DOE/RL-2010-74
Revision 2

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

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

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

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APPROVED
By Ashley R Jenkins at 6:47 am, May 14, 2015

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Approval Page

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

Approval

U.S. Department of Energy, Richland Operations Office

Signature 4/27/2015
Date

Lead Regulatory Agency:

☐ U.S. Environmental Protection Agency
☒ Washington State Department of Ecology

Concurrence

U.S. Environmental Protection Agency, Region 10

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Date

Washington State Department of Ecology

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Signature 4/30/15
Date

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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 preliminary evaluations conducted to support development of this treatability test plan (TTP) indicate that the aquifer characteristics are favorable in this area. Additionally, this area is located near the source of uranium and technetium-99, which are expected to be the focus of future remediation efforts. 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 technetium-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 technetium-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.

The testing will include measurements associated with the following test activities:

- 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.
- Conducting a short-duration step-drawdown pumping test to determine the optimum groundwater pumping rate to use during the longer-duration test. This test will require approximately 2 days to complete: 1 day for equipment setup and 1 day for testing.
- Conducting a longer-duration (30 days or more) pumping test to evaluate the groundwater pumping rate that can be sustained in this area of the aquifer. This test may employ a higher pumping rate for up to 3 days to collect water level drawdown data, followed by a lower pumping rate of at least (average 189 L/min [50 gpm]) and not to exceed 568 L/min (150 gpm) for the balance of the test (following the recovery period) to collect water quality information.

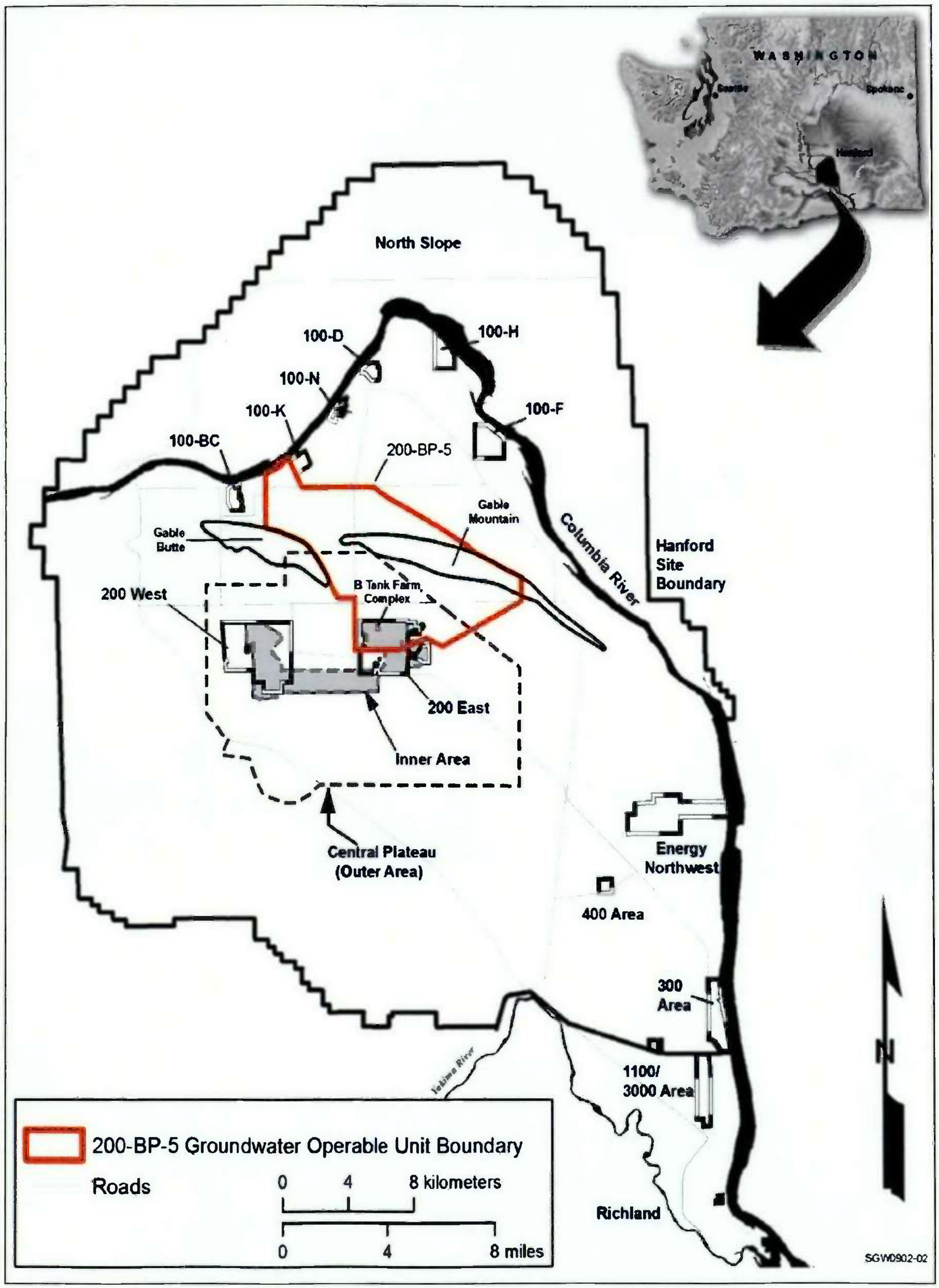

Figure ES-1. Location of the B Tank Farm Complex Area within the 200-BP-5 Groundwater OU

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) (Figure ES-2). The contaminated water pumped during this treatability test will be transferred to the 200 West Groundwater Treatment Facility for treatment. Use of the 200 West Groundwater Treatment Facility is allowed through the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*[1] (CERCLA), Section 104(d)(4), "Response Authorities," as discussed further in Chapter 2 of this report.

The test site is located on the west side of the BY Tank Farm (Figure ES-3). Two new groundwater wells were drilled and constructed for use during the test. The new extraction well (299-E33-268) will be used for pumping the groundwater from the aquifer. The other new well (299-E33-267) was located close to the extraction well to monitor the change in the elevation of the groundwater caused by the pumping.

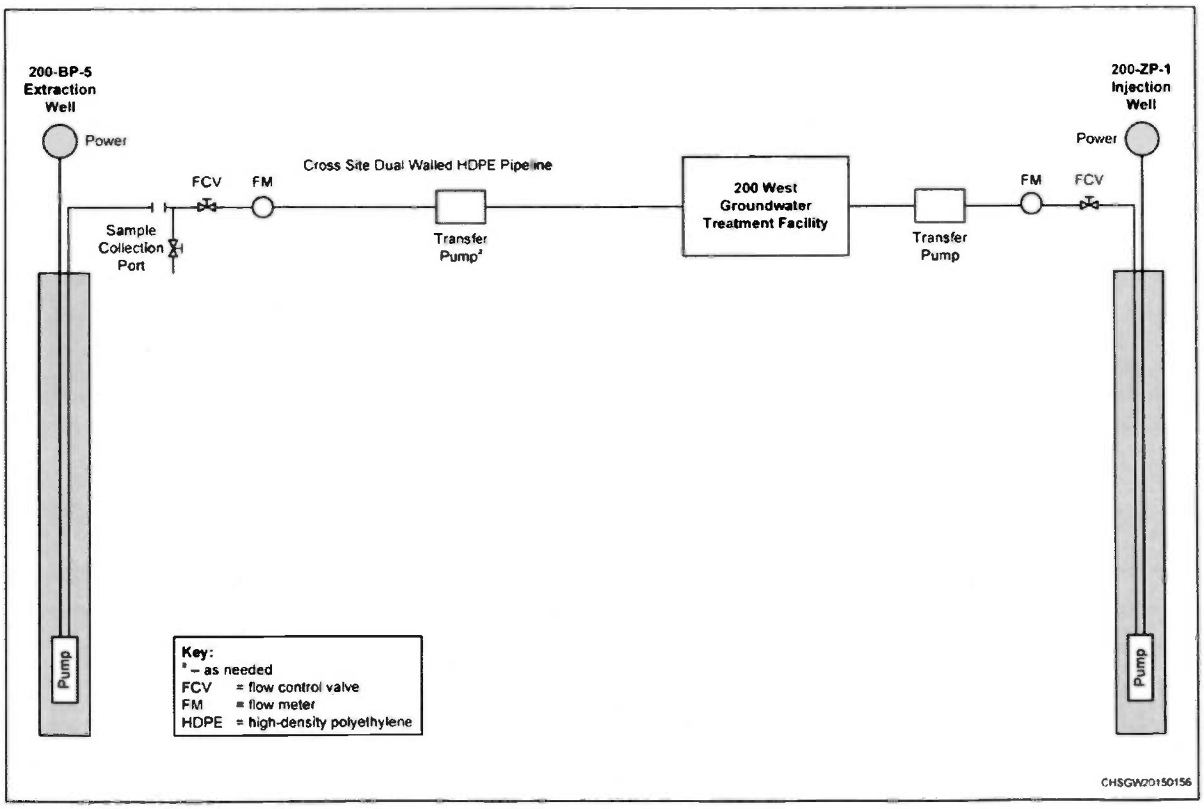

Figure ES-2. Process Flow Diagram for the 200-BP-5 OU Treatability Test

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[1] *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*, 42 USC 9601, et seq., Pub. L. 107-377, December 31, 2002. Available at: http://epw.senate.gov/cercla.pdf.

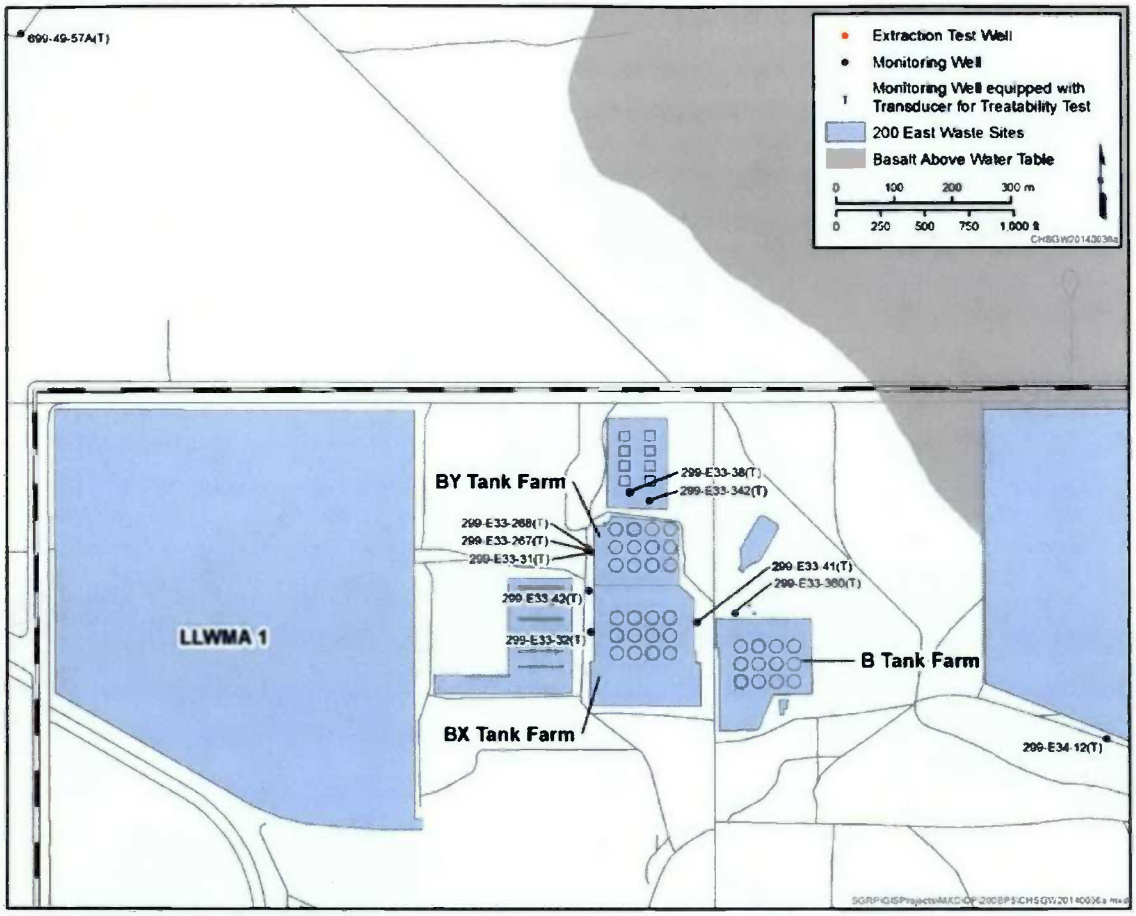

Figure ES-3. Location of the Test Well and Associated Groundwater Monitoring Wells for the Treatability Test near Waste Management Area B-BX-BY

The detailed design of the treatability test will begin when this test plan has been approved by the U.S. Department of Energy and the lead regulatory agency. During the design phase, the well pump will be sized, and the pipeline system requirements will be specified for installation from the extraction well to the 200 West Groundwater Treatment Facility (Figure ES-4). Construction activities will begin within 6 months after this test plan has been approved. Following completion of the testing, a *Hanford Federal Facility Agreement and Consent Order*,[2] also known as the Tri-Party Agreement (TPA), briefing will be held to present the preliminary results. Depending on the test results,

[2] Ecology, EPA, and DOE, 1989a, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington. Available at: http://www.hanford.gov/?page=81.

a decision will be made on the need for additional testing or operation. Following the briefing, a treatability test report will be prepared to summarize the results.

This treatability test is required by TPA (Ecology et al., 1989a) Milestone M-015-82. In accordance with the milestone, this TTP constitutes an amendment to DOE/RL-2007-18, *Remedial Investigation/Feasibility Study Work Plan for the 200-BP-5 Groundwater Operable Unit.*[3] As a result, this treatability test is considered part of the remedial investigation for the 200-BP-5 OU conducted as part of the CERCLA process.

Figure ES-4. Diagram of the Conveyance Pipeline from the 200-BP-5 Test Extraction Well to the 200 West Groundwater Treatment Facility

[3] DOE/RL-2007-18, 2008, *Remedial Investigation/Feasibility Study Work Plan for the 200-BP-5 Groundwater Operable Unit*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=DA06974296.

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Appendix

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Terms

AEA	alpha energy analysis
AM	action memorandum
ARAR	applicable or relevant and appropriate requirement
CAS	Chemical Abstracts Service
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
CHPRC	CH2M Plateau Remediation Company
DOE	U.S. Department of Energy
DOE-RL	DOE Richland Operations Office
DQA	data quality assessment
DQO	data quality objective
DWS	drinking water standard
ECO	Environmental Compliance Officer
Ecology	Washington State Department of Ecology
EE/CA	engineering evaluation/cost analysis
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
FS	feasibility study
FY	fiscal year
HASP	health and safety plan
HDPE	high-density polyethylene
HMS	Hanford Meteorological Station
IX	ion exchange
K_d	distribution coefficient
LLWMA	low-level waste management area
LSC	liquid scintillation counter
MCL	maximum contaminant level
N/A	not applicable
NCP	National Contingency Plan (40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan")
NTCRA	non-time-critical removal action

OU	operable unit
QA	quality assurance
QAPjP	quality assurance project plan
RBSL	risk-based screening level
RD/RAWP	remedial design/remedial action work plan
RI	remedial investigation
SAP	sampling and analysis plan
TBC	to be considered
TPA	Tri-Party Agreement
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TTP	treatability test plan
VOC	volatile organic compound

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 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 (TTP) 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 TTP constitutes an amendment to the 200-BP-5 OU remedial investigation (RI)/feasibility study (FS) work plan (DOE/RL-2007-18, *Remedial Investigation/Feasibility Study Work Plan for the 200-BP-5 Groundwater Operable Unit*). 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 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 groundwater plumes near the B Tank Farm Complex.
The treatability study test results will be used to support the preparation of an FS and the remedial design/remedial action work plan (RD/RAWP) for the 200-BP-5 OU.

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

Treatment of the extracted groundwater to remove contaminants will be conducted at the 200 West Groundwater Treatment Facility. The rationale for using the 200 West Groundwater Treatment Facility for the treatability testing is provided in Chapter 2. 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 200 West Groundwater Treatment Facility is discharged at associated injection wells under CERCLA Section 104(d)(4), as discussed further in Chapter 2 of this document.

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 technetium-99 groundwater plumes near the B Tank Farm Complex. The inferred distributions of uranium and technetium-99 in groundwater near the B Tank Farm Complex are shown for calendar years 2007 to 2009 in Figures 1-2 and 1-3, respectively.

