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DOE/RL-2010-74
Draft A

# Treatability Test Plan for the 200-BP-5 Groundwater Operable Unit

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

U.S. DEPARTMENT OF ENERGY Richland Operations Office

P.O. Box 550
Richland, Washington 99352





200-BP-5
attached to: 0090704

M-015-82A

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A. D. Aardal 09/13/2010
Release Approval Date

Printed in the United States of America

# Executive Summary

This test plan provides the approach for conducting a groundwater treatability test for the 200-BP-5 Operable Unit (OU) using the pump-and-treat technology. The purpose of this test is to evaluate the groundwater pumping rate that can be achieved near the B Tank Farm Complex (Figure ES-1). This area was selected for testing because the groundwater contains uranium and technetium-99 (Tc-99) contamination. The overall objective of this treatability test is to determine whether a sufficient groundwater pumping rate can be sustained, as a measure of the effectiveness of a pump-and-treat alternative to provide hydraulic containment and reduce the mass of the Tc-99 and uranium plumes near the B Tank Farm Complex. If the pumping can be sustained and a reasonable capture zone can be established, the hydrogeologic conditions should be amenable to a pump-and-treat alternative for containment and cleanup of these plumes.

The aquifer in the area of the uranium and Tc-99 groundwater contamination is thin (less than 3 m [9.8 ft] thick) and has an irregular basalt boundary at its base. These characteristics may limit the availability of groundwater needed to maintain an effective pumping rate.

Measurements will be collected during the following three test activities:

1. Monitoring for approximately 30 days before the pumping begins to establish baseline conditions, such as natural fluctuations in the elevation of the groundwater in the aquifer
2. Conducting a short duration (1 to 2 day) pumping test to determine the optimum groundwater pumping rate to use during the longer-duration test
3. Conducting a longer duration (3 to 30 day) pumping test to evaluate the groundwater pumping rate that can be sustained in this area of the aquifer

The pump-and-treat technology typically is used to pump contaminated groundwater through a vertical well to the ground surface for treatment (i.e., removal of the contamination). The contaminated water pumped during this treatability test will be transferred to the Effluent Treatment Facility (ETF) in the 200 East Area for treatment and disposal.

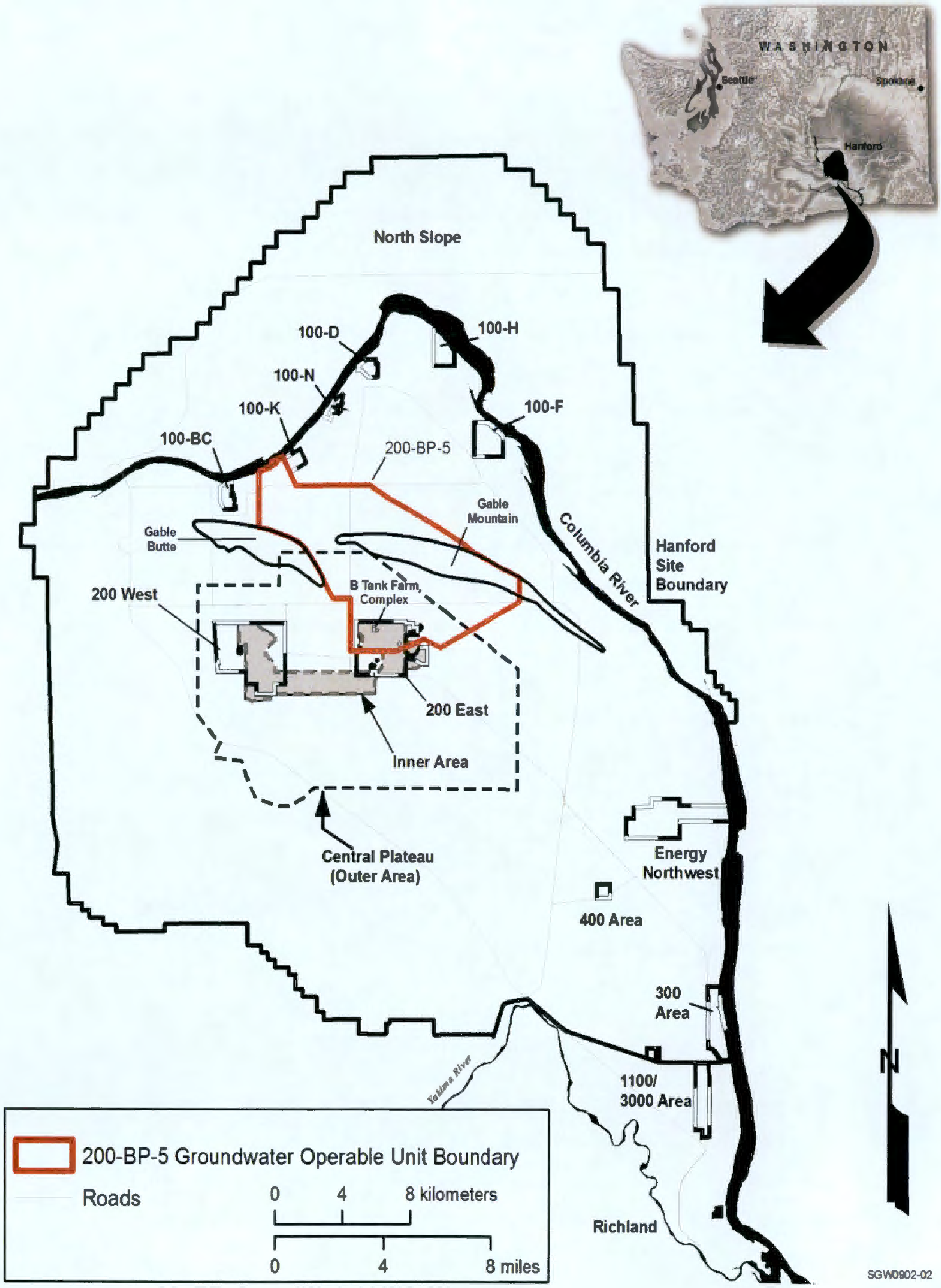


**Figure ES-1. Location of the B Tank Farm Complex Area Within the 200-BP-5 Groundwater Operable Unit**

Testing will be conducted on the west side of the BY Tank Farm (Figure ES-2). Additional testing may be conducted on the north side of the B Tank Farm. Two new groundwater wells will be drilled and constructed for use during the test on the west side of the BY Tank Farm. One new extraction well will be used for pumping the groundwater from the aquifer. The other new well will be installed close to the extraction well to monitor the change in the elevation of the groundwater caused by the pumping. A second new extraction well may be drilled and constructed for pumping the groundwater from the aquifer on the north side of the B Tank Farm. The well locations will be finalized during the detailed design of the treatability test.

The detailed design of the treatability test will begin when this test plan has been approved by the U.S. Department of Energy (DOE) and the Washington State Department of Ecology (Ecology). During this design phase, the construction details for the new extraction and associated monitoring wells will be specified, and the pipeline alignment for transferring the contaminated groundwater to ETF will be determined. Construction activities include installation of wells, pumps, and piping tied into the ETF transfer line and will begin within six months after this test plan has been approved. Following completion of the testing, a treatability test report will be prepared to summarize the results.

This treatability test is required by the *Hanford Federal Facility Agreement and Consent Order* (Ecology, et al., 1989a), also known as the Tri-Party Agreement (TPA), Milestone M-015-82. In accordance with the milestone, this treatability test plan constitutes an amendment to the 200-BP-5 OU remedial investigation (RI)/feasibility study (FS) work plan (DOE/RL-2007-18). As a result, this treatability test is considered part of the RI for the 200-BP-5 OU conducted as part of the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) process.

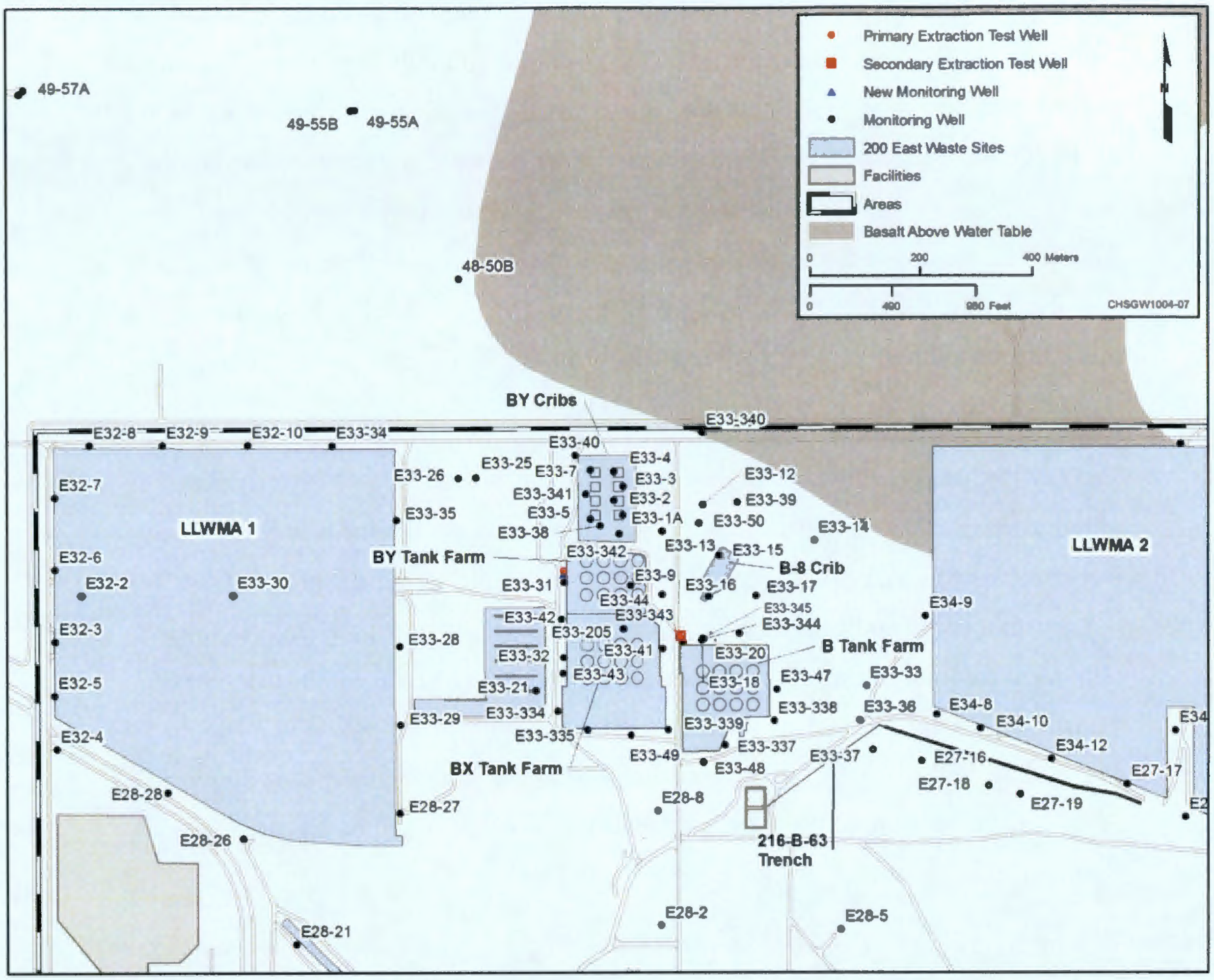


**Figure ES-2. Location of Groundwater Monitoring Wells and Proposed Test Wells near Waste Management Area B-BX-BY**

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# Terms

| | |
|---|---|
| ARAR | applicable or relevant and appropriate requirement |
| CERCLA | *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* |
| CFR | *Code of Federal Regulations* |
| CHPRC | CH2M HILL Plateau Remediation Company |
| COPC | contaminant of potential concern |
| DOE | U.S. Department of Energy |
| DOW | description of work |
| DQA | data quality assessment |
| DQO | data quality objective |
| DWS | drinking water standard |
| ECO | Environmental Compliance Officer |
| Ecology | Washington State Department of Ecology |
| EPA | U.S. Environmental Protection Agency |
| ETF | Effluent Treatment Facility |
| FS | feasibility study |
| FY | fiscal year |
| GPC | gas flow proportional counting |
| HASP | health and safety plan |
| HEIS | Hanford Environmental Information System |
| $K_d$ | distribution coefficient |
| LERF | Liquid Effluent Retention Facility |
| MCL | maximum contamination level |
| NEPA | *National Environmental Policy Act of 1969* |
| OU | operable unit |
| QA | quality assurance |
| QAPjP | quality assurance project plan |
| QC | quality control |

| | |
|---|---|
| RCRA | *Resource Conservation and Recovery Act of 1974* |
| RD/RAWP | remedial design/remedial action work plan |
| RI | remedial investigation |
| RL | DOE Richland Operations Office |
| ROD | record of decision |
| SALDS | State Approved Land Disposal Site |
| SAP | sampling and analysis plan |
| Tc-99 | technetium-99 |
| TEDF | Treated Effluent Disposal Facility |
| TPA | Tri-Party Agreement |
| Tri-Party Agreement | *Hanford Federal Facility Agreement and Consent Order* |
| WAC | *Washington Administrative Code* |
| WMA | Waste Management Area |

# 1 Project Description

The treatability test described in this plan is intended to evaluate the practicality of performing groundwater extraction for remediating contaminant plumes near Waste Management Area (WMA) B-BX-BY (B Tank Farm Complex) within the 200-BP-5 Groundwater Operable Unit (OU) at the Hanford Site (Figure 1-1). This treatability test plan is required by the Washington State Department of Ecology (Ecology), U.S. Environmental Protection Agency (EPA), and U.S. Department of Energy (DOE) Hanford Federal Facility Agreement and Consent Order (Ecology, et al., 1989a), also known as the Tri-Party Agreement (TPA), Milestone M-015-82, which reads as follows:

> *Submit a treatability test plan as an amendment of 200-BP-5 RI/FS work plan for determining if a 50 gpm pump-and-treat system can be sustained in the shallow and discontinuous aquifer to contain and reduce the mass of the uranium and commingled Tc-99 plumes near the B, BX, and BY tank farms. The plan will include initial aquifer tests to determine sustained yield. If sufficient sustained yield can be demonstrated, treatability testing will follow in accordance with the approved treatability test plan. Initiate aquifer tests within six months of approval of the treatability test plan. Full-scale deployment of the treatment system will be made via the 200-BP-5 RD/RA work plan.*

In accordance with Milestone M-015-82, this treatability test plan constitutes an amendment to the 200-BP-5 OU remedial investigation (RI)/feasibility study (FS) work plan (DOE/RL-2007-18). As a result, this treatability test is considered part of the RI for the 200-BP-5 OU conducted as part of the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) process.

## 1.1 Purpose and Scope

This test plan provides the overall approach for planning, designing, constructing, and operating an aquifer treatability test using the pump-and-treat technology. The purpose of this treatability test is to evaluate whether a 189 L/min (50 gpm) pumping rate can be sustained in the unconfined aquifer in the area of the uranium and technetium-99 (Tc-99) groundwater plumes near the B Tank Farm Complex. If the test results indicate that pumping can be sustained at a rate of at least 189 L/min (50 gpm), the technology will be further evaluated in the FS and/or the Remedial Design/Remedial Action Work Plan (RD/RAWP) for the 200-BP-5 OU. If testing indicates that a pumping rate of 189 L/min (50 gpm) is not sustainable, groundwater extraction from vertical wells may be screened out as a remedial technology.

During this treatability test, groundwater will be pumped from one groundwater extraction well. Evaluation of the sustained pumping rate will be based on the test results from this well.

Treatment of the extracted groundwater to remove contaminants will be conducted at the Effluent Treatment Facility (ETF) in the 200 East Area. Treatment of the groundwater is not within the scope of this treatability test. However, the test results will provide information (e.g., sustainable flow rates and initial contaminant concentrations) that can be used to support evaluation of effective treatment technologies in the FS and/or RD/RAWP for this OU.

The treated groundwater will not be injected into the aquifer within the 200-BP-5 OU. Water treated at the ETF is discharged at the State Approved Land Disposal Site (SALDS) located immediately north of the 200 West Area.

## 1.2 Site Description and Contaminants

The 200-BP-5 Groundwater OU extends from the 200 East Area northwest to the Columbia River and to the eastern flank of the Gable Mountain (Figure 1-1). This treatability test focuses on the uranium and Tc-99 groundwater plumes near the B Tank Farm Complex. The inferred distributions of uranium and

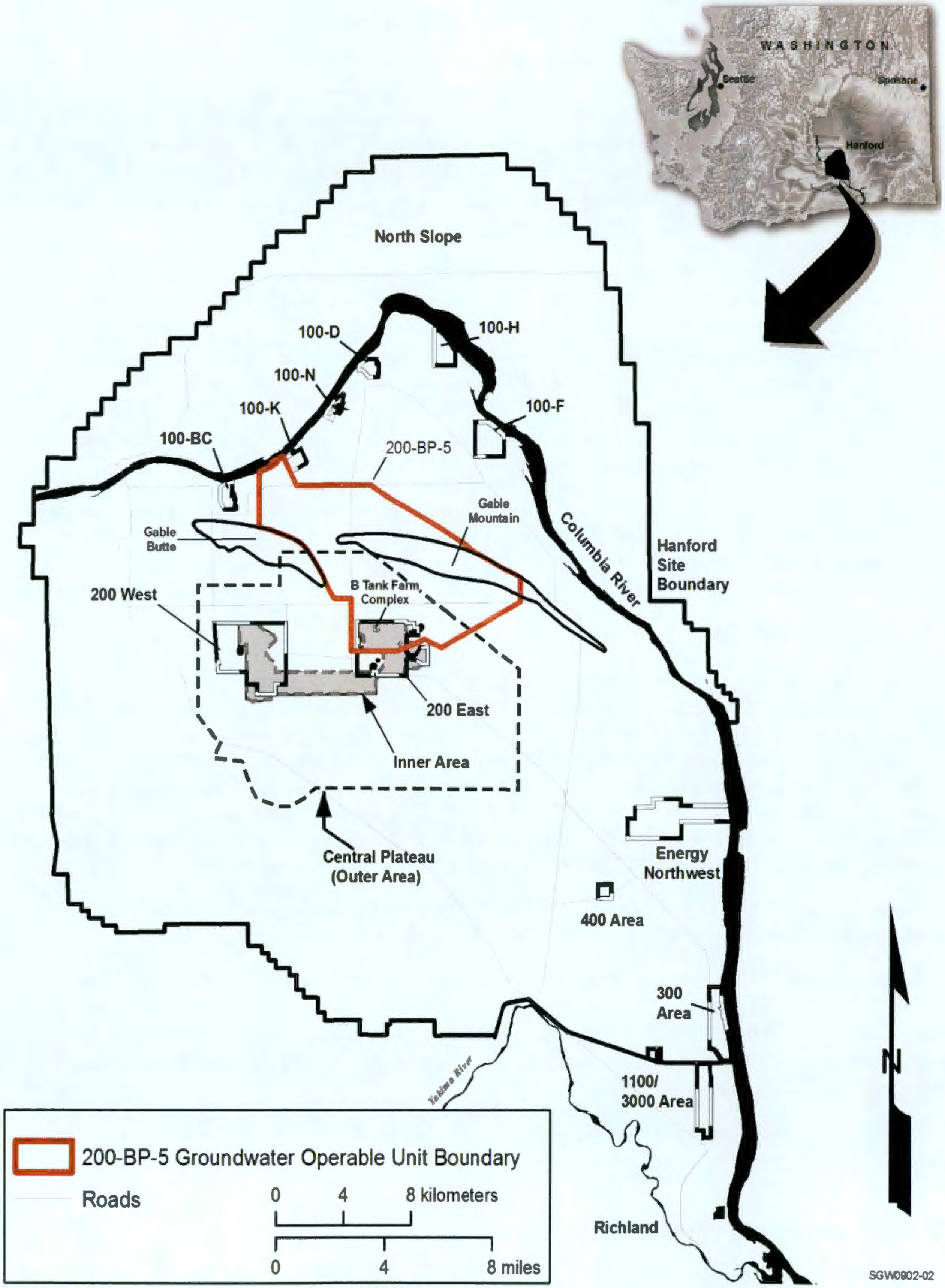



**Figure 1-1. Location of the 200-BP-5 Groundwater Operable Unit**

Tc-99 in groundwater near the B Tank Farm Complex is shown in Figure 1-2 and Figure 1-3, respectively.

Recent groundwater monitoring indicates that the highest Tc-99 concentrations in the 200-BP-5 OU groundwater are found in wells beneath the 216-BY Cribs, north of the BY tank farm. The highest Tc-99 concentration in groundwater in this area, during the 15 months from October 1, 2008 through December 31, 2009, was 39,000 pCi/L in February 2009 (DOE/RL-2010-11). The drinking water standard (DWS) for Tc-99 is 900 pCi/L. The highest uranium concentration during this time was 5,500 µg/L in June 2009 (DOE/RL-2010-11). The DWS for uranium is 30 µg/L.

(Note: The distributions of uranium and Tc-99 shown in Figure 1-2 and Figure 1-3 are from DOE/RL-2010-11. The contaminant distributions in DOE/RL-2010-11 are based on data from fiscal year [FY] 2009, supplemented by data from FY 2008 and FY 2007, as needed. Some of the values shown on Figure 1-2 and Figure 1-3, from FY 2008 or FY 2007, may exceed the values from FY 2009 reported in this section.)

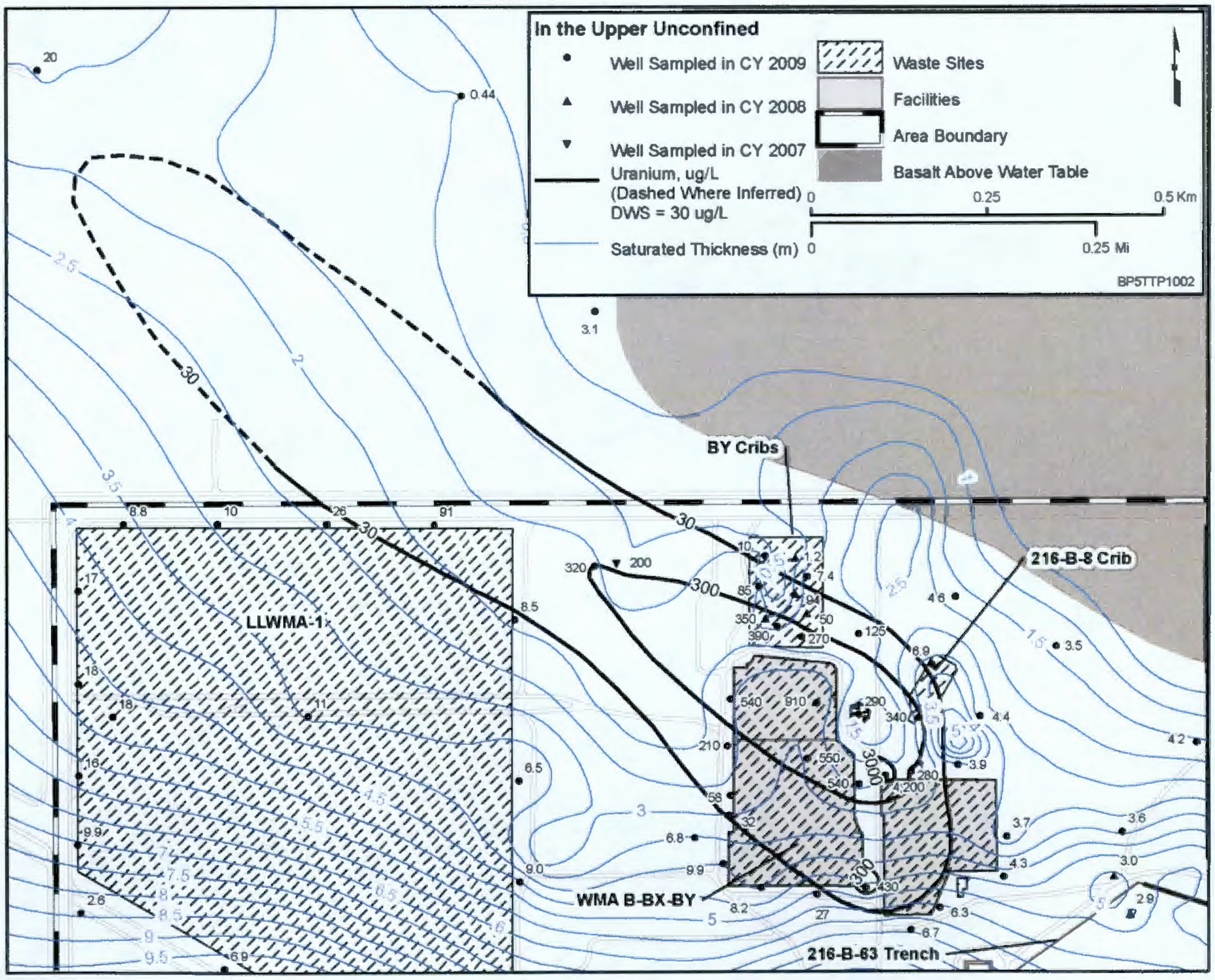



**Figure 1-2. Saturated Thickness of the Unconfined Aquifer near the B Tank Farm Complex with Inferred Uranium Distribution**

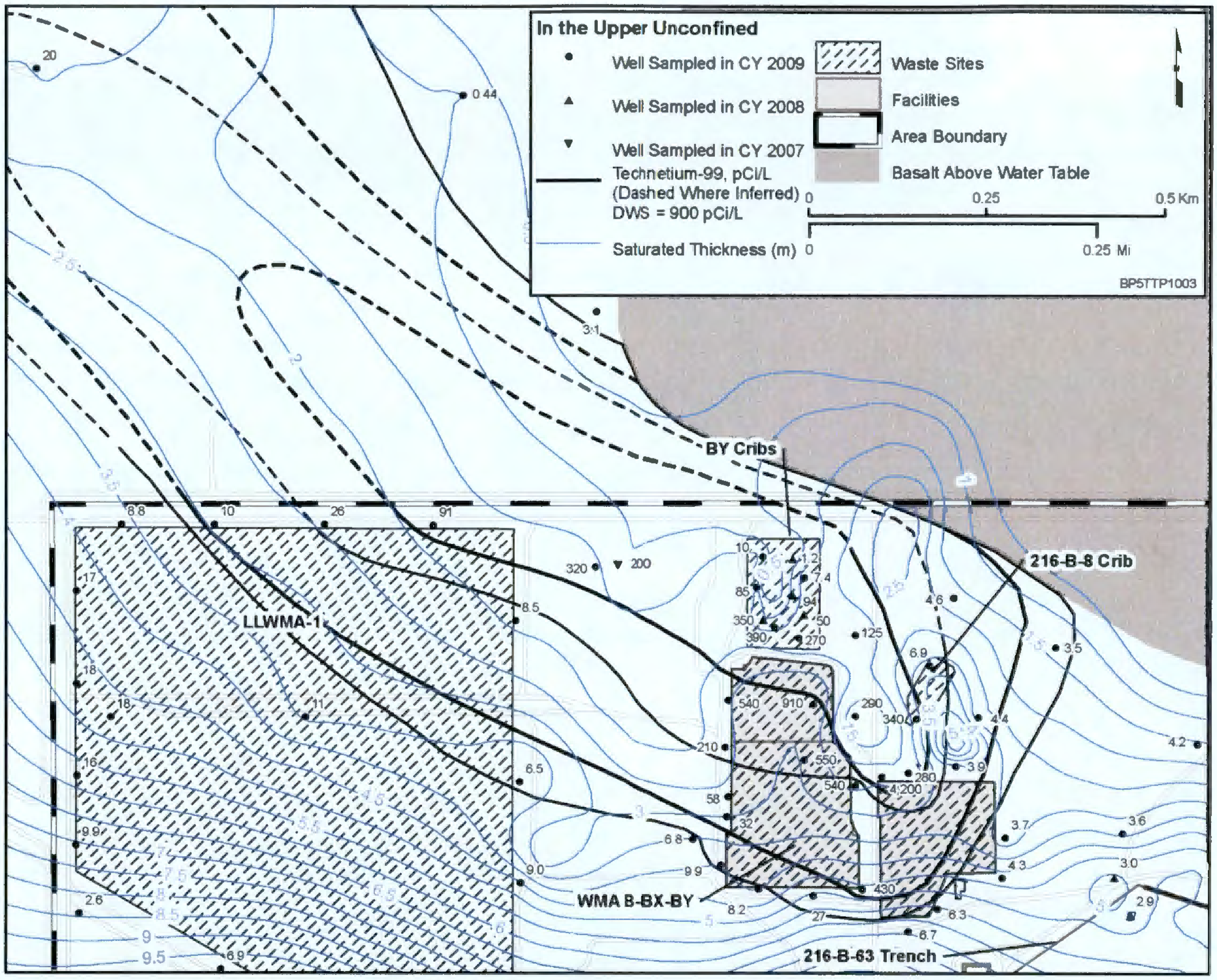



**Figure 1-3. Saturated Thickness of the Unconfined Aquifer near the B Tank Farm Complex with Inferred Technetium-99 Distribution**

The groundwater underlying the B Tank Farm Complex contains additional contaminants of potential concern (COPCs). These co-contaminants also would be expected to be present in the extracted groundwater sent to ETF for treatment. Co-contaminants in this area that exceed the DWS are listed in Table 1-1.

**Table 1-1. Groundwater Co-Contaminants**

| Co-Contaminant | Maximum Concentration | Drinking Water Standard |
|---|---|---|
| Iodine-129 | 6.74 pCi/L (April 2009) | 1 pCi/L |
| Cyanide | 1.73 mg/L (November 2008) | 0.2 mg/L |
| Tritium | 91,000 pCi/L (February 2009) | 20,000 pCi/L |
| Nitrate | 1,700 mg/L (December 2009) | 45 mg/L |

## 1.3 Preliminary Conceptual Site Model

The source of Tc-99 and uranium in the unconfined aquifer underlying the B Tank Farm Complex appears to be the overlying single shell tanks and/or cribs. The resulting groundwater plumes have migrated primarily to the northwest. Tc-99, which has a lower soil-water distribution coefficient ($K_d$) ($K_d$ = 0 mL/g) than uranium ($K_d$ = 0.4 mL/g), has migrated further from the presumed source area (PNNL-18564).

In the B Tank Farm Complex area, the unconfined aquifer occurs within the unconsolidated sands and gravels of the Hanford formation, and locally the gravel of the Cold Creek unit, that overlie the basalt bedrock. The uppermost surface of the basalt defines the lower surface of the unconfined aquifer. During drilling of wells at Low Level Waste Management Area 1 and Low Level Waste Management Area 2 (located to the west and east, respectively, of the B Tank Farm Complex), some of the drilling extended into the upper portion of the Elephant Mountain basalt (DOE/RL-2009-75; DOE/RL-2009-76). Based on examination of the basalt drill cuttings, it was concluded that past fluvial events had removed, either partially or entirely, the permeable basalt flow top at both locations. The conclusion that the relatively low-permeability Elephant Mountain basalt flow interior forms the base of the unconfined aquifer is believed to apply to the northern portion of the 200 East Area, including the area of the treatability test. However, if the Elephant Mountain basalt flow top is encountered in the subsurface during drilling to support this treatability test, drilling will be extended into the underlying Elephant Mountain basalt flow interior and the flow top will be considered part of the overlying unconfined aquifer system.

Because the water table is nearly flat (i.e., the local gradient is too small to be measured) and the uppermost surface of the basalt is irregular, the unconfined aquifer in this area exhibits variable thickness. The inferred aquifer saturated thickness is shown relative to the uranium and Tc-99 plume distributions in Figure 1-2 and Figure 1-3, respectively. The inferred aquifer saturated thickness ranges from 0.3 m (1 ft) to approximately 4.5 m (15 ft) in the area of the B Tank Farm Complex.

The aquifer characteristics may limit the success of the pumping test because the aquifer is thin in the area of the contaminant plumes. The aquifer may impose hydraulic limitations, which will affect the ability to withdraw groundwater from the aquifer at an effective pumping rate. The contact between the unconsolidated aquifer sediment and the basalt has created an irregular geologic boundary north of the B Tank Farm Complex where basalt extends above the water table, which may affect the travel path and availability of groundwater being pulled toward an extraction well. The variable and relatively thin nature of the aquifer may potentially affect long-term extraction well yields under sustained pumping conditions.

Water levels in the 200 East Area are undergoing a long-term decline due to the reduction of artificial recharge during the 1980s and 1990s. Between March 2008 and March 2009, the elevation of the water table declined by an average of 0.09 m. The FY 2009 water table is approximately 1.9 m higher than the estimated pre-Hanford conditions (DOE/RL-2010-11). Fluctuations in the water levels are affected by atmospheric pressure changes, seasonal changes in the Columbia River stage, and effluent discharges to the soil at the Treated Effluent Disposal Facility (TEDF) east of the 200 East Area (DOE/RL-2010-11).

