~~Uranium-238~~	~~500~~	~~10~~	~~±30%~~	~~70-130%~~

Table A-5. Gamma Spectroscopy, Germanium High-Energy Detectors (Gamma Energy Analysis)

CAS #	Constituent	Water EQL (pCi/L)	Soil EQL (pCi/g)	Precision Requirement Water/Soil	Accuracy Requirement Water/Soil
~~14391-65-2~~	~~Silver-108m~~	—	~~0.2~~	~~±30%~~	~~70-130%~~

Where EQL is not specified, current EQLs of laboratories contracted to the Hanford Site are applicable.

CAS = Chemical Abstracts Service

EQL = estimated quantitation limit