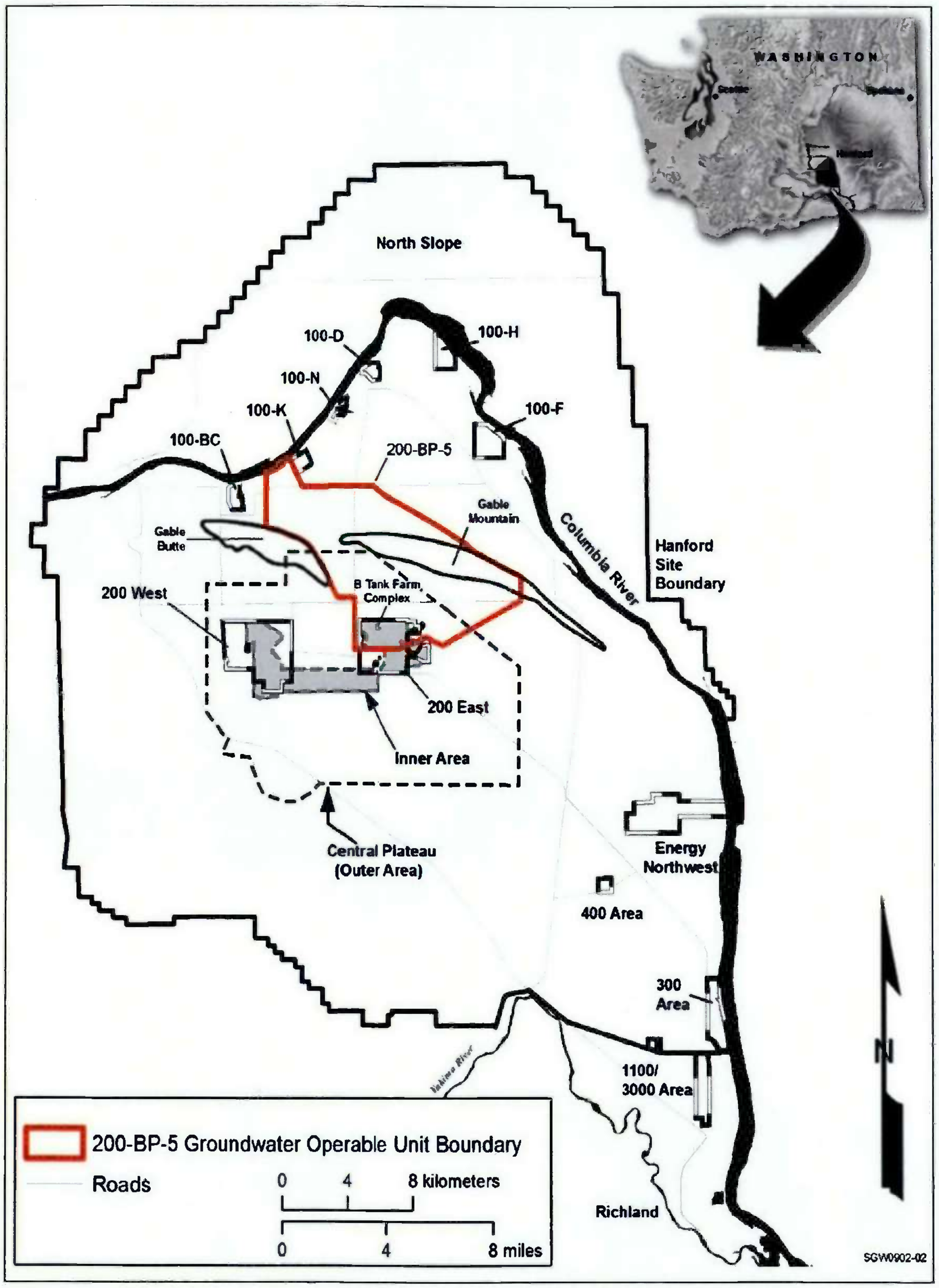

Figure 1-1. Location of the 200-BP-5 Groundwater OU

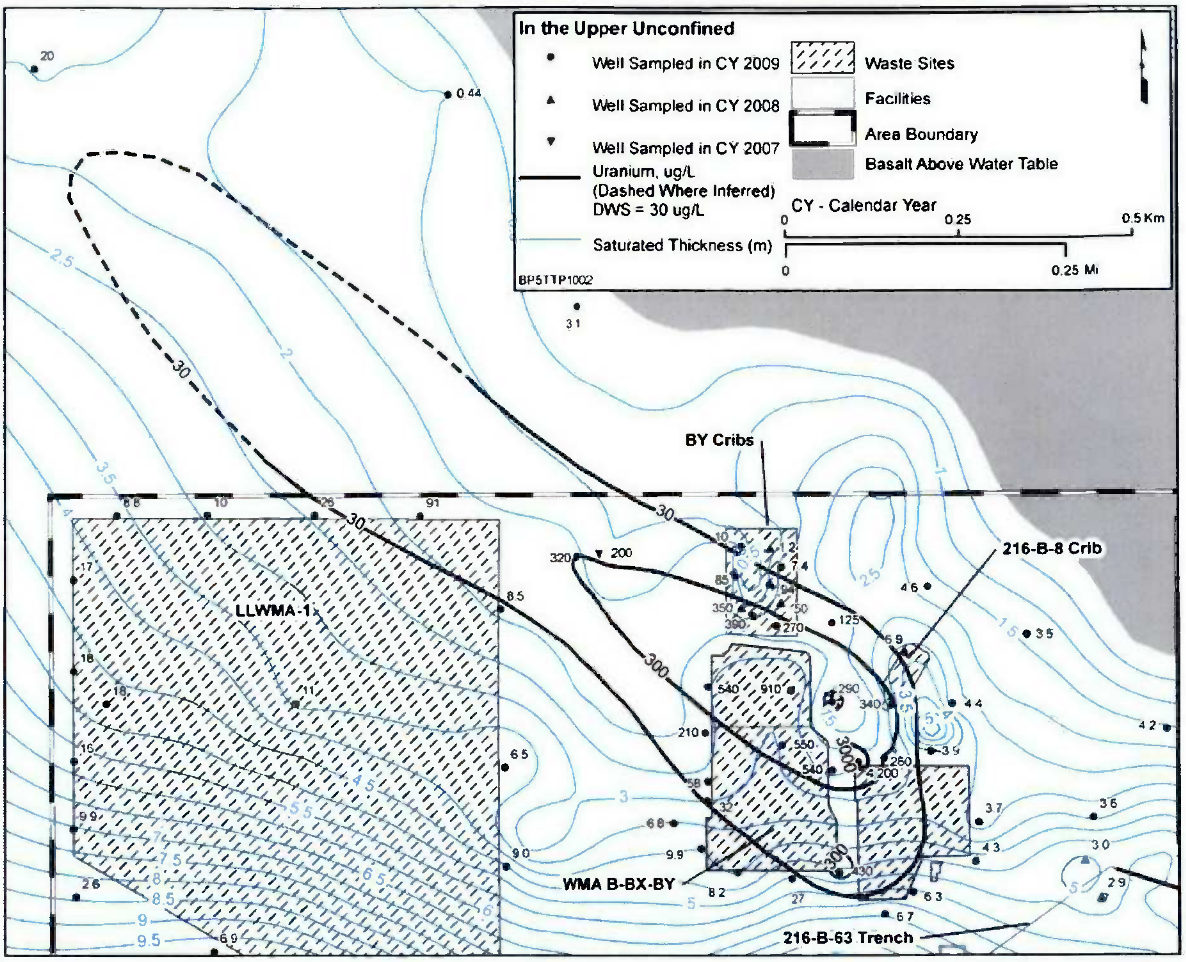

Figure 1-2. Saturated Thickness of the Unconfined Aquifer near the B Tank Farm Complex with Inferred Uranium Distribution

Recent groundwater monitoring indicates that the highest technetium-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 technetium-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, *Hanford Site Groundwater Monitoring and Performance Report for 2009 Volumes 1 & 2*). The drinking water standard (DWS) for technetium-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 techntium-99 shown in Figures 1-2 and 1-3 are from DOE/RL-2010-11.)

The groundwater underlying the B Tank Farm Complex contains additional contaminants of potential concern. These co-contaminants also would be expected to be present in the extracted groundwater sent to the 200 West Groundwater Treatment Facility. Co-contaminants in this area that exceed the DWS are listed in Table 1-1. As described in Section 4.4, the treatment processes at 200 West Groundwater Treatment Facility are capable of treating co-contaminants to concentrations that meet the release criteria for discharge.

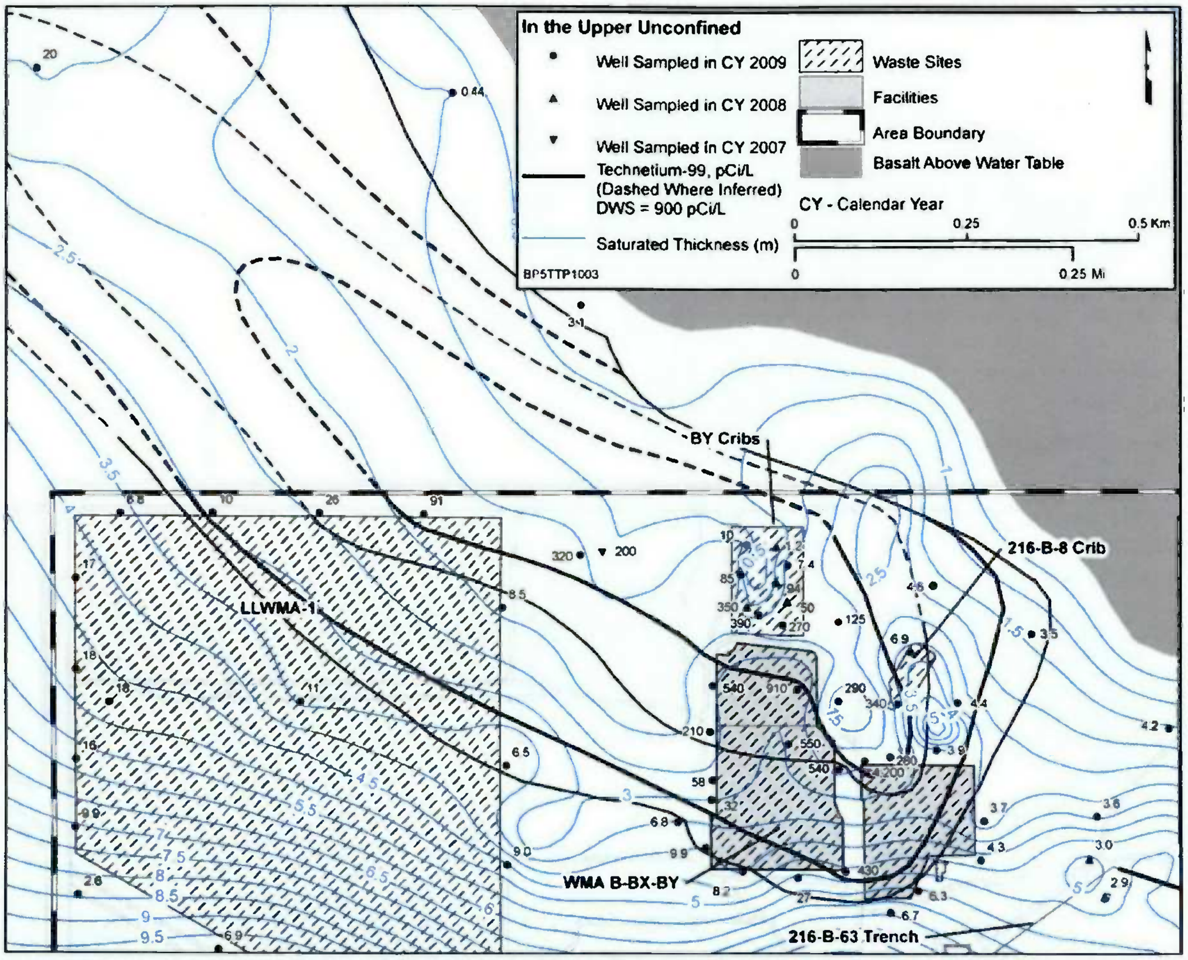

Figure 1-3. Saturated Thickness of the Unconfined Aquifer near the B Tank Farm Complex with Inferred Technetium-99 Distribution

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 technetium-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. Technetium-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, *Selection and Traceability of Parameters To Support Hanford-Specific RESRAD Analyses: Fiscal Year 2008 Status Report*).

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 overlies 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, *Interim Status Groundwater Monitoring Plan for the LLBG WMA-1*; DOE/RL-2009-76, *Interim Status Groundwater Monitoring Plan for the LLBG WMA-2*). 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 technetium-99 plume distributions in Figures 1-2 and 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.

Although the aquifer thickness is generally less than 2.5 m (8 ft) in most portions of the B Tank Farm Complex, monitoring well development information and short-term pumping tests indicate that the aquifer is transmissive and capable of sustaining groundwater pumping, especially in the area where the tests described in this TTP will be conducted. In portions of the uranium and technetium-99 plume, aquifer characteristics may limit the success of a pumping test because the aquifer's saturated thickness thins. This characteristic may impose hydraulic limitations, which in turn, affect the ability to withdraw groundwater from the aquifer at an effective pumping rate. The contact between the unconsolidated aquifer sediment and the basalt also represents an irregular, no-flow geologic boundary north of the B Tank Farm Complex where the basalt extends above the water table. This condition may affect the travel path and availability of groundwater containing uranium and technetium-99 being pulled toward an extraction well. The variable and relatively thin nature of the aquifer may limit capture of portions of the uranium and technetium-99 plume during long-term 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 (0.3 ft). The fiscal year (FY) 2009 water table is approximately 1.9 m (6.2 ft) higher than the estimated pre-Hanford Site conditions (DOE/RL-2010-11). Fluctuations in the water levels have shown recently to be affected by daily atmospheric pressure changes, seasonal changes in the Columbia River stage, and occasional effluent discharges to the soil at the Treated Effluent Disposal Facility 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 (DOE/ORP-2008-01, *RCRA Facility Investigation Report for Hanford Single-Shell Tank Waste Management Areas*). 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 (DOE/RL-2007-18). 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 map the elevation of the upper basalt surface, which in turn, provides an improved understanding of the aquifer's saturated thickness.

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.

The 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 whether a 189 L/min (50 gpm) groundwater pumping rate from the 200-BP-5 OU aquifer is sustainable and will estimate preliminary uranium and technetium-99 mass removal rates. The information obtained from the treatability test will be used to support the development and evaluation of a pump-and-treat alternative in the FS.

The other aspects of the pump-and-treat technology will be implemented during the test but are not within the scope of the treatability test. The contaminated water produced from the treatability test will be transferred to the 200 West Groundwater Treatment Facility for treatment (Figure 2-2). CERCLA activities managed under this test plan include treatability test activities and associated waste management, groundwater extraction, and conveyance of contaminated groundwater to the 200 West Groundwater Treatment Facility. Once the extracted groundwater enters the 200 West Groundwater Treatment Facility, all treatment activities will be managed under EPA et al., 2008, *Record of Decision Hanford 200 Area 200-ZP-1 Superfund Site, Benton County, Washington*, and associated operations and maintenance plan (DOE/RL-2009-124, *200 West Pump and Treat Operations and Maintenance Plan*). The operation and maintenance plan will be revised to incorporate operational and monitoring changes needed to receive the extracted 200-BP-5 OU groundwater for treatment and injection.

The waste streams will be managed at the 200 West Groundwater Treatment Facility in accordance with standard operating procedures for that facility. The treated water will be conveyed through pipelines from the 200 West Groundwater Treatment Facility to associated injection wells in the 200 West Area. Injection of the treated groundwater to the aquifer at the 200 West Groundwater Treatment Facility is allowed by CERCLA Section 104(d)(4), based on the following:

> *The preamble to the NCP states that when noncontiguous facilities are reasonably close to one another and wastes at these sites are compatible for a selected treatment or disposal approach, CERCLA Section 104(d)(4), "Response Authorities," allows the lead agency to treat these related facilities as one site for response purposes and, therefore, allows the lead agency to manage waste transferred between such noncontiguous facilities without having to obtain a permit. The 200-BP-5 OU Treatability Test extraction well (299-E33-268) and the 200 West Groundwater Treatment Facility are reasonably close to one another, and the wastes are compatible for the selected disposal approach. Therefore, these sites are considered to be a single site for response purposes.*

Potentially contaminated solid wastes, not to include liquid wastes, generated from treatment of 200-BP-5 OU contaminated groundwater will be disposed of at a secure long-term management facility, the Environmental Restoration Disposal Facility (ERDF), by CERCLA Section 104(d)(4):

> *The preamble to the NCP states that when noncontiguous facilities are reasonably close to one another and wastes at these sites are compatible for a selected treatment or disposal approach, CERCLA Section 104(d)(4) allows the lead agency to treat these related facilities as one site for response purposes and, therefore, allows the lead agency to manage waste*

transferred between such noncontiguous facilities without having to obtain a permit. The 200-BP-5 OU Treatability Test extraction well (299-E33-268) and the Environmental Restoration Disposal Facility are reasonably close to one another, and the wastes are compatible for the selected disposal approach. Therefore, these sites are considered to be a single site for response purposes.