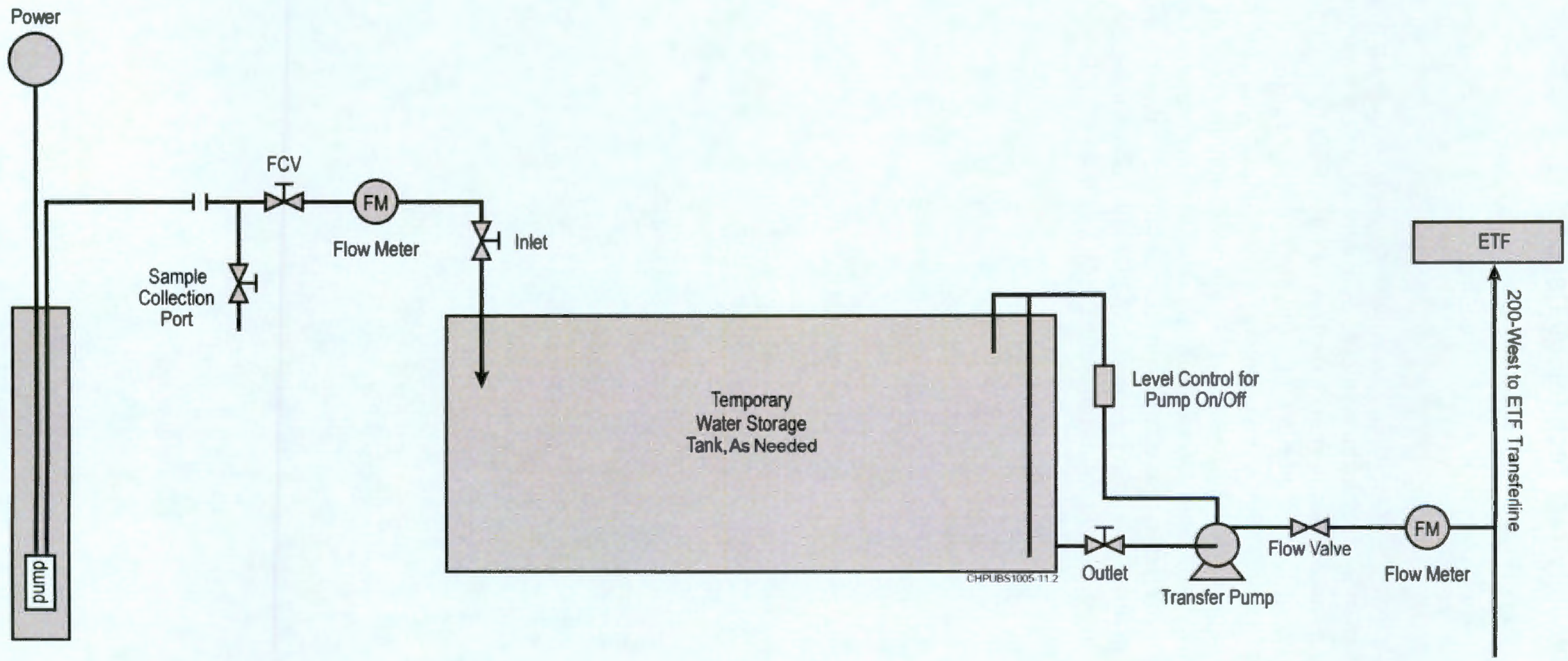
The composition of the groundwater in the area of the B Tank Farm Complex is variable because the groundwater is contaminated from more than one source, and the multiple sources are not chemically similar (DOE/ORP-2008-01). Major cations and anions are typically elevated above natural background concentrations, indicating impacts from liquid discharges and/or tank leaks.

As part of the RI for the 200-BP-5 OU, eight new wells were drilled in the B Tank Farm Complex area. Seven of these wells were drilled through the unconfined aquifer. Groundwater samples were collected during drilling to delineate the contaminant plume distributions. Short-term pumping tests were conducted at each well during well development. In addition, high-resolution seismic reflection survey data were used to refine the understanding of the uppermost basalt surface.

# 2 Treatability Test Technology Description

Pump-and-treat technology will be used to conduct this treatability test. This section of the test plan describes this technology and identifies which aspects of this technology are within the scope of the treatability test.

Pump-and-treat technology generally consists of a vertical extraction well or wells through which contaminated water is pumped to the surface for treatment; pipelines to convey the contaminated water to the treatment facility for contaminant removal and to convey the treated water from the treatment facility; disposition of the secondary waste streams; and disposition of the treated groundwater (Figure 2-1). This treatability test will evaluate the sustainable groundwater pumping rate. The other aspects of pump-and-treat technology will be implemented during the test but are not within the scope of the treatability test. The contaminated water will be transferred to ETF in the 200 East Area for treatment. The waste streams will be managed at ETF in accordance with standard operating procedures for that facility. The treated water will be conveyed through a pipeline to SALDS, just north of the 200 West Area, which has been approved for subsurface disposal (infiltration) of water from the ETF.




ETF = Effluent Treatment Facility
FCV = Flow Control Valve
FM = Flow Meter

**Figure 2-1. Conceptual Process Flow Diagram for the 200-BP-5 Treatability Test**

# 3 Test Performance and Data Quality Objectives

Test performance objectives and data quality objectives (DQOs) are used to clarify and guide the testing process. Test performance objectives identify information needed to accomplish the purpose of the test. The DQOs link the information requirements with the intended data uses to define the quantity and quality required for the measured variables.

## 3.1 Test Performance Objectives

The overall objective of this treatability test is to determine whether groundwater pumping at a rate of 189 L/min (50 gpm) can be sustained, as a measure of the effectiveness of a pump-and-treat alternative to hydraulically contain and reduce the mass of the Tc-99 and uranium plumes near the B Tank Farm Complex. If the pumping can be sustained and a reasonable capture zone can be established, the hydrologic conditions should be amenable to a pump and treat alternative for containment and cleanup of these plumes. Specific objectives for the treatability test include:

1. Determine the sustainable yield of an extraction test well near the uranium and Tc-99 plumes.

   The sustainable yield can be used to determine if a pump-and-treat alternative should be retained for evaluation in the FS and/or RD/RAWP.

2. Directly measure the aquifer response to sustained pumping near the uranium and Tc-99 plumes and calculate aquifer properties (i.e., aquifer transmissivity and specific yield) that are representative of large-scale conditions.

   The large-scale aquifer properties will be used to refine the localized hydrologic numerical model that will be used to simulate the effects of pumping on the aquifer including plume containment and mass removal (i.e., effectiveness of a pump-and-treat alternative).The use of hydraulic models will be required to support the design and evaluate the long-term performance of a pump-and-treat alternative. Such models provide a means of rapidly evaluating design alternatives for optimization and demonstrating that regulatory or performance requirements will be met.

3. Measure the concentrations of uranium and Tc-99 in the extracted groundwater during sustained pumping near the uranium and Tc-99 plumes.

   The concentrations of uranium and Tc-99 will be used to estimate mass removal rates.
   The concentrations of uranium, Tc-99, and other constituents in the groundwater will provide data for waste designation and waste acceptance at ETF.

## 3.2 Data Quality Objectives

The seven-step DQO process was conducted to define the data required for the design of this treatability test (SGW-44329). As part of the process, existing hydrogeologic data were identified and analyzed. The analysis indicated that the aquifer could sustain pumping rates of 189 L/min (50 gpm) or greater in the area of the uranium and Tc-99 contamination. Therefore, the recommendation from the DQO process was to use the existing data to develop a site-specific groundwater hydraulic model to support design and implementation of the treatability test.

The DQO summary report (SGW-44329) specifies general requirements for field measurements and measurement locations and identifies critical measurements without which the treatability test cannot be successful. The critical measurements include:

- Pumping rates (initial, final, average)

- Water levels (initial, intermediate, final) in the pumping well and all specified monitoring wells
- Observed barometric pressure trends measured at the test location or the Hanford Meteorological Station

DQOs for these critical measurements are determined based on the end uses of the data. The end use of the treatability test data is to support the evaluation of alternatives that will be included in the 200-BP-5 FS and/or RD/RAWP. The quality and quantity of data required to evaluate the pump and treat system and achieve the test performance objectives are specified in this treatability test plan (Section 4.1.4).

## 3.3 Relationship of Field Measurements to Performance Objectives

The primary field measurements during the treatability test are the pumping rate(s) and the water levels in the pumping and monitoring wells. The drawdown (i.e., decline in water level in response to pumping) in the pumping well and monitoring wells is a function of the pumping rate, the aquifer transmissivity (i.e., the hydraulic conductivity times the aquifer thickness), the aquifer storativity, the distance from the pumping well, and the elapsed time since pumping began. At a given distance and time, a higher pumping rate should result in an increased drawdown; a higher transmissivity should result in a decreased drawdown. The measurements of pumping rates can be used to determine the optimum sustainable yield of an extraction test well (Test Performance Objective 1). The measurements of water levels and pumping rate during the test can be used to calculate the large-scale values of aquifer transmissivity and specific yield for use in the refined localized hydrologic numerical model (Test Performance Objective 2).

As an initial step in planning the treatability test, a localized hydrologic model was developed, using existing data, to make an initial assessment of the aquifer response to pumping from a single well (ECF-200BP5-10-0254). The model was used to simulate pumping at rates of 189, 284, and 379 L/min (50, 75, and 100 gpm) at two different locations in the B Tank Farm Complex. The model indicated that a pumping rate of 189 L/min (50 gpm) could be sustained, but with very little drawdown because the aquifer near the B Tank Farm Complex is very transmissive. This evaluation met the initial step in TPA Milestone M-015-82 to demonstrate sufficient sustained yield to support the treatability testing. As described in Chapter 4, one aspect of the treatability test design is to determine the pumping rate that is expected to produce measureable drawdown responses to achieve Test Performance Objective 2. To be measurable, drawdown must be at least 3 cm (0.1 ft).

The concentrations of uranium and Tc-99 in samples of extracted groundwater will be collected during sustained pumping and analyzed in a laboratory to achieve Test Performance Objective 3.

## 3.4 Local-Scale Hydrologic Model

The initial hydraulic modeling was performed using a local-scale model for groundwater in the vicinity of the B Tank Farm Complex. As described in ECF-200BP5-10-0254, the model was implemented in the MODFLOW-2000 code. The modeling objective was to evaluate alternative well locations for the treatability test on the basis of whether the unconfined aquifer in these locations exhibited hydraulic properties that would be sufficient to allow sustained pumping at 189 L/min (50 gpm) or higher.

The local-scale model has a uniform, 10-m resolution grid in the horizontal direction. A single, variable-depth layer represents the unconfined aquifer in the Hanford formation. The FY 2008 water table elevation was used to define static boundary conditions in the model; declining water table changes in this area (approximately 5 cm/year [2 in./year]) were not considered significant over the relatively short timeframe of the modeled period. The most recent interpretation of the uppermost basalt surface was used to define the base of the unconfined aquifer. The following hydraulic parameters assigned to the Hanford formation in the single vertical layer were taken from RPP-9223:

- Porosity – 0.15
- Horizontal Hydraulic Conductivity – 3,000 m/d
- Vertical Hydraulic Conductivity – 300 m/d

All of the basalt surfaces (lower boundary and lateral boundaries) were represented as no-flow boundaries. Lateral boundaries other than basalt were represented as constant head boundaries. Although these boundary conditions would lead to predictions of full hydraulic capture for long time periods, they were considered suitable and sufficient for the relatively short duration of the modeled period. The simulated duration was three years. Based on the boundary conditions and hydraulic properties used in the simulation, steady state conditions would be expected to be reached within the first few days of simulated pumping. Therefore, it is reasonable to use the final simulation results to develop the conceptual design for the test.

Six cases representing two candidate well locations and three pumping rates, 189 L/min, 284 L/min, and 379 L/min (50 gpm, 75 gpm, and 100 gpm), were simulated. The pumping wells were assumed to be 0.2032 m (8 in.) diameter. The well locations were limited to areas with a minimum saturated thickness of 1.8 m (6 ft), based on experience with pump-and-treat technology in the 100 Areas, outside of the tank farm boundaries and in the vicinity of existing wells. The capture zone for each case was estimated at one-year intervals. The expected drawdown in the extraction well for each case was calculated, using a correction to the grid-block-centered average drawdown predicted by MODFLOW, for well efficiencies of 1.0, 0.7, and 0.5.

## 3.5 Previous Treatability Tests in the 200-BP-5 Operable Unit

A treatability test to evaluate pump-and-treat technology for remediation of 200-BP-5 OU groundwater was conducted from August 1994 through May 1995 (DOE/RL-95-59). One pilot-scale treatability test system was set up in close proximity to the 216-B-5 Reverse Well because the associated stronium-90, cesium-137, and plutonium-239/240 concentrations were identified as candidates for an interim response measure (DOE/RL-92-19). Well 299-E28-23 was the extraction well, and Well 299-E28-7 was the injection well (Figure 4-1). The other pilot-scale treatability test system was set up at the center of the cobalt-60 and Tc-99 plumes that had migrated north from the 216-BY Cribs toward Gable Gap because these contaminants also were identified as candidates for an interim response measure (DOE/RL-92-19). Well 699-50-53A was the extraction well, and well 699-49-55A was the injection well (Figure 4-1). Ion exchange technology was selected as the treatment technology for both 200-BP-5 OU pilot-scale treatability test systems.

Aquifer pumping at the 216-B-5 site provided substantial quantities of groundwater containing significant concentrations of cesium-137 and strontium-90 and lesser quantities of plutonium-239/240, which had adsorbed to the sediments. The treatment system performed satisfactorily for removal of all three contaminants. However, it was recommended that the treatability test be discontinued because the future risks from these plumes were assessed to be low (DOE/RL-95-59). The daily average groundwater-pumping rate at the extraction well averaged 102 L/min (27 gpm). (The well was capable of producing at least 132 L/min [35 gpm], but the well pump was capable of delivering only 106 L/min [28 gpm].) Water levels in the extraction and monitoring wells showed no response to pump-and-treat operations. The observed water-level fluctuations corresponded primarily to barometric pressure changes. The maximum sustained yield during operations could not be determined because pumping produced no drawdown in the extraction and monitoring wells (DOE/RL-95-59).

At the 216-BY Cribs plume site, the treatment system performed satisfactorily for removal of cobalt-60 and Tc-99 contaminants. It was recommended that the treatability test be discontinued because of the poor extraction rates due to the thin aquifer. The flow rate averaged approximately 13.2 L/min (3.5 gpm), so the system had to be operated on a batch-like processing schedule. The aquifer thickness at the location of the extraction well was less than 0.6 m (2 ft) thick. Well 699-50-53A was chosen as the extraction well because it was in the most contaminated portion of the 216-BY Cribs plumes, and none of the wells evaluated for the 216-BY Cribs test produced appreciable amounts of groundwater during pumping.

One of the lessons learned from the 1994-1995 treatability testing was the need to select a location for groundwater extraction that could sustain continuous groundwater pumping (DOE/RL-95-59). The lack of groundwater at the 216-BY Cribs site was considered the most significant difficulty encountered during the treatability testing. A focused subsurface investigation program was recommended to refine the aquifer hydrology, geology, and contaminant trend data. Use of high-resolution seismic reflection surveys to map the top of basalt (i.e., bottom of the aquifer) and to locate any preferential flow paths was recommended as having the potential for identifying thicker parts of the aquifer (DOE/RL-95-59).

During FY 2009, high-resolution seismic reflection surveys were acquired within the Gable Gap area north of the 200 East Area to help address data gaps regarding the presence/absence of potential channels, faults, or other hydrogeologic features that may control groundwater contaminant migration. Previously collected seismic data that lie within the 200-BP-5 OU were used to augment the new surveys and to ensure a consistent, site-wide interpretation. The combined geophysical data set was used to refine the top of basalt surface topographic map. This refined map is reflected in the saturated thickness of the aquifer shown on Figure 1-2 and Figure 1-3 and was used in the initial hydrologic numerical modeling of the aquifer response to pumping from a single well (ECF-200BP5-10-0254).

## 3.6 Additional Data Uses

In addition to meeting specific treatability test objectives, data collected during the treatability test may also be used to satisfy other data needs such as the following:

- Occupational health and safety
- Site characterization and conceptual model refinement
- Pump-and-treat remedial action alternative development, evaluation, and/or design
- Monitoring for pump-and-treat remedial action performance assessment

# 4 Treatability Test Conceptual Design and Operating Requirements

The 200-BP-5 Groundwater OU treatability test will consist of a pumping test at a newly-constructed extraction test well west of the BY Tank Farm, with an optional pumping test using a new or existing extraction well north of the B Tank Farm. The plan for the pumping test west of the BY Tank Farm includes three primary elements:

1. Test Approach. This element includes identifying the proposed location and conceptual design for the extraction test well and monitoring wells and specifying the measurements to be taken.

2. Phase 1 – Step-Drawdown Test. This phase of testing consists of pumping the test well for approximately 6-8 hours. During this time, the pumping rate is incrementally increased in a series of steps. The test is necessary to determine test well performance, including the optimum sustainable pumping rate. The optimum sustainable pumping rate will be used in Phase 2 of the test to produce measurable drawdown responses in the monitoring wells. Monitoring, for approximately 30 days before pumping begins, will be used to establish baseline conditions, such as natural fluctuations in the elevation of the groundwater.

3. Phase 2 – Constant-Rate Test. This phase of testing consists of pumping the test extraction well at a constant rate for 3 to 30 days following a full recovery from the Phase 1 Step-Drawdown pumping test. The constant rate selected is the optimum sustainable pumping rate as determined from the step-drawdown test. By monitoring drawdown at the test well and the monitoring wells, large-scale hydraulic parameters can be estimated for the aquifer in the vicinity of the B Tank Farm Complex and used to refine the predictive capability of the numerical hydrologic model.

Additional information on each of these elements is presented in the following subsections.

Following approval of this treatability test plan, detailed design-related activities will be initiated. This work will include preparation of the drawings, calculations, and specifications necessary to construct specific test elements. During the detailed design phase, the extraction test well location(s) and associated monitoring wells will be finalized, the test well specifications will be determined, pumps will be sized, water level instrumentation will be defined, the pipeline alignment to convey extracted water to ETF will be determined, and the engineered components (e.g., pipelines) will be designed. The design work will be conducted and documented in accordance with applicable CH2M HILL Plateau Remediation Company (CHPRC) procedures.

A final design package will be prepared including drawings, calculations, and construction specifications. The design package will be provided to the lead regulator for information. Regular briefings and/or monthly Project Manager meetings will be used to inform the regulatory agencies on the progress of the design. The design package will form the basis for procurement of construction services.

## 4.1 Test Approach

An aquifer pumping test allows quantitative estimates of aquifer hydraulic properties. The test generally consists of pumping water from a well, and measuring the well discharge (pumping rate) and associated water-level changes during the drawdown phase (pump on) and recovery (pump off) phases.

A short-term test such as the step-drawdown test includes water-level measurements at the test well and at nearby monitoring wells under increasing rates of discharge. It is recommended that the drawdown at the test well be limited to no greater than 25 percent (i.e., approximately 0.6 m [2 ft]) of the pre-test unconfined aquifer saturated thickness (PNNL-18279). Excessive drawdown at the pumping well can result in a detached seepage face in the well screen, "free-fall" of water along the well screen, and turbulent flow conditions. Steady-state or equilibrium flow is generally not achieved during this test. Pumping for a minimum of 100 minutes but for less than 3 hours during each discharge rate and pumping for an equal duration during each discharge rate are recommended. Interpretation of the step-drawdown test provides the optimum sustainable pumping rate for the test well, estimates of aquifer transmissivity and well efficiency, and rough approximations of the storage coefficient (Clark, 1977). A minimum of three discharge rates is required. Water levels monitored in the monitoring wells during the recovery phase can be used to establish that recovery has occurred following the last step.

As explained in PNNL-18732, the well discharge performance typically is evaluated using the relationship between well loss and drawdown presented by Cooper and Jacob (1946) (PNNL-18732). The well loss (the component of the drawdown that is attributable to the well rather than to the aquifer) is assessed by comparing the pumping rate and the drawdown/pumping-rate ratio.

A longer-term test such as the constant-rate discharge test includes water level measurements at the test well and at nearby monitoring wells under a constant rate of discharge. The constant-rate test consists of sustained pumping over several days or more at a sufficient rate to produce discernable drawdown responses at the monitoring wells. For the reasons described above for the step-drawdown test, it is recommended that the drawdown at the test well be limited to no greater than 25 percent of the pre-test unconfined aquifer saturated thickness (PNNL-18279). The constant-rate test is initiated after the step-drawdown recovery has been established. Steady-state or equilibrium flow is generally achieved during this test. The duration of the pumping phase of the extended constant-rate test is expected to be between 3 and 30 days. Pumping longer than 3 days may be needed to maximize the areal drawdown response to facilitate large-scale hydraulic/storage property determination and for detecting the presence of hydrologic boundaries. The detection of hydrologic boundaries is particularly relevant during this treatability test because the contaminated aquifer is shallow and discontinuous.

The time-series water level measurements in the pumping and monitoring wells during the drawdown phase (pump on) and subsequent water level recovery phase (pump off) of the constant-rate test are analyzed to determine large-scale aquifer hydraulic and storage parameters Analysis of the constant-rate pumping test data assumes that the observed water-level responses are caused solely by the pumping in the test well (PNNL-18732). For this reason, other causes of water-level changes (e.g., barometric pressure fluctuations) must be identified so that the effects can be removed. Removal of barometric pressure effects has been successfully implemented for similar large-scale aquifer test characterizations on the Central Plateau (PNNL-17732; PNNL-18732).

As explained in PNNL-18279, constant-rate discharge tests typically are analyzed using standard analytical methods such as type-curve matching methods (Theis, 1935) and straight line methods (Cooper and Jacob, 1946). The type curves represent a wide range of test and aquifer conditions. As noted in PNNL-18279, drawdown data from pumping tests in thin unconfined aquifers need to be evaluated and corrected for aquifer dewatering effects, in addition to corrections for barometric pressure and river stage fluctuations.

A more detailed discussion of the test methods, data corrections, and test analyses can be found in PNNL-17348, PNNL-18279, PNNL-18732, and Kruseman and de Ridder (1994).

### 4.1.1 Test Well Location and Conceptual Design

Selection of the test well site and the well design are two important elements in the overall planning step. In selecting the location for the 200-BP-5 Groundwater OU treatability test, the following factors were considered:

- Proximity of existing contaminant plumes (Tc-99 and uranium) potentially requiring remediation

- Aquifer characteristics (aquifer thickness and hydraulic conductivity) that are relatively uniform and representative of the area where remediation would be performed
- Ability for manpower and equipment to reach the site easily

Based on the above considerations, one new extraction well to be installed at the primary test site near well 299-E33-31, located adjacent to the west side of the BY tank farm (Figure 4-1), is proposed. This location was selected as the primary site based on capture zone numerical simulations (ECF-200BP5-10-0254), the unconfined aquifer's saturated thickness of approximately 2.4 m (8 ft), proximity of existing wells for use as monitoring wells, and the proximity of the defined uranium and Tc-99 plumes (Figure 4-2). Placing the test well site outside the tank farm boundary is expected to facilitate construction and overall test execution because the land area in the B Tank Farm Complex is congested with industrial buildings interconnected by roads, railroads, subsurface pipelines, and electrical transmission lines. Other considerations were to locate the well clear of subsurface and overhead interferences and near a source of electrical power. The well location will be finalized during the detailed design and the preparation of the drilling description of work (DOW). Minor changes (±15 m [50 ft]) to the well location may be needed due to logistics, infrastructure, or similar considerations.

Another candidate test well site on the north side of the B Tank Farm, just north of monitoring well 299-E33-343, was also identified but judged to be less favorable for the treatability test. This location is identified as a secondary location where testing could be performed based on the outcome of testing at the primary location. Although this location appears to lie closer to the Tc-99 and uranium source(s), it was not selected as the primary site because hydrogeologic conditions may be less representative of those present elsewhere within the footprint of the Tc-99 and uranium plumes. Just east of this area, the aquifer is overlain by the Cold Creek Unit silt facies and a perched water-bearing zone (SGW-39626). These conditions may combine to create a localized, leaky aquifer setting with characteristics that could markedly differ from the unconfined aquifer that typically characterizes the 200-BP-5 Groundwater OU. Development logs (SGW-39626) from newly installed monitoring wells placed on the north side of the B Tank Farm reported yields that averaged about 45 L/min (12 gpm) at wells 299-E33-343 and 299-E33-345 versus 102 L/min (27 gpm) at monitoring wells 299-E33-341 and 299-E33-342 located on the north side of the BX Tank Farm near the primary test well location. Additional information on the decision criteria for use in conducting an aquifer test at the secondary well site is presented in Section 4.1.2.

The use of existing wells, in lieu of constructing a new test well, was also considered at the primary test site. Existing monitoring wells 299-E33-3 (15.2 cm [6-in.]) and 299-E33-15 (20.3 cm [8-in.]) were identified at the B Tank Farm Complex with a diameter sufficient to accommodate a 189 L/min (50 gpm) pump. However, these two wells do not meet the selection/location criteria described in this section. Well 299-E33-3 is located inside the 216-BY Cribs area where the aquifer's saturated thickness is estimated at 1.5 m (4.9 ft). Well 299-E33-15 is located outside the boundaries of the Tc-99 and uranium plumes. Additionally, the screen intervals for these two wells were constructed by perforating the casing. This type of screen is less efficient and deemed inadequate for a groundwater extraction test well. All other existing wells in this area are reportedly 10.2 cm (4 in.) in diameter. This diameter is not large enough to accommodate a 189 L/min (50 gpm) pump.

### 4.1.2 Testing at Secondary Well Site

Although the area north of the B Tank Farm was not selected as the primary test site, hydrogeologic conditions may differ enough in this area to warrant the conduct of a second treatability test such that aquifer properties are measured across a range of geologic conditions present within the footprints of the Tc-99 and uranium plumes. To help determine the need for a second test, water levels at selected wells north of the B Tank Farm will be measured during the primary test. If these data allow for a reasonable estimate of aquifer properties in this area, then the second test will not be conducted. If aquifer properties in this area cannot be estimated due to insufficient water level response, or presence of some other external condition (geologic boundary or aquitard leakage), then the second test may be conducted.

### 4.1.3 Test Well Design Considerations

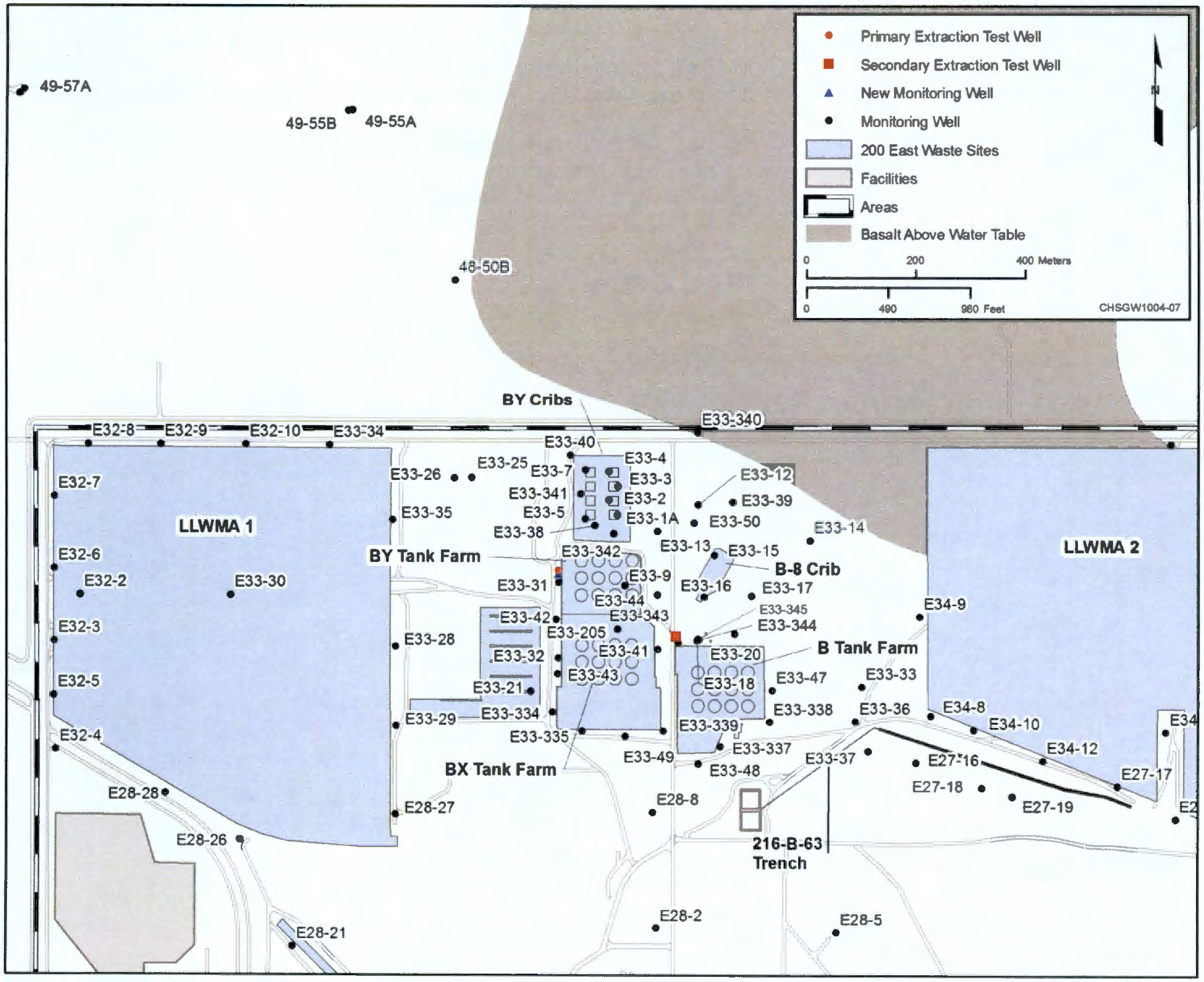
The test well design is an important component of the treatability test. The conceptual design for the test well includes the following elements:

- The extraction well should fully penetrate the unconfined aquifer to support and simplify the methods to be used for test data analysis.
- The primary objective for the test is to determine if the unconfined aquifer can sustain a pumping rate of 189 L/min (50 gpm). Therefore, the minimum pump size is 189 L/min (50 gpm).
- Another pump selection criterion is to ensure the pumping rate is sufficient to produce measureable water level changes at nearby monitoring wells that can be distinguished from natural temporal variations and thereby used for reliable aquifer hydraulic parameter estimates. A minimum drawdown of 3.0 cm (0.1 ft) must be achieved to meet this criterion. At a pumping rate of 189 L/min (50 gpm), the capture zone simulation (ECF-200BP5-10-0254) estimates water level drawdown in the vicinity of the primary test location of less than 3.0 cm (0.1 feet) at all existing monitoring well locations (Figure 4-3). At a pumping rate of 379 L/min (100 gpm) the capture zone simulation estimates water level drawdown values ranging from less than 0.9 cm (0.03 feet) at the most distant monitoring wells to 12.2 cm (0.4 feet) inside the test well casing. Based on these considerations, pumps with capacities ranging from 0 to 568 L/min (150 gpm) should be considered. Additionally, monitoring wells should be located at distances no greater than 75 m (250 ft). A final decision on the pump size would be made once the test well has been developed and initial information on well yield is obtained through the Phase 1—Step-Drawdown Test.
- The relatively thin aquifer saturated interval expected at the proposed primary and secondary test well sites (~2.4 m [8 ft]) and the optimum sustainable pumping rate (anticipated to be no greater than 568 L/min [150 gpm]) would require that the pump be installed in a sump below the screened interval. Therefore, the well and sump diameter and the sump depth must be sufficient to house the extraction pump and associated downhole equipment.
- Generally, the diameter of the well should not be larger than is necessary to house the extraction pump. For a pumping rate of 568 L/min (150 gpm) or less, a 20.3 cm (8-inch) diameter well should be sufficient. The hydraulic capture zone modeling assumed an extraction well diameter of 20.3 cm (8 inches) (section 3.4).

The well location(s) will be finalized and the well completion will be designed as part of the detailed design phase and specified in the design document (e.g., DOW) that directs well drilling and construction activities at the Hanford Site.

### 4.1.4 Disposal of Aquifer Test Water

Groundwater from aquifer testing will be treated at the ETF in 200 East Area (Figure 4-4). The water from the Phase 2 constant-rate test at the primary test site will be conveyed to the ETF using single-walled, above-ground pipeline to connect the extraction well to the existing ETF transfer line located south and east of the test site. Double-walled pipe may be used for the purpose of freeze protection, as needed. Pipeline layout and specifications will be defined during the detailed design.




1 
2 **Figure 4-1. Location of Groundwater Monitoring Wells and Proposed Test Wells near Waste Management Area B-BX-BY**

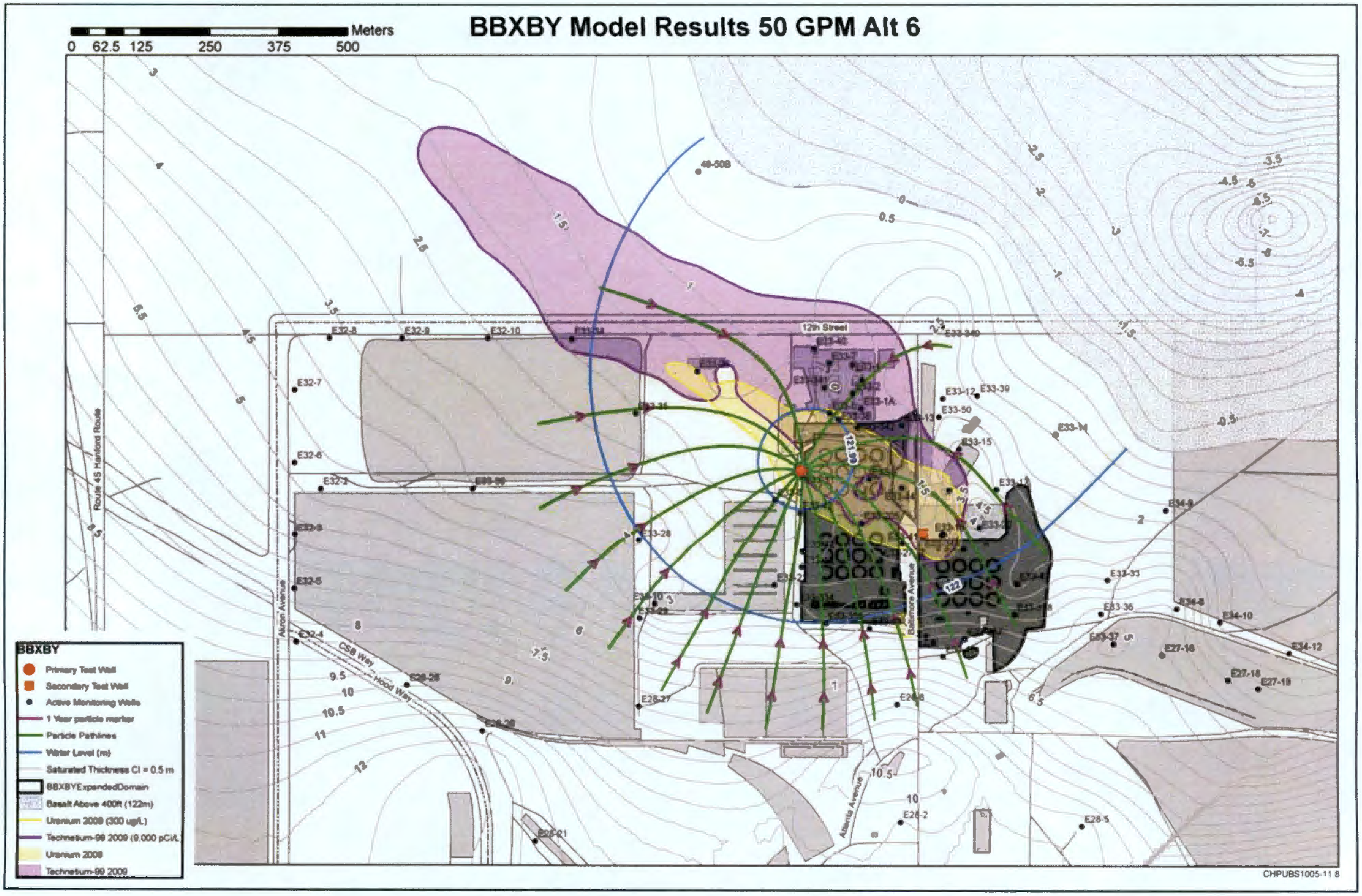



**Figure 4-2. Proposed Locations of Aquifer Groundwater Extraction Test Wells and the Inferred Capture Zone for the Primary Test Well Site (Based on ECF-200BP5-10-0254)**

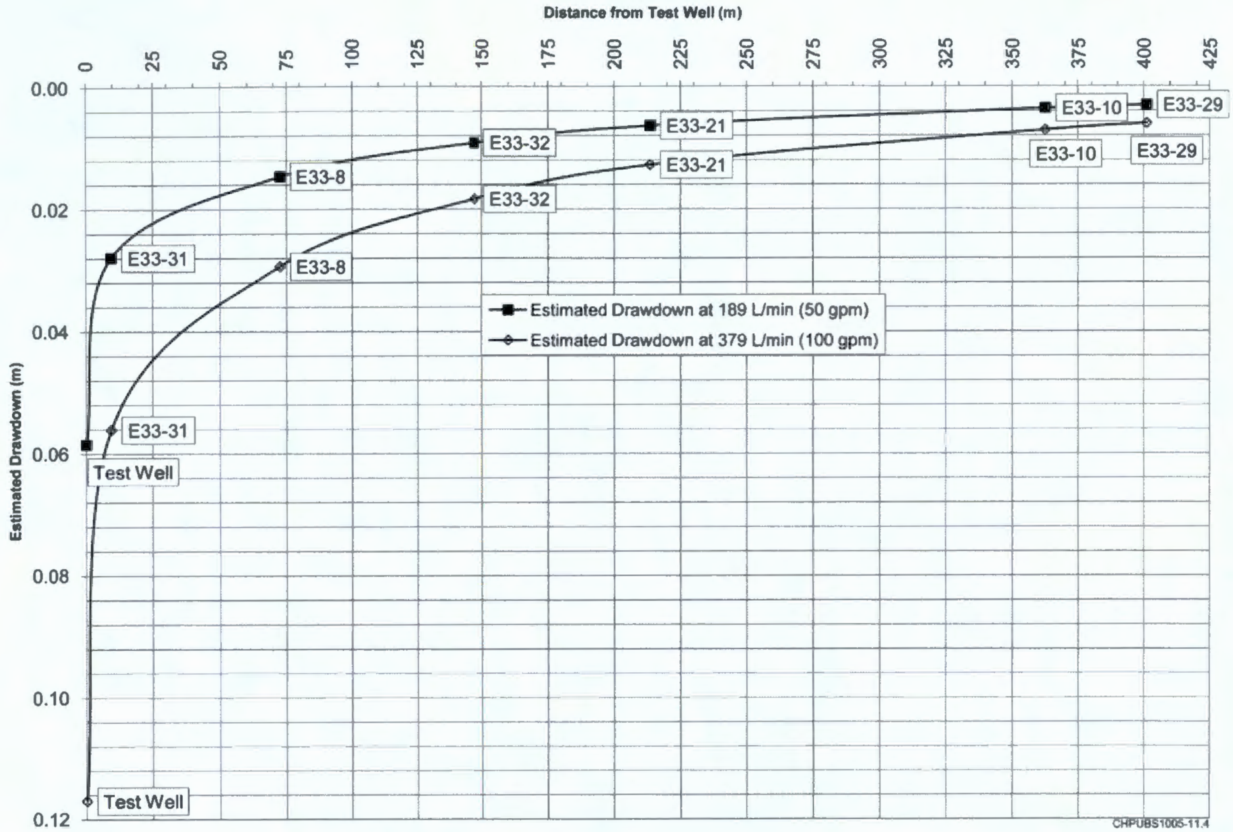



**Figure 4-3. Estimated Water Level Drawdown at Pumping Rates of 189 and 379 L/min (50 and 100 gpm) in the Vicinity of the Primary Test Well Site Using Initial Hydrologic Numerical Model (ECF-200BP5-10-0254)**

The 200 West Area Treatment Facility currently under construction is planned to begin operation by December 2011. When fully operational, it will treat all of the groundwater extracted from the 200-ZP-1 OU and the 200-UP-1 OU in the 200 West Area. Until then, the groundwater extracted from the 200-UP-1 OU and from the WMA T portion of the 200-ZP-1 OU is being treated at the ETF in the 200 East Area. The ETF does not have the capacity to treat the 200-BP-5 OU groundwater in addition to the 200-UP-1 OU and 200-ZP-1 OU groundwater. If the 200 West Area Treatment Facility is not available to treat the extracted 200-UP-1 OU and 200-ZP-1 OU groundwater at the time of the 200-BP-5 OU treatability test, the 200-UP-1 OU pump-and-treat system and the 200-ZP-1 OU pump-and-treat system at WMA T may need to be temporarily shut down to support the 200-BP-5 OU testing. The timing of the 200-BP-5 treatability test will be coordinated with ETF to ensure that ETF has sufficient storage capacity to receive the anticipated volume of aquifer test water.

During discussions with ETF staff regarding the groundwater chemistry in the proposed area of the 200-BP-5 OU treatability test (Section 1.2), it was concluded that 200-BP-5 groundwater quality would be compatible with the ETF treatment systems at the flow rates anticipated during the test. Concentrations of constituents in 200-BP-5 OU groundwater (e.g., chloride and silica) that may exceed the normal level that ETF is treating may be resolved by adjusting the flow rate or controlling the blending during the test. A Waste Profile Sheet for ETF will be prepared, based on groundwater monitoring data for wells located in the vicinity of the test well or from sampling of the test well(s) prior to initiation of the aquifer test(s). ETF will approve receipt of the groundwater prior to testing.

A summary of the ETF treatment system, including the existing transfer pipeline and a conceptual tie-in point from the extraction test well to the existing pipeline is provided in Section 4.4.

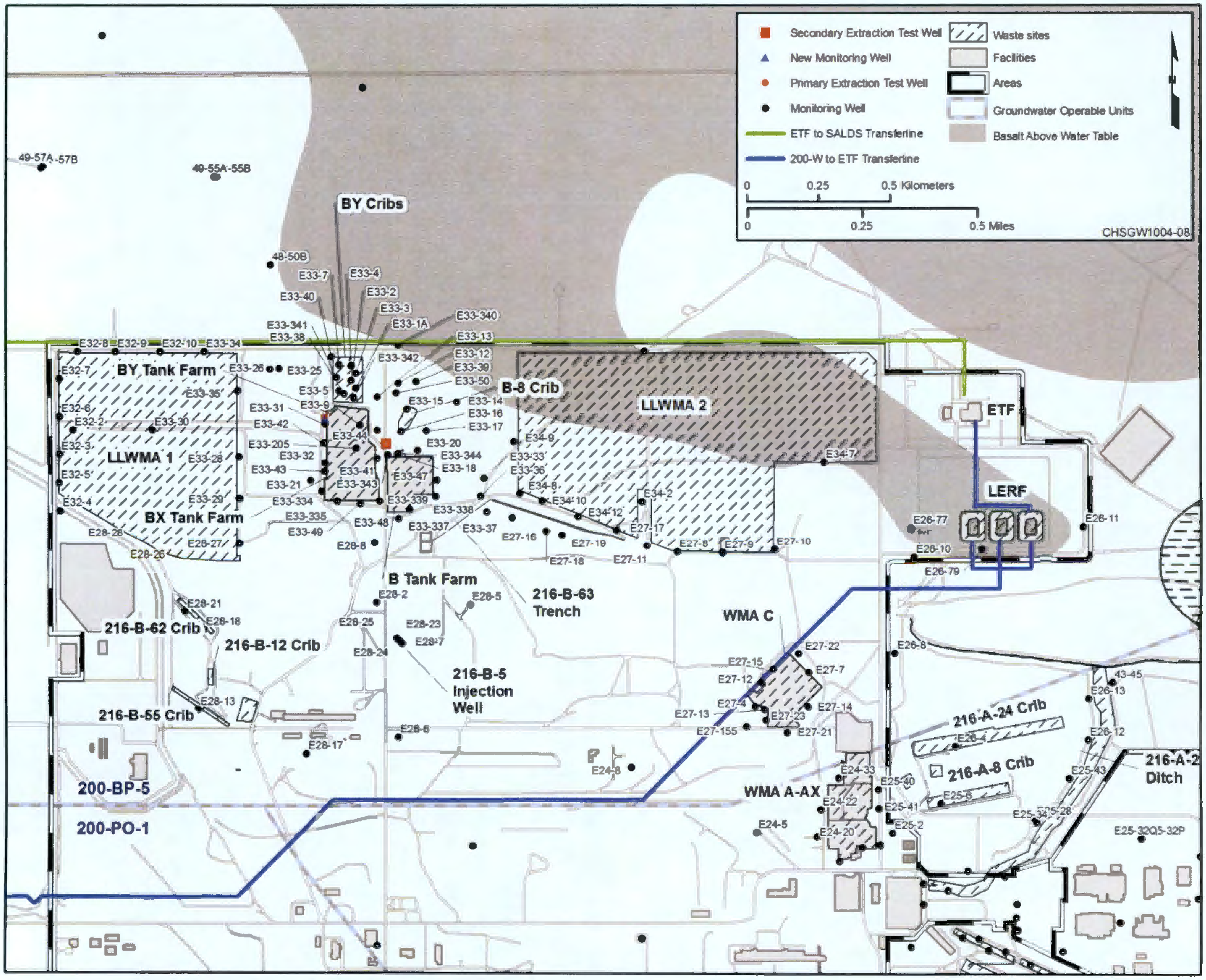



Figure 4-4. Locations of Pipelines from 200 West Area to ETF and from ETF to SALDS

### 4.1.5 Monitoring Well Network

Existing 10.2-cm (4-in.) diameter wells, located outside the tank farm boundaries, are available for monitoring in the vicinity of the primary and secondary test well sites. General information on these wells is provided in Table 4-1.

Calculation of the large-scale values of aquifer transmissivity and specific yield requires water level drawdown measurements at various distances from the extraction well as input data. The capture zone model simulation (ECF-200BP5-10-0254) predicts that pumping the primary test well at 189 L/min (50 gpm) will produce drawdown of less than 1.5 cm (0.05 ft) in all but the closest of the existing monitoring wells (Figure 4-3). The 379 L/min (100 gpm) capture zone model simulation predicts water level drawdown of less than 1.5 cm (0.05 feet) at distances greater than approximately 175 m (550 feet) from the proposed test well. Although automated water level monitoring equipment typically can measure water levels with an accuracy of 0.3 cm (0.01 feet), water level changes of less than 1.5 cm (0.05 feet) may be indistinguishable from natural temporal fluctuations in the unconfined aquifer. This uncertainty is a limiting factor for defining an effective capture radius.

Past water level monitoring performed in this area showed seasonal water level variations of about -3.0 cm (-0.1 ft) between January and April 2009, +6.1 cm (+0.2 ft) between April and August 2009 and -6.1 cm (-0.2 ft) between August and November 2009 (Figure 4-5). This seasonal variability could impact the interpretation of the constant-rate test results. Therefore, the primary monitoring wells proposed to be used as monitoring wells are those with estimated drawdown values of greater than 1.5 cm (0.05 feet), based on the 379 L/min (100 gpm) capture zone model simulation. This includes wells 299-E33-31, 299-E33-42, and 299-E33-32 (Figure 4-6). Monitoring wells such as wells 299-E34-12 and 699-49-57A that are outside the predicted capture zone will be used as background monitoring wells for recording seasonal variations, Columbia River stage fluctuations, and other water level fluctuations. Water level responses in other, secondary monitoring wells will be evaluated for estimating the radius of influence of the test well and any horizontal anisotropy associated with the radius of influence (PNNL-18279). Selection of the primary, secondary, and background monitoring wells will be finalized during the detailed test design.

The discrete water level measurements shown in Figure 4-5 have not been assessed for the temporal effects of barometric pressure fluctuations. However, the apparent seasonal variability in the data set further confirms the need to remove barometric pressure effects from the water level measurements made during the treatability test.

The constant-rate aquifer test will be designed to develop discernable drawdown in monitoring wells within about 76 m (250 ft) of the proposed test well that is significantly greater than these predicted uncertainties.

**Table 4-1. Groundwater Monitoring Wells in the Vicinity of the B Tank Farm Complex Proposed for Water Level Measurements During the 200-BP-5 Operable Unit Treatability Test**

| Monitoring Well Number | Location Relative to Test Well | Total Well Depth | | Distance from Proposed Test Well Site | | Estimated Drawdown (at 379 L/min [100 gpm] rate) | | Screened Interval Depth Top | | Screened Interval Depth Bottom | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ft | m | ft | m | ft | m | ft | m | ft | m |
| **Primary Test Well Site Monitoring Wells** | | | | | | | | | | | |
| Proposed New Monitoring Well | Upgradient | 256.0 | 78.0 | 15.5 | 4.8 | 0.25 | 0.08 | 234.9 | 71.6 | 255.9 | 78.0 |
| 299-E33-31 | Upgradient | 255.9 | 78.02 | 31.4 | 9.6 | 0.18 | 0.05 | 234.9 | 71.6 | 255.9 | 78.0 |
| 299-E33-42 | Upgradient | 260.2 | 79.33 | 251.3 | 76.6 | 0.09 | 0.03 | 238.5 | 72.7 | 259.2 | 79.0 |
| 299-E33-32 | Upgradient | 270.3 | 82.41 | 481.8 | 146.9 | 0.06 | 0.02 | 246.4 | 75.1 | 267.4 | 81.5 |
| 299-E33-343[a] | Cross-gradient; evaluation of need for testing at secondary site | 249.9 | 76.2 | 810.0 | 246.9 | 0.04 | 0.01 | 249.9 | 76.2 | 259.9 | 79.2 |
| 299-E33-345[a] | Cross-gradient; evaluation of need for testing at secondary site | 249.7 | 76.1 | 911.0 | 277.7 | 0.03 | 0.01 | 249.7 | 76.1 | 259.7 | 79.2 |
| 299-E33-38 | Downgradient | 239.6 | 73.0 | 377.3 | 115.0 | 0.10 | 0.03 | 218.6 | 66.6 | 239.6 | 73.0 |
| 299-E33-342[a] | Downgradient | 244.6 | 74.6 | 420.0 | 128.0 | 0.10 | 0.03 | 232.6 | 70.9 | 242.6 | 73.9 |
| 299-E34-12 | Background | 247.9 | 75.58 | 3130.4 | 954.4 | <0.01 | <0.01 | 223.9 | 68.2 | 244.2 | 74.4 |
| 699-49-57A | River Influence | 164.6 | 50.17 | 4340.4 | 1323.3 | <0.01 | <0.01 | 144.0 | 43.9 | 161.0 | 49.1 |
| **Secondary Test Well Site Monitoring Wells** | | | | | | | | | | | |
| 299-E33-18 | Cross-gradient-east | 271.0 | 82.6 | 267.0 | 81.4 | 0.09 | 0.03 | 246.0 | 75.0 | 266.0 | 81.1 |
| 299-E33-20 | Cross-gradient-east | 254.0 | 77.4 | 650.0 | 198.1 | 0.04 | 0.01 | 234.0 | 71.3 | 254.0 | 77.4 |
| 299-E33-41 | Cross-gradient-west | 244.9 | 74.7 | 300.0 | 91.4 | 0.08 | 0.02 | 244.9 | 74.7 | 262.0 | 79.9 |
| 299-E33-343[a] | Upgradient | 249.9 | 76.2 | 150.0 | 45.7 | 0.12 | 0.04 | 249.9 | 76.2 | 259.9 | 79.2 |
| 299-E33-345[a] | Cross-gradient-east | 249.7 | 76.1 | 267.0 | 81.4 | 0.09 | 0.03 | 249.7 | 76.1 | 259.7 | 79.2 |
| 299-E33-17 | Downgradient | 242.5 | 73.9 | 900.0 | 274.3 | 0.03 | 0.01 | 220.0 | 67.1 | 242.5 | 73.9 |

**Table 4-1. Groundwater Monitoring Wells in the Vicinity of the B Tank Farm Complex Proposed for Water Level Measurements During the 200-BP-5 Operable Unit Treatability Test**

| Monitoring Well Number | Location Relative to Test Well | Total Well Depth | | Distance from Proposed Test Well Site | | Estimated Drawdown (at 379 L/min [100 gpm] rate) | | Screened Interval Depth Top | | Screened Interval Depth Bottom | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ft | m | ft | m | ft | m | ft | m | ft | m |
| 299-E33-344[a b] | Perched Zone | 237.4 | 72.4 | 267.0 | 81.4 | NE | NE | 217.9 | 66.4 | 237.1 | 72.3 |
| 299-E34-12 | Background | 247.9 | 75.58 | 3130.4 | 954.4 | <0.01 | <0.01 | 223.9 | 68.2 | 2244.2 | 74.4 |
| 699-49-57A | River Influence | 164.6 | 50.17 | 4340.4 | 1323.3 | <0.01 | <0.01 | 144 | 43.9 | 161 | 49.1 |

a. Well installed as part of the 200-BP-5 OU RI.

b. Well monitors a perched zone.

NE = Not Estimated

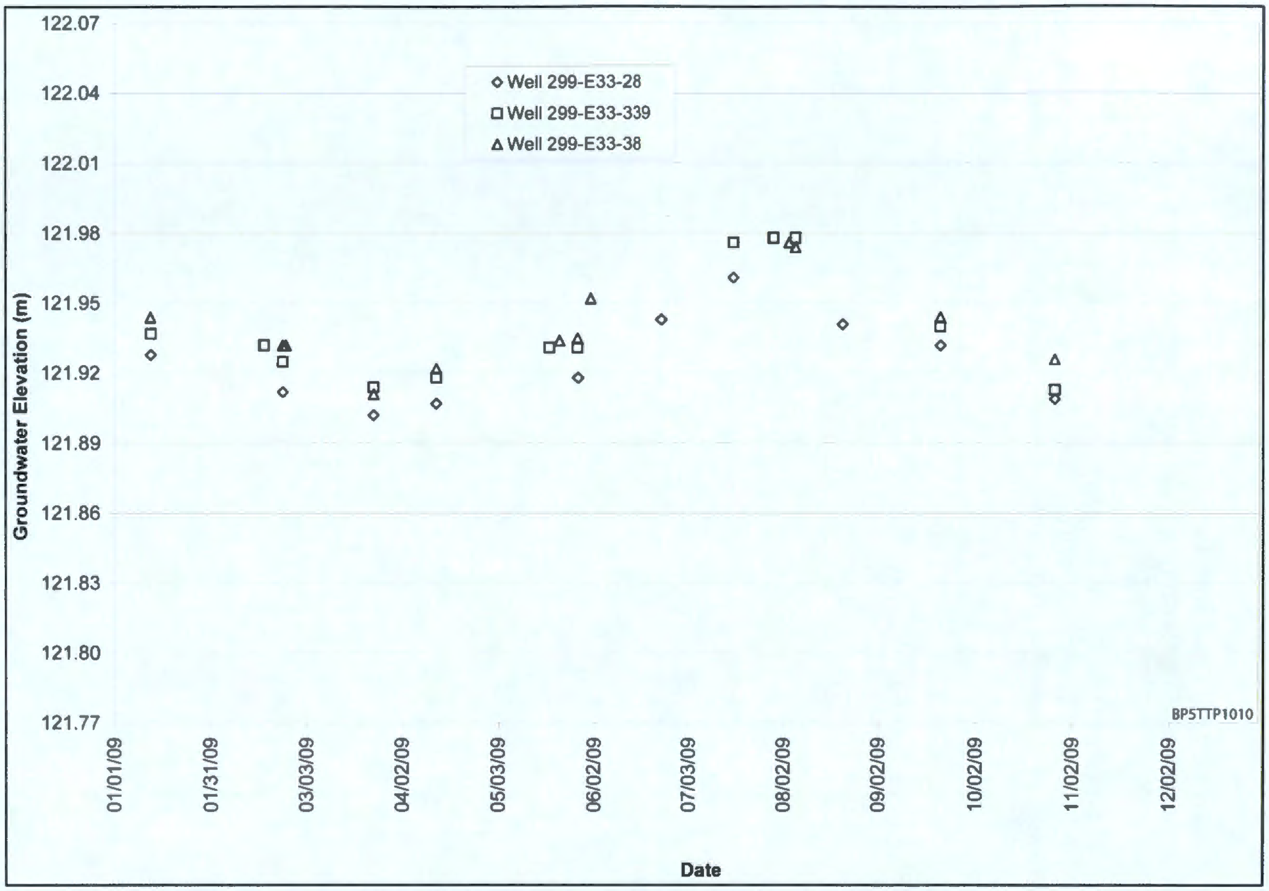



**Figure 4-5. Transient Water Level Changes Observed in 2009**

One proposed new 10.2-cm (4-in.) diameter monitoring well will be installed approximately midway between the proposed extraction test well and existing Well 299-E33-31. This new monitoring well will increase the probability of acquiring sufficient drawdown data at multiple well sites (test well, new monitoring well and 299-E33-31) for improved estimates of aquifer transmissivity. The location of the new monitoring well will be finalized during the detailed design.

### 4.1.6 Treatability Test Measurement Approach

The measurement approach for the treatability test is summarized in Table 4-2. The measurement approach provides the links between the test objectives, test components, key parameters, DQOs, and analytical methods. The flow diagram for conducting the treatability test is presented in Figure 4-7.

Because data are collected at different locations using different instruments, it is particularly important to synchronize all clock/timepieces used for recording field data and field notebook entries. All data logger time systems and field clocks used during the hydrologic testing and baseline monitoring periods should be synchronized to the official U.S. time (e.g., http://wwp.pacific-standard-time.com/). If the Hanford Meteorological Station is used for barometric pressure measurements, the method used to establish the time of the measurements must be understood so that this dataset can be compared to the other data collected during the test.

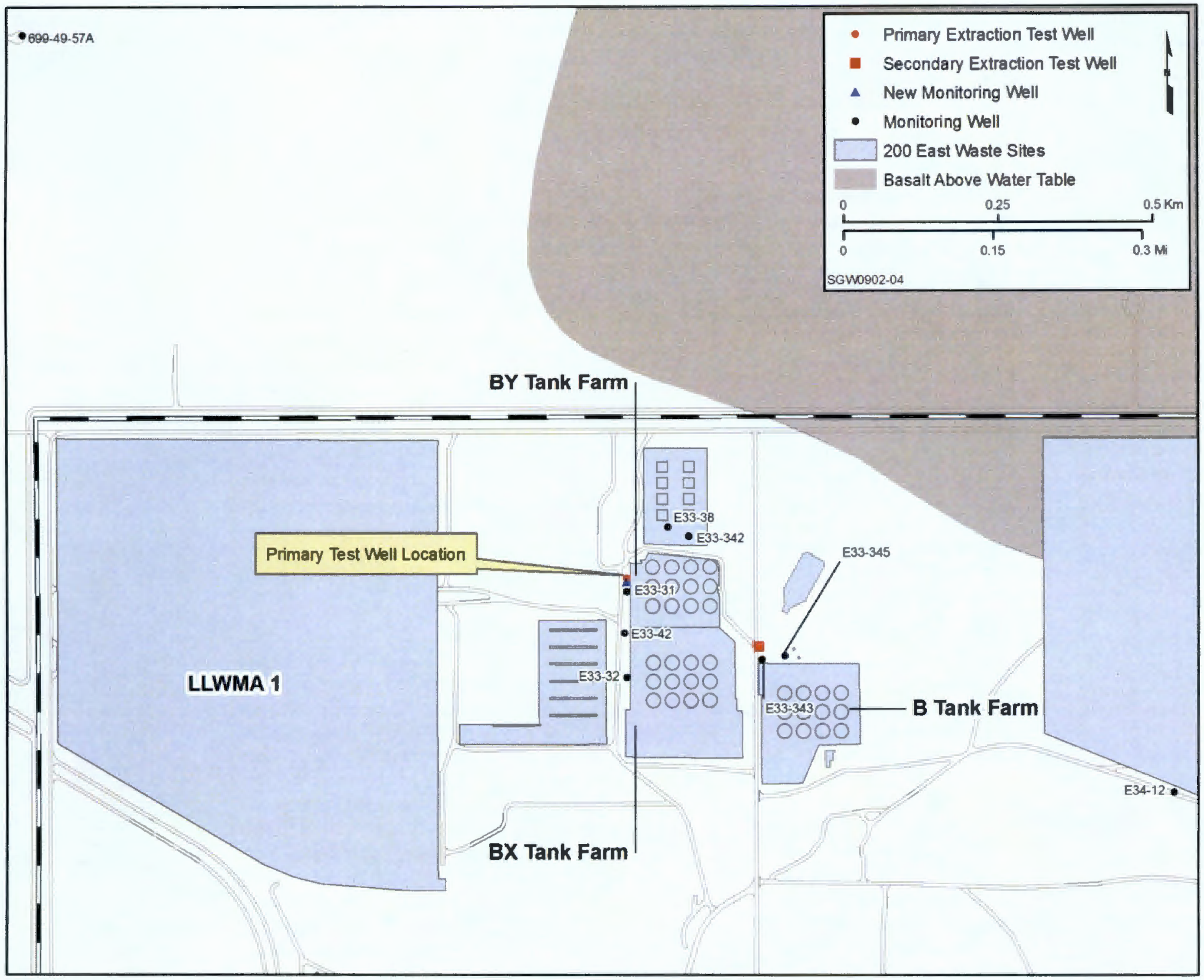


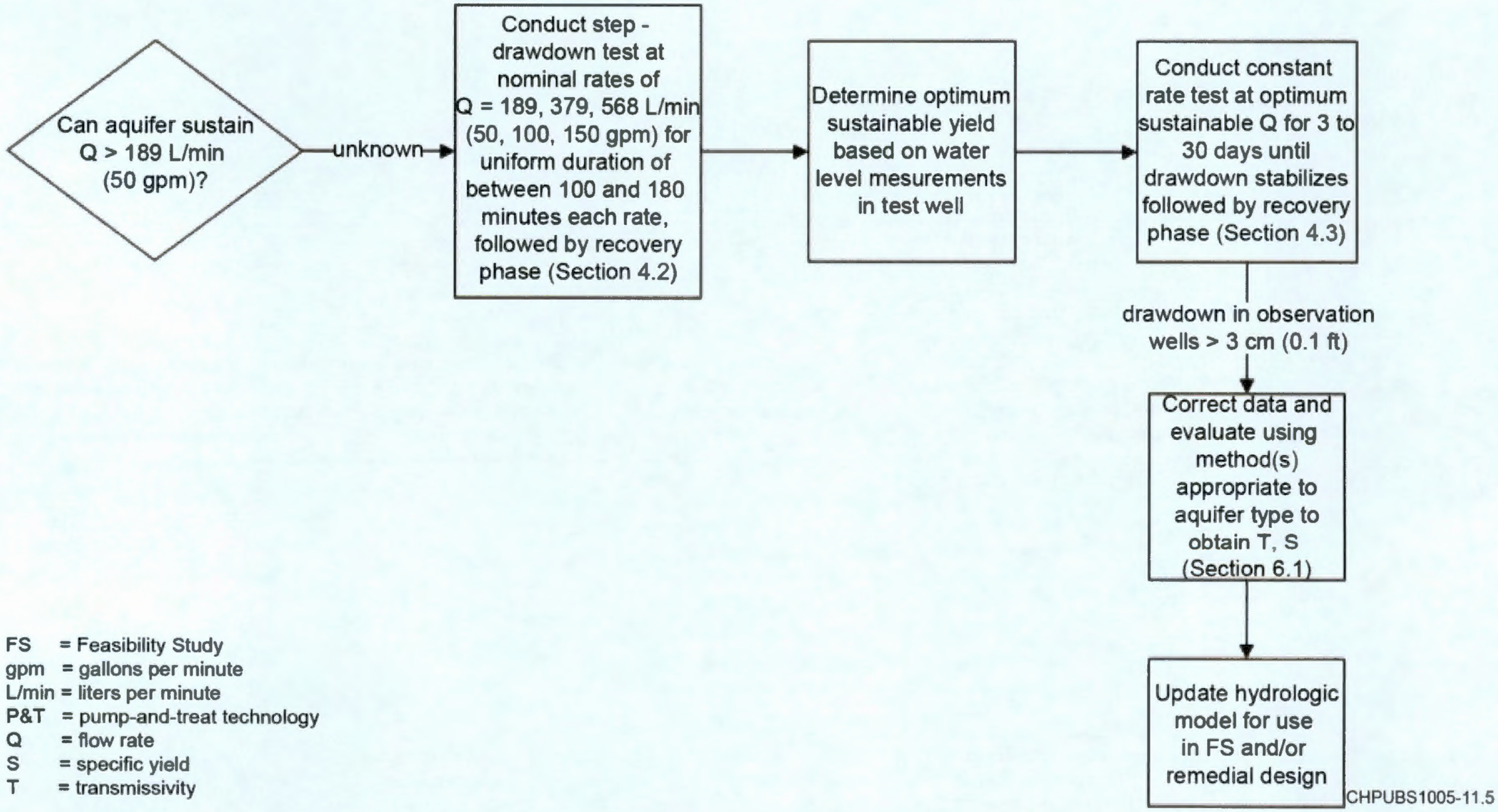

Figure 4-6. Detailed Map of Proposed Extraction Test Well Site(s) and Existing Wells to be Used as Monitoring Wells During the Primary 200-BP-5 Operable Unit Treatability Test

**Table 4-2. Measurement Approach for the 200-BP-5 Operable Unit Treatability Test**

| Test Objectives | Test Component | Key Parameters | Data Quality Objectives | Analytical Methods |
|---|---|---|---|---|
| Determine the sustainable yield of an extraction test well(s) in the vicinity of the uranium and Tc-99 plumes. | Step Drawdown Test: Pump test well at nominal rates of 189 L/min (50 gpm), then 379 L/min (100 gpm), then 568 L/min (150 gpm), for a uniform duration of between 100 and 180 minutes at each rate. Following pumping, initiate a recovery period that lasts two to three times longer than the pumping period. | Pumping rate at test well | Record volume of water pumped to approximately +/- 4 L/min (1 gal/min), every 15 minutes for calculation of average pumping rate. Record pumping rate when water level measurements are made. | Evaluate sustainable yield based on plots of drawdown vs. time. |
| | | Drawdown in test well | Measure drawdown to approximately +/- 0.30 cm (0.01 ft) at frequencies indicated in Table 4-3. | |
| | | Drawdown in monitoring wells | Measure drawdown to approximately +/- 0.30 cm (0.01 ft) at frequencies indicated in Table 4-4. | |
| | Constant-Rate Test: pump test well at optimum sustainable yield for 3 to 30 days until drawdown stabilizes. Following pumping, initiate a recovery period that lasts approximately twice as long as the pumping period. | Pumping rate at test well | Record volume of water pumped, to approximately +/- 4 L/min (1 gal/min), at a minimum every hour until flow rate stabilizes; then record every 12-24 hours for calculation of average pumping rate. Record pumping rate when water level measurements are made. | Evaluate water level drawdown for pumping rates. The optimum sustainable yield generally is the pumping rate that produces drawdown no greater than 25 percent of the pre-test saturated thickness of the aquifer. |
| | | Drawdown in test well | Measure drawdown to approximately +/- 0.30 cm (0.01 ft) at frequencies indicated in Table 4-5. | |
| | | Drawdown in monitoring wells | Measure drawdown to approximately +/- 0.30 cm (0.01 ft) at frequencies indicated in Table 4-4. | |

**Table 4-2. Measurement Approach for the 200-BP-5 Operable Unit Treatability Test**

| Test Objectives | Test Component | Key Parameters | Data Quality Objectives | Analytical Methods |
|---|---|---|---|---|
| Calculate aquifer properties (i.e., aquifer transmissivity and specific yield) that are representative of large-scale conditions. | Constant-Rate Test: pump test well at optimum sustainable yield for 3 to 30 days until drawdown stabilizes. Following pumping, initiate a recovery period that lasts approximately twice as long as the pumping period. | Pumping rate at test well | Record volume of water pumped, to approximately +/- 4 L/min (1 gal/min), at a minimum every hour until flow rate stabilizes; then record every 12-24 hours for calculation of average pumping rate. Record pumping rate when water level measurements are made. | Calculate large-scale values of aquifer transmissivity and specific yield from plots of drawdown vs. time and drawdown vs. distance using standard hydrologic analytical methods appropriate to unconfined aquifer. |
| | | Drawdown in test well | Measure drawdown to approximately +/- 0.30 cm (0.01 ft) at frequencies indicated in Table 4-5. | |
| | | Drawdown in monitoring wells | Measure drawdown to approximately +/- 0.30 cm (0.01 ft) at frequencies indicated in Table 4-4. | |
| Measure the concentrations of uranium and Tc-99 in the extracted groundwater during sustained pumping in the vicinity of the uranium and Tc-99 plumes. | Constant-Rate Test: pump test well at optimum sustainable yield for minimum of 3 days until drawdown stabilizes. Following pumping, initiate a recovery period that lasts approximately twice as long as the pumping period. | Uranium and technetium-99 concentrations | Collect groundwater samples at test well following 1 day, 2 days, and 3 days of pumping, and a fourth sample collected at the end of the test if extended past 3 days. Analyze for uranium and Tc-99 using methods indicated in Table 4.6. | Estimate mass removal rates using concentration analytical data and pumping rate data. |




FS = Feasibility Study
gpm = gallons per minute
L/min = liters per minute
P&T = pump-and-treat technology
Q = flow rate
S = specific yield
T = transmissivity

**Figure 4-7. Flow Diagram for the 200-BP-5 Operable Unit Treatability Test**

## 4.2 Phase 1 – Step-Drawdown Test

The Phase 1 test consists of a step drawdown test, which is a short-term test that can be used to estimate the well's specific capacity (defined as the ratio of the production rate or yield of a well to the drawdown required to produce that yield) and sustainable yield, local aquifer transmissivity (T), and local aquifer specific yield (S). Results from the Phase 1 test will be used to determine the optimum pumping rate for the Phase 2 constant-rate test to produce refined large-scale values for aquifer transmissivity and specific yield within the effective radius of the pumped test well.