The 200 West Groundwater Treatment Facility was constructed in 2012 and designed for cleanup of the 200-ZP-1 Groundwater OU in the 200 West Area. The 200 West Groundwater Treatment Facility is designed to capture and treat contaminated groundwater in order to reduce the mass of carbon tetrachloride, total chromium (trivalent and hexavalent), nitrate, trichloroethene, iodine-129, and technetium-99. The system design also includes provisions for future treatment of groundwater from the 200-UP-l Groundwater OU, including removal of uranium. It is expected that the uranium treatment capability will be installed at the 200 West Pump and Treat Facility by mid-FY 2015.

The maximum designed treatment flow rate capacity of the 200 West Groundwater Treatment Facility is 9,464 L/min (2,500 gpm). Table 2-1 summarizes impacts that the 200-BP-5 OU groundwater stream will have on contaminant concentrations at each sequential treatment step (i.e., uranium ion exchange [IX], technetium IX, and biological) in the treatment facility. The table assumes a 200-BP-5 OU flow rate of 568 L/min (150 gpm), which is a maximum condition. The table shows that with the additional 200-BP-5 OU flow, contaminant concentrations will remain below the design capacity at each step along the treatment process.

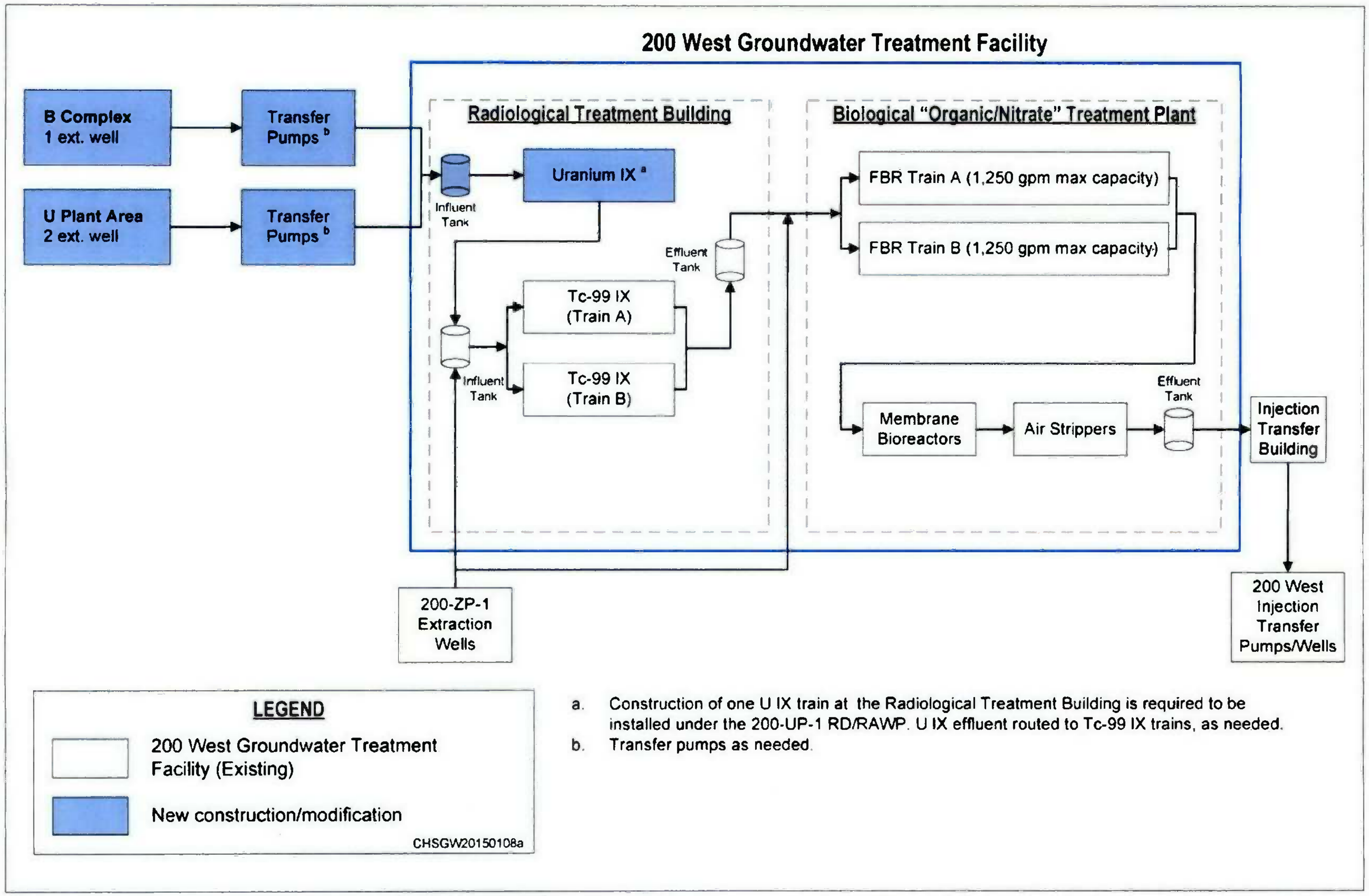

Figure 2-1. Conceptual Block Flow Diagram for the 200-BP-5 OU Treatability Test

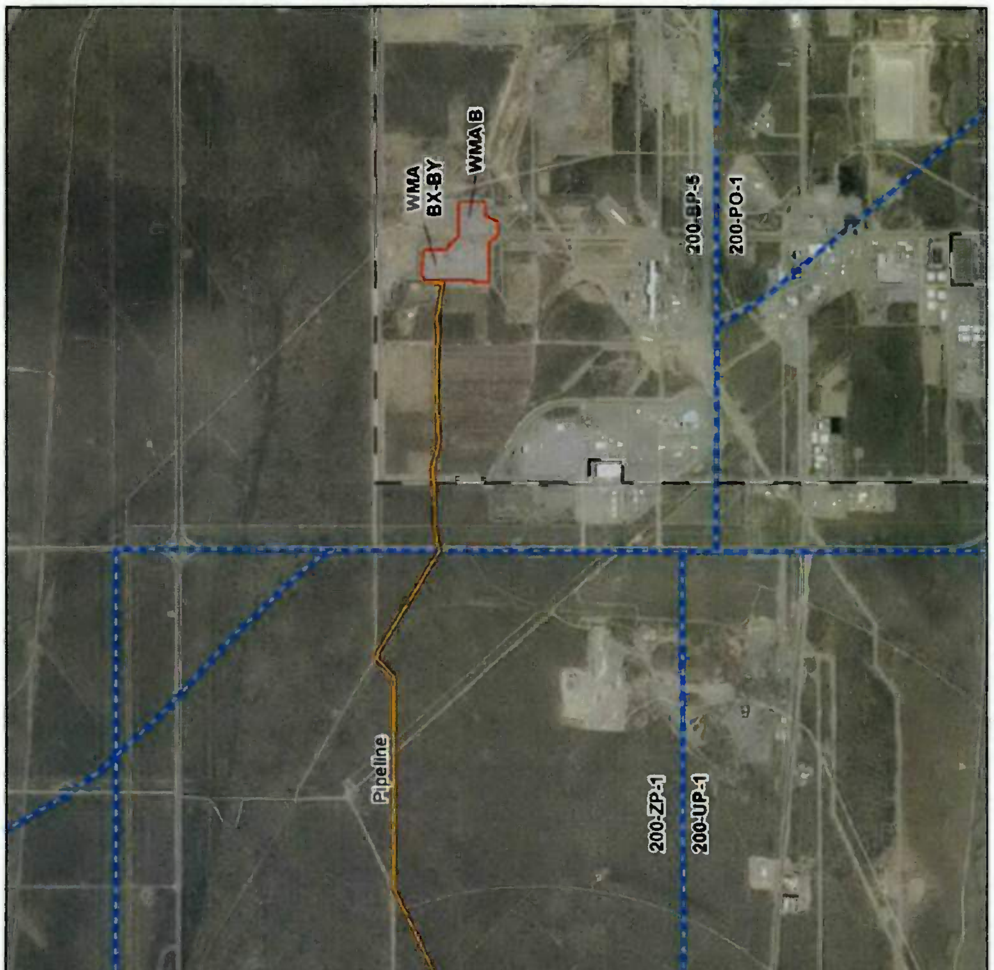

Figure 2-2. Diagram of the Conveyance Pipeline from the Test Extraction Well to the 200 West Groundwater Treatment Facility

Table 2-1. Comparison of Contaminant Concentrations To Be Treated at the Various 200 West Groundwater Treatment Train Systems versus the Current Treatment Train Contaminant Capacity

Contaminants of Concern (Unit of Concentration or Activity)	Uranium IX Treatment Train			Technetium-99 IX Treatment Train			Biological Treatment System		
	Influent Concentration without BP-5 Flow[a]	Blended Influent Concentration with BP-5 Flow[b]	Treatment Capacity of Train	Blended Influent Concentration without BP-5 Flow[c]	Blended Influent Concentration with BP-5 Flow[d]	Treatment Capacity of Train	Blended Influent Concentration without BP-5 Flow[e]	Blended Influent Concentration with BP-5 Flow[f]	Treatment Capacity of Train
Technetium-99 (pCi/L)	1,807	4,922	9,050	1,087	904	14,400	71	69	N/A
Iodine-129 (pCi/L)	0.89	2.21	N/A	0.38	1.15	N/A	0.21	0.41	N/A
Tritium (pCi/L)	313	3,571	N/A	4,359	4,681	N/A	2,207	2,327	N/A
Uranium (µg/L)	137	303	10,000[g]	2.4	2.4	N/A	1.6	1.7	N/A
Cyanide (µg/L)	0	46	N/A	0	22	N/A	0	6	25
Nitrate as NO_3 (µg/L)	287,950	489,515	N/A	188,275	315,593	N/A	111,326	147,058	199,350

a. Influent from planned 200-UP-1 OU uranium plume (U Plant area) extraction system flows at 568 L/min (150 gpm). Concentrations are based on the average concentrations of uranium plume groundwater analyses from Wells 299-W19-34A, -34B, -35, -36, -43, -48, and -101, over the period of January 1, 2009, through March 31, 2014.

b. Assumes conditions in note a, plus a 200-BP-5 OU flow rate of 568 L/min (150 gpm). 200-BP-5 OU concentrations are based on the average concentration of groundwater samples from Well 299-E33-31 (adjacent to the planned extraction well) over a period of high concentrations. The time period of peak concentrations varied by contaminant as follows: Technetium-99, November 19, 2007, through February 12, 2014; Iodine-129, February 16, 2000, through November 18, 2011; Tritium, November 19, 2007, through February 12, 2014; Uranium, November 19, 2007, through October 1, 2013; Cyanide, November 19, 2007, through February 12, 2014; and Nitrate, November 19, 2007, through October 1, 2013.

c. Assumes conditions in note a, plus expected technetium-99 removal across the uranium IX train. Water from uranium IX is blended with flow from the existing 200-ZP-1 OU extraction system at 1,703 L/min (450 gpm). 200-ZP-1 OU water concentrations into the technetium-99 IX train are based on a flow-weighted mass balance using typical extraction well flows and concentrations as of November 18, 2014.

d. Assumes conditions in note b, plus expected technetium-99 removal across the uranium IX train. Effluent from uranium IX system is blended with flow from the existing 200-ZP-1 OU extraction system at 1,230 L/min (325 gpm). 200-ZP-1 OU water concentrations into the technetium-99 IX train are based on a flow-weighted mass balance using typical extraction well flows and concentrations as of November 18, 2014. Water from 200-ZP-1 OU extraction wells does not contain significant concentrations of uranium that warrants treatment by the uranium IX treatment train and is fed directly to the technetium-99 IX treatment train.

e. Assumes conditions in note c. Effluent from technetium-99 IX system is blended with flow from existing 200-ZP-1 OU extraction system at 6,435 L/min (1,700 gpm). 200-ZP-1 OU water concentrations into the biological treatment process are based on average process sample concentrations as of November 18, 2014.

f. Assumes conditions in note d. Effluent from technetium-99 IX system is blended with flow from existing 200-ZP-1 OU extraction system at 6,340 L/min (1,675 gpm). 200-ZP-1 OU water concentrations into the biological treatment process are based on average process sample concentrations as of November 18, 2014.

g. Treatment capacity of uranium is estimated from studies at other sites and will be confirmed by careful monitoring. Concentrations are significantly less than the estimated capacity and are not expected to exceed treatment capacity.

IX = ion exchange

N/A = not applicable (not treated by train)

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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 uranium and commingled technetium-99 plumes near the B Tank Farm Complex. If 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 the following:

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

   The sustainable yield can be used to develop and evaluate a pump-and-treat alternative in the FS and/or RD/RAWP.

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

   The large-scale aquifer property information (transmissivity and specific yield) obtained from the treatability test will be used to refine the localized hydrologic numerical model. The use of a numerical hydrologic model is required to support the design and evaluation of a pump-and-treat alternative in the FS and the RD/RAWP. Such models provide a means of rapidly evaluating design alternatives for optimization, demonstrating that regulatory or performance requirements will be met, and estimating remedial action timeframes.

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

   The concentrations of uranium and technetium-99 measured in extracted groundwater will be used to estimate initial mass removal rates by multiplying the concentrations by the pumping rate.
   The concentrations of uranium, technetium-99, and other constituents in the groundwater also will provide data for waste designation and contaminated groundwater acceptance at the 200 West Groundwater Treatment Facility.

The test objectives will be achieved through the collection and evaluation of water level drawdown and water quality data. Additional information on data collection methods is presented in Chapter 4 of this document, and the overall approach for data evaluation is presented in Chapter 6.

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, *200-BP-5 OU Data Quality Objectives Summary Report*). 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 technetium-99 contaminant plumes. Therefore, the recommendation from the DQO process was to use the existing data to develop a site-specific groundwater hydrologic 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 the following:

- 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 (HMS)

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 OU 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 TTP (Section 4.1.4).

3.3 Relationship of Field Measurements to Performance Objectives

The primary field measurements collected during the treatability test are the pumping rate(s) and water levels in the pumping and monitoring wells and the uranium and technetium-99 concentrations at the test well. 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, *Initial Evaluation of Extraction Well Location Alternatives with B-BX-BY Local-Scale Groundwater Model*). The model was used to simulate water level drawdown and extent of the hydraulic capture zone at various pumping rates at three different locations identified as the westward well site, eastward well site, and existing Monitoring Well 299-E33-343, which is located very near the eastward well site.

As described further in Section 3.4, the model simulations 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. The estimated water level drawdown inside the extraction well at both the eastward and westward sites, assuming a 70 percent well efficiency, ranged from 0.04 to 0.07 m (0.13 to 0.23 ft) at a pumping rate of 189 L/min (50 gpm) and from 0.11 to 0.17 m (0.36 to 0.56 ft) at a pumping rate of 379 L/min (100 gpm). At Monitoring Well 299-E33-343, a sustainable pumping rate of 114 L/min (30 gpm) was estimated based on an evaluation of well development information.

The hydrologic numerical model simulations met the initial step in TPA (Ecology et al., 1989a) 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 technetium-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 near 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 (32.8 ft) 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 time frame 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, *Modeling Data Package for B-BX-BY Field Investigation Report (FIR)*:

- Porosity—0.15
- Horizontal Hydraulic Conductivity—3,000 m/day
- Vertical Hydraulic Conductivity—300 m/day

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 periods, they were considered suitable and sufficient for the relatively short duration of the modeled period. The simulated duration was 3 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 (eastward and westward well sites) and three pumping rates were simulated: 189, 284, and 379 L/min (50, 75, and 100 gpm). The pumping wells were assumed to be 20.3 cm (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 near existing wells. The capture zone for each case was estimated at 1-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, *200-BP-5 Operable Unit*

Treatability Test Report). One pilot-scale treatability test system was set up in proximity to the 216-B-5 Reverse Well because the associated strontium-90, cesium-137, and plutonium-239/240 concentrations were identified as candidates for an interim response measure (DOE/RL-92-19, *200 East Groundwater Aggregate Area Management Study Report*). 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 technetium-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). IX 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 as 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 technetium-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. At the location of the extraction well, the aquifer 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 to 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, sitewide 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 in Figures 1-2 and 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 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

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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 located west of the BY Tank Farm. The plan for the pumping test at this location includes the following elements:

1. **Aquifer Test Theory and Approach (Section 4.1).** This element describes the overall theory behind the treatability test and identifies the planned location and conceptual design for the test well and observation wells and measurements to be taken.