Current estimates of aquifer transmissivity in the vicinity of the B Tank Farm Complex were made from slug tests and from drawdown measurements collected during the development of new wells. The estimates vary widely, and the values from slug tests are generally an order of magnitude smaller than those from well development data, even when the data are from the same well (SGW-44329; PNNL-19277). This variability is expected because slug tests only test a small region around the well bore and have limitations in high transmissivity formations. Drawdown data collected during well development are qualitative indicators at best. The estimates of local transmissivity range from less than 2000 $ft^2/d$ to more than 54,000 $ft^2/d$.

Given the range of estimates of aquifer transmissivity, a minimum of three pumping steps at 189, 379, and 568 L/min (50, 100, and 150 gpm) are proposed for the step-drawdown test, based on estimates of aquifer response using the initial hydrologic numerical model (ECF-200BP5-10-0254). These pumping rates are expected to encompass the range of sustained pumping rates that would yield drawdown in monitoring wells sufficient to calculate aquifer hydraulic parameters accurately during the Phase 2 constant-rate test. The planned pumping rates may be changed by the field team lead based on hydraulic data collected during development of the proposed new test extraction well, or on test well performance observed during the conduct of the Phase 1 test itself.

### 4.2.1 Phase 1 Test Mobilization

Prior to the Phase 1 testing, the following activities will occur:

The new test well and new monitoring well at the primary test location will be sited, designed, drilled, constructed, and developed. The conceptual design for the new test well is discussed in Section 4.1.1.

Automated water level measuring devices (e.g., pressure transducers) will be installed at the proposed test well and monitoring well locations (Table 4-1) and programmed to measure water levels on a minimum of an hourly basis for the 30 day period preceding the test. These baseline data will be used to evaluate water level fluctuations that are not induced by pumping. Water level changes in response to changes in barometric pressure will be evaluated using the barometric pressures recorded hourly by the Hanford Meteorological Station. Water level changes in response to river stage fluctuations will be identified using the automated water level measurements performed at the background monitoring wells. This series of measurements should be conducted once the proposed new test well and monitoring well have been constructed and fully developed.

Pressure transducers are recommended for use in the monitoring wells to allow collection of detailed (e.g., hourly) water level changes for evaluation of drawdown vs. time required by the analytical method(s). Manual water level measurements (e.g., using an electronic water level indicator tape [e-tape]) also will be performed at each location where a transducer is deployed. The measurement will be performed after the transducer is secured to the pump and inserted into the well casing. The manual water level measurement will be used to convert pressure transducer water depths to groundwater elevations during the data evaluation step.

Groundwater samples will be collected at the primary test well site and from the secondary test well site if the second treatability test is performed. These samples will be collected to measure baseline conditions. At a minimum, the samples will be analyzed for uranium and Tc-99.

At the conclusion of the 30 day pre-test monitoring period, water level and barometric pressure data will be plotted as a function of time to identify the presence, frequency, and magnitude of temporal fluctuations. Based on this evaluation, the presence and magnitude of the temporal fluctuations will be identified, and the source of each temporal fluctuation identified before proceeding with the remaining Phase 1 operations and monitoring activities.

Phase 1 mobilization activities also will include:

- Verifying that all pre-test, baseline monitoring water level information has been downloaded from the pressure transducers, and the transducers programmed to record water level measurements at the frequencies listed in Table 4-3 and Table 4-4
- Visually inspecting and conducting functional tests on the downhole pump, pump controller, and other water conveyance instruments as applicable (e.g., transfer pump)
- Verifying that all support personnel and equipment are in place

### 4.2.2 Phase 1 Test Operations and Monitoring

The Phase 1 step-drawdown test is performed by pumping the test well at a minimum of three discharge rates (i.e., steps), over a period of 6 to 8 hours, with each step of uniform duration between 100 to 180 minutes as follows:

1. Pumping Step 1 – Initiate pumping at a rate of 189 L/min (50 gpm) with flow rate and water level measurements recorded as described in Section 4.1.4 and at the frequencies listed in Table 4-3 and Table 4-4. Continue pumping for approximately 2 hours.
2. Pumping Step 2 – Increase the pumping rate to 379 L/min (100 gpm) with flow rate and water level measurements recorded as described in Section 4.1.4 and at the frequencies listed in Table 4-3 and Table 4-4. Continue pumping for approximately 2 hours.
3. Pumping Step 3 – Increase pumping rate to 568 L/min (150 gpm) and repeat flow rate and water level measurements as described in this section. It should be noted that the pumping water level may not have stabilized by the end of each step.
4. Recovery Phase – After completing 2 hours of pumping at the 568 L/min (150 gpm) rate, terminate all pumping and begin water level measurement recovery phase. Measure and record measurements at the frequencies listed in Table 4-3 and Table 4-4. A recovery phase lasting approximately 24 hours (i.e., two to three times longer than the drawdown phase) is recommended.

The step test at the primary test location is estimated to generate 136,275 L (36,000 gallons) of water if each of the three steps is performed for 2 hours.

It is recommended that the drawdown at the test well be limited to no greater than 25 percent of the pre-test unconfined aquifer saturated thickness (PNNL-18279). If the pumping water level drops below this point during any one of the three steps, additional forward testing (increased pumping rates) may be eliminated. The pumping rate may be reduced halfway back to the rate of the prior step and the new step repeated.

Control and measurement of the pumping rate during the Phase 1 Step-Drawdown Test is paramount to the implementation and evaluation of the test results, as noted in the DQO summary report (Section 3.2 of this report). For example, the pumping rate should be measured and recorded when water level measurements are made. Average pumping rates would be determined by recording the total volume of water pumped at 15 minute intervals during this phase of the testing.

All clock/timepieces used for recording field data and field notebook entries should be synchronized to the official U.S. time (e.g., http://wwp.pacific-standard-time.com/).

The need for a Phase 1 step-drawdown test at the secondary test location will be based on evaluation of data from testing at the primary test location.

**Table 4-3. Proposed Water Level Measurement Frequencies at the Test Well During the Phase 1 Step-Drawdown Test of the 200-BP-5 Operable Unit Treatability Test**

| Individual Step-Drawdown Period[a] | | Step-Drawdown Recovery Period | |
|---|---|---|---|
| **Measurement Time Interval** | **Measurement Frequency** | **Measurement Time Interval** | **Measurement Frequency** |
| **At Each of the Pumping Rate Steps** | | **Following Termination of Pumping** | |
| 0 to 1 minutes | 1 to 2 seconds[b] | 0 to 1 minutes | 1 to 2 seconds[b] |
| 1 to 3 minutes | 5 seconds | 1 to 3 minutes | 5 seconds |
| 3 to 5 minutes | 10 seconds | 3 to 5 minutes | 10 seconds |
| 5 to 10 minutes | 15 seconds | 5 to 10 minutes | 15 seconds |
| 10 to 20 minutes | 20 seconds | 10 to 20 minutes | 20 seconds |
| 20 to 30 minutes | 30 seconds | 20 to 30 minutes | 30 seconds |
| 30 to 60 minutes | 1 minute | 30 to 60 minutes | 1 minute |
| 1 to 2 hours | 2 minutes | 1 to 2 hours | 2 minutes |
| - | - | 2 to 4 hours | 5 minutes |
| - | - | 4 to 8 hours | 10 minutes |
| - | - | >8 hours | 15 minutes |

a. Each individual step to follow measurement frequencies indicated.

b. Dependent on data acquisition/measurement system capabilities.

**Table 4-4. Proposed Water Level Measurement Frequencies at Monitoring Wells During the Phase 1 Step-Drawdown Test and Phase 2 Constant-Rate Test of the 200-BP-5 Operable Unit Treatability Test**

| Primary and Background Monitoring Wells[a] | | Secondary Monitoring Wells[a] | |
|---|---|---|---|
| **Measurement Time Interval** | **Measurement Frequency** | **Measurement Time Interval** | **Measurement Frequency** |
| 0 to 1 minutes | 2 seconds[b] | 0 to 5 minutes | 15 seconds |
| 1 to 3 minutes | 5 seconds[b] | 5 to 30 minutes | 30 seconds |

**Table 4-4. Proposed Water Level Measurement Frequencies at Monitoring Wells During the Phase 1 Step-Drawdown Test and Phase 2 Constant-Rate Test of the 200-BP-5 Operable Unit Treatability Test**

| Primary and Background Monitoring Wells[a] | | Secondary Monitoring Wells[a] | |
|---|---|---|---|
| Measurement Time Interval | Measurement Frequency | Measurement Time Interval | Measurement Frequency |
| 3 to 5 minutes | 10 seconds[b] | 30 to 60 minutes | 1 minute |
| 5 to 10 minutes | 15 seconds[b] | 1 to 2 hours | 2 minutes |
| 10 to 20 minutes | 20 seconds[b] | 2 to 4 hours | 5 minutes |
| 20 to 30 minutes | 30 seconds[b] | 4 to 8 hours | 10 minutes |
| 30 to 60 minutes | 1 minute[b] | >8 hours | 15 minutes |
| 1 to 2 hours | 2 minutes[b] | -- | -- |
| 2 to 4 hours | 5 minutes[b] | -- | -- |
| 4 to 8 hours | 10 minutes[b] | -- | -- |
| >8 hours | 15 minutes[b] | -- | -- |

a. Indicated measurement frequency during both step-drawdown and recovery periods.

b. Dependent on data acquisition/measurement system capabilities.

### 4.2.3 Phase 1 Test Demobilization

All groundwater extracted during the Phase 1 testing will be pumped or transported to ETF for treatment. The pressure transducer data, flow rate data, and water level drawdown measurement data will be reviewed. Based on these measurements, a pumping rate for the Phase 2 constant-rate test will be selected that produces at least 3 cm (0.1 ft) of drawdown in the primary monitoring wells (Section 4.1.3).

## 4.3 Phase 2 – Constant-Rate Test

The primary objectives for the Phase 2 constant-rate test(s) are to determine if the aquifer can sustain a pumping rate of 189 L/min (50 gpm) and to measure large-scale values of aquifer transmissivity and specific yield. The duration of the test necessary to establish whether the yield is sustainable generally depends on the aquifer type (unconfined, confined, or leaky aquifer) and the presence of hydrogeologic boundary conditions that can significantly affect the sustainable yield determination. ILRI Publication 47, Analysis, and Evaluation of Pumping Test Data (Kruseman and de Ridder, 19944) recommends that the aquifer test continue until water level drawdown values stabilize (i.e., infinite-acting radial flow conditions are established), which generally occurs within three days in an unconfined aquifer and within one day in a leaky aquifer. The delineation of an aquifer boundary requires a longer extension of the test.

Based on knowledge of geologic conditions in the B Tank Farm Complex, boundary conditions are not expected in the vicinity of the primary test well site. Therefore, the minimum test duration is 3 days. A maximum duration of 30 days is proposed with the final test duration to be determined in the field based on evaluation of the water level drawdown measurements. Following the minimum 3-day test duration, and once water levels stabilize in the test well and monitoring wells, the drawdown phase of the test will be terminated and the recovery phase of the test will be initiated. A recovery monitoring phase lasting approximately twice as long as the pumping phase is recommended (PNNL-18279).

At the secondary test well site, boundary or aquitard leakage conditions may occur. Therefore, a minimum test duration between 1 and 3 days, with a maximum duration of 30 days, is proposed. The final test duration will be determined in the field based on evaluation of the water level data. Once water levels stabilize, the drawdown phase will be terminated and the recovery phase will be initiated.

Water levels will be considered stable when they don't change by more than approximately 0.30 cm (0.01 ft) (i.e., the precision of the measurement instruments) over a 12 to 24 hour period. This criterion is subject to revision based on observed field conditions (e.g., unusual water level fluctuations not attributable to the pumping test). Alternatively, the field team lead may declare the test complete if a semi-log time-drawdown plot for a monitoring well at least 61 m (200 ft) from the pumped well displays a well-developed straight-line segment (determined quantitatively using pressure derivative analysis) preferably but not necessarily spanning at least one full log cycle.

### 4.3.1 Phase 2 Test Mobilization

Phase 2 testing will begin after the water levels in the monitoring wells have recovered to static levels following the Phase 1 testing. This recovery is expected to occur within three days of completing the Phase 1 testing. Phase 2 mobilization activities will include:

- Verify that infrastructure is in place for transfer of extracted groundwater to ETF and that ETF is ready to accept the anticipated maximum volume of groundwater to be produced during the Phase 2 testing.
- Pump or transport remaining extracted groundwater from the Phase 1 testing to ETF.
- Verify that all Phase 1 – Step-drawdown test water level information has been downloaded from the monitoring well pressure transducers and that the transducers are programmed to record water level measurements at the frequencies listed in Table 4-4 and Table 4-5.
- Perform manual water level measurements at each location where a transducer is deployed. The measurement will be performed after the transducer is secured to the pump and inserted into the well casing. The manual water level measurement will be used to convert pressure transducer water depths to groundwater elevations during the data transformation – data evaluation step.
- Visually inspect and conduct functional tests on the downhole pump, pump controller, and other water conveyance instruments as applicable (e.g., transfer pump).
- Arrange for all water sampling containers required for the time series sampling described in Section 4.3.4.
- Verify that all support personnel and equipment are in place.

**Table 4-5. Proposed Water Level Measurement Frequencies at the Test Well During the Phase 2 Constant-Rate Test of the 200-BP-5 Operable Unit Treatability Test**

| Drawdown Period | | Recovery Period | |
|---|---|---|---|
| Measurement Time Interval | Measurement Frequency | Measurement Time Interval | Measurement Frequency |
| Once Pumping Initiated | | Following Termination of Pumping | |
| 0 to 1 minutes | 1 to 2 seconds* | 0 to 1 minutes | 1 to 2 seconds* |
| 1 to 3 minutes | 5 seconds | 1 to 3 minutes | 5 seconds |
| 3 to 5 minutes | 10 seconds | 3 to 5 minutes | 10 seconds |

**Table 4-5. Proposed Water Level Measurement Frequencies at the Test Well During the Phase 2 Constant-Rate Test of the 200-BP-5 Operable Unit Treatability Test**

| Drawdown Period | | Recovery Period | |
|---|---|---|---|
| **Measurement Time Interval** | **Measurement Frequency** | **Measurement Time Interval** | **Measurement Frequency** |
| 5 to 10 minutes | 15 seconds | 5 to 10 minutes | 15 seconds |
| 10 to 20 minutes | 20 seconds | 10 to 20 minutes | 20 seconds |
| 20 to 30 minutes | 30 seconds | 20 to 30 minutes | 30 seconds |
| 30 to 60 minutes | 1 minute | 30 to 60 minutes | 1 minute |
| 1 to 2 hours | 2 minutes | 1 to 2 hours | 2 minutes |
| 2-4 hours | 5 minutes | 2 to 4 hours | 5 minutes |
| 4-8 hours | 10 minutes | 4 to 8 hours | 10 minutes |
| >8 hours | 15 minutes | >8 hours | 15 minutes |

* Dependent on data acquisition/measurement system capabilities.

### 4.3.2 Phase 2 Test Operations and Monitoring

The constant-rate test at the primary test location will be initiated at the optimum pumping rate, as determined from Phase 1 testing. It is recommended that the drawdown in the pumped well be limited to no greater than 25 percent of the pre-test unconfined aquifer saturated thickness (PNNL-18279). The optimum pumping rate is designed to provide the maximum practical hydraulic stress on the aquifer to meet all of the test objectives.

Using the optimum pumping rate has two advantages. First, it reduces the required pumping period without increasing the total amount of water pumped. Second, it renders easier and accurate interpretation of the drawdown data.

Once the test is initiated, the field team lead and designated support personnel (Section 8.1) will ensure coverage is provided to maintain pump operations and flow control. Communications will be maintained with ETF staff to shut off the extraction well pump, if necessary, to maintain safe operation at the ETF facility. If the Phase 2 test is interrupted, the test may resume after adequate aquifer recovery period (typically twice the pumping period prior to interruption) as determined by the field team lead.

The field team lead and designated support staff shall evaluate test well water level data on a daily basis to determine if the steady state criteria have been achieved after the minimum pumping duration (3 days primary well site; 1 to 3 days secondary well site) have been completed. Pumping will be terminated, and the recovery phase of the test initiated will be based on evaluation of the data.

During Phase 2 testing, samples of extracted groundwater from the primary test well site will be collected following 1 day, 2 days, and 3 days of pumping and a fourth sample will be collected at the end of the test if extended past 3 days. Samples at the secondary test well site will be collected following ½ day and 1 day of pumping. If the test is extended beyond a 1 day period, a third sample will be collected at the end of day 2 and a fourth sample will be collected just prior to the end of the test. The samples will be collected from a sample port installed at the wellhead. Additional information on laboratory testing requirements is provided in Section 4.3.4.

Control and measurement of the pumping rate during the Phase 2 constant-rate test is paramount to the implementation and evaluation of the test results, as noted in the DQO summary report (Section 3.2 of this report). For example, the pumping rate should be measured and recorded when water level measurements are made. Average pumping rates would be determined by recording the total volume of water pumped at 1 hour intervals during this phase of the testing. Once the flow rate conditions have stabilized, the measurement frequency would be reduced to a 12 to 24 hour interval.

All clock/timepieces used for recording field data and field notebook entries should be synchronized to the official U.S. time (e.g., http://wwp.pacific-standard-time.com/).

If Phase 2 constant-rate testing is conducted at the secondary test location, the scope and operating parameters for the test will be based on the configuration of the test wells and on evaluation of data from testing at the primary test location.

### 4.3.3 Phase 2 Test Operations and Maintenance

During the Phase 2 test, groundwater will need to be conveyed to ETF for treatment. If the water is pumped to the ETF cross-site pipeline, the conveyance piping will be visually inspected for leaks on a daily basis while water is being transferred. All inspection results will be documented.

### 4.3.4 Sampling and Analysis

Groundwater samples collected from the test well(s) during the Phase 2 aquifer test will be analyzed for uranium and Tc-99 (Table 4-6). One field duplicate sample will also be collected on day 1 for each test. Laboratory test results will be used to estimate contaminant mass recovery rates for uranium and Tc-99.

The parameters listed in Table 4-7 and Table 4-8 will be analyzed in a single sample taken from each test well(s), prior to the initiation of the Phase 1 or Phase 2 testing, only if ETF representatives determine that existing analytical data for monitoring wells located in the vicinity of the test well(s) do not provide adequate characterization information for a waste acceptance determination. In the event the Phase 2 testing is extended beyond a 90 day period, one sample will be collected on a quarterly basis from the test well(s) and analyzed for the parameters listed in Table 4-7 and 4-8.

Additional details on sampling and analysis requirements, including quality assurance (QA)/quality control (QC) requirements, are provided in the sampling and analysis plan (SAP) included as Appendix A.

### 4.3.5 Phase 2 Test Decommissioning and Demobilization

Following completion of the Phase 2 testing, the treatability test well and downhole equipment will be left in place, pending selection of the final remedial alternative. If it is determined, through the FS and record of decision (ROD) and/or the RD/RAWP, that this well is no longer needed, all downhole equipment will be decontaminated and decommissioned. If used, the conveyance piping will be left in place, pending the selection of the final remedial alternative, unless it is interfering with other above-ground activities. In that case, it will be decontaminated and decommissioned.

## 4.4 Treatment Process Description

The treatment system includes the transfer of extracted groundwater from the test well to interim storage at the Liquid Effluent Retention Facility (LERF), the treatment system at the 200 Area ETF, and the discharge of the treated effluent to SALDS.

### 4.4.1 Pipelines

The groundwater transfer pipeline consists of three main sections:

- The existing cross-site pipelines associated with the LERF basins and the ETF in the 200 East Area (Figure 4-4)
- The existing transfer pipeline that conveys the treated effluent from ETF to the SALDS site north of the 200 West Area (Figure 4-4)
- A temporary transfer pipeline to convey the groundwater extracted from the 200-BP-5 test well to the ETF cross-site transfer line in the 200 East Area (Section 4.1.2)

The existing cross-site pipeline used to convey water to the LERF basins is an underground, 15.2-cm (6-in.) diameter, polyvinyl chloride (PVC) pipe. This pipeline was installed as a spare line, parallel to and in the same trench as the main cross-site pipeline associated with the 200 Area Treated Effluent Disposal Facility system. The 15.2 cm diameter spare line is currently being used to transfer extracted groundwater from the 200-UP-1 OU pump-and-treat and the WMA T portion of the 200-ZP-1 OU pump-and-treat to the LERF basins and ETF.

The existing transfer pipeline used to convey treated water from ETF to SALDS is an underground, 20.3-cm (8-in.) diameter, PVC pipe.

The temporary transfer pipeline to convey groundwater extracted from the 200-BP-5 OU treatability test well to the ETF pipeline will be single-walled and above ground (Section 4.1.4). There are two available manholes south of the test area that could be used for tie-in to the existing pipeline. The location of the tie-in will be determined during the detailed design phase of the test.

Routine walkdowns of the pipeline will be performed during test operations.

**Table 4-6. 200-BP-5 Treatability Test Analytical Performance Requirements for Water Matrices – Phase 2 Time-Series Sampling**

| Chemical Abstracts Service No. or Constituent Identifier No. | Analyte | Survey or Analytical Method[a] | Water Lowest Overall RBSL[b] (pCi/L) | Water Target Detection Limits (pCi/L)[c] | Water Precision Required (%)[d] | Water Accuracy Required (%)[d] |
|---|---|---|---|---|---|---|
| 14133-76-7 | Technetium-99 | Tc-99 LSC (low level) | 900 | 900 | ≤20 | 80-120 |
| U-233/234 | Uranium-233/234 | Isotopic Uranium AEA | None (20)[g] | 20 | ≤20 | 80-120 |
| 15117-96-1 | Uranium-235 | | None (24)[g] | 24 | ≤20 | 80-120 |
| U-238 | Uranium-238 | | None (24)[g] | 24 | ≤20 | 80-120 |
| 7440-61-1 | Uranium (total) | Kinetic phosphorescence analysis, or EPA Method 200.8 | 0.5 | 0.5 | ≤20 | 80-120 |

**Table 4-7. 200-BP-5 Treatability Test Radionuclide Analytical Performance Requirements for Water Matrices – for ETF Waste Acceptance**

| Chemical Abstracts Service No. or Constituent Identifier No. | Analyte | Survey or Analytical Method[a] | Water Lowest Overall RBSL[b] (pCi/L) | Water Target Detection Limits (pCi/L)[c] | Water Precision Required (%)[d] | Water Accuracy Required (%)[d] |
|---|---|---|---|---|---|---|
| 12587-46-1 | Gross alpha[e] | GPC | 15 | 3 | ≤20 | 80-120 |
| 12587-47-2 | Gross beta[e] | GPC | None[f] | 4 | ≤20 | 80-120 |
| 14596-10-2 | Americium-241[e] | Am-241 AEA | 15 | 15 | ≤20 | 80-120 |
| 14762-75-5 | Carbon-14 | C-14-liquid scintillation | 609 | 609 | ≤20 | 80-120 |
| 10198-40-0 | Cobalt-60 | Gamma GS | 100 | 100 | ≤20 | 80-120 |
| 10045-97-3 | Cesium-137[e] | Gamma GS | 43 | 43 | ≤20 | 80-120 |
| 15046-84-1 | Iodine-129 | Chemical separation low energy spectroscopy | 1 | 1 | ≤20 | 80-120 |
| 13994-20-2 | Neptunium-237 | AEA | 15 | 15 | ≤20 | 80-120 |
| 13981-16-3 | Plutonium-238 | AEA | 15 | 15 | ≤20 | 80-120 |
| 15117-48-3/ 14119-33-6 | Plutonium-239/240[e] | AEA | 15 | 15 | ≤20 | 80-120 |
| 10098-97-2 | Strontium-90[e] | Strontium-89, 90-Total Sr gas proportional counting | 8 | 8 | ≤20 | 80-120 |
| 14133-76-7 | Technetium-99 | Technetium-9 9 LSC (low level) | 900 | 900 | ≤20 | 80-120 |
| TH-232 | Thorium-232[e] | Isotopic Thorium AEA | 15 | 15 | ≤20 | 80-120 |
| 10028-17-8 | Tritium | Tritium - H3 LSC (mid level) | 20,000 | 20,000 | ≤20 | 80-120 |
| U-233/234 | Uranium-233/234 | Isotopic Uranium AEA | None (20)[g] | 20 | ≤20 | 80-120 |
| 15117-96-1 | Uranium-235 | | None (24)[g] | 24 | ≤20 | 80-120 |
| U-238 | Uranium-238 | | None (24)[g] | 24 | ≤20 | 80-120 |

**Table 4-7. 200-BP-5 Treatability Test Radionuclide Analytical Performance Requirements for Water Matrices – for ETF Waste Acceptance**

| Chemical Abstracts Service No. or Constituent Identifier No. | Analyte | Survey or Analytical Method[a] | Water Lowest Overall RBSL[b] (pCi/L) | Water Target Detection Limits (pCi/L)[c] | Water Precision Required (%)[d] | Water Accuracy Required (%)[d] |
|---|---|---|---|---|---|---|

a. EPA Methods 903.1 and 904.0 are found in EPA-600/4-80-032.

b. Human health RBSL obtained from following references: WAC 173-340-720, *Safe Drinking Water Act of 1974*, and WAC 246-290-310.

c. Detection limits are based on optimal conditions in a standard fixed laboratory. Interferences and matrix effects may decrease sensitivity, resulting in an increase to the values shown.

d. Accuracy criteria are the minimum for associated batch laboratory control sample percent recoveries. Laboratories must meet statistically based control if more stringent. With the exception of gamma energy analysis, additional analysis specific evaluations also performed for matrix spikes, tracers, and carriers, as appropriate to the method. Precision criteria are based on batch laboratory replicate sample analyses.

e. Not a contaminant of potential concern for groundwater in the vicinity of B Tank Farm Complex (DOE/RL-2007-18, Table A1-3 and Table A1-4).

f. The federal MCL for gross beta particle activity is 4 mrem/yr. The average annual concentration shall not produce an annual dose from all beta emitting isotopes equivalent to the total body or any internal organ dose >4 mrem/yr.

g. No existing MCLs for uranium isotopes. Values shown in parenthesis are concentrations in water that would produce an effective dose equivalent of 4 mrem/yr if consumed at average annual rates (from Table 1.0-6 ofDOE/RL-2008-01.

AEA = alpha energy analysis
RBSL = risk-based screening level
GPC = gas flow proportional counting
GS = gamma spectroscopy
LSC = liquid scintillation counter
MCL = maximum contaminant level
EPA = U.S. Environmental Protection Agency
mrem/yr = millirem per year

**Table 4-8. 200-BP-5 Treatability Test Chemical Analytical Performance Requirements for Water Matrices – for ETF Waste Acceptance**

| Chemical Abstracts Service No. | Analyte | Survey or Analytical Method[a] | Water Lowest Overall RBSL (µg/L)[b] | Water Target Detection Limits (µg/L)[c] | Water Precision Required (%)[d] | Water Accuracy Required (%)[d] |
|---|---|---|---|---|---|---|
| | | **Metals** | | | | |
| 7429-90-5 | Aluminum | EPA Methods 6010 (trace), 6020, or 200.8 (trace) | 50 | 50 | ≤20 | 80-120 |
| 7440-36-0 | Antimony[e] | EPA Methods 6010 (trace), 6020, or 200.8 (trace) | 6.0 | 6.0 | ≤20 | 80-120 |
| 7440-38-2 | Arsenic[e] | EPA Methods 6010 (trace), 6020, 7062, or 200.8 | 0.058 | 0.058 | ≤20 | 80-120 |
| 7440-39-3 | Barium[e] | EPA Methods 6010, 6020, or 200.8 | 4 | 4 | ≤20 | 80-120 |
| 7440-41-7 | Beryllium[e] | EPA Methods 6010, 6020, or 200.8 | 2 | 4 | ≤20 | 80-120 |
| 7440-43-9 | Cadmium | EPA Methods 6010, 6020, or 200.8 | 0.25 | 0.25 | ≤20 | 80-120 |
| 7440-70-2 | Calcium[e] | EPA Methods 6010 | -- | 1,000 | ≤20 | 80-120 |
| 7440-47-3 | Chromium (III)/Chromium (total) | EPA Methods 6010, 6020, or 200.8 | 74 | 74 | ≤20 | 80-120 |
| 7440-48-4 | Cobalt[e] | EPA Methods 6010, 6020, or 200.8 | 4.8 | 4 | ≤20 | 80-120 |
| 18540-29-9 | Hexavalent Chromium | EPA Method 7196 | 11 | 11 | ≤20 | 80-120 |
| 7439-89-6 | Iron | EPA Method 6010 | 300 | 300 | ≤20 | 80-120 |
| 7439-92-1 | Lead[e] | EPA Methods 6010, 6020, or 200.8 | 2.1 | 2 | ≤20 | 80-120 |
| 7439-95-4 | Magnesium[e] | EPA Methods 6010, 6020, or 200.8 | -- | 1,000 | ≤20 | 80-120 |

**Table 4-8. 200-BP-5 Treatability Test Chemical Analytical Performance Requirements for Water Matrices – for ETF Waste Acceptance**

| Chemical Abstracts Service No. | Analyte | Survey or Analytical Method[a] | Water Lowest Overall RBSL (µg/L)[b] | Water Target Detection Limits (µg/L)[c] | Water Precision Required (%)[d] | Water Accuracy Required (%)[d] |
|---|---|---|---|---|---|---|
| 7439-96-5 | Manganese[e] | EPA Methods 6010, 6020, or 200.8 | 50 | 50 | ≤20 | 80-120 |
| 7439-97-6 | Mercury[e] | EPA Methods 6010, 6020, or 200.8 | 0.05 | 0.5 | ≤20 | 80-120 |
| 7440-09-7 | Potassium[e] | EPA Methods 6010, 6020, or 200.8 | -- | 100 | ≤20 | 80-120 |
| 7440-21-3 | Silicon[e] | EPA Methods 6010, 6020, or 200.8 | -- | 20 | ≤20 | 80-120 |
| 7440-23-5 | Sodium | EPA Methods 6010, 6020, or 200.8 | -- | 1,000 | ≤20 | 80-120 |
| 7440-28-0 | Thallium | EPA Methods 6010 (trace), 6020, or 200.8 | 2.0 | 2.0 | ≤20 | 80-120 |
| 7440-61-1 | Uranium (total) | Kinetic phosphorescence analysis, or EPA Method 200.8 | 0.5 | 0.5 | ≤20 | 80-120 |
| 7440-62-2 | Vanadium[e] | EPA Methods 6010 (trace), 6020, or 200.8 | 112 | 25 | ≤20 | 80-120 |
| 7440-66-6 | Zinc[e] | EPA Methods 6010, 6020, or 200.8 | 120 | 120 | ≤20 | 80-120 |
| **Volatile and Semi-Volatile Organic Compounds** | | | | | | |
| 78-93-3 | 2-Butanone[e] | EPA Method 8260 | 4,800 | 10 | ≤20 | 80-120 |
| 67-64-1 | Acetone[e] | EPA Method 8260 | 7,200 | 20 | ≤20 | 80-120 |
| 56-23-5 | Carbon tetrachloride[e] | EPA Method 8260 | 0.23 | 1 | ≤20 | 80-120 |
| 117-81-7 | bis(2-Ethylhexyl) phthalate[e] | EPA Method 8270 | 6.0 | 10 | ≤20 | 80-120 |
| 126-73-8 | Tributyl phosphate[e] | EPA Method 8270 | 16.2 | 100 | ≤20 | 80-120 |

**Table 4-8. 200-BP-5 Treatability Test Chemical Analytical Performance Requirements for Water Matrices – for ETF Waste Acceptance**

| Chemical Abstracts Service No. | Analyte | Survey or Analytical Method[a] | Water Lowest Overall RBSL (µg/L)[b] | Water Target Detection Limits (µg/L)[c] | Water Precision Required (%)[d] | Water Accuracy Required (%)[d] |
|---|---|---|---|---|---|---|
| | | **General Chemistry** | | | | |
| 14798-03-9 | Ammonium[e] | EPA 350.1 | - | 10 | ≤20 | 80-120 |
| 16887-00-6 | Chloride | IC, EPA Methods 300.0, or 9056 | 230,000 | 230,000 | ≤20 | 80-120 |
| 57-12-5 | Cyanide | EPA Methods 9010 total cyanide, or 335 | 5.2 | 5.2 | ≤20 | 80-120 |
| 16984-48-8 | Fluoride[e] | IC, EPA Methods 300.0, or 9056 | 200 | 200 | ≤20 | 80-120 |
| 20461-54-5 | Iodide[e] | IC, EPA Methods 300.0, or 9056 | -- | 100 | ≤20 | 80-120 |
| 14797-55-8 | Nitrate | IC, EPA Methods 300.0, or 9056 | 1,600 | 1,600 | ≤20 | 80-120 |
| 14797-65-0 | Nitrite | IC, EPA Methods 300.0, or 9056 | 40 | 40 | ≤20 | 80-120 |
| 14808-79-8 | Sulfate | IC, EPA Methods 300.0, or 9056 | 70,000 | 70,000 | ≤20 | 80-120 |
| ALKALINITY | Alkalinity[e] | Method 310.1/310.2 | -- | 5,000 | ≤20 | 80-120 |
| PH | pH[e] | Method 9040 | -- | 0.1 | +/-0.1 pH units | +/-0.1 pH units |
| HARDNESS | Total hardness[e] | Method 2340 (calculate from Ca + Mg) | N/A | N/A | N/A | N/A |
| TDS | Total dissolved solids[e] | Method 160.1 | 500,000 | 500,000 | ≤20 | 80-120 |
| TSS | Total suspended solids[e] | Method 160.2 | N/A | N/A | ≤20 | 80-120 |
| TOC | Total organic carbon[e] | Method 415.1 | N/A | N/A | ≤20 | 80-120 |

a. For 4-digit EPA methods, see SW-846. For EPA Methods 300.0, 335, and 353, see EPA-600/4-79-020. For EPA Method 200.8, see EPA/600/R-94-111.

b. Human health RBSL obtained from following references:WAC 173-340-720, *Safe Drinking Water Act of 1974*, and WAC 246-290-310.

c. Detection limits are based on optimal conditions in a standard fixed laboratory. Interferences and matrix effects may decrease sensitivity, resulting in an increase to the values shown.

d. Accuracy criteria are the minimum for associated batch laboratory control sample percent recoveries. Laboratories must meet statistically based control if more stringent. Additional analyte-specific evaluations also are performed for matrix spikes and surrogates, as appropriate to the method. Precision criteria are based on batch

**Table 4-8. 200-BP-5 Treatability Test Chemical Analytical Performance Requirements for Water Matrices – for ETF Waste Acceptance**

| Chemical Abstracts Service No. | Analyte | Survey or Analytical Method[a] | Water Lowest Overall RBSL (µg/L)[b] | Water Target Detection Limits (µg/L)[c] | Water Precision Required (%)[d] | Water Accuracy Required (%)[d] |
|---|---|---|---|---|---|---|

laboratory replicate matrix spike analyses.

e. Not a contaminant of potential concern for groundwater in the vicinity of B Tank Farm Complex (DOE/RL-2007-18, Table A1-3, Table A1-4).

– = No information available

N/A = Not applicable

RBSL = risk based screening level

EPA = U.S. Environmental Protection Agency

IC = ion chromatography

### 4.4.2 Liquid Effluent Retention Facility

The LERF consists of three double lined surface impoundments with a nominal capacity of 29.5 million L (7.8 million gal) each. Each liner is constructed of high-density polyethylene. A cover made of low-density polyethylene ensures that the waste is not lost to the environment through evaporation. Extracted groundwater from the 200-UP-1 pump-and-treat and WMA T portion of the 200-ZP-1 pump-and-treat is stored in basin 43. This basin will have sufficient storage capacity for receipt of groundwater extracted during the 200-BP-5 treatability test if it is not in use to support the 200-UP-1 and 200-ZP-1 pump-and-treat operations.

A concrete catch basin at the northwest corner of each basin is equipped with risers that extend to the bottom of the basin. A submersible pump is used in one of these risers to pump the waste to the ETF for processing or pump a basin's contents to any other basin. Groundwater is pumped from the LERF to the ETF through a double walled fiberglass pipeline. The pipeline is equipped with leak detection located in the annulus between the inner and outer pipes.

### 4.4.3 Effluent Treatment Facility

Treatment of extracted groundwater will occur at the ETF and will follow associated facility operational procedures and plans.

The ETF is composed of a series of process units that are located in primary and secondary treatment trains. Typically, an aqueous waste is processed in the primary treatment train first, which provides for the removal of contaminants. The secondary treatment train processes the waste byproducts from the primary treatment train. In the secondary treatment train, contaminants are concentrated and dried into a powder and the liquid fraction is routed back to the primary treatment train. The flexibility of the ETF allows some aqueous wastes to be processed in the secondary treatment train first. The preferred operating scenario will depend on the specific chemistry of the groundwater (and/or volume for other aqueous waste streams).

The primary treatment train consists of the following process units:

- Filtration – suspended solids removal
- Ultraviolet light oxidation – organic destruction

- pH adjustment – removal of carbonates
- Degasification – removal of carbon dioxide and other dissolved gasses
- Reverse osmosis – removal of dissolved solids and radionuclides
- Ion exchange – removal of dissolved solids and radionuclides

The secondary treatment train provides the following process units:

- ETF evaporator – concentration of secondary waste streams
- Thin film dryer – dewatering of secondary waste streams

Three verification tanks receive the treated groundwater and laboratory analysis is performed on each tank to determine if the discharge limits are met. The verification tanks alternate between three operating modes: receiving treated wastewater, holding treated wastewater during laboratory analysis and verification, or discharging verified wastewater. Should the groundwater not meet the *State Waste Discharge Permit ST-4500* (Ecology, 2000 as extended per Ecology 2005) or final delisting (40 *Code of Federal Regulations* [CFR] 261, Appendix IX, Table 2) requirements, it can be returned to the primary process for additional treatment.

Groundwater that meets release criteria is pumped from the ETF to SALDS for discharge (Figure 4-4).

Containerized waste generated as a result of treating groundwater is temporarily stored at the ETF, designated, and disposed at the Environmental Restoration Disposal Facility or the Central Waste Complex, in accordance with the applicable acceptance criteria.

## 4.5 Waste Management

The specific requirements for waste identification, characterization, segregation, packaging, labeling, storage, and inspection for waste generation activities associated with the 200-BP-5 Groundwater OU treatability test will be managed under the waste control plan for this OU. The existing waste control plan (DOE/RL-2003-30) will be updated as needed before the start of the test to address these activities and to add the new wells installed to support this treatability test.

All investigation derived liquids (development and pump test water) will be collected at the wellhead and pumped to the ETF in accordance with the approved waste profile.

# 5 Data Management

This treatability test will generate water level measurements, pumping rate measurements, and groundwater quality data. Data collected for this treatability test will be managed in accordance with the project-specific quality assurance project plan (QAPjP) included in the SAP (Appendix A) and summarized in the following subsections.

## 5.1 Data Management

Personnel conducting the tests will record all pertinent test activity in bound logbooks in accordance with Section 2.1.6 of the SAP (Appendix A). All data will be electronically logged or recorded on data collection sheets or logbooks. Each new test day shall be identified by the date at the top of the logbook page. Each new entry will be designated by a time-of-day entry and start on a new line; data of sufficient detail will be entered to provide a full description of the activity or data being logged. All timepieces used for recording field notebook entries, as well as all data logger time systems and field clocks, will be synchronized to official U.S. time (e.g., http://wwp.pacific-standard-time.com/). At the conclusion of each day's activities, the logger will provide his/her initials at the end of the log for that day and place a diagonal line across the remaining unused page for that day's activities. Calibration data for monitoring/measuring equipment will be recorded in the logbooks. Photographs/digital/video images will be taken and noted in the logbook for reference and will then be cataloged and retained for future reference. Data to be recorded include the measurements and observations identified in the previous sections of this plan and any other data necessary to reconstruct the experiments for a final report.

Data from each sampling event will be compiled into a database for this project. The database will include a record of all paper copies of sampling records, chain-of-custody sheets, and analytical laboratory reports. It will also include the project logbook and instrument calibration records. In addition to paper copies of the data, all numerical values obtained from the testing will be entered into an electronic spreadsheet for further analysis.

All newly generated groundwater quality data will be evaluated and entered into the Hanford Environmental Information System (HEIS) database in accordance with the SAP (Appendix A). All hydraulic water level monitoring data will be managed as described in the SAP (Appendix A).

## 5.2 Data Quality Assessment

Aquifer transmissivity, and specific yield estimates will be compared with values estimated from testing performed elsewhere within the 200 East Area and values determined from numerical model calibrations. Data collected for this test will be acceptable if the aquifer hydraulic parameter estimates are within 1 to 2 orders of magnitude of values determined from numerical modeling and reported in the literature for comparable geologic materials.

The data quality assessment (DQA) 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 whether quantitative data are of the correct type and are of adequate quality and quantity to meet project DQOs. The DQA process will be applied to the laboratory analytical data for contaminant concentrations described in the SAP (Appendix A). The results of the DQA will be used to interpret the data and determine if the objectives of this activity have been met.

# 6 Data Analysis, Interpretation, and Reports

Test data that are determined to be of sufficient quality and quantity for use in addressing the test plan performance objectives will be analyzed. The analytical methods and interpretations will be included in the treatability test report.

## 6.1 Data Analysis and Interpretation

Evaluation of aquifer test data typically uses the following analytical methods:

- **Data transformation** – Electronic pressure data collected and stored by the transducers will be converted from absolute time units into elapsed time units. Water levels recorded as height above the transducer will be used to calculate water level drawdown.
- **Corrections to drawdown data** – Corrections to the water level data will be required to remove fluctuations induced by barometric pressure changes. It also may be necessary to correct the data to account for factors such as regional water level fluctuations induced by seasonal Columbia River fluctuations. As noted in PNNL-18279, drawdown data from pumping tests in thin unconfined aquifers need to be evaluated and corrected for aquifer dewatering effects. Corrections to the data will be documented in the treatability test report.
- **Selection of data analysis method** – As discussed in Section 4.1, standard analytical methods that are used to analyze hydrologic test data include type-curve matching methods and straight line methods. A detailed discussion of the analytical methods, including recommended methods for unconfined (primary test location) and leaky (secondary test location) aquifer test analysis and limitations of the various analytical solutions, is provided in PNNL-17348, PNNL-18279, PNNL-18732, and Kruseman and de Ridder (1994). Typically, the corrected water level drawdown at the test well and monitoring wells is plotted as a function of elapsed time and compared to type curves that represent different test and aquifer conditions. As described in PNL-8539, the derivative of the corrected water level as a function of time can also be used to evaluate the data. Based on these comparisons, the appropriate curve-matching method(s) and straight-line methods will be selected.
- **Estimation of aquifer parameters** – The following aquifer parameters will be estimated using the selected data analysis methods:
  - Sustainable pumping rates for varying aquifer saturated thicknesses
  - Aquifer transmissivity
  - Specific yield (unconfined aquifer) or storativity (leaky aquifer)
- **Estimation of initial contaminant mass removal rates** – The mass removal rates during the constant-rate test will be estimated using the concentrations of uranium and Tc-99 in the samples of the extracted groundwater, the pumping rate, and the elapsed time.

A more detailed discussion of the following aspects of the test methods, data corrections, and test analyses can be found in PNNL-17348, PNNL-18279, PNNL-18732, and Kruseman and de Ridder (1994):

- Limitations of various analytical solutions (Theis, 1935; Cooper and Jacob, 1946), as well as the recommended methods for unconfined aquifer test analysis
- Barometric pressure removal from well water-level response data sets for detailed hydrologic test analysis applications

- Unconfined aquifer drawdown corrections for aquifer de-saturation effects
- Limiting drawdown at the test well to no more than 25 percent of the unconfined aquifer thickness for step-drawdown and constant-rate pumping tests
- Diagnostic drawdown derivative applications to be used to determine the length of the pumping test time, and to determine when restrictive limitations for the Theis (1935) and the Cooper and Jacob (1946) analytical techniques can be used to analyze unconfined aquifer test response, or for hydrologic boundary detection

## 6.2 Treatability Test Report

Following completion of the treatability test, a treatability test report will be prepared to evaluate the Phase 1 and Phase 2 test results, validate the capture zone model and support capture model refinement, and assess whether the pump-and-treat technology should be considered as a remedial technology in support of the 200-BP-5 OU CERCLA decision making process.

# 7 Health and Safety

The CHPRC hazardous waste operations safety and health program was developed for employees involved in hazardous waste site activities. The program was developed to comply with the requirements of 29 CFR 1910.120 and 10 CFR 835 to ensure the safety and health of workers during hazardous waste operations.

A site-specific health and safety plan (HASP) will be developed in accordance with the health and safety program to define the chemical, radiological, and physical hazards and to specify the controls and requirements for work activities. Access and work activities will be controlled in accordance with approved work packages, as required by established internal work requirements and processes. The HASP, which will address the health and safety hazards of each phase of site operation, includes the requirements for hazardous waste operations and/or construction activities, as specified in 29 CFR 1910.120.

Project field staff must comply with the HASP at all times. Unescorted site visitors are required to read and sign the HASP before entering the test and construction areas and must have completed the required training outlined in the HASP. Escorted visitors are briefed on health and safety concerns and must be escorted by the site superintendent (or designee) at all times when they are in the test and construction areas.

During the testing, emergency response for the 200-BP-5 OU treatability test activities will be covered by the site-specific HASP. The HASP specifies primary emergency response actions for site personnel, area alarms, implementation of the emergency action plan and emergency equipment at the task site, emergency coordinators, emergency response procedures, and spill containment procedures. A copy of the HASP will be maintained by the site superintendent (or designee).

# 8 Compliance with Applicable or Relevant and Appropriate Requirements

The applicable or relevant and appropriate requirements (ARARs) that potentially are pertinent to this treatability test are listed in Table 8-1 (Federal ARARs), Table 8-2 (State ARARs), and Table 8-3 (To Be Considered criteria). Onsite activities such as this treatability test must comply with ARARs, but only need to comply with the substantive parts of those requirements.

**Table 8-1. Identification of Federal Applicable or Relevant and Appropriate Requirements and To Be Considered**

| ARAR Citation | ARAR or TBC | Requirement | Rationale for Use |
|---|---|---|---|
| | | **Other Federal ARARs** | |
| *Archeological and Historic Preservation Act of 1974*, 16 USC 469a-1 through -2(d) | ARAR | Requires that the treatability test at the 200-BP-5 Groundwater OU does not cause the loss of any archaeological or historic data. This act mandates preservation of the data and does not require protection of the actual historical sites. | Archeological and historic sites have been identified within the 200 Areas; therefore, the substantive requirements of this act are applicable to actions that might disturb these sites. This requirement is action-specific. |
| *National Historic Preservation Act of 1966*, 16 USC 470, Section 106, et seq. | ARAR | Requires federal agencies to consider the impacts of their undertaking on cultural properties through identification, evaluation and mitigation processes. | Cultural and historic sites have been identified within the 200 Areas; therefore, the substantive requirements of this act are applicable to actions that might disturb these types of sites. This requirement is location-specific. |
| *Native American Graves Protection and Repatriation Act*, 25 USC 3001, et seq. | ARAR | Establishes federal agency responsibility for discovery of human remains, associated and unassociated funerary objects, sacred objects, and items of cultural patrimony. | Substantive requirements of this act are applicable if remains and sacred objects are found during remediation. This is a location-specific requirement. |
| *Endangered Species Act of 1973*, 16 USC 1531, et seq., subsection 16 USC 1536(c) | ARAR | Establishes requirements for actions by Federal agencies that are likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. If remediation is within critical habitat or buffer zones surrounding threatened or endangered species, mitigation measures must be taken to protect the resource. | Substantive requirements of this act are applicable if threatened or endangered species are identified in areas where treatability test will occur. This is a location-specific requirement. |

ARAR = applicable or relevant and appropriate requirement
CFR = *Code of Federal Regulations*
MCL = maximum contaminant level
OU = operable unit
TBC = to be considered
USC = United States Code
WAC = *Washington Administrative Code*

**Table 8-2. Identification of State Applicable and Relevant or Appropriate Requirements and To Be Considered**

| ARAR Citation | ARAR | Requirement | Rationale for Use |
|---|---|---|---|
| **"Dangerous Waste Regulations," WAC 173-303** | | | |
| "Identifying Solid Waste," WAC 173-303-016 | ARAR | Identifies those materials that are and are not solid wastes. | Substantive requirements of these regulations are applicable because they define which materials are subject to the designation regulations. Specifically, materials that are generated during the treatability test would, if a solid waste, be subject to the requirements for solid wastes. This requirement is action-specific. |
| "Recycling Processes Involving Solid Waste," WAC 173-303-017 | ARAR | Identifies materials that are and are not solid wastes when recycled. | Substantive requirements of these regulations are applicable because they define which materials are subject to the designation regulations. Specifically, materials that are generated during the treatability test would if a solid waste be subject to the requirements for solid wastes. This requirement is action-specific. |
| "Designation of Dangerous Waste," WAC 173-303-070(3) | ARAR | Establishes whether a solid waste is, or is not, a dangerous waste or an extremely hazardous waste. | Substantive requirements of these regulations are applicable to materials generated during the treatability test. Specifically, solid waste that is generated during this treatability test would if a dangerous waste be subject to the dangerous waste requirements. This requirement is action-specific. |
| "Excluded Categories of Waste," WAC 173-303-071 | ARAR | Describes those categories of wastes that are excluded from the requirements of WAC 173-303 (excluding WAC 173-303-050). | This regulation is applicable to treatability test in the 200-BP-5 Groundwater OU should wastes identified in WAC 173-303-071 be generated. This requirement is action-specific. |

**Table 8-2. Identification of State Applicable and Relevant or Appropriate Requirements and To Be Considered**

| ARAR Citation | ARAR | Requirement | Rationale for Use |
|---|---|---|---|
| "Conditional Exclusion of Special Wastes," WAC 173-303-073 | ARAR | Establishes the conditional exclusion and the management requirements of special wastes, as defined in WAC 173-303-040. | Substantive requirements of these regulations are applicable to special wastes generated during the treatability test. Specifically, the substantive standards for management of special waste are relevant and appropriate to the management of special waste that will be generated during the treatability test. This requirement is action-specific. |
| "Requirements for Universal Waste," WAC 173-303-077 | ARAR | Identifies those wastes exempted from regulation under WAC 173-303-140 and WAC 173-303-170 through 173-303-9906 (excluding WAC 173-303-960). These wastes are subject to regulation under WAC 173-303-573. | Substantive requirements of these regulations are applicable to universal waste generated during the treatability test. Specifically, the substantive standards for management of universal waste are relevant and appropriate to the management of universal waste that will be generated during the treatability test. This requirement is action-specific. |
| "Recycled, Reclaimed, and Recovered Wastes," WAC 173-303-120<br>Specific subsections:<br>WAC 173-303-120(3)<br>WAC 173-303-120(5) | ARAR | These regulations define the requirements for recycling materials that are solid and dangerous waste. Specifically, WAC 173-303-120(3) provides for the management of certain recyclable materials, including spent refrigerants, antifreeze, and lead-acid batteries. WAC 173-303-120(5) provides for the recycling of used oil. | Substantive requirements of these regulations are applicable to certain materials that might be generated during the treatability test. Eligible recyclable materials can be recycled and/or conditionally excluded from certain dangerous waste requirements. This requirement is action-specific. |

**Table 8-2. Identification of State Applicable and Relevant or Appropriate Requirements and To Be Considered**

| ARAR Citation | ARAR | Requirement | Rationale for Use |
|---|---|---|---|
| "Land Disposal Restrictions," WAC 173-303-140(4) | ARAR | This regulation establishes state standards for land disposal of dangerous waste and incorporates, by reference, Federal land-disposal restrictions of 40 CFR 268 that are relevant and appropriate to solid waste that is designated as dangerous or mixed waste in accordance with WAC 173-303-070(3). | The substantive requirements of this regulation are applicable to materials generated during the treatability test. Specifically, dangerous/mixed waste that is generated during the treatability test would be subject to the relevant and appropriate substantive land-disposal restrictions. The offsite treatment, disposal or management of such waste would be subject to all applicable substantive and procedural laws and regulations, including LDR requirements. This requirement is action-specific. |
| "Requirements for Generators of Dangerous Waste," WAC 173-303-170 | ARAR | Establishes the requirements for dangerous waste generators. | Substantive requirements of these regulations are applicable to materials generated during the treatability test. Specifically, the substantive standards for management of dangerous/mixed waste are relevant and appropriate to the management of dangerous waste that will be generated during the treatability test. For purposes of this treatability test, WAC 173-303-170(3) includes the substantive provisions of WAC 173-303-200 by reference. WAC 173-303-200 further includes certain substantive standards from WAC 173-303-630 and -640 by reference. This requirement is action-specific. |

**Table 8-2. Identification of State Applicable and Relevant or Appropriate Requirements and To Be Considered**

| ARAR Citation | ARAR | Requirement | Rationale for Use |
|---|---|---|---|
| "Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facility Waste Analysis Plan" | TBC | Establishes criteria for waste acceptance at 200 Area ETF. | Effluent from extraction wells will be sent to 200 Area ETF for treatment. |
| ***"Minimum Functional Standards for Solid Waste Handling," WAC 173-304 and "Solid Waste Management — Reduction and Recycling," RCW 70.95*** | | | |
| "Minimum Functional Standards for Solid Waste Handling"<br>WAC 173-304<br>Specific subsections:<br>WAC 173-304-190,<br>WAC 173-304-200(2)<br>WAC 173-304-460<br>"Solid Waste Management — Reduction and Recycling,"<br>RCW 70.95 | ARAR | Establishes the requirements for the onsite storage of solid wastes that are not radioactive or dangerous wastes. | Substantive requirements of these regulations are applicable to materials generated during the treatability test. Specifically, nondangerous, nonradioactive solid wastes (i.e., hazardous substances that are only regulated as solid waste) that will be containerized for removal from the CERCLA site would be managed onsite according to the substantive requirements of this standard. This requirement is action-specific. |
| ***"Solid Waste Handling Standards," WAC 173-350*** | | | |
| "On-Site Storage, Collection and Transportation Standards,"<br>WAC 173-350-300 | ARAR | Establishes the requirements for the temporary storage of solid waste in a container onsite and the collecting and transporting of the solid waste. | The substantive requirements of this newly promulgated rule are applicable to the onsite collection and temporary storage of solid wastes for the 200-BP-5 Groundwater OU treatability test activities. Compliance with this regulation is being implemented in phases for existing facilities. These requirements are location specific. |
| ***"Minimum Standards for Construction and Maintenance of Wells," WAC 173-160*** | | | |
| WAC 173-160-161 | ARAR | Identifies well planning and construction requirements. | The substantive requirements of these regulations are ARAR to actions that include construction of wells used for groundwater extraction and |
| WAC 173-160-171 | ARAR | Identifies the requirements for locating a well. | |

**Table 8-2. Identification of State Applicable and Relevant or Appropriate Requirements and To Be Considered**

<table>
<tr><th>ARAR Citation</th><th>ARAR</th><th>Requirement</th><th>Rationale for Use</th></tr>
<tr><td>WAC 173-160-181</td><td>ARAR</td><td>Identifies the requirements for preserving natural barriers to groundwater movement between aquifers.</td><td rowspan="7">monitoring. The substantive requirements of WAC 173-160-161, 173-160-171, 173-160-181, 173-160-400, 173-160-420, 173-303-430, 173-160-440, 173-160-450, and 173-160-460 are relevant and appropriate to groundwater well construction and monitoring for 200-BP-5 Groundwater OU treatability test. These requirements are action-specific.</td></tr>
<tr><td>WAC 173-160-400</td><td>ARAR</td><td>Identifies the minimum standards for resource protection wells and geotechnical soil borings.</td></tr>
<tr><td>WAC 173-160-420</td><td>ARAR</td><td>Identifies the general construction requirements for resource protection wells.</td></tr>
<tr><td>WAC 173-160-430</td><td>ARAR</td><td>Identifies the minimum casing standards.</td></tr>
<tr><td>WAC 173-160-440</td><td>ARAR</td><td>Identifies the equipment cleaning standards.</td></tr>
<tr><td>WAC 173-160-450</td><td>ARAR</td><td>Identifies the well sealing requirements.</td></tr>
<tr><td>WAC 173-160-460</td><td>ARAR</td><td>Identifies the decommissioning process for resource protection wells.</td></tr>
</table>

ARAR = applicable or relevant and appropriate requirement
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR = *Code of Federal Regulations*
HWMA = *Hazardous Waste Management Act of 1976*
LDR = land disposal restrictions
OU = operable unit
UIC = Underground Injection Control (Program)
WAC = *Washington Administrative Code*

**Table 8-3. Identification of To Be Considered Criteria**

| Criteria To Be Considered | Rationale for Use |
|---|---|
| "Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facility Waste Analysis Plan" | Establishes criteria for waste acceptance at 200 Area Effluent Treatment Facility. Effluent from extraction wells will be sent to 200 Area Effluent Treatment Facility for treatment. |

# 9 National Environmental Policy Act Values

In accordance with DOE Order 451.1B and the *National Environmental Policy Act of 1969* (NEPA) (42 USC 4321), CERCLA actions must address and incorporate NEPA values such as socioeconomic, ecological, off-site, and cumulative impacts in CERCLA documents to the extent practicable.

Based on the outcome of this treatability test, the pump-and-treat technology may be considered as a remedial alternative for the 200-BP-5 OU. In the FS and/or in the RD/RAWP, alternatives to address the release or threatened release of hazardous substances will be identified and analyzed.

The NEPA values associated with this treatability test are based on the information presented in this test plan, including the site characteristics (Chapter 1) and conceptual design (Chapter 4). Applying a "sliding scale" of NEPA analysis to the 200-BP-5 OU (DOE, 2004), and considering the CERCLA ARARs (Chapter 8), the principle resource areas of concern include transportation, air emissions, ecological resources, potential adverse effects to cultural and historical resources, socioeconomics (including environmental justice concerns), and solid and liquid radioactive and hazardous waste management (Table 9-1).

In addition, DOE included the combined effects anticipated from ongoing CERCLA/Agreement (Ecology et al., 1989a) response actions as part of the cumulative impact analysis in DOE/EIS-0391, which includes a site-wide cumulative impact groundwater analysis. This presented the public with a separate opportunity for comment as part of that NEPA process, and will be used to inform the public concerning ongoing implementing cleanup actions on the Hanford Site.

**Table 9-1. NEPA Values Evaluation**

| NEPA Value | Description | Evaluation |
|---|---|---|
| Transportation | Considers impacts of the proposed action on local traffic (i.e., traffic at the Hanford Site) and traffic in the surrounding region. | Implementation of treatability test would be expected to produce short term impacts on local traffic. A majority of the impact would be associated with the method selected for conveyance of extracted groundwater to ETF. An above-ground pipeline to tie in to the ETF pipeline might cross existing traffic routes. Use of purgewater trucks would increase truck traffic. Transportation impacts will be considered in the detailed design phase of the treatability test. |
| Air Quality | Considers potential air quality concerns associated with emissions generated during the proposed action. | Criteria and toxic air pollutant airborne releases associated with the treatability test are expected to be minor with the use of appropriate work controls (no radiological air emissions are anticipated). Any potential of airborne release of contaminants during the test will be controlled in accordance with DOE radiation control and air pollution control standards, to minimize emissions of air pollutants at the Hanford Site, and protect all communities outside the Site boundaries.<br><br>Operation of trucks, drilling rigs, and other diesel-powered equipment for this treatability test would be expected, in the short-term, to introduce quantities of sulfur dioxide, nitrogen dioxide, particulates, and other pollutants to the atmosphere, typical of similar-sized construction projects. These releases would not be expected to cause any air quality standards to be exceeded and (as needed) dust generated during remedial activities would be minimized by watering or other dust-control measures. Vehicular and equipment |

**Table 9-1. NEPA Values Evaluation**

| NEPA Value | Description | Evaluation |
|---|---|---|
| | | emissions will be controlled and mitigated in compliance with the substantive standards for air quality protection that apply to the Hanford Site. |
| Natural, Cultural, and Historical Resources | Considers impacts of the proposed action on wildlife, wildlife habitat, archeological sites and artifacts, and historically significant properties. | Impacts on ecological resources in the vicinity of the treatability test will continue to be mitigated in accordance with DOE/RL-96-32 and DOE/RL-96-88, and with the applicable standards of all relevant biological species protection regulations. A site-specific ecological resource review will be conducted before initiation of physical activities.<br><br>Because the test site has already been disturbed, and only isolated artifacts could be encountered during project activities, implementation of DOE/RL-98-10 and consultation with area Tribes, as needed, will help ensure appropriate mitigation to avoid or minimize any adverse cultural or historical resource effects and address any relevant concerns.<br><br>Impacts to other cultural values will be minimized through implementation of DOE/RL-98-10, DOE/RL-2005-27, and consultation with area Tribes as needed. This will help ensure appropriate mitigation to avoid or minimize any adverse effects to natural and cultural resources and address any other relevant concerns.<br><br>Potential impacts to cultural and historical resources that may be encountered during the short-term construction activities associated with implementing the test will be mitigated through compliance with the appropriate substantive requirements of the *National Historic Preservation Act of 1966* and other ARARs related to cultural preservation. A site-specific cultural resource review will be conducted before initiation of physical activities. |
| Socioeconomic Impacts | Considers impacts pertaining to employment, income, other services (e.g., water and power utilities), and the effect of implementation of the proposed action on the availability of services and materials. | The proposed treatability test is within the scope of current DOE, Richland Operations Office environmental restoration activities and will have minimal impact on the current availability of services and materials. This work is expected to be accomplished largely using employees from the existing contractor workforce. Even if the test creates additional service sector jobs, the total expected increase in employment would be expected to be less than 1% of the current employment levels. The socioeconomic impact of the project will contribute to the continuing overall positive employment and economic impacts on eastern Washington communities from Hanford Site cleanup operations. |

**Table 9-1. NEPA Values Evaluation**

| NEPA Value | Description | Evaluation |
|---|---|---|
| Environmental Justice | Considers whether the proposed response actions would have inappropriately or disproportionately high and adverse human health or environmental effects on minority or low income populations. | Per Executive Order 12898, DOE seeks to ensure that no group of people bears a disproportionate share of negative environmental consequences resulting from proposed federal actions. There are no impacts associated with the proposed treatability test that could reasonably be determined to affect any member of the public; therefore, they would not have the potential for high and disproportional adverse impacts on minority or low-income groups. |

**Table 9-1. NEPA Values Evaluation**

| NEPA Value | Description | Evaluation |
|---|---|---|
| Cumulative Impacts (Direct and Indirect) | Considers whether the proposed action could have cumulative impacts on human health or the environment when considered together with other activities locally, at the Hanford Site, or in the region. | The concern is associated directly with the targeted area. Because of the temporary nature of the test activities and their remote location, cumulative impacts on air quality or noise with other Hanford Site or regional construction and cleanup projects would be minimal. When soils at the drilling sites for this treatability test are found to be contaminated with hazardous substances in concentrations presenting a material threat to human health and the environment, that threat will be mitigated. The groundwater extracted from the 200-BP-5 OU during the test will be treated. The net anticipated effect could be a positive contribution to cumulative environmental effects at the Hanford Site through removal, treatment, and disposal of such hazardous substances and contaminants of concern into a facility that has been designed and legally authorized to contain such contaminants safely, like the ERDF. The soil removed during drilling will meet the ERDF waste acceptable criteria as described in WCH-191.<br><br>The volume of soil that will be generated for disposal during implementation of the treatability test is estimated to be approximately 20 tons over the expected duration of this test (the test is anticipated to occur over a 1 year period, resulting in 20 tons per year (and attendant transportation requirements).<br><br>The volume of groundwater that will be generated for treatment and disposal during implementation of the treatability test is estimated to be approximately 6 million liters (1.5 million gallons) over the expected duration of this test.<br><br>Wastes generated during implementation of the treatability test would be manageable within the capacities of existing facilities. For perspective, the ERDF received over 700,000 tons of waste in calendar year 2008 and over 430,000 tons in calendar year 2007). Radiological contamination is expected to be minimal because the proposed well locations are outside of known waste sites. The ERDF received approximately 22,500 Ci in calendar year 2008 and approximately 13,000 Ci in calendar year 2007.<br><br>The extracted groundwater will be treated at ETF and disposed at SALDS. This water would be stored in LERF basin 43, which has a 29.5 million liter (7.8 million gallon) storage capacity. Annually, the ETF treats approximately 19 to 83 million liters (5 to 22 million gallons) stored in basin 43. |
| Mitigation | Considers whether or not adverse impacts can be avoided, response action planning should minimize them to the extent practicable. This value identifies required mitigation activities. | Compliance with the substantive requirements of the ARARs will mitigate potential environmental impacts on the natural environment, including migratory birds, and endangered species. DOE has also established policies and procedures for the management of ecological and cultural resources when actions might affect such resources (DOE/RL-96-32; DOE/RL-96-88, and DOE/RL-98-10). Cultural resource and biological |

**Table 9-1. NEPA Values Evaluation**

| NEPA Value | Description | Evaluation |
|---|---|---|
| | | species reviews/surveys are undertaken that also provide suggested migration activities to assure adverse effects associated with implementing the actions are minimized or avoided. Health and safety procedures, documented in the Health and Safety Plan, established by site contractors would mitigate risks to workers from the remedial activities. |
| Irreversible and Irretrievable Commitment of Resources | Considers the use of nonrenewable resources for the proposed response actions and the effects that resource consumption would have on future generations.<br>(When a resource [e.g., energy minerals, water, wetland] is used or destroyed and cannot be replaced within a reasonable amount of time, its use is considered irreversible.) | Nonrenewable resources will not be used to backfill the wells drilled during this treatability test. During the test, normal usage of resources such as fuel and water will be irreversibly used. |

# 10 Project Management

The following subsections address the project organization, change control, and the schedule for the 200-BP-5 OU treatability test.