2. **Phase 1—Step-Drawdown Test (Section 4.2).** This phase of testing consists of pumping the test well for approximately 6 to 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 barometric fluctuations reflected in elevation changes of the groundwater.

3. **Phase 2—Constant-Rate Test (Section 4.3).** This phase of testing consists of pumping the test well at a constant rate for 30 days or more. The constant rate test will initially use the optimum sustainable pumping rate as determined from the step-drawdown test for up to 3 days. By monitoring drawdown at the test well and the closest monitoring wells, large-scale hydraulic parameters can be estimated for the aquifer near the B Tank Farm Complex and used to refine the predictive capability of the numerical hydrologic model. At the conclusion of pumping at the optimum rate, the well will continue to be pumped (once the recovery phase has been completed) for at least 27 days. During this portion of the test, groundwater quality samples will be obtained periodically to develop information on contaminant mass removal rates.

Following completion of the Phase 1 and the 30 days of Phase 2 testing, the water level drawdown and water quality data will be evaluated, as described in Section 6.1, to estimate hydraulic containment and contaminant removal rates.

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

During the design phase for installing the pipeline to the 200 West Groundwater Treatment Facility, the well pump will be sized, and the pipeline system requirements will be specified for conveyance of extracted water to the 200 West Groundwater Treatment Facility. The design work will be conducted and documented in accordance with applicable CH2M Plateau Remediation Company (CHPRC) procedures.

A final design package will be prepared, including drawings, calculations, and construction specifications for the pipeline to the 200 West Groundwater Treatment Facility. The design package will be provided to the lead regulatory agency 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 materials and construction services.

If Phase 2 testing is successful, the Tri-Party agencies (Ecology, EPA, and DOE) may replace the TTP with an engineering evaluation/cost analysis (EE/CA) and action memorandum (AM) to continue the extraction of contaminated water as a non-time-critical removal action (NTCRA). The EE/CA AM will identify the scope of work for the NTCRA and proposed alternatives, and will analyze these alternative for effectiveness, implementability, and cost. The information from the EE/CA NTCRA will be used to support the 200-BP-5 OU FS and proposed plan.

4.1 Aquifer Test Theory and 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 the recovery phase (pump off). The information obtained from an aquifer pumping test will allow for the design of an extraction well array to hydraulically contain the uranium and technetium-99 plumes.

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, *Aquifer Testing Recommendations for Well 299-W15-225: Supporting Phase I of the 200-ZP-1 Groundwater Operable Unit Remedial Design*). 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 step, is recommended. Interpretation of the step-drawdown test results provides the optimum sustainable pumping rate for the constant-rate test, estimates well efficiency, and provides rough approximations of transmissivity and storage coefficient (Clark, 1977, "The Analysis and Planning of Step Drawdown Tests"). A minimum of three discharge rates or steps is required. Water levels measured 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, *Field Test Report, Preliminary Aquifer Testing Characterization Results for Well 299-W15-224: Supporting Phase I of the 200-ZP-1 Groundwater Operable Unit Remedial Design*, the well discharge performance typically is evaluated using the relationship between well loss and drawdown presented in Cooper and Jacob, 1946, "A Generalized Graphical Method for Evaluating Formation Constants and Summarizing Well Field History." 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 adjacent monitoring wells. For the reasons described 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 pretest unconfined aquifer saturated thickness (PNNL-18279). The constant-rate test is initiated after the step-drawdown recovery has been completed. Steady-state or equilibrium flow conditions are generally achieved during this type of test. The duration of the pumping phase during a constant-rate test is expected to be approximately 3 days. Pumping for longer than 3 days is only necessary when determination of hydrologic boundaries is required. The presence of hydrologic boundaries within the immediate vicinity of the test well is not expected.

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, *Analysis of the Hydrologic Response Associated With Shutdown and Restart of the 200-ZP-1 WMA T Tank Farm Pump-and-Treat System*; 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, 1952, "The Relation Between the Lowering of the Piezometric Surface and the Rate and Duration of Discharge of a Well Using Ground-Water Storage") 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, *Results of Detailed Hydrologic Characterization Tests—Fiscal and Calendar Year 2005*; PNNL-18279; PNNL-18732; and Kruseman and de Ridder, 1994, *Analysis and Evaluation of Pumping Test Data.*

During the pumping portion of the aquifer test, groundwater samples are also collected for laboratory analysis to develop information on contaminant concentrations. This information can be used to assess treatment requirements and to estimate contaminant mass removal rates.

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 (technetium-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 these considerations, one new extraction well, 299-E33-268, was installed near Well 299-E33-31, located adjacent to the west side of the BY Tank Farm (Figure 4-1). This location was selected 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 technetium-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.

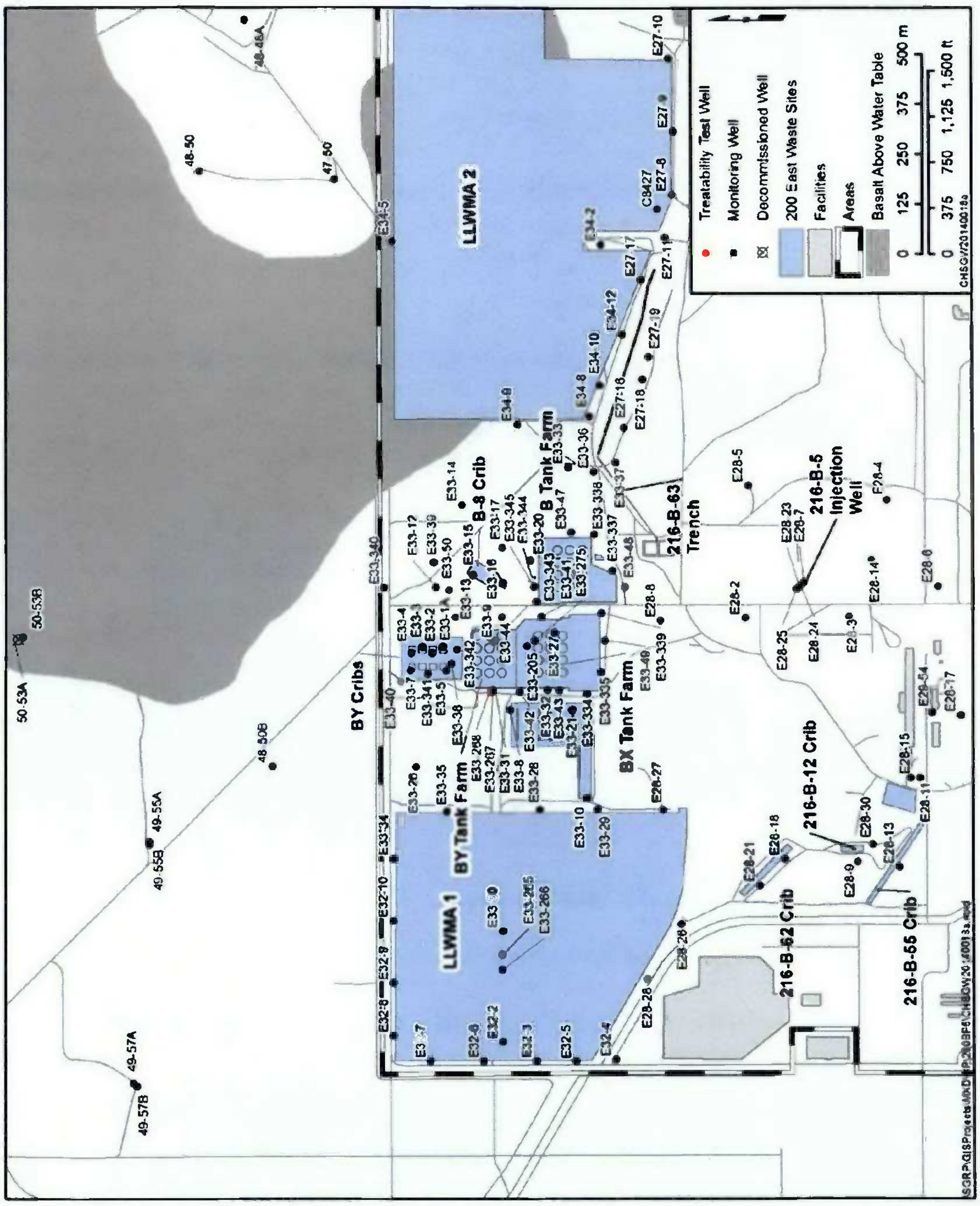
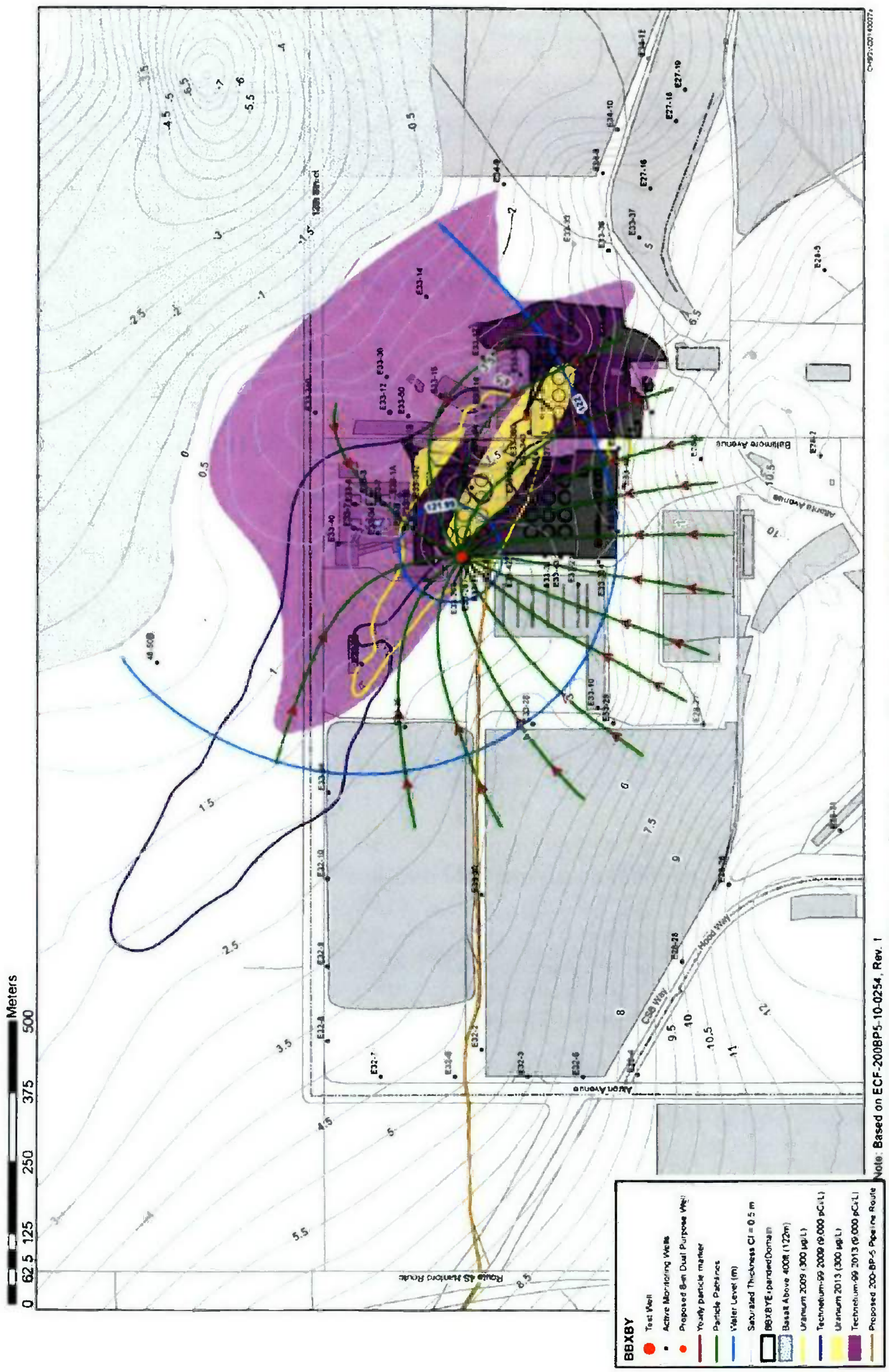


Figure 4-1. Location of Past Treatability Test Groundwater Wells, New Test Well near Waste Management Area B-BX-BY, and Other Monitoring Wells within and Adjacent to the Northern 200 East Area



Source: ECF-200BP5-10-0254, *Initial Evaluation of Extraction Well Location Alternatives with B-BX-BY Local-Scale Groundwater Model.*

Figure 4-2. Location of Aquifer Groundwater Extraction Test Well and the Inferred Capture Zone

The use of existing wells, in lieu of constructing a new test well, was also considered. 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 technetium-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 Test Well Design Considerations

The test well design is an important component of the treatability test. The 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 pump should be sized to support this objective.
- 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 test well of less than 3 cm (0.1 ft) 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 ft) at the most distant monitoring wells to 12.2 cm (0.4 ft) inside the test well casing. Based on these considerations, pumps with capacities extending to 568 L/min (150 gpm) should be considered. Additionally, monitoring wells should be located at distances no greater than 75 m (250 ft).
- The relatively thin aquifer saturated thickness at the well site (~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 in.) diameter well should be sufficient. The hydraulic capture zone modeling assumed an extraction well diameter of 20.3 cm (8 in.) (Section 3.4).

The well location(s) are shown in Figure 4-1.

4.1.3 Disposal of Aquifer Test Water

Groundwater from aquifer testing will be treated at the 200 West Groundwater Treatment Facility (Figures 2-1 and 2-2). The water from the test will be conveyed using a dual-walled aboveground pipeline. Pipeline layout and specifications will be defined during the detailed design.

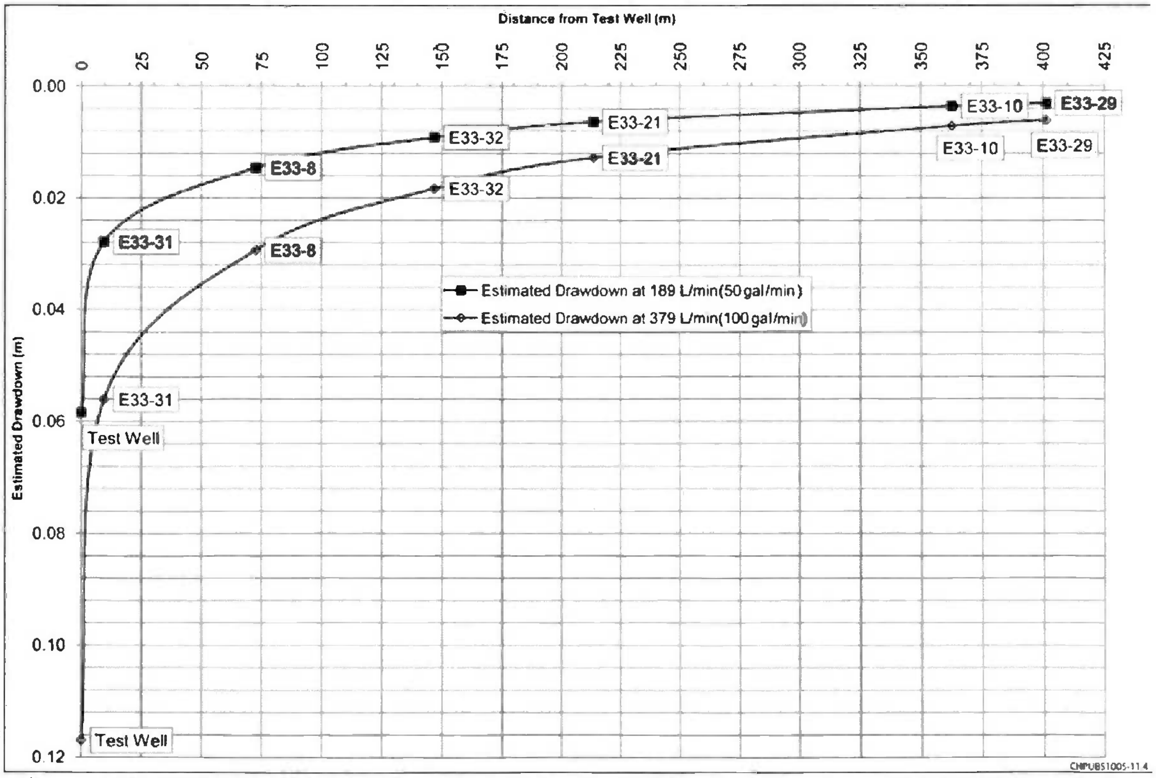
During discussions with 200 West Groundwater Treatment Facility staff regarding the groundwater chemistry in the proposed area of the 200-BP-5 OU treatability test (Section 1.2), it was concluded that 200-BP-5 OU groundwater quality would be compatible with the 200 West Groundwater Treatment Facility treatment systems at the flow rates anticipated for the critical test components.