## 10.1 Project Organization

The project organization is shown in Figure 10-1. The primary role of each member of the project organization is as follows:

**Regulatory Lead.** Ecology has approval authority as the lead regulatory agency for the 200-BP-5 OU and the work being performed under this test plan. Ecology works with the DOE Richland Operations Office (RL) to resolve concerns over the work as described in this test plan in accordance with the TPA (Ecology et al., 1989a).

**DOE OU Lead.** The DOE OU Lead is responsible for authorizing the Contractor to perform activities under CERCLA, the *Resource Conservation and Recovery Act of 1976* (RCRA); the *Atomic Energy Act of 1954*; and the TPA for the Hanford Site. It is the responsibility of RL to obtain lead regulatory agency approval of the test plan authorizing the field activities. The DOE OU Lead is responsible for overseeing day-to-day activities of the Contractor performing the work scope and working with the Contractor and the regulatory agencies to identify and resolve issues.

**200-BP-5 Groundwater OU Project Manager.** The 200-BP-5 Groundwater OU Project Manager (or designee) is responsible for managing sampling documents and requirements, field activities, subcontracted tasks, and ensuring that the project file is properly maintained. The 200-BP-5 OU Project Manager ensures that the sampling design requirements are converted into field instructions (e.g., work packages) providing specific direction for field activities. The 200-BP-5 OU Project Manager works closely with QA, Health and Safety, and the Field Team Lead to integrate these and other lead disciplines in the planning and implementation of the work scope. The 200-BP-5 OU Project Manager maintains a list of individuals or organizations filling each of the functional elements of the project organization. In addition, the 200-BP-5 OU Project Manager is responsible for version control of the test plan to ensure that personnel are working to the most current job requirements. The 200-BP-5 OU Project Manager also coordinates with RL and the primary contractor management on all sampling activities. The 200-BP-5 OU Project Manager supports RL in coordinating sampling activities with the regulators.

**Quality Assurance Manager.** The QA Manager (or designee) is responsible for QA issues on the project. Responsibilities include overseeing implementation of the project QA requirements, reviewing project documents (including the DQO summary report, field sampling plan, and the QAPjP), and participating in QA assessments on sample collection and analysis activities, as appropriate. The QA Engineer must be independent of the unit generating the data.

**Field Team Lead.** The Field Team Lead, or lead scientist, will act as the technical lead for the duration of the aquifer test. The lead scientist is responsible for ensuring and documenting that the data are collected in accordance with the Treatability Test Plan and associated SAP. The lead scientist, in conjunction with the 200-BP-5 OU Project Manager, will provide clarification of test requirements and test steps, as needed.

**Environmental Compliance Officer.** The Environmental Compliance Officer (ECO) provides technical oversight, direction, and acceptance of project and subcontracted environmental work and also develops appropriate mitigation measures with a goal of minimizing adverse environmental impacts. The ECO also reviews plans, procedures, and technical documents to ensure that environmental requirements have been addressed; identifies environmental issues that affect operations and develops cost effective solutions; and responds to environmental/regulatory issues or concerns raised by RL and/or regulatory agencies. The ECO also oversees project implementation for compliance with applicable internal and external environmental requirements.

Project management roles and responsibilities discussed in this section apply to the major activities covered under the SAP (Appendix A). Additional project organization responsibilities are described in the SAP (Appendix A).

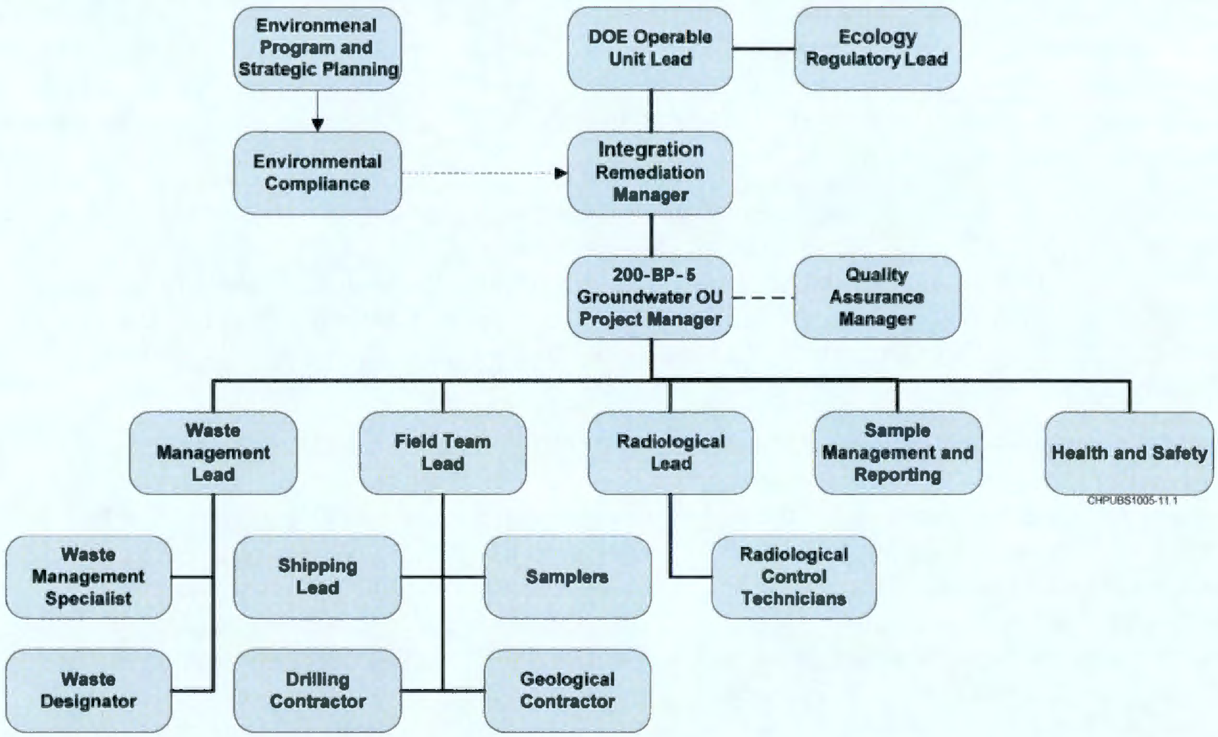



**Figure 10-1. Project Organization for the 200-BP-5 Operable Unit Treatability Test**

## 10.2 Change Management

The following three types of changes during the treatability test could affect compliance with the requirements in the test plan:

- A **fundamental change** is a change that does not meet the requirements set forth in the test plan or that incorporates testing activities not defined in the scope of the test plan.
- A **significant change** generally involves a significant change to a component of the test that does not fundamentally alter the overall test approach.
- A **minor change** will not have a significant impact on the scope, schedule, or cost of the test. Minor field changes can be made by the person in charge of the field activity. Minor changes should be documented in the project file (e.g., through interoffice memoranda or logbooks). A non-significant change will not impact the requirements of the test plan.

Determining the significance of the change is the responsibility of DOE and the lead regulatory agency. The 200-BP-5 Groundwater OU Project Manager is responsible for tracking all changes and obtaining appropriate reviews by contractor staff. The 200-BP-5 Groundwater OU Project Manager will discuss the change with DOE. DOE will then discuss with the lead regulatory agency significant changes, as needed, including changes in accordance with Section 9.3 and Section 12.0 of the *Hanford Federal Facility Agreement and Consent Order Action Plan* (Ecology, et al., 1989b). Appropriate documentation will follow, in accordance with the requirements for that type of change.

## 10.3 Schedule

Figure 10-2 provides the overall project schedule for the 200-BP-5 OU treatability test activities described in this test plan. The following activities in the schedule meet the requirements of TPA Milestone M-015-82 (Ecology et al., 1989a) for the 200-BP-5 OU.

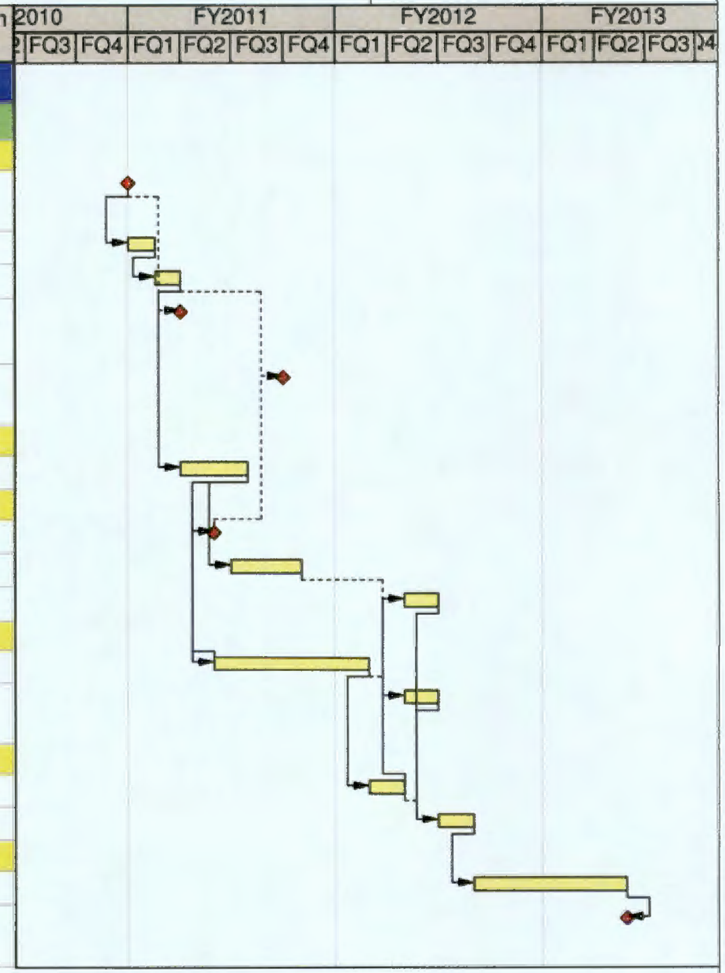
- Submit a treatability test plan as an amendment to the 200-BP-5 RI/FS work plan for determining if a 189 L/min (50 gpm) pump-and-treat system can be sustained in the shallow and discontinuous aquifer to contain and reduce the mass of the uranium and commingled Tc-99 plumes near the B, BX, and BY tank farms. This requirement will be met by submitting Draft A of this test plan to the regulatory agency.

- Initiate aquifer tests within six months of approval of the treatability test plan. This requirement will be met by the start of test construction (i.e., start of well drilling or pipeline/system construction).

The durations for the major tasks were based on durations for similar tasks performed for the 200-UP-1 pump-and-treat interim action and the professional judgment of those performing the work. The basis for the schedule assumes conformance with requirements of the TPA and pertinent laws and regulations.

Initiation of Phase 1 and Phase 2 testing will be coordinated with ETF to ensure adequate availability for storage and treatment of the extracted groundwater. The testing schedule also will be adjusted as needed to minimize impacts of discharges from the 242-A Evaporator to TEDF. Infiltration of treated water from the evaporator may recharge the aquifer, raising the water table elevation and potentially offsetting pumping induced water table elevation changes. The schedule also will be adjusted as needed to avoid expected seasonal fluctuations of the Columbia River that could impact water levels in the testing area.

| Activity Name | Start | Finish | Duration |
|---|---|---|---|
| **200-BP-5 Operable Unit** | 30-Sep-10 | 28-Feb-13 | 882 |
| **200-BP-5 OU Treatability Test** | 30-Sep-10 | 28-Feb-13 | 882 |
| **Treatability Test Plan** | 30-Sep-10 | 30-Jun-11 | 272 |
| Submit Draft A Treatability Test Plan to Regulatory Agency | | 30-Sep-10 | 0 |
| Regulatory Agency Review | 01-Oct-10 | 15-Nov-10 | 46 |
| Treatability Test Plan Completion and Approval | 16-Nov-10 | 31-Dec-10 | 46 |
| TPA Milestone M-15-82A - Submit Treatability Test Plan | | 31-Dec-10 | 0 |
| TPA Milestone M-15-82B - Initiate Aquifer Tests Within 6 Months of Test Plan Approval | 30-Jun-11 | | 0 |
| **Treatability Test Design** | 01-Jan-11 | 30-Apr-11 | 120 |
| Treatability Test Design | 01-Jan-11 | 30-Apr-11 | 120 |
| **Well Drilling** | 01-Mar-11 | 31-Mar-12 | 397 |
| Initiate Treatability Test | 01-Mar-11 | | 0 |
| Well Drilling - Primary Test Location | 01-Apr-11 | 01-Aug-11 | 123 |
| Well Drilling - Secondary Test Location (Optional) | 01-Feb-12 | 31-Mar-12 | 60 |
| **Pipeline / System Construction** | 01-Mar-11 | 31-Mar-12 | 397 |
| Pipeline / System Construction - Primary Location | 01-Mar-11 | 30-Nov-11 | 275 |
| Pipeline / System Construction - Secondary Location (Optional) | 01-Feb-12 | 31-Mar-12 | 60 |
| **Treatability Test** | 01-Dec-11 | 31-May-12 | 183 |
| Treatability Test - Primary Test Location | 01-Dec-11 | 31-Jan-12 | 62 |
| Treatability Test - Secondary Test Location (Optional) | 01-Apr-12 | 31-May-12 | 61 |
| **Treatability Test Report** | 01-Jun-12 | 28-Feb-13 | 273 |
| Treatability Test Report - Draft A | 01-Jun-12 | 28-Feb-13 | 273 |
| Submit Draft A Treatability Test Report to Regulatory Agency | | 28-Feb-13 | 0 |




Current Bar Labels
Milestone

**200-BP-5 OU TREATABILITY TEST**

(c) Primavera Systems, Inc

**Figure 10-2. 200-BP-5 Operable Unit Treatability Test Schedule**

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# Appendix A

# Sampling and Analysis Plan

# Contents

## Figures



## Tables

# Terms

| | |
|---|---|
| AEA | alpha energy analysis |
| aG | amber glass |
| aGs | amber glass septum |
| ALARA | as low as reasonably achievable |
| CERCLA | *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* |
| CFR | *Code of Federal Regulations* |
| CHPRC | CH2M HILL Plateau Remediation Company |
| DOE | U.S. Department of Energy |
| DQA | data quality assessment |
| DQI | data quality indicator |
| DQO | data quality objective |
| ECO | environmental compliance officer |
| Ecology | Washington State Department of Ecology |
| EPA | U.S. Environmental Protection Agency |
| FS | feasibility study |
| G | glass |
| GS | gamma spectroscopy |
| IC | ion chromatography |
| HEIS | Hanford Environmental Information System |
| HGET | Hanford General Employee Training |
| LSC | liquid scintillation counter |
| MCL | maximum contaminant level |
| N/A | not applicable |
| OU | operable unit |
| QA | quality assurance |
| QAPjP | quality assurance project plan |
| QC | quality control |
| P | plastic |

| | |
|---|---|
| RD/RAWP | Remedial Design/Remedial Action Work Plan |
| RBSL | risk-based screening level |
| RCRA | *Resource Conservation and Recovery Act of 1976* |
| RCT | radiological control technician |
| RL | DOE Richland Operations Office |
| RPD | relative percent difference |
| SAP | sampling and analysis plan |
| Tc-99 | technetium-99 |
| TPA | Tri-Party Agreement |
| Tri-Party Agreement | *Hanford Federal Facility Agreement and Consent Order* |
| TSS | total suspended solids |
| WMA | Waste Management Area |

# A1 Introduction

This sampling and analysis plan (SAP) provides sampling and analysis requirements for water associated with the Treatability Test for the 200-BP-5 Groundwater Operable Unit (OU). The treatability test objectives, parameters, and data quality objectives are included in this document, which serves an amendment to DOE/RL-2007-18, to which this SAP is included as Appendix A. Other measurements and data collected during the treatability test, such as water level data and pumping rates, are addressed in the Treatability Test Plan but are not included in this SAP.

The 200-BP-5 Groundwater OU extends from the 200 East Area northwest to the Columbia River and to the eastern flank of the Gable Mountain (Figure A1-1). The purpose of the treatability test is to evaluate whether groundwater pumping at a rate of 50 gpm can be sustained in the vicinity of Waste Management Area (WMA) B-BX-BY (B Tank Farm Complex). The test is proposed in the vicinity of Well 299-E33-31, on the west side of the BY tank farm (Figure A1-2). Installation of one new extraction well and one new monitoring well is planned for the treatability test.

A site on the north side of B Tank Farm, in the vicinity of Well 299-E33-343, has been identified as a secondary location where testing may be performed based on data obtained during testing at the primary location. Specific information regarding the decision criteria to determine whether an aquifer test will be conducted at the secondary location is presented in Section 4.1.2 of the Treatability Test Plan.

The 200-BP-5 Treatability Test consists of two phases. The Phase 1 step-drawdown test consists of pumping the test well over an approximate eight to ten hour period. During the Phase 1 test, the pumping rate will be increased incrementally in a series of steps to determine the pumping rate to be employed during Phase 2. Phase 2 constant-rate testing will consist of pumping the test well at a constant rate for a duration of 3 to 30 days to obtain water level drawdown measurements for use in estimating the unconfined aquifer's hydraulic parameters (transmissivity and specific yield). The Phase 2 sustainable pumping rate will be evaluated to determine if a pump-and-treat alternative should be retained for evaluation in the feasibility study (FS) and/or the Remedial Design/Remedial Action Work Plan (RD/RAWP). The large-scale aquifer properties will be used to refine the localized hydrologic numerical model that will be used to simulate the effects of pumping on the aquifer including plume containment and mass removal (i.e., effectiveness of a pump-and-treat alternative).

## A1.1 Groundwater Sampling Data Needs

The process used to identify the treatability test data needs and the data needs outcome is summarized in the Treatability Test Plan. The treatability test data will be used to evaluate whether pump-and-treat can be successfully implemented in the unconfined aquifer of the B Tank Farm Complex. Data will be collected to estimate the mass recovery rates of uranium and technetium-99 (Tc-99) during the test. The concentrations of uranium, Tc-99, and other constituents in the groundwater will provide data for waste designation and waste acceptance at the Effluent Treatment Facility.

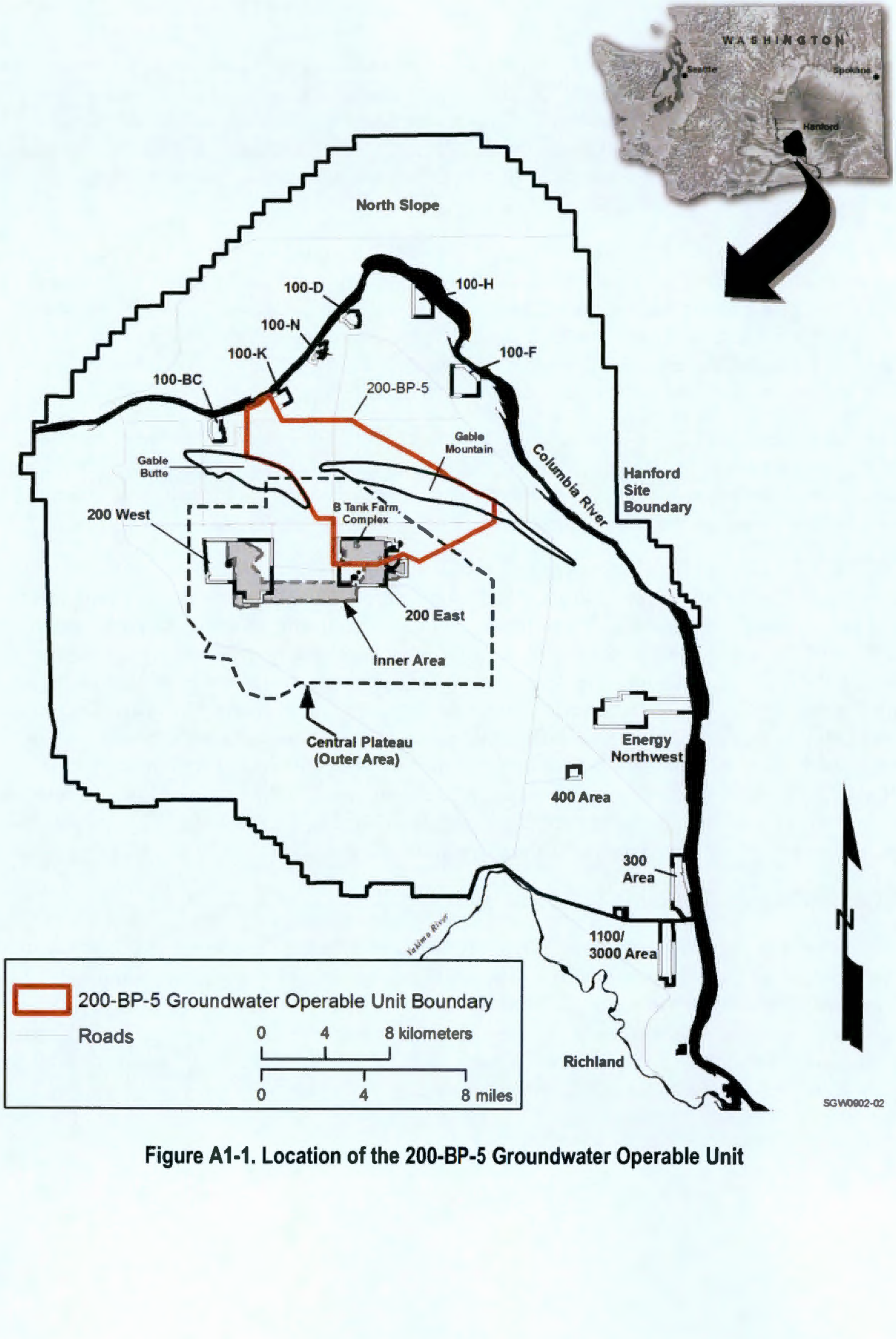



Figure A1-1. Location of the 200-BP-5 Groundwater Operable Unit

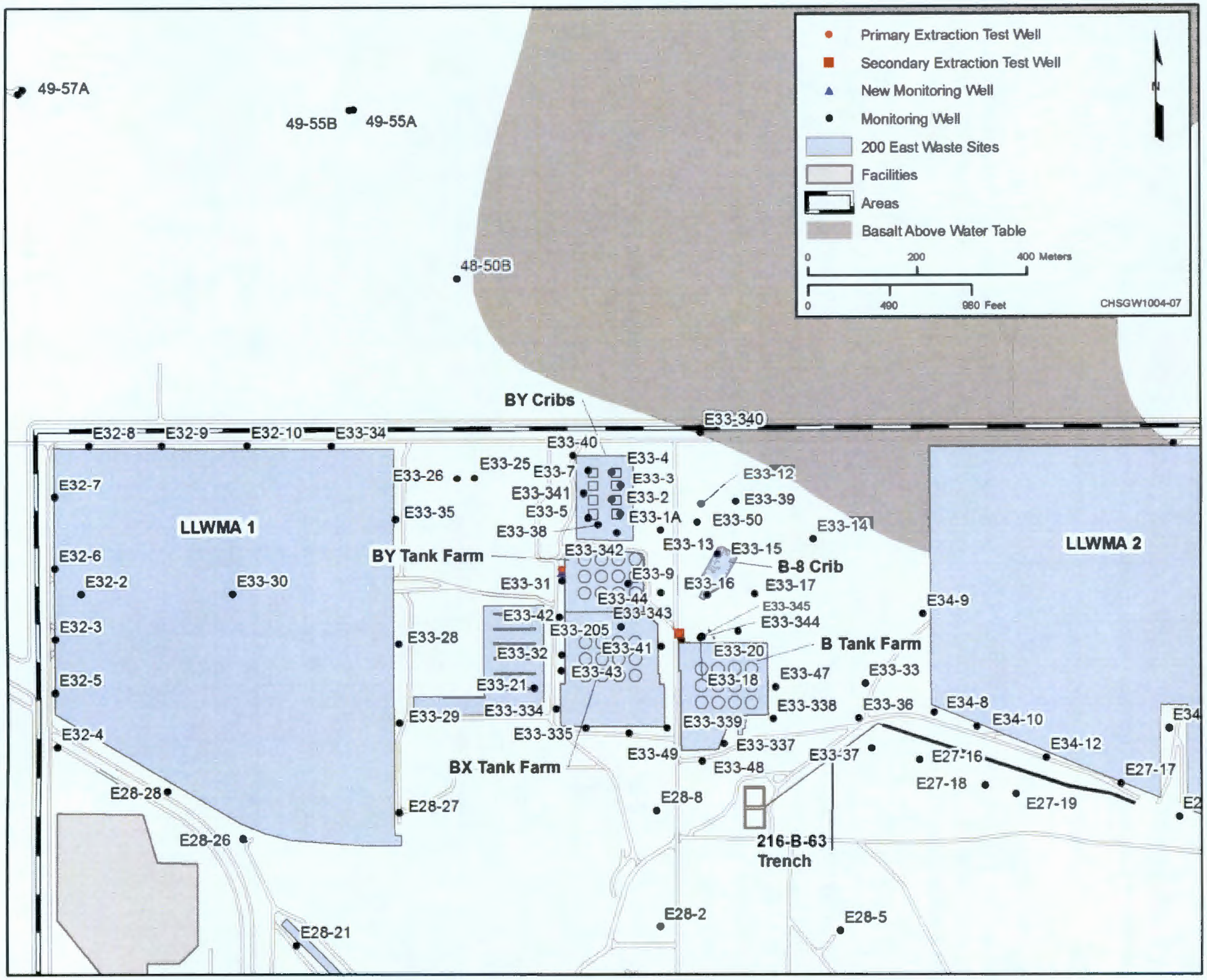



Figure A1-2. Location of Groundwater Monitoring Wells and Proposed Test Wells near Waste Management Area B-BX-BY

Data collected during the treatability test may also be used in support of satisfying the following additional data needs:

- Occupational health and safety
- Site characterization and conceptual model refinement
- Pump-and-treat remedial action alternative development, evaluation, and/or design
- Monitoring for pump-and-treat remedial action performance assessment

## A1.2 Groundwater Characterization

Groundwater samples will be collected and analyzed to evaluate the effectiveness of the pump-and-treat technology in removing uranium and Tc-99 from the aquifer. Sampling will be performed in accordance with the field sampling, sample handling, and documentation activity requirements in DOE/RL-96-68, Volumes 1 through 4. The analytical parameters and performance requirements have been selected to satisfy these data needs.

Table A1-1 presents the potential field parameters and sample analytes for groundwater samples collected as part of the Treatability Test. All samples collected will be analyzed for Tc-99 and uranium (uranium-233/234, uranium-235, uranium-238, and total uranium). Samples will be analyzed for the additional analytes listed in Table A1-1, if needed, to provide adequate characterization information for a waste acceptance determination. Section A3.2 summarizes the treatability test activities. The groundwater sample and analysis activities are presented in Section A3.3.

**Table A1-1. 200-BP-5 Operable Unit Treatability Test Sample Analytes and Field Parameters**

| | | |
|---|---|---|
| **Field Parameters** | | |
| pH<br>Oxidation-Reduction Potential | Temperature | Specific Conductivity |
| **Radionuclides** | | |
| Gross alpha | Iodine-129 | Thorium-232 |
| Gross beta | Neptunium-237 | Tritium |
| Americium-241 | Plutonium-238 | Uranium-233/234 |
| Carbon-14 | Plutonium-239/240 | Uranium-235 |
| Cobalt-60 | Strontium-90 | Uranium-238 |
| Cesium-137 | Technetium-99 | |
| **Nonradionuclides** | | |
| 2-Butanone | Chromium (total) | Potassium |
| Acetone | Cobalt | Silicon |
| Alkalinity | Cyanide | Sodium |
| Aluminum | Fluoride | Sulfate |
| Ammonium | Hexavalent chromium | Thallium |
| Antimony | Iodide | Total dissolved solids |
| Arsenic | Iron | Total hardness |
| Barium | Lead | Total organic carbon |
| Beryllium | Magnesium | Total suspended solids |
| bis(2-Ethylhexyl)phthalate | Manganese | Tributyl phosphate |

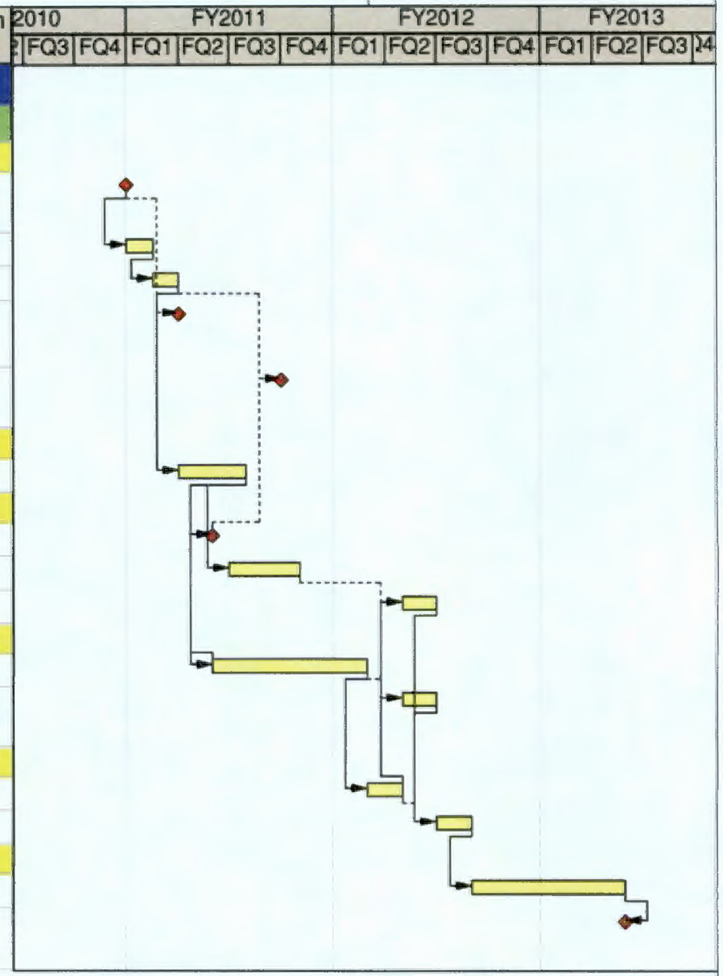
**Table A1-1. 200-BP-5 Operable Unit Treatability Test Sample Analytes and Field Parameters**

| | | |
|---|---|---|
| Cadmium | Mercury | Uranium (total) |
| Calcium | Nitrate | Vanadium |
| Carbon tetrachloride | Nitrite | Zinc |
| Chloride | | |

## A1.3 Project Schedule

Activities within the scope of this SAP are included in the schedule presented in Figure 10-2 of the Treatability Test Plan for the 200-BP-5 OU and Figure A1-3. The schedule provides the overall project schedule for the treatability test activities. The durations for the major tasks are based on durations for similar tasks performed for the 200-UP-1 pump-and-treat interim action and the professional judgment of those performing the work.

| Activity Name | Start | Finish | Duration |
|---|---|---|---|
| **200-BP-5 Operable Unit** | 30-Sep-10 | 28-Feb-13 | 882 |
| **200-BP-5 OU Treatability Test** | 30-Sep-10 | 28-Feb-13 | 882 |
| **Treatability Test Plan** | 30-Sep-10 | 30-Jun-11 | 272 |
| Submit Draft A Treatability Test Plan to Regulatory Agency | | 30-Sep-10 | 0 |
| Regulatory Agency Review | 01-Oct-10 | 15-Nov-10 | 46 |
| Treatability Test Plan Completion and Approval | 16-Nov-10 | 31-Dec-10 | 46 |
| TPA Milestone M-15-82A - Submit Treatability Test Plan | | 31-Dec-10 | 0 |
| TPA Milestone M-15-82B - Initiate Aquifer Tests Within 6 Months of Test Plan Approval | 30-Jun-11 | | 0 |
| **Treatability Test Design** | 01-Jan-11 | 30-Apr-11 | 120 |
| Treatability Test Design | 01-Jan-11 | 30-Apr-11 | 120 |
| **Well Drilling** | 01-Mar-11 | 31-Mar-12 | 397 |
| Initiate Treatability Test | 01-Mar-11 | | 0 |
| Well Drilling - Primary Test Location | 01-Apr-11 | 01-Aug-11 | 123 |
| Well Drilling - Secondary Test Location (Optional) | 01-Feb-12 | 31-Mar-12 | 60 |
| **Pipeline / System Construction** | 01-Mar-11 | 31-Mar-12 | 397 |
| Pipeline / System Construction - Primary Location | 01-Mar-11 | 30-Nov-11 | 275 |
| Pipeline / System Construction - Secondary Location (Optional) | 01-Feb-12 | 31-Mar-12 | 60 |
| **Treatability Test** | 01-Dec-11 | 31-May-12 | 183 |
| Treatability Test - Primary Test Location | 01-Dec-11 | 31-Jan-12 | 62 |
| Treatability Test - Secondary Test Location (Optional) | 01-Apr-12 | 31-May-12 | 61 |
| **Treatability Test Report** | 01-Jun-12 | 28-Feb-13 | 273 |
| Treatability Test Report - Draft A | 01-Jun-12 | 28-Feb-13 | 273 |
| Submit Draft A Treatability Test Report to Regulatory Agency | | 28-Feb-13 | 0 |




Current Bar Labels
◆ Milestone

200-BP-5 OU TREATABILITY TEST

(c) Primavera Systems, Inc

**Figure A1-3. 200-BP-5 Operable Unit Treatability Test Schedule**

# A2 Quality Assurance Project Plan

This Quality Assurance Project Plan (QAPjP) establishes the quality requirements for environmental data collection, including planning, implementation, and assessment of sampling, field measurements, and laboratory analysis. This QAPjP has been developed to comply with the requirements of the following:

- DOE/RL-96-68
- DOE O 414.1C
- 10 *Code of Federal Regulations* (CFR) 830, Subpart A
- EPA/240/B-01/003

Section 6.5 and Section 7.8 of the Washington State Department of Ecology (Ecology), U.S. Environmental Protection Agency (EPA), and U.S. Department of Energy (DOE), *Hanford Federal Facility Agreement and Consent Order Action Plan* (Ecology et al., 1989b), require that the quality assurance (QA)/quality control (QC) and sampling and analysis activities specify the QA requirements for treatment, storage, and disposal units, as well as for past practice processes. Therefore, this QAPjP follows the QA elements of EPA/240/B-01/003. This QAPjP demonstrates conformance to Part B requirements of ANSI/ASQC E4-1994.