A summary of the 200 West Groundwater Treatment Facility including the transfer pipeline is provided in Section 4.4.

4.1.4 Monitoring Well Network

Existing 10.2 cm (4 in.) diameter wells, located outside the tank farm boundaries, are available for monitoring near the test well. 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 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 ft) at distances greater than approximately 175 m (550 ft) 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 ft), water level changes of less than 1.5 cm (0.05 ft) may be indistinguishable from natural temporal fluctuations in the unconfined aquifer. This uncertainty is a limiting factor for defining an effective capture radius.



Source: ECF-200BP5-10-0254, *Initial Evaluation of Extraction Well Location Alternatives with B-BX-BY Local-Scale Groundwater Model.*

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

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 OU Treatability Test

Monitoring Well Number	Location Relative to Test Well	Total Well Depth		Distance from Proposed Test Well Site[a]		Estimated Drawdown (at 379 L/min [100 gpm] rate)		Top of Screened Interval, Depth (bgs)		Bottom of Screened Interval, Depth (bgs)	
		(ft)	(m)	(ft)	(m)	(ft)	(m)	(ft)	(m)	(ft)	(m)
Primary Monitoring Wells											
299-E33-367	Downgradient	256.0	78.0	15.5	4.8	0.25	0.08	244.9	74.6	255.9	78.0
299-E33-31	Downgradient	255.9	78.02	31.4	9.6	0.18	0.05	234.9	71.6	255.9	78.0
299-E33-42	Cross-gradient-west	260.2	79.33	251.3	76.6	0.09	0.03	238.5	72.7	259.2	79.0
299-E33-32	Cross-gradient-west	270.3	82.41	481.8	146.9	0.06	0.02	246.4	75.1	267.4	81.5
Background Monitoring Wells											
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 Monitoring Wells											
299-E33-38	Cross-gradient-east	239.6	73.0	377.3	115.0	0.10	0.03	218.6	66.6	239.6	73.0
299-E33-41	Downgradient	244.9	74.7	746.7	227.6	0.08	0.02	244.9	74.7	262.0	79.9
299-E33-342[b]	Cross-gradient-east	244.6	74.6	420.0	128.0	0.10	0.03	232.6	70.9	242.6	73.9
299-E33-360	Downgradient	272	82.9	907.8	276.7			251.7	76.7	271.6	82.8

a. Distances are estimated from scale maps and will be verified following test well and monitor well installation, and through field measurements, or coordinate inverse calculations.

b. Well was installed as part of DOE/RL-2007-18, *Remedial Investigation/Feasibility Study Work Plan for the 200-BP-5 Groundwater Operable Unit.*

OU = operable unit

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 4-4). This seasonal variability could affect the interpretation of the constant-rate test results. Therefore, the primary monitoring wells are those with estimated drawdown values of greater than 1.5 cm (0.05 ft), based on the 379 L/min (100 gpm) capture zone model simulation. This includes Wells 299-E33-267, 299-E33-31, 299-E33-42, and 299-E33-32 (Figure 4-5). Monitoring wells that are outside the predicted capture zone, such as 299-E34-12 and 699-49-57A, 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).

The discrete water level measurements shown in Figure 4-4 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.

One new 10.2 cm (4 in.) diameter monitoring well (299-E33-267) was installed approximately midway between the extraction test well (299-E33-268) 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.

4.1.5 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 overall logic diagram for conducting the treatability test is presented in Figure 4-6.

Because data are collected at different locations using different instruments, it is particularly important to synchronize all clocks and 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 local U.S. time (e.g., Pacific Standard Time). If the HMS is used for barometric pressure measurements, the method used to establish the time of the measurements must be understood so this dataset can be compared to the other data collected during the test.

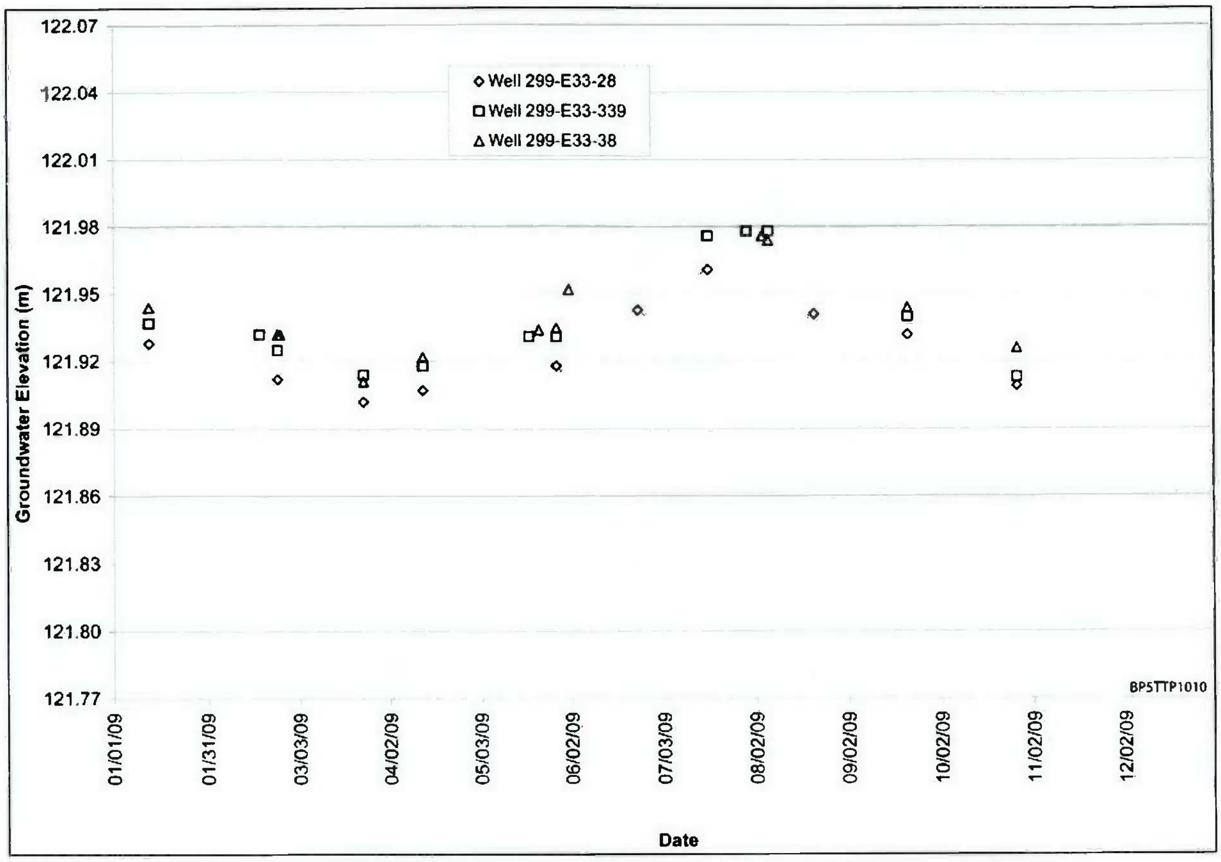


Figure 4-4. Transient Water Level Changes Observed in 2009

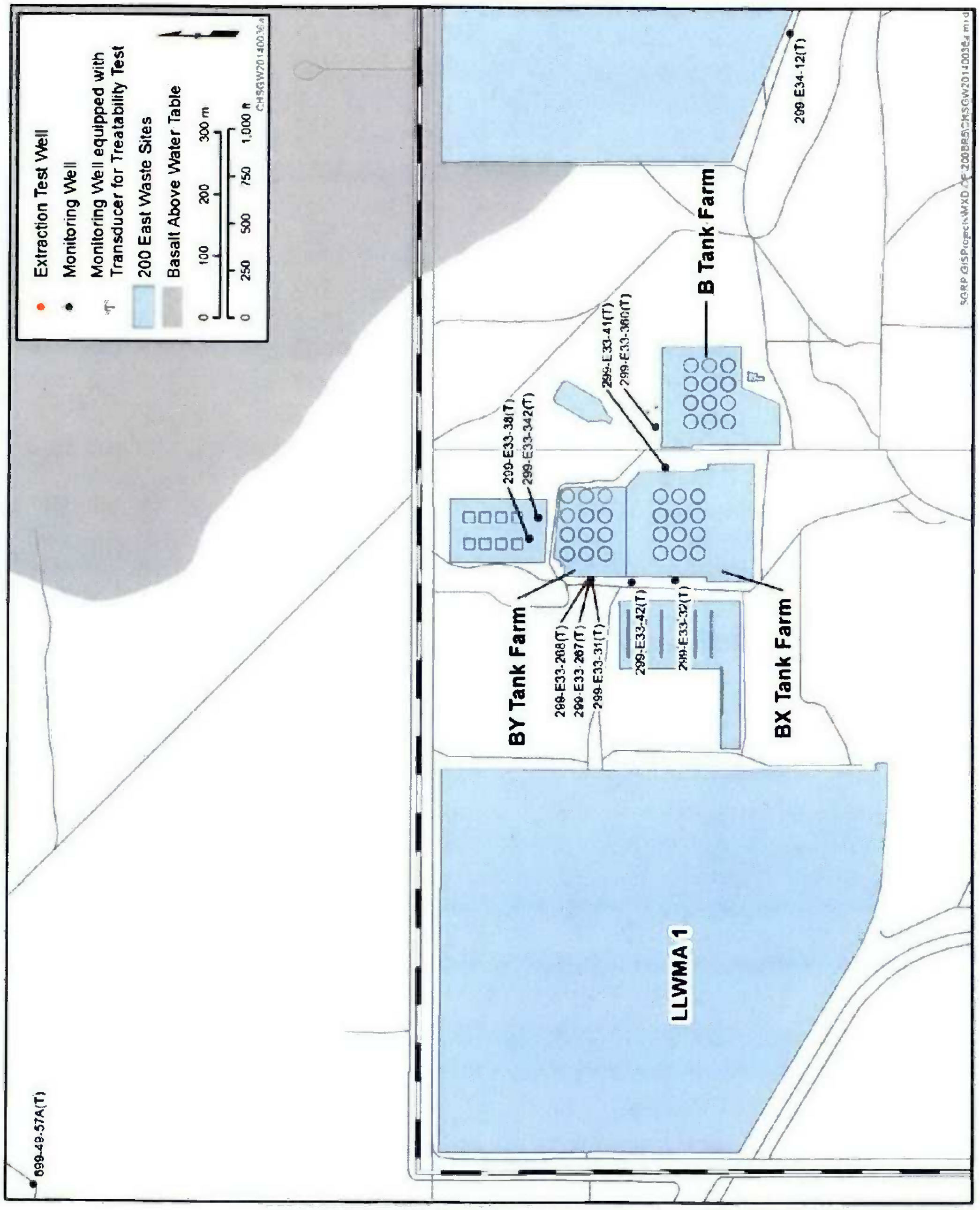


Figure 4-5. Map of Extraction Test Well Site and Wells Used to Monitor Groundwater during the 200-BP-5 OU Treatability Test

Table 4-2. Measurement Approach for the 200-BP-5 OU Treatability Test

Test Objectives	Test Component	Key Parameters	DQOs	Analytical Methods
Determine the sustainable yield of an extraction test well near the uranium and technetium-99 plumes.	Step-Drawdown Test 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 gpm), 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 versus time. Calculate optimum sustainable yield.
		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 at an average rate of at least 189 L/min (50 gpm) for 30 days or more. Following pumping, monitor aquifer recovery.	Pumping rate at test well	Record volume of water pumped to approximately +/- 4 L/min (1 gpm), every hour at a minimum, until flow rate stabilizes; then record every 12 to 24 hours for calculation of average pumping rate. Record pumping rate when water level measurements are made.	Evaluate water level drawdown for pumping rates, and calculate sustainable yield.
		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 OU Treatability Test

Test Objectives	Test Component	Key Parameters	DQOs	Analytical Methods
Calculate aquifer properties (i.e., aquifer transmissivity and specific yield) that are representative of large-scale conditions.	Constant-Rate Test at optimum sustainable yield for up to 3 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 gpm), at a minimum, every hour until flow rate stabilizes; then record every 12 to 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.
	Optimum sustainable yield determined from step-drawdown test	Drawdown in test well	Measure drawdown to approximately +/- 0.30 cm (0.01 ft) at frequencies indicated in Table 4-5.	Refine hydrologic numerical model to incorporate aquifer properties, and update capture zone evaluations.
		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 technetium-99 in the extracted groundwater during sustained pumping near the uranium and technetium-99 plumes.	Constant-Rate Test at an average rate of at least 189 L/min (50 gpm) for 30 days or more	Uranium and technetium-99 concentrations	Collect groundwater samples at the test well following 1 day, 2 days, and 3 days of pumping, and weekly thereafter up to 30 days, with a final sample collected at the end of the test. Analyze for uranium and technetium-99 using methods indicated in Table 4-6.	Estimate mass removal rates using concentration analytical data and pumping rate data.

DQO = data quality objective
OU = operable unit

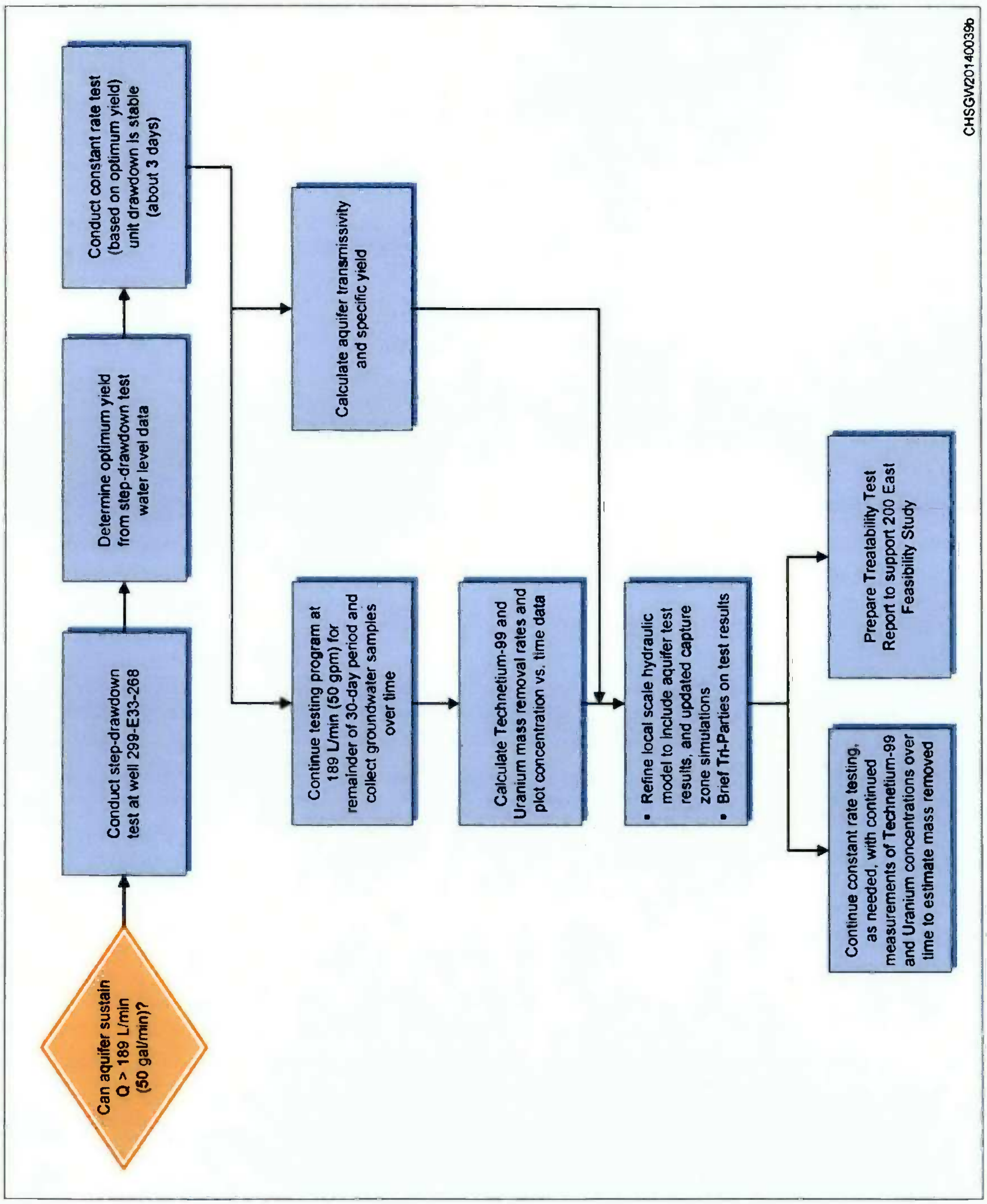


Figure 4-6. Logic Diagram for the 200-BP-5 OU Treatability Test

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, and local aquifer specific yield. Results from the Phase 1 test will be used to determine the optimum pumping rate for the Phase 2 constant-rate test, which will provide data 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 near 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, *Conceptual Models for Migration of Key Groundwater Contaminants Through the Vadose Zone and Into the Unconfined Aquifer Below the B-Complex*). 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 186 m^2/day (2,000 ft^2/day) to more than 5,017 m^2/day (54,000 ft^2/day). The transmissivity value used in the local-scale hydrologic numerical model is approximately 5,574 m^2/day (60,000 ft^2/day).

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 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, In-Situ® Level TROLL® 700, or similar) 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 HMS barometric pressures recorded hourly. 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.

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® Level TROLL is a registered product name of In-Situ Inc., Fort Collins, Colorado.

- 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 test well site. These samples will be collected to measure baseline conditions. Samples will be analyzed for uranium and technetium-99 and the other contaminants as discussed in Section 4.3.4.
- At the conclusion of the 30-day pretest 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 the following inspections:

- Verifying that all pretest, baseline monitoring water level information has been downloaded from the pressure transducers, and the transducers have been programmed to record water level measurements at the frequencies listed in Tables 4-3 and 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.

Table 4-3. Proposed Water Level Measurement Frequencies at the Test Well during the Phase 1 Step—Drawdown Test of the 200-BP-5 OU 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

Table 4-3. Proposed Water Level Measurement Frequencies at the Test Well during the Phase 1 Step—Drawdown Test of the 200-BP-5 OU Treatability Test

Individual Step-Drawdown Period[a]		Step-Drawdown Recovery Period	
Measurement Time Interval	Measurement Frequency	Measurement Time Interval	Measurement Frequency
-	-	>8 hours	15 minutes

a. Each individual step to follow measurement frequencies indicated.
b. Dependent on data acquisition/measurement system capabilities.
OU = operable unit

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 OU 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
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.
OU = operable unit

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 Tables 4-3 and 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 Tables 4-3 and 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 might not have stabilized by the end of each step.

Recovery Phase—After completing 2 hours of pumping at the 568 L/min (150 gpm) rate, terminate all pumping, and begin the water level measurement recovery phase. Measure and record measurements at the frequencies listed in Tables 4-3 and 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 is estimated to generate 136,275 L (36,000 gal) 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 pretest unconfined aquifer saturated thickness (PNNL-18279). Assuming a saturated thickness of approximately 2.4 m (8 ft), the maximum drawdown at the end of pumping Step 3 should not exceed 0.61 m (2 ft). 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 clocks and timepieces used for recording field data and field notebook entries should be synchronized to the local U.S. time (e.g., Pacific Standard Time).

All groundwater extracted during the Phase 1 testing will be conveyed to 200 West Groundwater Treatment Facility 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 up to a maximum pumping rate of 568 L/min (150 gpm) (Section 4.1.2).

4.3 Phase 2—Constant-Rate Test

The primary objective for the Phase 2 constant-rate tests is 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. Kruseman and de Ridder (1994) recommend that the aquifer test continue until water level drawdown values stabilize (i.e., infinite-acting radial flow conditions are established), which generally occurs within 3 days in an unconfined aquifer. Based on knowledge of geologic conditions in the B Tank Farm Complex, boundary conditions are not expected near the test well site. Therefore, the minimum test duration is 3 days; however, the test could be extended to 30 days or more to evaluate technetium and uranium concentration changes over time and temporal changes in the radius of influence changes. Following the drawdown phase of the test, 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) but no longer than 7 days.

Water levels will be considered stable when they do not change by more than approximately 0.3 cm (0.01 ft) (i.e., the precision of the measurement instruments) over a 12- to 24-hour period. This criterion is subject to modification 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 3 days of completion of Phase 1 testing. Phase 2 mobilization will include the following activities:

- Verify that infrastructure is in place for transfer of extracted groundwater to the 200 West Groundwater Treatment Facility and that the 200 West Groundwater Treatment Facility 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 the 200 West Groundwater Treatment Facility.
- 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 Tables 4-4 and 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 OU 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
5 to 10 minutes	15 seconds	5 to 10 minutes	15 seconds
10 to 20 minutes	20 seconds	10 to 20 minutes	20 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 OU Treatability Test

Drawdown Period		Recovery Period	
Measurement Time Interval	**Measurement Frequency**	**Measurement Time Interval**	**Measurement Frequency**
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	2 to 4 hours	5 minutes
4 to 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.
OU = operable unit

4.3.2 Phase 2—Test Operations and Monitoring

The constant-rate test will be initiated at the optimum pumping rate, as determined from Phase 1 testing, for up to 3 days and up to 568 L/min (150 gpm), followed by pumping at an average rate of at least 189 L/min (50 gpm) and not to exceed 568 L/min (150 gpm), for a total pumping duration of 30 days or more. The drawdown in the pumped well will be limited to no greater than 25 percent of the pretest unconfined aquifer saturated thickness (PNNL-18279). Assuming a saturated thickness of approximately 2.4 m (8 ft), the maximum allowable drawdown during the Phase 2 test should not exceed 0.61 m (2 ft). The optimum pumping rate is designed to provide the maximum practical hydraulic stress on the aquifer to meet all 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 10.1) will ensure coverage is provided to maintain pump operations and flow control. Communications will be maintained with the 200 West Groundwater Treatment Facility staff to shut off the extraction well pump, if necessary, to maintain safe operation at the 200 West Groundwater Treatment 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) has 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 test well will be collected following 1 day, 2 days, and 3 days of pumping, and weekly thereafter, with a final sample collected at 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 clocks and timepieces used for recording field data and field notebook entries should be synchronized to the local U.S. time (e.g., Pacific Standard Time).

4.3.3 Phase 2—Test Operations and Maintenance

During the Phase 2 test, groundwater will be conveyed to the 200 West Groundwater Treatment Facility for treatment using a newly constructed aboveground pipeline.

4.3.4 Sampling and Analysis

Groundwater samples collected from the test well during the Phase 2 aquifer test will be analyzed for uranium and technetium-99 (Table 4-6). In addition, samples will be collected for other contaminants of interest (nitrate, iodine-129, cyanide, and tritium) on a weekly basis (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 technetium-99.

200-BP-5 OU groundwater investigation-derived liquid waste characterization and designation sample collection will be in accordance with the latest version of DOE/RL-2009-124. All investigation-derived liquids (development and pump test water) will be collected at the wellhead and pumped to the 200 West Groundwater Treatment Facility in accordance with the language provided in Chapter 2.

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

4.4 Treatment Process Description

The treatment system includes the transfer of extracted groundwater from the test well to the 200 West Groundwater Treatment Facility and discharge to the associated injection wells in the 200 West Area (Figures 2-1 and 2-2).

4.4.1 Pipelines

The groundwater transfer pipeline consists of two main sections:

- The proposed cross-site pipeline extending from the test well to the 200 West Groundwater Treatment Facility (Figure 2-2)
- The existing transfer pipelines that convey the treated effluent from the 200 West Groundwater Treatment Facility to the associated injection wells in the 200 West Area

The proposed cross-site pipeline is being designed to convey B Tank Farm Complex contaminated groundwater to the 200 West Groundwater Treatment Facility as an aboveground pipe within a pipe design. Current design requirements appear to be directed toward a 15.2 cm (6 in.) diameter, high-density polyethylene (HDPE) inner pipe within a 25.4 cm (10 in.) diameter, HDPE outer pipe. The final pipeline requirements will be finalized as design is completed. All HDPE pipe will be welded.

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

CAS No. or Constituent Identifier No.	Analyte	Survey or Analytical Method[a]	Water Lowest Overall RBSL (pCi/L)	RBSL Basis	Water Target Detection Limits (pCi/L)[b]	Water Precision Required (%)	Water Accuracy Required (%)[c]
14133-76-7	Technetium-99	Technetium-99 LSC (Low Level)	900	40 CFR 141.66	15	≤20	70–130
U-233/234	Uranium-233/234	Isotopic Uranium AEA	None (20)[d]	40 CFR 141.66	1	≤20	70–130
15117-96-1	Uranium-235		None (24)[d]	40 CFR 141.66	1	≤20	70–130
U-238	Uranium-238		None (24)[d]	40 CFR 141.66	1	≤20	70–130
7440-61-1	Uranium (Total)	Kinetic Phosphorescence or EPA Method 6020	30	40 CFR 141.66	1	≤20	70–130
Sample Schedule—Samples for the above Parameters Will Be Collected on Day 1, Day 2, Day 3, and Weekly Thereafter (Week 1, Week 2, Week 3, and Week 4) through Day 30, with a Final Sample Collected on the Last Day of the Test							
15046-84-1	Iodine-129	Chemical Separation Low-Energy Spectroscopy	1	40 CFR 141.66	1	≤20	70–130
10028-17-8	Tritium	Tritium LSC (Mid-Level)	20,000	40 CFR 141.66	400	≤20	70–130
57-12-5	Cyanide	EPA Methods 9010 Total Cyanide or 335	200	40 CFR 141.62	20	≤20	80–120
14797-55-8	Nitrate	Ion Chromatography, EPA Methods 300.0 or 9056	10,000	40 CFR 141.62	250	≤20	80–120
Sample Schedule—Samples for the above Parameters Will Be Collected on Day 1 and Each Week of Testing							

Sources: 40 CFR 141.62, "National Primary Drinking Water Regulations," "Maximum Contaminant Levels for Inorganic Contaminants."

40 CFR 141.66, "National Primary Drinking Water Regulations," "Maximum Contaminant Levels for Radionuclides."

SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B.*

a. EPA Methods 300.0 and 335.4 are found in EPA/600/R-93/100, *Methods for Determination of Inorganic Substances in Environmental Samples.*

b. Detection limits are based on optimal conditions in a standard fixed laboratory for radiological analyses. For cyanide and nitrate, the quantitation limit is provided. The quantitation limit is 3 to 10 times the detection limit. The quantitation limit for nitrate is provided versus nitrogen in nitrate. Interferences and matrix effects may decrease sensitivity, resulting in an increase to the values shown.

c. Accuracy criteria are for associated batch laboratory control sample percent recoveries. With the exception of gamma ray 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.

d. 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 annual average rates (DOE/RL-2008-01, *Hanford Site Groundwater Monitoring Report for Fiscal Year 2007*, Table 1.0-6).

AEA = alpha energy analysis
CAS = Chemical Abstracts Service
EPA = U.S. Environmental Protection Agency
RBSL = risk-based screening level
LSC = liquid scintillation counter
MCL = maximum contaminant level

The existing transfer pipelines used to convey treated water from the 200 West Groundwater Treatment Facility to the associated injection wells consists of variable-diameter (3 in., 4 in., or 6 in.) HDPE, above-grade pipe that is reduced to 7.62 cm (3 in.) diameter HDPE, above grade pipe near the injection wellhead; all HDPE pipe is welded. As effluent enters the injection wellhead equipment rack, a 7.62 cm (3 in.) diameter HDPE to 304L stainless-steel flange is used to connect the 7.62 cm (3 in.) diameter HDPE supply line that delivers effluent to the injection well.

4.4.2 200 West Groundwater Treatment Facility

The 200 West Groundwater Treatment Facility equipment includes radiological inlet tank for blending with other OU groundwater needing radiological treatment; IX columns to remove radionuclides; effluent vessel for blending with other OU groundwater needing only organic and inorganic treatment; fluidized bed reactor for removal of nitrate, metals, and volatile organic compounds (VOCs); membrane bioreactor to remove VOCs and filter out biosludge; air strippers to remove VOCs; effluent for pH adjustment and equalization; and transfer pump for conveying the treated water to injection wells. Figure 2-1 provides a block diagram of the ancillary equipment flow-through system within the 200 West Groundwater Treatment Facility. Treatment of extracted groundwater will follow associated facility operational procedures and plans.

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, *Waste Control Plan for the 200-BP-5 Operable Unit*) 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 200 West Groundwater Treatment Facility in accordance with the language provided in Chapter 2.

Potentially contaminated solid wastes, not to include liquid wastes, generated from treatment of 200-BP-5 OU contaminated groundwater will be disposed of at a secure long-term management facility (i.e., ERDF). Disposal of CERCLA-related waste at ERDF is one method used to reduce risks to human health and the environment because it removes waste from exposure pathways in the environment and places it in an engineered landfill specifically designed to handle such wastes. This part of the treatability test refers to incidental waste generated during operation of the treatment action. All such waste is managed in accordance with the regulatory approved waste control plan.

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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 A2.1.6 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 local U.S. time (e.g., Pacific Standard Time). At the conclusion of each day's activities, the logger will provide their 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 and measuring equipment will be recorded in the logbooks. Photographs and digital video images will be taken and noted in the logbook for reference and then 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 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 will be 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 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.

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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, *Selected Hydraulic Test Analysis Techniques for Constant-Rate Discharge Tests*, 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 type curve matching 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 (1) the concentrations of uranium and technetium-99 in the samples of the extracted groundwater, (2) the pumping rate, and (3) 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, 1952; 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 desaturation 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 (1952) and the Cooper and Jacob (1946) analytical techniques can be used to analyze unconfined aquifer test response, or for hydrologic boundary detection

6.1.1 Evaluation of Containment for Uranium and Commingled Technetium-99 Plumes

Following determination of aquifer transmissivity from the testing conducted at the well site, as described previously, the transmissivity values will be converted to hydraulic conductivity. This is accomplished by dividing the transmissivity value by the aquifer's saturated thickness under nonpumping conditions. Once the hydraulic conductivity value is determined, it will be uploaded into the local-scale hydrologic numerical model, and updated plume capture simulations will be performed.

6.1.2 Evaluation of Contaminant Mass Removal

Contaminant mass (uranium and technetium-99) removal rates observed during the treatability test will be estimated by multiplying the concentrations measured in the analytical samples by the pumping rate. Mass removal rates may also be estimated using the Central Plateau groundwater flow and contaminant transport model to be performed as part of the FS effort.

6.2 Treatability Test Reporting

Following completion and evaluation of the 30-day Phase 2 treatability test data, a briefing will be held with the Tri-Party agencies to summarize the Phase 1 and Phase 2 test results. The need for performing additional testing (i.e., continuous pumping) will be evaluated based on the results of the test as discussed in Section 4.3. Alternatively, continuous pumping could be performed as an interim action. An interim action would require preparation of an EE/CA AM, as discussed in Section 4.0.

Following the briefing, a treatability test report will be prepared. This report will present detailed information for the Phase 1 and 30-day Phase 2 testing and data evaluation to support the 200-BP-5 OU FS and associated TPA (Ecology et al., 1989a) Milestone M-15-21A. The FS will use the test data to develop and evaluate remedial alternatives for the uranium and technetium-99 plumes.

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, "Occupational Safety and Health Standards," "Hazardous Waste Operations and Emergency Response," and 10 CFR 835, "Occupational Radiation Protection," 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).

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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 [TBC] 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 or 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 469a-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 USC469a-1 through 468a-2(d) 36 CFR 60, "National Register of Historic Places" 36 CFR 65, "National Historic Landmarks Program" 36 CFR 800, "Protection of Historic Properties"	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 of 1990 25 USC 3001, et seq. 43 CFR 10, "Native American Graves Protection and Repatriation Regulations"	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., 16 USC 1536(c) 50 CFR 402, "Interagency Cooperation—Endangered Species Act of 1973, as Amended"	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.

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

ARAR Citation	ARAR or TBC	Requirement	Rationale for Use
Migratory Bird Treaty Act of 1918 16 USC 703-712, et seq.	ARAR	Protects all migratory bird species and prevents "take" of protected migratory birds, their young, or their eggs."	Remedial actions that require mitigation measures to deter nesting by migratory birds on, around, or within remedial action site and methods to identify and protect occupied bird nests. This requirement is location specific.

ARAR = applicable or relevant and appropriate requirement
CFR = Code of Federal Regulations
OU = operable unit
TBC = to be considered
USC = United States Code

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

ARAR Citation	ARAR or TBC	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 and includes provisions for exemption from WAC 173-303.	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, if a solid waste, would be subject to the requirements for solid wastes. This requirement is action specific.

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

ARAR Citation	ARAR or TBC	Requirement	Rationale for Use
"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, if a dangerous waste, would 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.
"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 Specific subsections: WAC 173-303-120(3) 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 or Relevant and Appropriate Requirements or To Be Considered

ARAR Citation	ARAR or TBC	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, "Land Disposal Restrictions," 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 land disposal restriction 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.
"Tank Systems," WAC 173-303-640(3)	ARAR	This regulation establishes state design standards for tank systems.	The substantive portions of this regulation are pertinent if a tank is needed as part of the treatability test operations. This requirement is action specific.