In addition to the requirements cited above, EPA-505-B-04-900A was used as a resource for identification of QAPjP elements. This manual is not imposed through the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989a), also known as the Tri-Party Agreement (TPA). However, it is a valuable resource and provides a comprehensive treatment of quality elements that could be addressed in a SAP. It was also designed to be compatible with EPA/240/B-01/003, which forms the basis for this QAPjP.

This QAPjP is divided into the following four sections that describe the quality requirements and controls applicable to this investigation:

1. **Project Management (Section A2.1)** – This section addresses elements of project management, including the project history and objectives, roles, and responsibilities of the participants. These elements ensure that the project has a defined goal, that the participants understand the goal and the approach to be used, and that the planning outputs are documented.

2. **Data Generation and Acquisition (Section A2.2)** – This section addresses aspects of project design and implementation. Implementation of these elements ensure that appropriate methods for sampling, measurement and analysis, data collection or generation, data handling, and QC activities are employed and are properly documented.

3. **Assessment and Oversight (Section A2.3)** – This section addresses the activities for assessing the effectiveness of the implementation of the project and associated QA and QC activities. The purpose of assessment is to ensure that the QAPjP is implemented as prescribed.

4. **Data Validation and Usability (Section A2.4)** – This section addresses the QA activities occurring after the data collection or generation phase of the project is completed. Implementation of these elements ensures that data conform to the specified criteria, thus achieving the project objectives.

## A2.1 Project Management

The following sections address the basic aspects of project management and are designed to ensure that the project has defined goals, that the participants understand the goals and the approaches used, and that the planned outputs are appropriately documented. Project management roles and responsibilities discussed in this section apply to the major activities covered under the SAP.

### A2.1.1 Project and Task Organization

The primary contractor, or its approved subcontractor, is responsible for planning, coordinating, collecting, preparing, packaging, and shipping samples to the laboratory. The project organization, in regard to sampling activities, is described in the following sections and is shown on Figure A2-1. The 200-BP-5 Groundwater OU Project Manager maintains a list of individuals or organizations as points of contact for each functional element in the figure. For each functional primary contractor role, there is a corresponding oversight role within DOE.

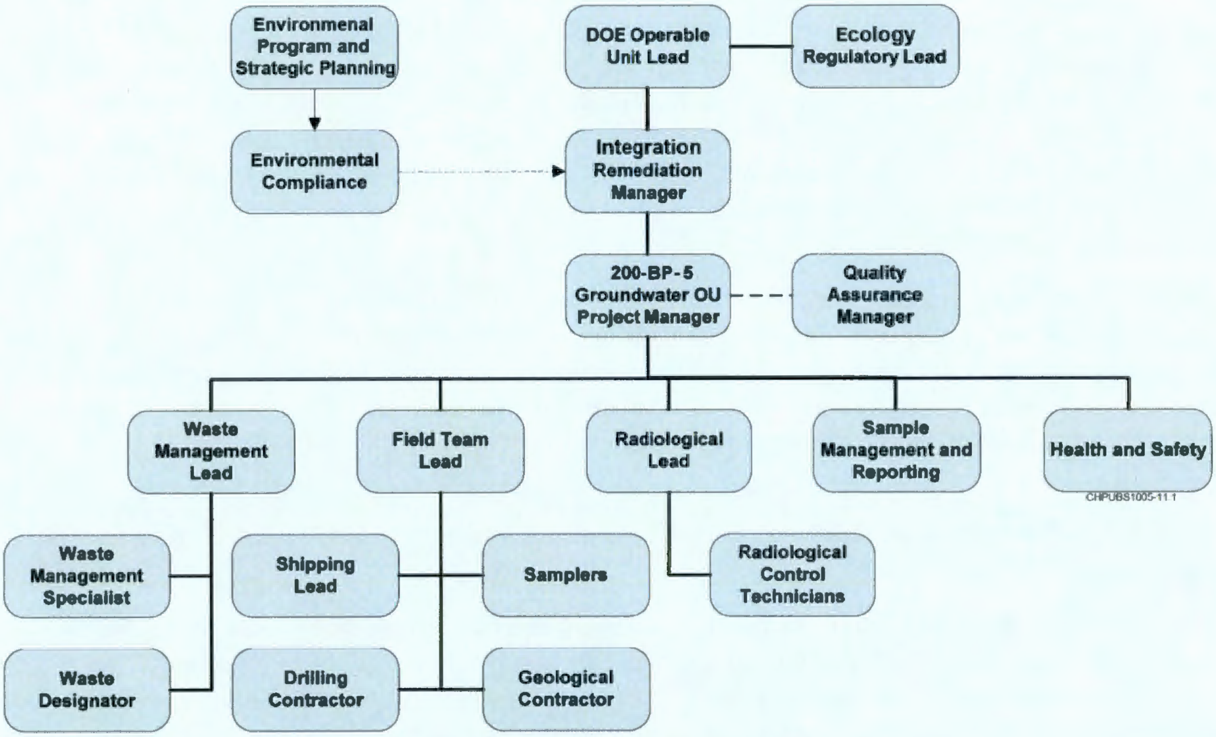



**Figure A2-1. Project Organization**

**Regulatory Lead.** Ecology has approval authority as lead regulatory agency for the 200-BP-5 OU and the work being performed under this SAP. Ecology works with the DOE Richland Operations Office (RL) to resolve concerns over the work as described in this SAP in accordance with the TPA (Ecology et al., 1989a).

**DOE OU Lead.** The DOE OU Lead is responsible for authorizing the Contractor to perform activities under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA), the *Resource Conservation and Recovery Act of 1976* (RCRA); the *Atomic Energy Act of 1954*; and the TPA (Ecology et al., 1989a) for the Hanford Site. It is the responsibility of RL to obtain lead regulatory agency approval of the SAP authorizing the field sampling activities. The DOE OU Lead is responsible for overseeing day-to-day activities of the Contractor performing the work scope and working with the Contractor and the regulatory agencies to identify and resolve issues.

**200-BP-5 Groundwater OU Project Manager.** The 200-BP-5 Groundwater OU Project Manager (or designee) is responsible for managing sampling documents and requirements, field activities, subcontracted tasks, and ensuring the project file is properly maintained. The 200-BP-5 Groundwater OU Project Manager ensures that the sampling design requirements are converted into field instructions (e.g., work packages) providing specific direction for field activities. The 200-BP-5 Groundwater OU Project Manager works closely with QA, Health and Safety, and the Field Team Lead to integrate these and other lead disciplines in planning and implementing the work scope. The 200-BP-5 Groundwater OU Project Manager maintains a list of individuals or organizations filling each of the functional elements of the project organization. In addition, the 200-BP-5 Groundwater OU Project Manager is responsible for version control of the SAP to ensure that personnel are working to the most current job requirements. The 200-BP-5 Groundwater OU Project Manager also coordinates with RL and the primary contractor management on all sampling activities. The 200-BP-5 Groundwater OU Project Manager supports RL in coordinating sampling activities with the regulators.

**Quality Assurance Manager.** The QA Manager (or designee) is responsible for QA issues on the project. Responsibilities include overseeing implementation of the project QA requirements, reviewing project documents (including the data quality objective [DQO] summary report, field sampling plan, and the QAPjP), and participating in QA assessments on sample collection and analysis activities, as appropriate. The QA Engineer must be independent of the unit generating the data.

**Field Team Lead.** The field team lead, or lead scientist, will act as the technical lead for the duration of the aquifer test. The lead scientist is responsible for ensuring and documenting that the data are collected in accordance with the Treatability Test Plan and associated SAP. The lead scientist, in conjunction with the 200-BP-5 Groundwater OU Project Manager, will provide clarification of test requirements and test steps, as needed.

The field team lead is responsible for planning and coordinating field sampling resources. The field team lead ensures samplers are appropriately trained and available. Additional related responsibilities include ensuring that the sampling design is understood and can be performed as specified by directing training, mock-ups, and practice sessions with field personnel.

The field team lead directs the samplers. The samplers collect groundwater, soil, vapor, and multimedia samples, including replicates/duplicates, and prepare sample blanks in accordance with the SAP, corresponding standard procedures, and work packages. The samplers complete field logbook entries, chain-of-custody forms, and shipping paperwork, and ensure delivery of the samples to the analytical laboratory.

**Environmental Compliance Officer.** The Environmental Compliance Officer (ECO) provides technical oversight, direction, and acceptance of project and subcontracted environmental work and also develops appropriate mitigation measures with a goal of minimizing adverse environmental impacts. The ECO also reviews plans, procedures, and technical documents to ensure that environmental requirements have been addressed; identifies environmental issues that affect operations and develops cost-effective solutions; and responds to environmental/regulatory issues or concerns raised by RL and/or regulatory agencies. The ECO also oversees project implementation for compliance with applicable internal and external environmental requirements.

**Health and Safety.** The Health and Safety organization is responsible for coordinating industrial safety and health support within the project, as carried out through health and safety plans, job hazard analyses, and other pertinent safety documents required by federal regulation or by internal primary contractor work requirements. In addition, the Health and Safety organization provides assistance to project personnel in complying with applicable health and safety standards and requirements. The Health and Safety organization coordinates with Radiological Lead to determine personal protective clothing requirements.

**Radiological Lead.** The Radiological Lead is responsible for radiological/health physics support within the project. Specific responsibilities include conducting as low as reasonably achievable (ALARA) reviews, exposure and release modeling, and radiological controls optimization for all work planning. In addition, the Radiological Lead identifies radiological hazards and implements appropriate controls to maintain worker exposures ALARA (e.g., requiring personal protective equipment). The Radiological Lead also interfaces with the project Health and Safety contact, and plans and directs Radiological Control Technician (RCT) support for all activities.

**Sample Management and Reporting.** The Sample Management and Reporting organization coordinates laboratory analytical work, ensuring that the laboratories conform to Hanford Site internal laboratory QA requirements (or their equivalent), as approved by DOE, EPA, and Ecology. Sample Management and Reporting receives the analytical data from the laboratories, performs the data entry into the Hanford Environmental Information System (HEIS), and arranges for data validation. Sample Management and Reporting is responsible for informing the 200-BP-5 Groundwater OU Project Manager of any issues reported by the analytical laboratory. The Sample Management and Reporting organization develops and oversees the implementation of the letter of instruction to the analytical laboratories, oversees data validation, and works with the 200-BP-5 Groundwater OU Project Manager to prepare a characterization report on the sampling and analysis results.

The Sample Management and Reporting organization is also responsible for conducting the DQO process, or equivalent. Additional related responsibilities include development of the DQOs and SAP, including the sampling design, preparing associated presentations, resolving technical issues, and preparing revisions to the SAP.

**Contract Laboratories.** The contract laboratories analyze samples in accordance with established procedures and provide necessary sample reports and explanation of results in support of data validation. The laboratories must meet site-specified QA requirements and must have an approved QA plan in place.

**Waste Management Lead.** The Waste Management Lead communicates policies and procedures, and also ensures project compliance for storage, transportation, disposal, and waste tracking in a safe and cost-effective manner. In addition, the Waste Management Lead is responsible for identifying waste management sampling/characterization requirements to ensure regulatory compliance, interpreting the characterization data to generate waste designations and profiles, and preparing and maintaining other documents to confirm compliance with waste acceptance criteria.

### A2.1.2 Problem Definition and Background

The purpose of this treatability test is to evaluate whether a 50 gpm pumping rate can be sustained in the unconfined aquifer in the area of the uranium and Tc-99 groundwater plumes in the vicinity of the B Tank Farm Complex. If the test results indicate that pumping can be sustained at a rate of at least 50 gpm, the technology will be further evaluated in the FS and/or the RD/RAWP for the 200-BP-5 OU. If testing indicates that a pumping rate of 50 gpm is not sustainable, groundwater extraction from vertical wells may be screened out as a remedial technology.

Groundwater contaminant plumes of uranium, Tc-99, and other contaminants originate from source areas in the vicinity of the B Tank Farm Complex and are found in the unconfined aquifer. Recent data show that uranium and technetium-99 concentrations in the groundwater exceed federal maximum contaminant levels (MCLs) (DOE/RL-2010-11).

The source of the uranium and Tc-99 in the unconfined aquifer underlying the B Tank Farm Complex appears to be the overlying single-shell tanks and/or cribs. Tc-99 is mobile, and uranium is slightly mobile in groundwater in the B Tank Farm Complex. The groundwater plumes have migrated primarily to the northwest. Because the water table is nearly flat (i.e., the local gradient is too small to be measured) and the uppermost surface of the basalt is irregular, the unconfined aquifer in this area exhibits variable thickness. The variable and relatively thin nature of the aquifer may affect the long-term yield under sustained pumping.

### A2.1.3 Project and Task Description

This SAP governs the groundwater sampling and analysis associated with the 200-BP-5 Treatability Test. Section A3 of this SAP details the sampling to be performed under this SAP to obtain required data. Samples of groundwater will be collected as detailed in Section A3 and analyzed for Tc-99 and uranium (uranium-233/234, uranium-235, uranium-238, and total uranium) in accordance with Table A2-1. A sample collected from the test well prior to the initiation of Phase 1 or Phase 2 testing will be analyzed for the additional analytes and parameters listed in Table A2-1 if characterization information adequate for waste acceptance determination of that analyte does not exist from nearby wells. If Phase 2 testing extends beyond 90 days, a quarterly sample will be collected from the test well and analyzed for all of the analytes and parameters listed in Table A2-1. Additional sampling may occur at the direction of the 200-BP-5 Groundwater OU Project Manager during the treatability test. Results obtained from activities performed under the scope this SAP will be used with other Treatability Test data to prepare a report evaluating the test results and recommending whether pump-and-treat technology should be considered as a viable remedial technology during the 200-BP-5 OU FS and/or the RD/RAWP.

### A2.1.4 Quality Objectives and Criteria

The QA objective of this plan is to develop guidance for obtaining data of known and appropriate quality. Data quality indicators (DQIs) describe data quality by evaluation against identified DQOs and the work activities identified in this SAP. 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. The principal DQIs are precision, bias or accuracy, representativeness, comparability, completeness, and sensitivity and are defined for the purposes of this document in the following sections.

Quality objectives and project-specific measurement requirements are presented in Table A2-1. In consultation with the laboratory, the 200-BP-5 Groundwater OU Manager, and/or others as appropriate, the Sample Management and Reporting organization identifies appropriate analytical methods.

#### *A2.1.4.1 Precision*

Precision is a measure of the data spread when more than one measurement exists of the same sample. Precision can be expressed as the relative percent difference (RPD) for duplicate measurements, or relative standard deviation for triplicates. Analytical precision for laboratory analyses is included in Table A2-1.

#### *A2.1.4.2 Accuracy*

Accuracy is an assessment of the closeness of the measured value to the true value. Radionuclide measurements requiring chemical separations use this technique to measure method performance. For radionuclide measurements analyzed by gamma spectroscopy, laboratories typically compare results of blind audit samples against known standards to establish accuracy. Accuracy determination for chemical analyses is based on spiked sample results (e.g., matrix spike and laboratory control sample). The validity of calibrations is evaluated by comparing results from the measurement of a standard to known values and/or by generation of in-house statistical limits based on three standard deviations (plus or minus three standard deviations). Table A2-1 lists the laboratory accuracy parameters for this SAP.

#### *A2.1.4.3 Representativeness*

Representativeness is a measure of how closely analytical results reflect the actual concentration and distribution of the constituents in the matrix sampled. Sampling plan design, sampling techniques, and sample handling protocols (e.g., storage, preservation, and transportation) are discussed in subsequent sections of this SAP. The required documentation will establish the protocols to be followed and will ensure appropriate sample identification and integrity.

#### *A2.1.4.4 Comparability*

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

#### *A2.1.4.5 Completeness*

Table A2-1 identifies the sample analytes, field parameters, and analytical performance requirements for samples collected under the scope of this SAP. Uranium and Tc-99 are the primary analytes for technical evaluation. The analytical data set will be considered incomplete if one or more of the target analytes for water samples listed in Table A2-1 (uranium-233/234, uranium-235, uranium-238, total uranium, and Tc-99) are not reported.

#### *A2.1.4.6 Sensitivity*

Sensitivity is the capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest.

### A2.1.5 Special Training and Certification

A graded approach is used to ensure that workers receive a level of training commensurate with responsibilities and that complies with applicable DOE orders and government regulations. The field team lead, in coordination with line management, will ensure special training requirements for field personnel are met.

Typical training requirements or qualifications have been instituted by the primary contractor management team to meet training requirements imposed by the contract, regulations, DOE orders, DOE contractor requirement documents, American National Standards Institute/American Society of Mechanical Engineers, and the *Washington Administrative Code*. For example, the environmental, safety, and health training program provides workers with the knowledge and skills necessary to execute assigned duties safely. Field personnel typically have completed the following training before starting work:

- Occupational Safety and Health Administration 40-Hour Hazardous Waste Worker Training and supervised 24-hour hazardous waste site experience
- 8-Hour Hazardous Waste Worker Refresher Training (as required)
- Hanford General Employee Radiation Training
- Hanford General Employee Training, or equivalent (e.g., CHPRC General Employee Training)
- Radiological Worker Training

**Table A2-1. 200-BP-5 Treatability Test Analytical Performance Requirements for Water Matrices**

| Chemical Abstracts Service No. or Constituent Identifier No. | Analyte | Survey or Analytical Method[a] | Lowest Overall RBSL[b] | Target Detection Limits[c] | Precision Required (%) | Accuracy Required (%) |
|---|---|---|---|---|---|---|
| **Target Analytes for Water Samples[d]** | | | | | | |
| 14133-76-7 | Technetium-99 | Technetium-99 LSC (low level) | 900 pCi/L | 900 pCi/L | ≤20[e] | 80-120[e] |
| U-233/234 | Uranium-233/234 | Isotopic Uranium AEA | None (20 pCi/L)[f] | 20 pCi/L | ≤20[e] | 80-120[e] |
| 15117-96-1 | Uranium-235 | | None (24 pCi/L)[f] | 24 pCi/L | ≤20[e] | 80-120[e] |
| U-238 | Uranium-238 | | None (24 pCi/L)[f] | 24 pCi/L | ≤20[e] | 80-120[e] |
| 7440-61-1 | Uranium (total) | Kinetic Phosphorescence Analysis, or EPA Method 200.8 | 0.5 µg/L | 0.5 µg/L | ≤20[g] | 80-120[g] |
| **Additional Analytes for ETF Waste Acceptance[d]** | | | | | | |
| 12587-46-1 | Gross alpha[h] | GPC | 15 pCi/L | 3 pCi/L | ≤20[e] | 80-120[e] |
| 12587-47-2 | Gross beta[h] | GPC | None[i] | 4 pCi/L | ≤20[e] | 80-120[e] |
| 14596-10-2 | Americium-241[h] | Am-241 AEA | 15 pCi/L | 15 pCi/L | ≤20[e] | 80-120[e] |
| 14762-75-5 | Carbon-14 | C-14-liquid scintillation | 609 pCi/L | 609 pCi/L | ≤20[e] | 80-120[e] |
| 10198-40-0 | Cobalt-60 | GEA | 100 pCi/L | 100 pCi/L | ≤20[e] | 80-120[e] |
| 10045-97-3 | Cesium-137[h] | GEA | 43 pCi/L | 43 pCi/L | ≤20[e] | 80-120[e] |
| 15046-84-1 | Iodine-129 | Chemical separation low-energy spectroscopy | 1 pCi/L | 1 pCi/L | ≤20[e] | 80-120[e] |
| 13994-20-2 | Neptunium-237 | AEA | 15 pCi/L | 15 pCi/L | ≤20[e] | 80-120[e] |
| 13981-16-3 | Plutonium-238 | AEA | 15 pCi/L | 15 pCi/L | ≤20[e] | 80-120[e] |
| 15117-48-3/ 14119-33-6 | Plutonium-239/240[h] | AEA | 15 pCi/L | 15 pCi/L | ≤20[e] | 80-120[e] |
| 10098-97-2 | Strontium-90[h] | Strontium-89, -90 Total strontium gas proportional counting | 8 pCi/L | 8 pCi/L | ≤20[e] | 80-120[e] |
| TH-232 | Thorium-232[h] | Isotopic Thorium AEA | 15 pCi/L | 15 pCi/L | ≤20[e] | 80-120[e] |
| 10028-17-8 | Tritium | Tritium - $H_3$ LSC (mid level) | 20,000 pCi/L | 20,000 pCi/L | ≤20[e] | 80-120[e] |

**Table A2-1. 200-BP-5 Treatability Test Analytical Performance Requirements for Water Matrices**

| Chemical Abstracts Service No. or Constituent Identifier No. | Analyte | Survey or Analytical Method[a] | Lowest Overall RBSL[b] | Target Detection Limits[c] | Precision Required (%) | Accuracy Required (%) |
|---|---|---|---|---|---|---|
| 7429-90-5 | Aluminum | EPA Methods 6010, 6020, or 200.8 | 50 µg/L | 50 µg/L | ≤20[g] | 80-120[g] |
| 7440-36-0 | Antimony[h] | EPA Methods 6010, 6020, or 200.8 | 6.0 µg/L | 6.0 µg/L | ≤20[g] | 80-120[g] |
| 7440-38-2 | Arsenic[h] | EPA Methods 6010, 6020, 7062, or 200.8 | 0.058 µg/L | 4 µg/L[j] | ≤20[g] | 80-120[g] |
| 7440-39-3 | Barium[h] | EPA Methods 6010, 6020, or 200.8 | 4 µg/L | 4 µg/L | ≤20[g] | 80-120[g] |
| 7440-41-7 | Beryllium[h] | EPA Methods 6010, 6020, or 200.8 | 2 µg/L | 4 µg/L[j] | ≤20[g] | 80-120[g] |
| 7440-43-9 | Cadmium | EPA Methods 6010, 6020, or 200.8 | 0.25 µg/L | 2.0 µg/L[j] | ≤20[g] | 80-120[g] |
| 7440-70-2 | Calcium[h] | EPA Methods 6010 | -- | 1,000 µg/L | ≤20[g] | 80-120[g] |
| 7440-47-3 | Chromium (total) | EPA Methods 6010, 6020, or 200.8 | 74 µg/L | 74 µg/L | ≤20[g] | 80-120[g] |
| 7440-48-4 | Cobalt[h] | EPA Methods 6010, 6020, or 200.8 | 4.8 µg/L | 4 µg/L | ≤20[g] | 80-120[g] |
| 18540-29-9 | Hexavalent Chromium | EPA Method 7196 | 11 µg/L | 11 µg/L | ≤20[g] | 80-120[g] |
| 7439-89-6 | Iron | EPA Method 6010 | 300 µg/L | 300 µg/L | ≤20[g] | 80-120[g] |
| 7439-92-1 | Lead[h] | EPA Methods 6010, 6020, or 200.8 | 2.1 µg/L | 2 µg/L | ≤20[g] | 80-120[g] |
| 7439-95-4 | Magnesium[h] | EPA Methods 6010, 6020, or 200.8 | -- | 1,000 µg/L | ≤20[g] | 80-120[g] |
| 7439-96-5 | Manganese[h] | EPA Methods 6010, 6020, or 200.8 | 50 µg/L | 50 µg/L | ≤20[g] | 80-120[g] |
| 7439-97-6 | Mercury[h] | EPA Methods 6010, 6020, or 200.8 | 0.05 µg/L | 0.5 µg/L[j] | ≤20[g] | 80-120[g] |

**Table A2-1. 200-BP-5 Treatability Test Analytical Performance Requirements for Water Matrices**

| Chemical Abstracts Service No. or Constituent Identifier No. | Analyte | Survey or Analytical Method[a] | Lowest Overall RBSL[b] | Target Detection Limits[c] | Precision Required (%) | Accuracy Required (%) |
|---|---|---|---|---|---|---|
| 7440-09-7 | Potassium[h] | EPA Methods 6010, 6020, or 200.8 | -- | 100 μg/L | ≤20[g] | 80-120[g] |
| 7440-21-3 | Silicon[h] | EPA Methods 6010, 6020, or 200.8 | -- | 20 μg/L | ≤20[g] | 80-120[g] |
| 7440-23-5 | Sodium | EPA Methods 6010, 6020, or 200.8 | -- | 1,000 μg/L | ≤20[g] | 80-120[g] |
| 7440-28-0 | Thallium | EPA Methods 6010, 6020, or 200.8 | 2.0 μg/L | 2.0 μg/L | ≤20[g] | 80-120[g] |
| 7440-61-1 | Uranium (total) | Kinetic phosphorescence analysis, or EPA Method 200.8 | 0.5 μg/L | 0.5 μg/L | ≤20[g] | 80-120[g] |
| 7440-62-2 | Vanadium[h] | EPA Methods 6010, 6020, or 200.8 | 112 μg/L | 25 μg/L | ≤20[g] | 80-120[g] |
| 7440-66-6 | Zinc[h] | EPA Methods 6010, 6020, or 200.8 | 120 μg/L | 120 μg/L | ≤20[g] | 80-120[g] |
| 78-93-3 | 2-Butanone[h] | EPA Method 8260 | 4,800 μg/L | 10 μg/L | ≤20[g] | 80-120[g] |
| 67-64-1 | Acetone[h] | EPA Method 8260 | 7,200 μg/L | 20 μg/L | ≤20[g] | 80-120[g] |
| 56-23-5 | Carbon tetrachloride[h] | EPA Method 8260 | 0.23 μg/L | 1 μg/L[j] | ≤20[g] | 80-120[g] |
| 117-81-7 | bis(2-Ethylhexyl) phthalate[h] | EPA Method 8270 | 6.0 μg/L | 10 μg/L[j] | ≤20[g] | 80-120[g] |
| 126-73-8 | Tributyl phosphate[h] | EPA Method 8270 | 16.2 μg/L | 100 μg/L[j] | ≤20[g] | 80-120[g] |
| 14798-03-9 | Ammonium[h] | EPA 350.1 | - | 10 μg/L | ≤20[g] | 80-120[g] |
| 16887-00-6 | Chloride | IC, EPA Methods 300.0, or 9056 | 230,000 μg/L | 230,000 μg/L | ≤20[g] | 80-120[g] |
| 57-12-5 | Cyanide | EPA Methods 9010 total cyanide, or 335 | 5.2 μg/L | 5.2 μg/L | ≤20[g] | 80-120[g] |
| 16984-48-8 | Fluoride[h] | IC, EPA Methods 300.0, or 9056 | 200 μg/L | 200 μg/L | ≤20[g] | 80-120[g] |
| 20461-54-5 | Iodide[h] | IC, EPA Methods 300.0, or 9056 | - | 100 μg/L | ≤20[g] | 80-120[g] |

**Table A2-1. 200-BP-5 Treatability Test Analytical Performance Requirements for Water Matrices**

| Chemical Abstracts Service No. or Constituent Identifier No. | Analyte | Survey or Analytical Method[a] | Lowest Overall RBSL[b] | Target Detection Limits[c] | Precision Required (%) | Accuracy Required (%) |
|---|---|---|---|---|---|---|
| 14797-55-8 | Nitrate | IC, EPA Methods 300.0, or 9056 | 1,600 µg/L | 1,600 µg/L | ≤20[g] | 80-120[g] |
| 14797-65-0 | Nitrite | IC, EPA Methods 300.0, or 9056 | 40 µg/L | 40 µg/L | ≤20[g] | 80-120[g] |
| 14808-79-8 | Sulfate | IC, EPA Methods 300.0, or 9056 | 70,000 µg/L | 70,000 µg/L | ≤20[g] | 80-120[g] |
| ALKALINITY | Alkalinity[h] | Method 310.1/310.2 | -- | 5,000 µg/L | ≤20[g] | 80-120[g] |
| PH | pH[h] | Method 9040 or 150.1 | -- | 0.1 pH units | ±0.1 pH units | ±0.1 pH units |
| HARDNESS | Total hardness[h] | Method 2340 (calculate from Ca + Mg) | N/A | N/A | N/A | N/A |
| TDS | Total dissolved solids[h] | Method 160.1 | 500,000 µg/L | 500,000 µg/L | ≤20 | 80-120 |
| TSS | Total suspended solids[h] | Method 160.2 | N/A | N/A | ≤20 | 80-120 |
| TOC | Total organic carbon[h] | Method 415.1 | N/A | N/A | ≤20 | 80-120 |

a. For 4-digit EPA methods, see SW-846. For EPA Methods 300, 335, and 353, see EPA-600/4-79-020. For EPA Method 200.8, see EPA-600/R-94-111. EPA Methods 903.1 and 904.0 are found in EPA-600/4-80-032.

b. Human health RBSL was obtained from the following references: WAC 173-340-720, the *Safe Drinking Water Act of 1974*, and WAC 246-290-310.

c. Target detection limits are based on optimal conditions in a standard fixed laboratory. Interferences and matrix effects may decrease sensitivity, resulting in an increase to the values shown.

d. Samples collected will be analyzed for target analytes for water samples listed. In addition, samples will be analyzed for additional analytes for ETF waste acceptance, on an as needed basis, if characterization information adequate for waste acceptance determination for that analyte does not exist from nearby wells. Quarterly samples, if collected, will be analyzed for target analytes for water and additional analytes for ETF Waste Acceptance.

e. Accuracy criteria are for associated batch laboratory control sample percent recoveries. With the exception of gamma energy analysis, additional analysis-specific evaluations are also performed for matrix spikes, tracers, and carriers, as appropriate to the method. Precision criteria are based on batch laboratory replicate sample analyses.

f. No MCLs exist for uranium isotopes. Values shown in parenthesis are concentrations in water that would produce an effective dose equivalent of 4 mrem/yr if consumed at average annual rates (DOE/RL-2008-01, Table 1.0-6).

g. Accuracy criteria are the minimum for associated batch laboratory control sample percent recoveries. Laboratories must meet statistically based control if more stringent. Additional analyte-specific evaluations also are performed for matrix spikes and surrogates, as appropriate to the method. Precision criteria are based on batch laboratory replicate matrix spike analyses.

h. Not a groundwater contaminant of potential concern for the vicinity of B Tank Farm Complex (DOE/RL-2007-18, Table A1-3, Table A1-4).

**Table A2-1. 200-BP-5 Treatability Test Analytical Performance Requirements for Water Matrices**

| Chemical Abstracts Service No. or Constituent Identifier No. | Analyte | Survey or Analytical Method[a] | Lowest Overall RBSL[b] | Target Detection Limits[c] | Precision Required (%) | Accuracy Required (%) |
|---|---|---|---|---|---|---|

i. The federal MCL for gross beta particle activity is 4 mrem/yr. The average annual concentration shall not produce an annual dose from all beta emitting isotopes equivalent to the total body or any internal organ dose >4 mrem/yr.

j. Calculated lowest overall RBSL is less than established capabilities of the analytical method. The analytical detection limits will be used for working levels and will be reviewed to establish whether lower detection limit capabilities have become available.

| | | | | | |
|---|---|---|---|---|---|
| AEA | = | alpha energy analysis | mrem/yr | = | millirem per year |
| EPA | = | U.S. Environmental Protection Agency | N/A | = | not applicable |
| GPC | = | gas flow proportional counting | LSC | = | liquid scintillation counter |
| GS | = | gamma spectroscopy | RBSL | = | risk-based screening level |
| IC | = | ion chromatography | | | |

Project-specific safety training, geared specifically to the project and the day's activity, will be provided. Project-specific training includes the following:

- Training requirements or qualifications needed by sampling personnel will be in accordance with QA requirements.
- Samplers are required to have training and/or experience in the type of sampling that is being performed in the field.
- Qualification requirements for RCTs are established by the Radiation Protection Program; the RCTs assigned to these activities will be qualified through the prescribed training program and will undergo ongoing training and qualification activities.