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

ARAR Citation	ARAR or TBC	Requirement	Rationale for Use
"Solid Waste Handling Standards," WAC 173-350			
"On-Site Storage, Collection and Transportation Standards," 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 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.
WAC 173-160-171	ARAR	Identifies the requirements for locating a well.	
WAC 173-160-181	ARAR	Identifies the requirements for preserving natural barriers to groundwater movement between aquifers.	
WAC 173-160-400	ARAR	Identifies the minimum standards for resource protection wells and geotechnical soil borings.	
WAC 173-160-420	ARAR	Identifies the general construction requirements for resource protection wells.	
WAC 173-160-430	ARAR	Identifies the minimum casing standards.	
WAC 173-160-440	ARAR	Identifies the equipment cleaning standards.	
WAC 173-160-450	ARAR	Identifies the well sealing requirements.	
WAC 173-160-460	ARAR	Identifies the decommissioning process for resource protection wells.	

ARAR = applicable or relevant and appropriate requirement
CFR = Code of Federal Regulations
OU = operable unit
TBC = to be considered
WAC = Washington Administrative Code

Table 8-3. Identification of To Be Considered Criteria

Criteria To Be Considered	Rationale for Use
EPA et al., 2008, *Record of Decision, Hanford 200 Area 200-ZP-1 Superfund Site, Benton County, Washington*	Contaminated water extracted from the 200-BP-5 OU and added to the 200 West Pump and Treat Facility influent for treatment will attain the cleanup levels for treated effluent.
DOE/RL-2009-124, *200 West Pump and Treat Operations and Maintenance Plan*	Groundwater extracted from the 200-BP-5 OU will meet the design requirements that allow the addition of the groundwater to the 200 West Pump and Treat Facility influent for treatment.

EPA = U.S. Environmental Protection Agency
OU = operable unit

9 Project Management

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

9.1 Project Organization

The project organization is shown in Figure 9-1. The primary role of each member of the project organization is as follows:

- **Regulatory Lead.** The **lead regulatory agency** has approval authority for the 200-BP-5 OU and the work being performed under this test plan. The lead regulatory agency works with the DOE Richland Operations Office (DOE-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*, the *Atomic Energy Act of 1954*, and the TPA (Ecology et al., 1989a) for the Hanford Site. It is the responsibility of DOE-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, and 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. The 200-BP-5 OU Project Manager is also 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 coordinates with DOE-RL and the primary contractor management on all sampling activities. The 200-BP-5 OU Project Manager supports DOE-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 QAPjP), and participating in QA assessments on sample collection and analysis activities, as appropriate.
The QA Manager 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 TTP 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 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 DOE-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).

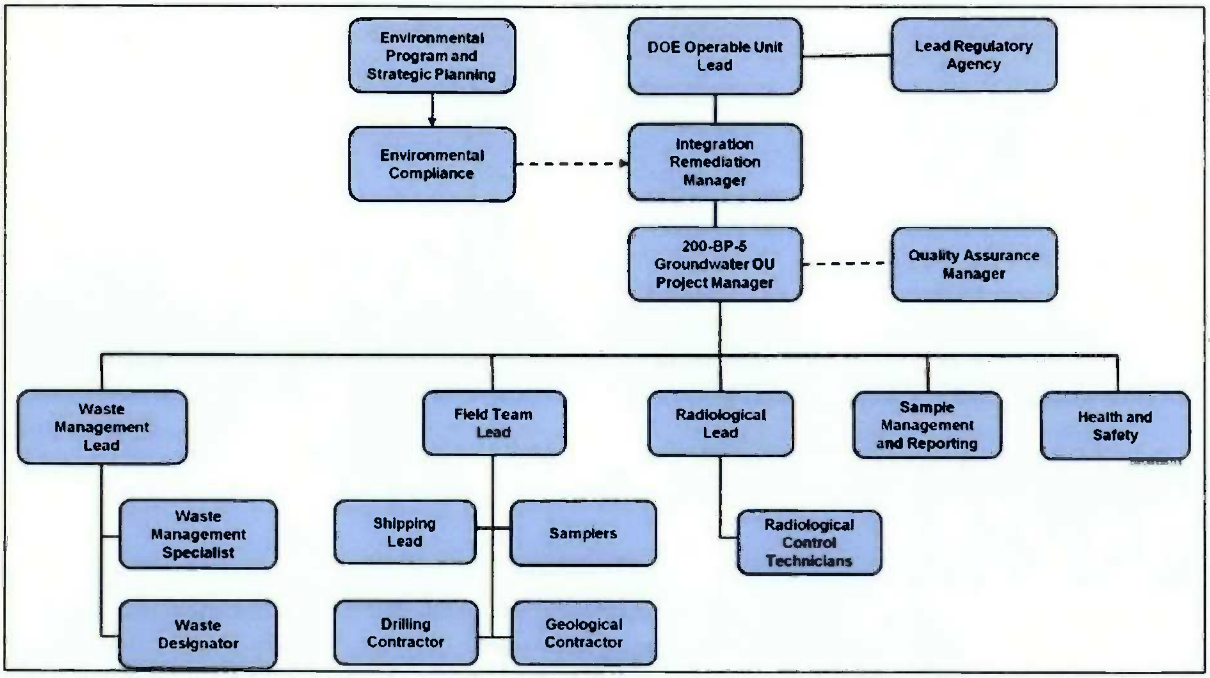


Figure 9-1. Project Organization for the 200-BP-5 OU Treatability Test

9.2 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 nonsignificant change will not affect 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 TPA Action Plan (Ecology, et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*). Appropriate documentation will follow, in accordance with the requirements for that type of change.

9.3 Schedule

Figure 9-2 provides the overall project schedule for the 200-BP-5 OU treatability test activities described in this test plan. The initial line item in Figure 9-2, TPA (Ecology et al., 1989a) Milestone M-15-82A (Submit Treatability Test Plan by December 31, 2010), was met on September 24, 2010, when Draft A was transmitted to the regulatory agencies. The initial test plan was signed by DOE-RL and Ecology on February 1, 2011 (DOE/RL-2010-74, *Treatability Test Plan for the 200-BP-5 Groundwater Operable Unit*). The second part of TPA (Ecology et al., 1989a) Milestone M-15-82A was fulfilled in April 2011, when water level monitoring equipment (e.g., water level and barometric transducers) was installed in 11 monitoring wells to initiate the aquifer testing. The specific requirements of TPA (Ecology et al., 1989a) Milestone M-015-82 for the 200-BP-5 OU are as follows:

- Submit a TTP as an amendment to the 200-BP-5 OU RI/FS work plan (DOE/RL-2007-18) 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 technetium-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 6 months of approval of the TTP. This requirement will be met by the start of test construction (i.e., start of well drilling or pipeline/system construction).

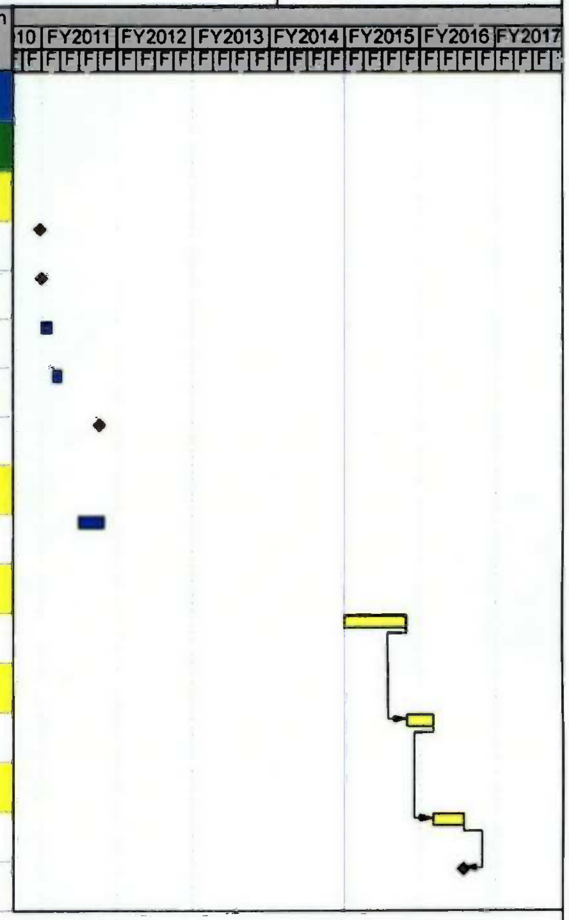
Following issuance of the initial TTP (February 2011) and subsequent construction completion (April 2012), the operation portion of the test was postponed due to funding constraints. In FY 2014, operational restrictions precluded the use at the Effluent Treatment Facility and initiated a change in design to use the 200 West Groundwater Treatment Facility for treatment of 200-BP-5 OU extracted groundwater, including installation of a pipeline for conveyance of 200-BP-5 OU groundwater to the 200 West Groundwater Treatment Facility. This direction is reflected in Figure 9-2, incorporating line items for TTP revision and pipeline design and construct line items. The durations for the major tasks were based on durations for similar tasks performed for the 200-UP-1 OU 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 (Ecology et al., 1989a) and pertinent laws and regulations.

Initiation of Phase 1 and Phase 2 testing will be coordinated with the 200 West Groundwater Treatment Facility 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 receipt from other sources.

9.4 Cost Estimate

The level of effort and total estimated cost to complete the Phase 1 and Phase 2 portions of the treatability test is 14,370 hours and $3,798,000 (Table 9-1). The cost estimate is based on the best available information regarding the anticipated scope of the testing. Refinements in the overall scope of the work and nature of the equipment used to complete the testing may occur during the design and construction phase. Therefore, actual costs are expected to vary.

Activity Name	Start	Finish	Duration
200-BP-5	27-Sep-10 A	[illegible]	[illegible]
200-BP-5 Treatability T[illegible]t	27-Sep-10 A	30-Apr-16	578
Treatability Test Plan	27-Sep-10 A	07-Jul-11 A	0
TPA Milestone M-15-82A - Submit Treatability Test Plan by December 31, 2010		27-Sep-10 A	0
Submit Draft A Treatability Test Plan to Regulatory Agency		27-Sep-10 A	0
Regulatory Agency Review	28-Sep-10 A	22-Nov-10 A	0
Treatability Test Plan, Rev 1 (ETF) Completion and Approval	23-Nov-10 A	07-Jan-11 A	0
TPA Milestone M-15-82B - Initiate Aquifer Tests Within 6 Months of Test Plan Approval		07-Jul-11 A	0
Pipeline / System Construction	01-Apr-11 A	01-Aug-11 A	0
Extraction Well Drilling	01-Apr-11 A	01-Aug-11 A	0
Treatability Test Design	01-Oct-14 A	31-Jul-15	304
Design & Construct Pipeline to 200W P&T	01-Oct-14 A	31-Jul-15	304
Treatability Test	01-Aug-15	30-Nov-15	122
Treatability Testing	01-Aug-15	30-Nov-15	122
Treatability Test Report	01-Dec-15	30-Apr-16	152
Treatability Test Report - Draft A	01-Dec-15	30-Apr-16	152
Submit Draft A Treatability Test Report to Regulatory Agency		30-Apr-16	0



Remaining Work
Critical Remaining Work
Milestone

200-BP-5 OU TREATABILITY TEST

Figure 9-2. 200-BP-5 OU Treatability Test Schedule

Table 9-1. Estimated Level of Effort and Cost

Activity	Schedule Duration (Months)	Level of Effort (Man-Months)	Level of Effort (Man-hours)	Cost
Design	4	8	1,280	$128,000
Construction				
Pipeline	9			$300,000
Well Drilling	4			$540,000
Treatability Test				
Phase 1/Phase 2 Operations	6	8	1,280	$128,000
Phase 1/Phase 2 Sampling	6	2	320	$32,000
Phase 1/Phase 2 Analytical	7.5	N/A	N/A	$14,000
200-BP-5 OU Treatability Test Report (Includes Briefing)	9	3.5	560	$56,000
Subtotals	**8 to 9**	**21.5**	**3,440**	**$1,198,000**
Design and Installation of Pipeline to 200 West Groundwater Treatment Facility	**10**	**10**	**10,930**	**$2,600,00**
Totals	**18 to 19**	**31.5**	**14,370**	**$3,798,000**

N/A = not applicable
OU = operable unit

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Appendix A

Sampling and Analysis Plan

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Contents

Figures

Tables

Terms

AEA	alpha energy analysis
ALARA	as low as reasonably achievable
CAS	Chemical Abstracts Service
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CHPRC	CH2M Plateau Remediation Company
DOE	U.S. Department of Energy
DOE-RL	DOE Richland Operations Office
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
FSP	field sampling plan
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document*
HEIS	Hanford Environmental Information System
IC	ion chromatography
LSC	liquid scintillation counter
MCL	maximum contaminant level
MDL	method detection limit
OU	operable unit
QA	quality assurance
QAPjP	quality assurance project plan
QC	quality control
RD/RAWP	remedial design/remedial action work plan
RBSL	risk-based screening level
RCT	radiological control technician

RPD	relative percent difference
S&GRP	Soil and Groundwater Remediation Project
SAP	sampling and analysis plan
SMR	Sample Management and Reporting
TPA	Tri-Party Agreement
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TTP	treatability test plan

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 (DQOs) are included in this document, which serves an amendment to DOE/RL-2007-18, *Remedial Investigation/Feasibility Study Work Plan for the 200-BP-5 Groundwater Operable Unit*, 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 (TTP) 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 A-1). The purpose of the treatability test is to evaluate whether groundwater pumping at a rate of 189 L/min (50 gpm) can be sustained near Waste Management Area B-BX-BY (B Tank Farm Complex). The testing will be conducted near Well 299-E33-31, on the west side of the BY Tank Farm (Figure A-2). Installation of one new extraction well (299-E33-268) and one new monitoring well (299-E33-267) was completed for the treatability test.

The 200-BP-5 OU treatability test consists of two phases. The Phase 1 step-drawdown test consists of pumping the extraction well (299-E33-268) for approximately 6 to 9 hours. 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 (299-E33-268) at a constant rate for a duration of up to 3 days, until drawdown stabilizes, to obtain water level drawdown measurements for use in estimating the unconfined aquifer's hydraulic parameters (transmissivity and specific yield). Once the 3-day constant-rate pumping is completed, the well will be pumped at an average rate of at least 189 L/min (50 gpm), not to exceed 568 L/min (150 gpm), to obtain water quality samples for estimating contaminant mass removal rates. The total Phase 2 pumping duration is estimated at 30 days or more. All Phase 1 and Phase 2 water level measurements will be collected using programmable pressure transducers.

The Phase 2 sustainable pumping rate will be evaluated in the feasibility study (FS) to determine if a pump-and-treat alternative can be successful at the 200-BP-5 OU. 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 data needs outcome is summarized in the TTP. 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 during the test. Concentrations of uranium, technetium-99, and other constituents in the groundwater will provide data for waste designation and waste acceptance at the 200 West Groundwater Treatment Facility.