In addition, pre-job briefings will be performed to evaluate an activity and associated hazards by considering many factors including the following:

- Objective of the activities
- Individual tasks to be performed
- Hazards associated with the planned tasks
- Controls applied to mitigate the hazards
- Environment in which the job will be performed
- Facility where the job will be performed
- Equipment and material required
- Safety procedures applicable to the job
- Training requirements for individuals assigned to perform the work
- Level of management control
- Proximity of emergency contacts

Training records are maintained for each individual employee in an electronic training record database. The contractor's training organization maintains the training records system. Line management will be used to confirm that an individual employee's training is appropriate and up-to-date prior to performing any field work.

### A2.1.6 Documents and Records

The 200-BP-5 Groundwater OU Project Manager is responsible for ensuring the current version of the SAP is being used and for providing any updates to field personnel. Version control is maintained by the administrative document control process. Changes to the SAP affecting the DQOs will be reviewed and approved by DOE and the lead regulatory agency prior to implementation.

Three types of changes during the treatability test could affect compliance with the requirements in the test plan.

- A **fundamental change** is a change that does not meet the requirements set forth in the test plan or that incorporates testing activities not defined in the scope of the test plan.
- A **significant change** generally involves a significant change to a component of the test that does not fundamentally alter the overall test approach.
- A **minor change** will not have a significant impact on the scope, schedule, or cost of the test. Minor field changes can be made by the person in charge of the field activity. These minor changes should be documented in the project file (for example, through interoffice memoranda or logbooks). Non-significant changes will not impact the requirements of the test plan.

Determining the significance of the change is the responsibility of DOE and the lead regulatory agency. The 200-BP-5 Groundwater OU Project Manager is responsible for tracking all changes and obtaining appropriate reviews by contractor staff. The 200-BP-5 Groundwater OU Project Manager will discuss the change with DOE. DOE will then discuss with the lead regulatory agency significant changes, as needed, including changes described in Section 9.3 and Section 12.0 of the TPA Action Plan (Ecology et al., 1989b). Appropriate documentation will follow, in accordance with the requirements for the type of change.

The field team lead is responsible for ensuring that the field instructions are maintained and aligned with any revisions or approved changes to the SAP. The field team lead will ensure that deviations from the SAP or problems encountered in the field are documented appropriately (e.g., in the field logbook or on nonconformance report forms) in accordance with internal corrective action procedures.

The 200-BP-5 Groundwater OU Project Manager, field team lead, or designee, is responsible for communicating field corrective action requirements and ensuring immediate corrective actions are applied to field activities.

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 data with a single line, entering the correct data, and initialing and dating the changes.

The 200-BP-5 Groundwater OU 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
- Inspection or assessment reports and corrective action reports
- Interim progress reports
- Final reports
- Laboratory data packages
- Verification and validation reports

The laboratory is responsible for maintaining, and having available upon request, the following:

- Analytical logbooks
- Raw data and QC sample records
- Standard reference material and/or proficiency test sample data
- Instrument calibration information

Records may be stored in either electronic or hard copy format. Documentation and records, regardless of medium or format, are controlled in accordance with internal work requirements and processes to ensure the accuracy and retrievability of stored records. Records required by the TPA will be managed in accordance with TPA requirements.

## A2.2 Data Generation and Acquisition

The following sections address data generation and acquisition to ensure that the project's methods for sampling, measurement and analysis, data collection or generation, data handling, and QC activities are appropriate and documented.

The field team lead is responsible for ensuring that all field procedures are followed completely and that field sampling personnel are adequately trained to perform sampling activities under this SAP. The field team lead must document all deviations from procedures or other problems pertaining to sample collection, chain-of-custody, sample analytes, sample transport, or noncompliant monitoring. As appropriate, such deviations or problems will be documented in the file logbook or in nonconformance report forms in accordance with internal corrective action procedures. The field team lead or 200-BP-5 Groundwater OU Project Manager is responsible for communicating field corrective action requirements and for ensuring that immediate corrective actions are applied to field activities.

### A2.2.1 Sampling Process Design (Experimental Design)

The sampling design is judgmental sampling. In judgmental sampling, the selection of sampling units (i.e., the number and location and/or timing of collecting samples) is based on knowledge of the feature or condition under investigation and on professional judgment. Judgmental sampling is distinguished from probability-based sampling in that inferences are based on professional judgment, not statistical scientific theory. Therefore, conclusions about the target population are limited and depend entirely on the validity and accuracy of professional judgment. Probabilistic statements about parameters are not possible.

The types, numbers, and locations of samples are provided in Section A3.1 of this SAP.

### A2.2.2 Sampling Methods

Section A3.2 describes the sampling methods. The specific information includes the following:

- Field sampling methods
- Corrective actions for sampling activities
- Decontamination of sampling equipment
- Radiological field data

### A2.2.3 Sample Handling and Custody

A sampling and data tracking database is used to track the samples from the point of collection through the laboratory analysis process. Samplers should note any anomalies (e.g., sample appears unusual, sample is sludge) with the samples to prevent batching across similar matrices. If anomalies are found, the samplers should write "DO NOT BATCH" on the chain-of-custody form and inform Sample Management and Reporting.

Laboratory analytical results are entered and maintained in HEIS. The HEIS sample numbers are issued to the sampling organization for the project. Each chemical, radiological, and physical properties sample is identified and labeled with a unique HEIS sample number.

Section A3.5 provides the following specific sample handling information:

- Sample packaging
- Container labeling
- Sample custody requirements
- Sample transportation

Sample custody during laboratory analysis is addressed in the applicable laboratory standard operating procedures. Laboratory custody procedures will ensure that sample integrity and identification are maintained throughout the analytical process. Storage of samples at the laboratory will be consistent with laboratory instructions prepared by Sample Management and Reporting.

### A2.2.4 Analytical Methods

Information on analytical methods is provided in Table A2-1. These analytical methods are controlled in accordance with the laboratory's QA Plan and the requirements of this QAPjP. The primary contractor participates in overseeing off-site analytical laboratories to qualify them for performing Hanford Site analytical work.

If the laboratory uses a nonstandard or unapproved method, then the laboratory must provide method validation data to confirm that the method is adequate for the intended use of the data. This includes information such as determination of detection limits, quantitation limits, typical recoveries, and analytical precision and bias. Deviations from the analytical methods noted in Table A2-1 must be approved by the Sample Management and Reporting organization in consultation with 200-BP-5 Groundwater OU Project Manager.

Laboratories providing analytical services in support of this SAP will have a corrective action program in place that addresses analytical system failures and documents the effectiveness of any corrective actions. Issues that may affect analytical results are to be resolved by the Sample Management and Reporting organization in coordination with the 200-BP-5 Groundwater OU Project Manager.

### A2.2.5 Quality Control

The QC procedures must be followed in the field and laboratory to ensure that reliable data are obtained. Field QC samples will be collected to evaluate the potential for cross-contamination and provide information pertinent to field sampling variability. Field QC sampling will include the collection of equipment rinsate blank and field duplicate samples. Laboratory QC samples estimate the precision and accuracy of the analytical data. Field and laboratory QC samples are summarized in Table A2-2.

**Table A2-2. Field and Laboratory Quality Control Requirements**

| Sample Type | Purpose | Frequency |
|---|---|---|
| **Field Quality Control** | | |
| Field Duplicate | Estimate precision, including sampling and analytical variability | One per Phase 2 test, collected during day 1 for each test. |
| Equipment Rinsate Blanks | Verify adequacy of sampling equipment decontamination | As needed[a]<br>If only disposable equipment is used, then an equipment rinsate blank is not required. Otherwise, 1 per 20 samples, *per media sampled.* |
| **Laboratory Quality Control[b]** | | |
| Method Blank | Assess response of an entire laboratory analytical system | At least one per batch[b], or as identified by the method guidance, *per media sampled.* |
| Matrix Spike | Identify analytical (preparation + analysis) accuracy; possible matrix affect on the analytical method used | When required by the method guidance, at least one per batch[b], or as identified by the method guidance, *per media sampled.* |
| Matrix Duplicate or Matrix Spike Duplicate | Estimate analytical accuracy and precision | When required by the method guidance, at least one per batch[b], or as identified by the method guidance, *per media sampled.* |
| Laboratory Control Samples | Assess method accuracy | At least one per batch[b], or as identified by the method guidance, *per media sampled.* |

a. Whenever a new type of non-dedicated equipment is used, an equipment blank shall be collected every time sampling occurs until it can be shown that 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). Maximum batch size is 20 samples.

#### *A2.2.5.1 Field Quality Control Samples*

Field QC samples will be collected to evaluate the potential for cross-contamination, provide information pertinent to field sampling variability and laboratory performance. The QC samples and the required frequency for collection are described in this section.

**Equipment rinsate blanks** are collected for reused sampling devices to assess the adequacy of the decontamination process. Equipment rinsate blank samples 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 (e.g., single-use) equipment is used, equipment rinsate blank samples will not be required.

For equipment rinsate blank samples, results greater than 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 greater than 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 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. One field duplicate sample will be collected during the first day of testing for each Phase 2 test (primary location and, if performed, secondary location).

#### *A2.2.5.2 Laboratory Quality Control Samples*

The laboratory QC samples (e.g., method blanks, laboratory control sample/blank spike, and matrix spike) are defined for the three-digit EPA methods (EPA-600/4-79-20) and for the four-digit EPA methods (SW-846), and will be run at the frequency specified in the respective reference unless superseded by agreement between the primary contractor and laboratory.

#### *A2.2.5.3 Quality Control Requirements*

Table A2-2 lists the field QC requirements for sampling. If only disposable equipment is used or equipment is dedicated to a particular well, then an equipment rinsate blank is not required.

Field duplicates must agree within 20 percent, as measured by the RPD, to be acceptable. Only those field duplicates with at least one result greater than five times the appropriate detection limit are evaluated. Field duplicate results not satisfying evaluation criteria will be qualified and flagged in HEIS, as appropriate.

For chemical analyses, the control limits for laboratory duplicate samples, matrix spike samples, matrix spike duplicate samples, and laboratory control samples are typically derived from historical data at the laboratories in accordance with SW-846. Typical control limits are within 20 percent of the expected values, although the limits may vary considerably depending upon the method and analyte. For this project, the control limits for laboratory QC samples are specified in Table 2-1.

Holding time is the elapsed time period between sample collection and analysis. Exceeding required holding times could result in changes in constituent concentrations due to volatilization, decomposition, or other chemical alterations. Required holding times depend on the analytical method, as specified for three-digit EPA methods (EPA-600/4-79-020) or for the four-digit EPA methods (SW-846).

Additional QC measures include laboratory audits and participation in nationally based performance evaluation studies. The contract laboratories participate in national studies such as the EPA-sanctioned Water Pollution and Water Supply Performance Evaluation studies. The CH2M HILL Plateau Remediation Company (CHPRC) Soil and Groundwater Remediation Project periodically audits the analytical laboratories to identify, resolve, and prevent quality problems. Audit results are used to improve performance. Summaries of audit results and performance evaluation studies are presented in the annual groundwater monitoring report.

### A2.2.6 Instrument and Equipment Testing, Inspection, and Maintenance

Equipment used for collection, measurement, and testing should meet applicable standards (e.g., American Society for Testing and Materials) or should have been evaluated as acceptable and valid in accordance with the procedures, requirements, and specifications. The field team lead, or equivalent, will ensure the data generated from instructions using a software system are backed up and/or downloaded on a regular basis. Software configuration will be acceptance tested prior to use in the field.

Measurement and testing equipment used in the field or in the laboratory directly affecting 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. Maintenance requirements (e.g., documentation of routine maintenance) will be included in the individual laboratory and onsite organization's QA plan or operating procedures, as appropriate. Maintenance of laboratory instruments will be performed in a manner consistent with the three-digit EPA methods (EPA-600/4-79-020) and four-digit EPA methods (SW-846), as amended, or with auditable DOE Hanford Site and contractual requirements. Consumables, supplies, and reagents will be reviewed per SW-846 requirements and will be appropriate for their use.

#### A2.2.7 Instrument and Equipment Calibration and Frequency

Specific field equipment calibration information is provided in Section A3.4. Analytical laboratory instruments and measuring equipment are calibrated in accordance with the laboratory's QA plan.

#### A2.2.8 Inspection and Acceptance of Supplies and Consumables

Supplies and consumables used in support of sampling and analysis activities are procured in accordance with internal work requirements and processes described in the contractor acquisition system. Responsibilities and interfaces necessary to ensure that items procured/acquired for the contractor meet the specific technical and quality requirements must be in place. The procurement system ensures purchased items comply with applicable procurement specifications. Supplies and consumables are checked and accepted by users prior to use.

Supplies and consumables procured by the analytical laboratories are procured, checked, and used in accordance with the laboratory's QA plan.

#### A2.2.9 Nondirect Measurements

Nondirect measurements include data obtained from sources such as computer databases, programs, literature files, and historical databases. Nondirect measurements will not be evaluated as part of the activities under the scope of this SAP.

#### A2.2.10 Data Management

The Sample Management and Reporting organization, in coordination with the 200-BP-5 Groundwater OU Project Manager, is responsible for ensuring that analytical data is appropriately reviewed, managed, and stored in accordance with the applicable programmatic requirements governing data management procedures. Electronic data access, when appropriate, will be via a database (e.g., HEIS or a project-specific database). Where electronic data are not available, hard copies will be provided in accordance with Section 9.6 of the TPA Action Plan (Ecology et al., 1989b).

Laboratory errors are reported to the Sample Management and Reporting organization on a routine basis. For reported laboratory errors, a sample issue resolution form will be initiated in accordance with contractor procedures. This process is used to document analytical errors and to establish their resolution with the 200-BP-5 Groundwater OU Project Manager. The sample issue resolution forms become a permanent part of the analytical data package for future reference and for records management.

Planning for sample collection and analysis will be in accordance with the programmatic requirements governing fixed laboratory sample collection activities, as discussed in the sampling procedures. In the event that specific procedures do not exist for a particular work evolution, or if it is determined that additional guidance is needed to complete certain tasks, a work package will be developed to provide adequate control of the activities, as appropriate. Examples of sampling procedure requirements include activities associated with the following:

- Chain of custody/sample analysis requests
- Project and sample identification for sampling services
- Control of certificates of analysis
- Logbooks
- Checklists
- Sample packaging and shipping

Approved work control packages and procedures will be used to document field activities including radiological and non-radiological measurements when this SAP is implemented. Field activities will be recorded in the field logbook. Examples of the types of documentation for field radiological data include the following:

- Instructions regarding the minimum requirements for documenting radiological controls information in accordance with 10 CFR 835.
- Instructions for managing the identification, creation, review, approval, storage, transfer, and retrieval of primary contractor radiological records.
- The minimum standards and practices necessary for preparing, performing, and retaining radiological-related records.
- The indoctrination of personnel on the development and implementation of sample plans.
- The requirements associated with preparing and transporting regulated material.
- Daily reports of radiological surveys and measurements collected during conduct of field investigation activities. Data will be cross-referenced between laboratory analytical data and radiation measurements to facilitate interpreting the investigation results.

## A2.3 Assessment and Oversight

The elements in assessment and oversight address the activities for assessing the effectiveness of project implementation and associated QA and QC activities. The purpose of assessment is to ensure that the QAPjP is implemented as prescribed.

### A2.3.1 Assessments and Response Actions

Contractor management, Regulatory Compliance, QA, and/or Health and Safety organizations may conduct random surveillances and assessments to verify compliance with the requirements outlined in this SAP, project work packages, procedures, and regulatory requirements.

If circumstances arise in the field dictating the need for additional assessment activities, then additional assessments would be performed. Deficiencies identified by these assessments will be reported in accordance with existing programmatic requirements. The project's line management chain coordinates the corrective actions/deficiencies in accordance with the contractor QA program, the corrective action management program, and associated procedures implementing these programs.

Oversight activities in the analytical laboratories, including corrective action management, are conducted in accordance with the laboratories' QA plans. The contractor oversees offsite analytical laboratories and qualifies the laboratories for performing Hanford Site analytical work.

### A2.3.2 Reports to Management

Reports to management on data quality issues will be made if and when these issues are identified. Issues reported by the laboratories are communicated to the Sample Management and Reporting organization, which then initiates a sample issue resolution form in accordance with contractor procedures. This process is used to document analytical or sample issues and to establish resolution with the 200-BP-5 Groundwater OU Project Manager.

## A2.4 Data Validation and Usability

The elements in this section address the QA activities that occur after the data collection or generation phase of the project is completed. Implementation of these elements determines whether the data conform to the specified criteria, thus satisfying project objectives.

### A2.4.1 Data Review, Verification, and Validation

The criteria for verification include, but are not limited to, review for completeness (e.g., samples were analyzed as requested), use of the correct analytical method or procedure, transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight, and correct application of conversion factors. Laboratory personnel may perform data verification.

### A2.4.2 Verification and Validation Methods

The work activities shall follow documented procedures and processes for data validation and verification, as summarized below. Validation of groundwater data consists of assessing whether the data collected and measured truly reflect aquifer conditions. Verification means assessing data accuracy, completeness, consistency, availability, and internal control practices to determine overall reliability of the data collected. Other data quality requirements that shall be met include proper chain-of-custody, sample handling, use of proper analytical techniques as applied for each constituent, and the quality and acceptability of the laboratory analyses conducted.

Groundwater monitoring staff perform checks on laboratory electronic data files for formatting, allowed values, data flagging (i.e., qualifiers), and completeness. Hardcopy results are verified to check for (1) completeness, (2) notes on condition of samples upon receipt by the laboratory, (3) notes on problems encountered during analysis of the samples, and (4) correct reporting of results. If data are incomplete or deficient, staff work with the laboratory to correct the problem found during the analysis.

The data validation process provides the requirements and guidance for validating groundwater data that are routinely collected. Validation is a systematic process of reviewing verified data against a set of criteria (e.g., those listed in Table A2-1) to determine whether the data are acceptable for their intended use.

Results of laboratory and field QC evaluations and holding-time criteria are considered when determining data usability. Staff review the data to identify whether observed changes reflect changes in groundwater quality or potential data errors, and they may request data reviews of laboratory, field, or water-level data for usability purposes. The laboratory may be asked to check calculations or re-analyze the sample. Results of the data reviews are used to flag the data appropriately in the HEIS database and/or to add comments.

### A2.4.3 Reconciliation with User Requirements

The data quality assessment (DQA) 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 whether quantitative data are of the correct type and are of adequate quality and quantity to meet project DQOs. The 200-BP-5 Groundwater OU Project Manager is responsible for determining if a DQA is necessary and for ensuring that, if required, one is performed. The results of the DQA will be used in interpreting the data and determining if the objectives of this activity have been met.

# A3 Field Sampling Plan

This field sampling plan identifies the groundwater sampling activities to meet the data needs associated with the 200-BP-5 Treatability Test.

## A3.1 Sample Location and Frequency

Groundwater samples will be collected before the Phase 1 step-drawdown test to establish baseline conditions. Samples will be collected at the primary test well site and from the secondary test well site if the second treatability test is performed.

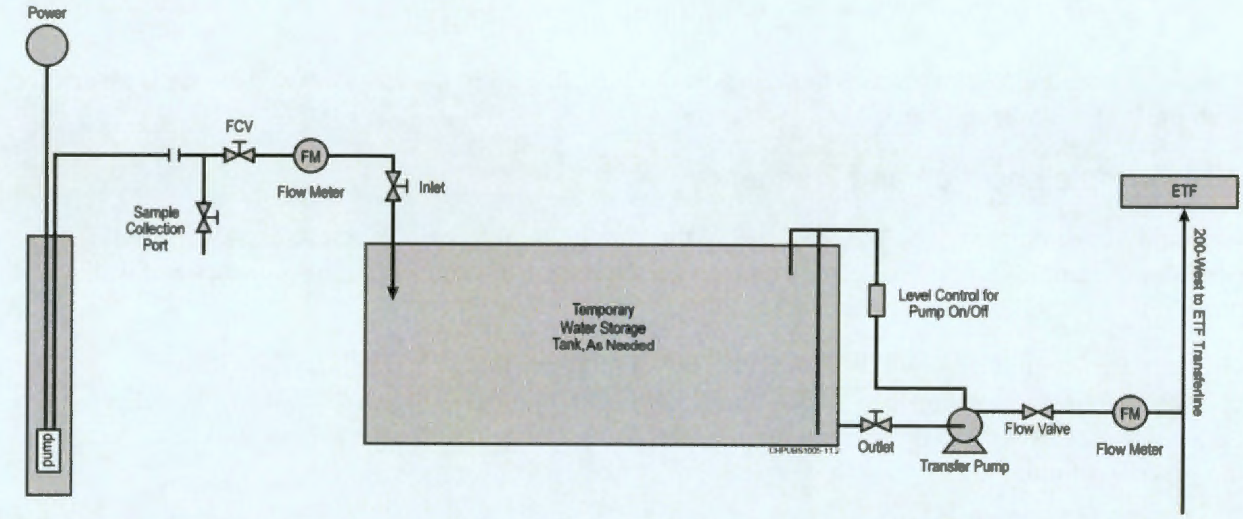
Groundwater samples also will be collected from the primary test well site during the Phase 2 constant-rate test following 1 day, 2 days, and 3 days of pumping. A fourth sample will be collected just prior to the end of the test if pumping extends past 3 days. A field duplicate sample will be collected on the first day of pumping.

If an aquifer test is conducted at the secondary test location, samples will be collected from the secondary test well following 0.5 day and 1 day of pumping. If the test extends past 1 day, a third sample will be collected at the end of 2 days of pumping and a fourth sample will be collected just prior to the end of the test. A field duplicate sample will be collected on the first day of pumping.

The samples will be collected from a sample port installed at the wellhead. The location of the sample port in relation to other elements of the groundwater discharge process is shown schematically on Figure A3-1. Groundwater samples will be collected at the extraction well and at the two closest monitoring wells during the recovery phase of the Step 2 test.

## A3.2 Sampling Methods

Sample collection performed under this SAP will be performed in accordance with site sampling procedures. Prior to sample collection, the sample port will be purged to clear the sample port and piping supplying the sample port of stagnant water. Sample preservation, containers, and holding times are presented in Table A3-1.




ETF = Effluent Treatment Facility
FCV = Flow Control Valve
FM = Flow Meter

**Figure A3-1. Conceptual Diagram of Extracted Groundwater Process Flow**

**Table A3-1. Groundwater Sample Container, Preservation, and Holding Time Guidelines[a]**

| Method Name[b] | Bottle Type | Volume (mL) | Preservation Requirement | Holding Time |
|---|---|---|---|---|
| Am-241 AEA | G/P | 1,000 | $HNO_3$ to pH <2 | 6 months |
| AEA | G/P | 1,000 | $HNO_3$ to pH <2 | 6 months |
| Isotopic Thorium AEA | G/P | 1,000 | $HNO_3$ to pH <2 | 6 months |
| Isotopic Uranium AEA | G/P | 1,000 | $HNO_3$ to pH <2 | 6 months |
| C-14 – LSC | G/P | 1,000 | None | 6 months |
| Technetium-99 – LSC low level | G/P | 1,000 | HCl to pH <2 | 6 months |
| Tritium – LSC mid level | G | 60 | None | 6 months |
| Gas flow proportional counting | G/P | 1,000 | $HNO_3$ to pH <2 | 6 months |
| GEA | G/P | 1,000 | $HNO_3$ to pH <2 | 6 months |
| Chemical separation low-energy spectroscopy | G/P | 2,000 | None | 6 months |
| Strontium-90 | G/P | 2,000 | $HNO_3$ to pH <2 | 6 months |
| EPA 6020 or 200.8 | G/P | 300 | $HNO_3$ to pH <2 | 6 months |
| EPA 6010 | G/P | 500 | $HNO_3$, pH <2 | 6 months |
| Uranium kinetic phosphorescence analysis | G/P | 500 | $HNO_3$, pH <2, Cool 4°C | 6 months |
| EPA 8260 | aGs | 4x40 | HCl to pH <2, Cool 4°C | 14 days |
| EPA 8270 | aG | 1,000 | Cool 4°C | 7 days/40 days |
| EPA 350.1 | G/P | 250 | $H_2SO_4$ to pH <2, Cool 4°C | 28 days |
| EPA 310.1/310.2 | G/P | 250 | Cool 4°C | 14 days |
| EPA 415.1 | G | 250 | HCl or $H_2SO_4$ to pH <2, Cool 4°C | 28 days |
| EPA 9010 | G/P | 1,000 | NaOH to pH >/= 12, Cool 4°C | 14 days |
| EPA 7196 | aG | 500 | Cool 4°C | 24 hours |
| EPA 300.0 or 9056 | P | 120 | Cool 4°C | 48 hours/ 28 days |
| EPA 160.1 (TDS) | G/P | 1,000 | Cool 4°C | 7 days |
| EPA 160.2 (TSS) | G/P | 1,000 | Cool 4°C | 7 days |
| EPA 9040 or 150.1 (pH) | G/P | 125 | None | Immediately |

a. Sample aliquots for multiple analytical methods may be collected in a single container to reduce the overall number of sample containers provided the laboratory-required analysis volumes and preservation requirements are met.

b. Analytical method selection is based on available methods by laboratories currently contracted to the Hanford Site. For the four-digit EPA methods, see SW-846. Equivalent methods may be substituted. For EPA Methods 160.1, 160.2, and 300.0, see EPA/600/R-93/100. For EPA Methods 310.1 to .0, see EPA-600/4-79-020.

48 hours/28 days = 48 hours for nitrate, nitrite, and phosphate; 28 days for other constituents.

7 days/40 days = 7 days collection to extraction; 40 days extraction to analysis.

| | | | | | |
|---|---|---|---|---|---|
| AEA | = | alpha energy analysis | HCl | = | hydrochloric acid |
| aG | = | amber glass | $HNO_3$ | = | nitric acid |
| aGs | = | amber glass septum (no headspace) | NaOH | = | sodium hydroxide |
| EPA | = | U.S. Environmental Protection Agency | P | = | plastic |
| LSC | = | liquid scintillation counter | TDS | = | total dissolved solids |
| G | = | glass | TSS | = | total suspended solids |
| $H_2SO_4$ | = | sulfuric acid | | | |

### A3.2.1 Decontamination of Sampling Equipment

Sampling equipment shall be decontaminated in accordance with the sampling equipment decontamination procedure. To prevent potential contamination of the samples, care should be taken to use decontaminated equipment for each sampling activity.

Special care should be taken to avoid the following common ways in which cross-contamination or background contamination may compromise the samples:

- Improperly storing or transporting sampling equipment and sample containers
- Contaminating the equipment or sample bottles by setting the equipment/sample bottle on or near potential contamination sources (e.g., uncovered ground)
- Handling bottles or equipment with dirty hands or gloves
- Improperly decontaminating equipment before sampling or between sampling events

### A3.2.2 Corrective Actions and Deviations for Sampling Activities

The 200-BP-5 Groundwater OU Project Manager, field team lead, or designee must document deviations from procedures or other problems pertaining to sample collection, chain-of-custody, target analytes, sample transport, or noncompliant monitoring. Examples of deviations include samples not collected because of field conditions, changes in sample locations because of physical obstructions, or additions of samples.

As appropriate, such deviations or problems will be documented in the field logbook or on nonconformance report forms in accordance with internal corrective action procedures. The 200-BP-5 Groundwater OU Project Manager, field team lead, or designee, will be responsible for communicating field corrective action requirements and for ensuring immediate corrective actions are applied to field activities.

Changes in sample locations not affecting the DQOs will require notification and approval of the 200-BP-5 Groundwater OU Project Manager. Changes to sample locations affecting the DQOs will require concurrence from DOE and lead regulatory agency. Changes to the SAP will be documented as noted in Section A2.1.6.

## A3.3 Documentation of Field Activities

Logbooks or data forms are required for field activities. Requirements for the logbook are provided in Section A2.1.5. Data forms may be used to collect field information; however, the information recorded on data forms must follow the same requirements as those for logbooks. The data forms must be referenced in the logbooks.

A summary of information to be recorded in logbooks is as follows:

- Purpose of activity
- Day, date, time, weather conditions
- Names, titles, organizations of personnel present
- Deviations from the QAPjP or procedures
- All site activities, including field tests
- Materials quality documentation (e.g., certifications)
- Details of samples collected (e.g., preparation, splits, duplicates, matrix spikes, blanks)
- Location and types of samples
- Chain-of-custody details and variances relating to chain-of-custody
- Field measurements
- Field calibrations and surveys, and equipment identification numbers, as applicable
- Equipment decontaminated, number of decontaminations, and variations to any decontamination procedures
- Equipment failures or breakdowns, and descriptions of any corrective actions
- Telephone calls relating to field activities

## A3.4 Calibration of Field Equipment

The field team lead is responsible for ensuring that field equipment is calibrated appropriately. Onsite environmental instruments are calibrated in accordance with the manufacturer's operating instructions, internal work requirements and processes, and/or work packages that provide direction for equipment calibration or verification of accuracy by analytical methods. The results from all instrument calibration activities are recorded in logbooks and/or work packages. Either hard copy or electronic calibration activity records are acceptable.

Calibrations must be performed as follows:

- Prior to initial use of a field analytical measurement system
- At the frequency recommended by the manufacturer or procedure, or as required by regulations
- Upon failure to meet specified QC criteria

Field instrumentation, calibration, and QA checks will be performed in accordance with the following:

- Calibration of radiological field instruments on the Hanford Site is performed by Pacific Northwest National Laboratory, as specified in their program documentation.
- Daily calibration checks will be performed and documented for each instrument used to characterize areas under investigation. These checks will be made on standard materials sufficiently like the matrix under consideration for direct comparison of data. Analysis times will be sufficient to establish detection efficiency and resolution.
- Standards used for calibration will be traceable to nationally or internationally recognized standard agency source or measurement system, if available.

## A3.5 Sample Handling

This section describes sample handling methods.

### A3.5.1 Packaging

Level I EPA pre-cleaned sample containers will be used for groundwater samples collected for chemical analysis. Container sizes may vary depending on laboratory-specific volumes/requirements for meeting analytical detection limits. The Radiological Engineering organization will measure both the contamination levels and dose rates associated with the sample containers. This information, along with other data, will be used to select proper packaging, marking, labeling, and shipping paperwork and to verify that the sample can be received by the analytical laboratory in accordance with the laboratory's acceptance criteria. If the dose rate on the outside of a sample container or the curie content exceeds levels acceptable by an offsite laboratory, the field team lead (in consultation with the Sample Management and Reporting organization), can send smaller volumes to the laboratory. Preliminary container types and volumes are identified in Table A3-1.

### A3.5.2 Container Labeling

The sample location, depth, and corresponding HEIS numbers are documented in the sampler's field logbook. A custody seal (e.g., evidence tape) is affixed to each sample container and/or the sample collection package in such a way as to indicate potential tampering.

Each sample container will be labeled with the following information on firmly affixed, water resistant labels:

- Sampling authorization form
- HEIS number
- Sample collection date and time
- Analysis required
- Preservation method (if applicable)
- Sample authorization form number

In addition, sample records must include the following information:

- Analysis required
- Source of sample
- Matrix (e.g., water and soil)
- Field data (e.g., pH and radiological readings)

### A3.5.3 Sample Custody

Sample custody will be maintained in accordance with existing Hanford Site protocols to ensure the maintenance of sample integrity throughout the analytical process. Chain-of-custody procedures will be followed throughout sample collection, transfer, analysis, and disposal to ensure sample integrity is maintained. A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples shipped to any laboratory.

Shipping requirements will determine how sample shipping containers are prepared for shipment. The analyses requested for each sample will be indicated on the accompanying chain-of-custody form. Each time the responsibility changes for the custody of the sample, the new and previous custodians will sign the record and note the date and time. The sampler will make a copy of the signed record before sample shipment and will transmit the copy to the Sample Management and Reporting organization within 48 hours of shipping.

The following information is required on a completed chain-of-custody form:

- Project name
- Signature of sampler
- Unique sample number
- Date and time of collection
- Matrix
- Preservatives
- Signatures of individual involved in sample transfer
- Requested analyses (or reference thereto)

### A3.5.4 Sample Transportation

Sample transportation will be in compliance with the applicable regulations for packaging, marking, labeling, and shipping hazardous materials, hazardous substances, and hazardous waste mandated by the U.S. Department of Transportation (49 CFR 171through 49 CFR 177, Chapter 1) in association with the International Air Transportation Authority, DOE requirements, and applicable program-specific implementing procedures.

## A3.6 Management of Waste

All waste (including unexpected waste) generated by sampling activities will be managed in accordance with DOE/RL-2003-30. Pursuant to 40 CFR 300.440, approval from the CERCLA RL Remedial Project Manager is required before returning unused samples or waste from offsite laboratories.

# A4 Health and Safety Plan

Field operations will be performed in accordance with health and safety requirements and appropriate CHPRC Soil and Groundwater Remediation Project requirements. Work control documents will be prepared to provide further control of site operations. Safety documentation will include an activity hazard analysis and, as applicable, radiological work permits. The sampling procedures and associated activities will implement ALARA practices to minimize the radiation exposure to the sampling team, consistent with the requirements defined in 10 CFR 835.

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