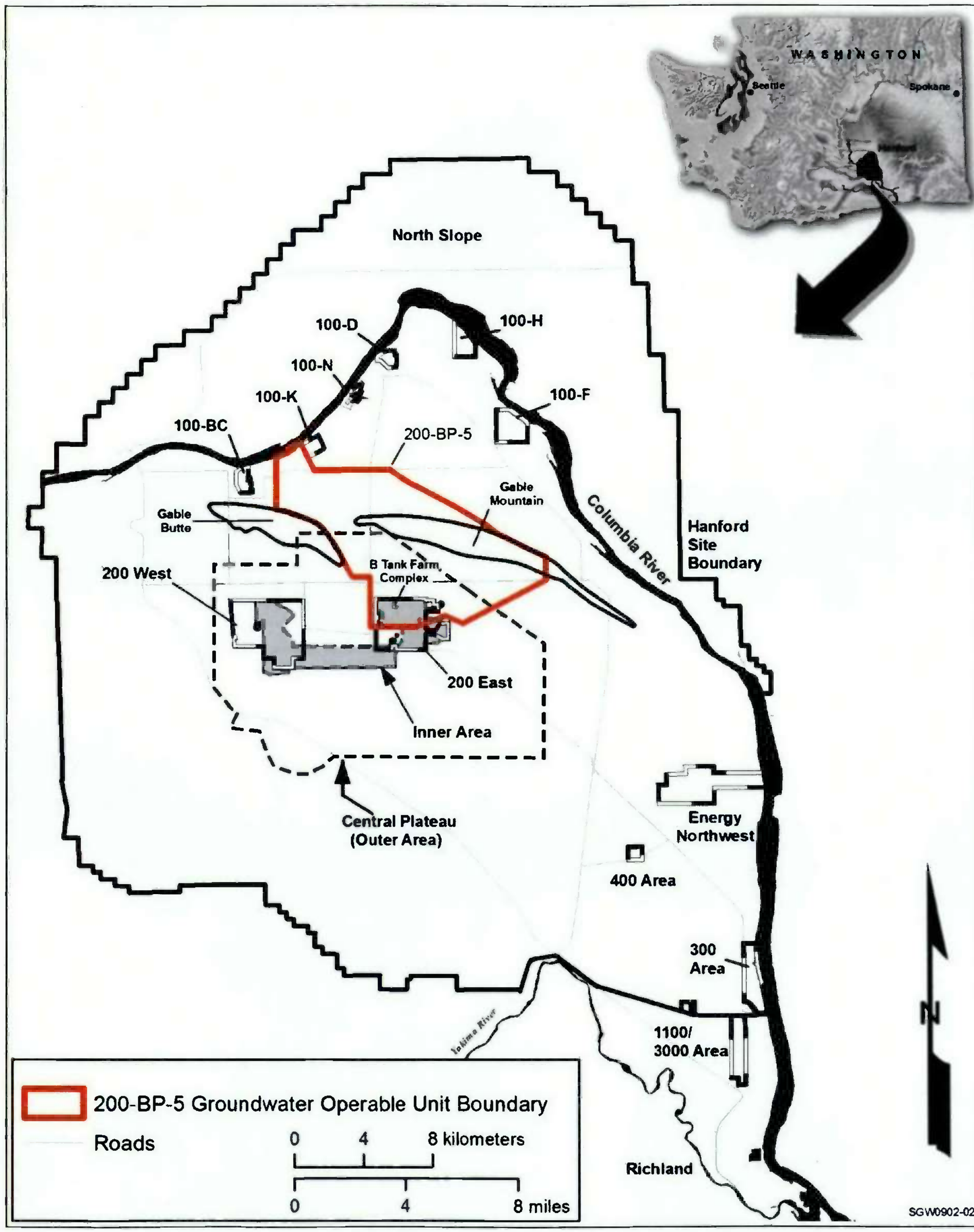

Figure A-1. Location of the 200-BP-5 Groundwater OU

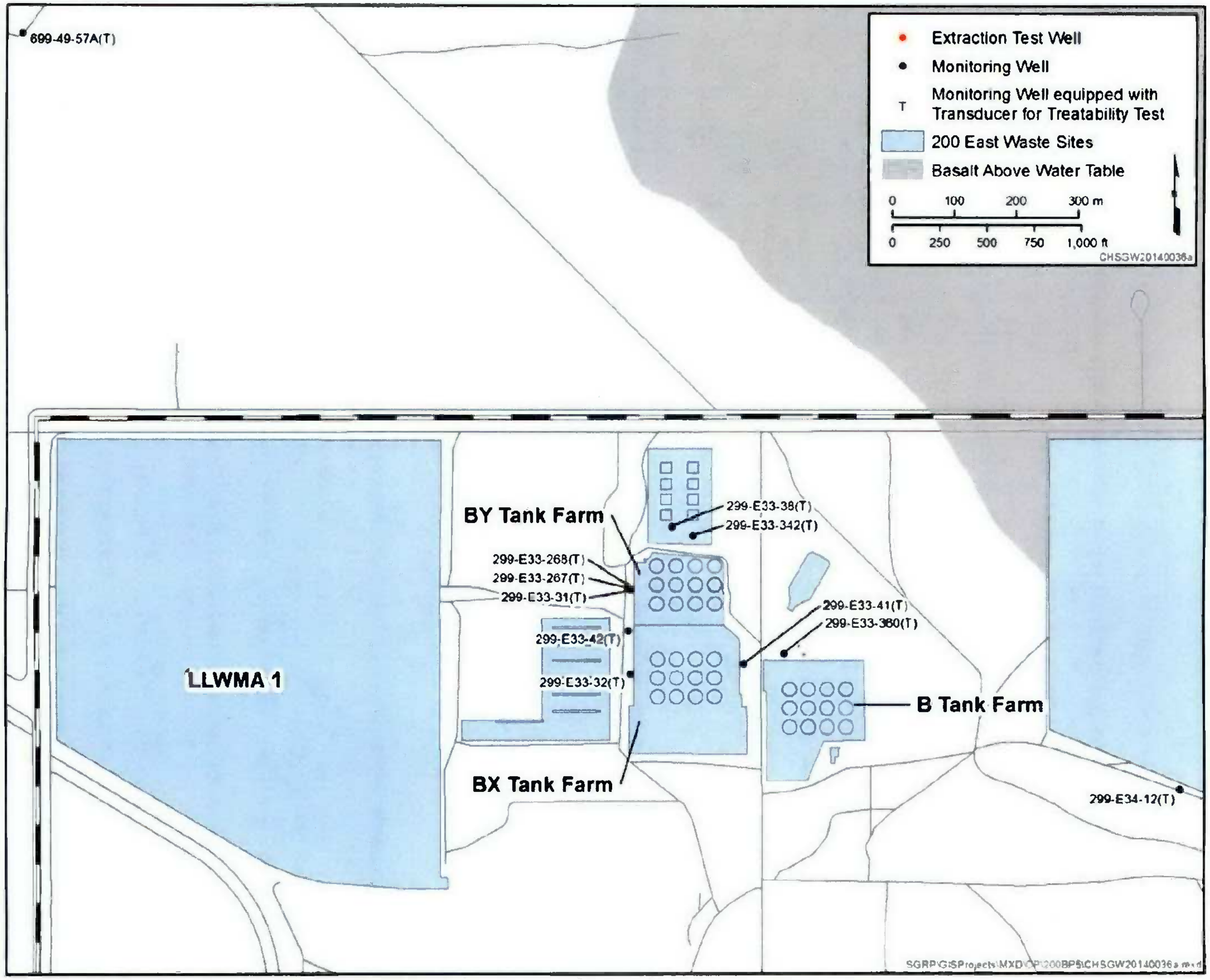

Figure A-2. Location of Groundwater Monitoring Wells and Proposed Test Well near Waste Management Area B-BX-BY

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 provide data to evaluate the effectiveness of the pump-and-treat technology in removing uranium and technetium-99 from the aquifer. The effectiveness of pump-and-treat technology may also be evaluated for removing co-contaminants (e.g., iodine-129, tritium, cyanide, hexavalent chromium, nitrite, and nitrate) from the aquifer. Sampling will be performed in accordance with field sampling, sample handling, and documentation activity requirements in DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD), Volumes 1 through 4. The analytical parameters and performance requirements have been selected to satisfy these data needs.

Table A-1 presents the main sample analytes for groundwater samples collected as part of the treatability test. All samples collected will be analyzed for technetium-99 and uranium (uranium-233/234, uranium-235, uranium-238, and total uranium). Samples will be analyzed for the additional analytes listed in Table A-1, as needed. Characterization information for waste acceptance determinations will be in accordance with the latest version of DOE/RL-2009-124, *200 West Pump and Treat Operations and Maintenance Plan*. All investigation-derived liquids (development and pump test water) will be collected at the wellhead and pumped to the 200 West Groundwater Treatment Facility in accordance with the language provided in Chapter 2 of the TTP. Section A3.2 summarizes the treatability test activities. The groundwater sample and analysis activities are presented in Section A3.3.

Table A-1. 200-BP-5 OU Treatability Test Sample Analytes and Field Parameters

Field Parameters		
pH Oxidation-Reduction Potential	Temperature	Specific Conductivity
Radionuclides		
Iodine-129 Technetium-99	Tritium Uranium-233/234	Uranium-235 Uranium-238
Nonradionuclides		
Cyanide	Nitrate	Uranium (Total)

OU = operable unit

A1.3 Project Schedule

Activities within the scope of this SAP are included in the overall project schedule presented in Figure 9-2 of the TTP for the 200-BP-5 OU and Figure A-3. Durations for the major tasks are based on similar tasks performed for the 200-UP-1 OU pump-and-treat interim action and the professional judgment of those performing the work.

A2 Quality Assurance Project Plan

This quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection. It includes planning, implementation, and assessment of sampling tasks, field measurements, laboratory analysis, and data review. This QAPjP complies with requirements from the following documents:

- HASQARD (DOE/RL-96-68)
- EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5)

This section describes the applicable quality requirements and controls. Section 6.5 and Section 7.8 of the Tri-Party Agreement (TPA) Action Plan (Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*) 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 Washington State Department of Ecology (Ecology) Publication No. 04-03-030, *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, and EPA/240/R-02/009, *Guidance for Quality Assurance Project Plans* (EPA QA/G-5). This QAPjP is intended to supplement the contractor's environmental QA program plan.

In addition to the requirements cited in this section, EPA-505-B-04-900A, *Intergovernmental Data Quality Task Force Uniform Federal Policy for Quality Assurance Project Plans: Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs Part 1: UFP-QAPP Manual*, was used as a resource for identification of QAPjP elements. This manual is not imposed through the TPA (Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order*). 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.

Activity Name	Start	Finish	Duration
200-BP-5	27-Sep-10 A	30-Apr-16	578
200-BP-5 Treatability Test	27-Sep-10 A	30-Apr-16	578
Treatability Test Plan	27-Sep-10 A	07-Jul-11 A	0
TPA Milestone M-15-82A - Submit Treatability Test Plan by December 31, 2010		27-Sep-10 A	0
Submit Draft A Treatability Test Plan to Regulatory Agency		27-Sep-10 A	0
Regulatory Agency Review	28-Sep-10 A	22-Nov-10 A	0
Treatability Test Plan, Rev 1 (ETF) Completion and Approval	23-Nov-10 A	07-Jan-11 A	0
TPA Milestone M-15-82B - Initiate Aquifer Tests Within 6 Months of Test Plan Approval		07-Jul-11 A	0
Pipeline / System Construction	01-Apr-11 A	01-Aug-11 A	0
Extraction Well Drilling	01-Apr-11 A	01-Aug-11 A	0
Treatability Test Design	01-Oct-14 A	31-Jul-15	304
Design & Construct Pipeline to 200W P&T	01-Oct-14 A	31-Jul-15	304
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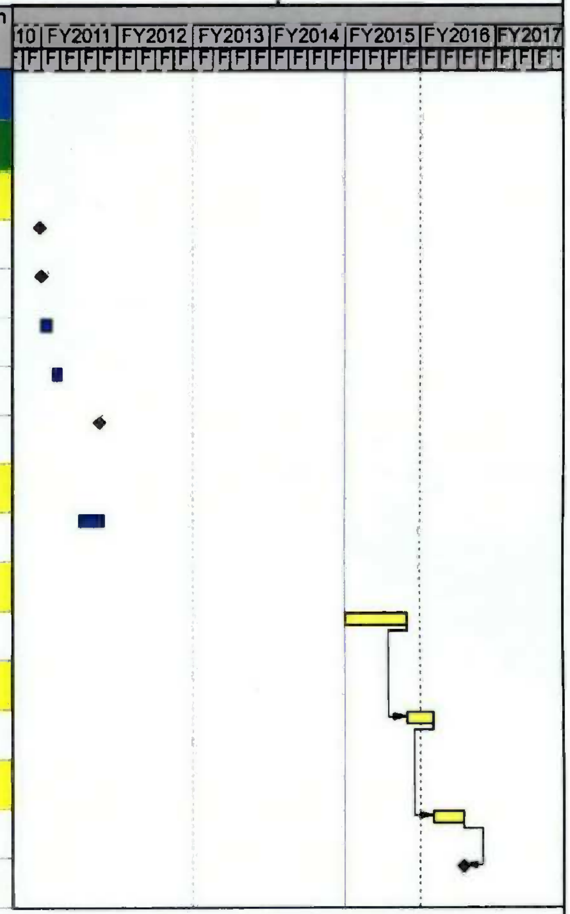

Remaining Work
Critical Remaining Work
◆ Milestone

200-BP-5 OU TREATABILITY TEST

Figure A-3. 200-BP-5 OU Treatability Test Schedule

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, participants understand the goal and approach to be used, and 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 ensures 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 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 subsections address the basic aspects of project management and are designed to ensure that the project has defined goals, participants understand the goals and approaches used, and 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 subsections and is shown in Figure A-4. 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 the U.S. Department of Energy (DOE).

- **Regulatory Lead.** The **lead regulatory agency** has approval authority as lead regulatory agency for the 200-BP-5 OU and the work being performed under this SAP. The lead regulatory agency works with the DOE Richland Operations Office (DOE-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), *Resource Conservation and Recovery Act of 1976*; *Atomic Energy Act of 1954*; and TPA (Ecology et al., 1989a) for the Hanford Site. It is the responsibility of DOE-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.

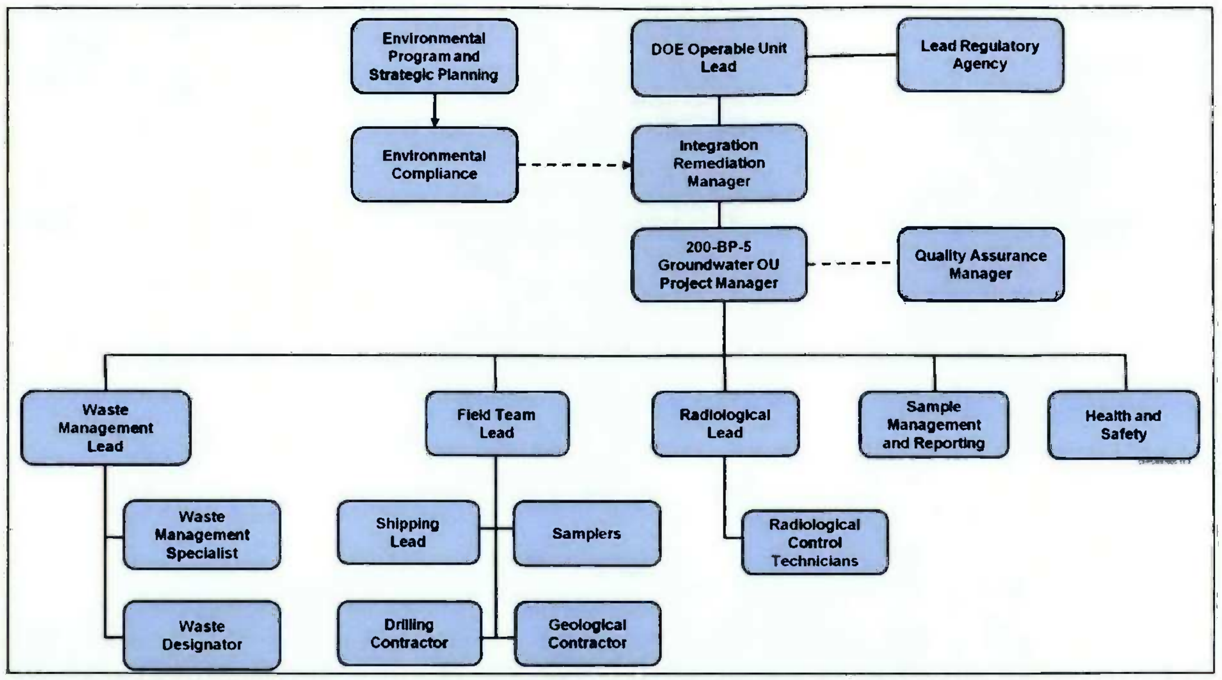

Figure A-4. Project Organization

- **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, and subcontracted tasks and ensuring that 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 DOE-RL and the primary contractor management on all sampling activities. The 200-BP-5 Groundwater OU Project Manager supports DOE-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 [FSP], and the QAPjP), and participating in QA assessments on sample collection and analysis activities, as appropriate. The QA Manager 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 TTP 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 that 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 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 DOE-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 assists project personnel in complying with applicable health and safety standards and requirements. The Health and Safety organization coordinates with the 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** (SMR) organization coordinates laboratory analytical work, ensuring that the laboratories conform to Hanford Site internal laboratory QA requirements (or their equivalent), as approved by DOE, the U.S. Environmental Protection Agency (EPA), and Ecology. SMR receives the analytical data from the laboratories, performs data entry into the Hanford Environmental Information System (HEIS), and arranges for data validation. SMR is responsible for informing the 200-BP-5 Groundwater OU Project Manager of any issues reported by the analytical laboratory. The SMR organization develops and oversees 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 SMR organization is also responsible for conducting the DQO process, or equivalent. Additional related responsibilities include developing DQOs and the 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 explanations 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 ensures project compliance for storage, transportation, disposal, and waste tracking in a safe and cost-effective manner. The Waste Management Lead is also 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 189 L/min (50 gpm) pumping rate can be sustained in the unconfined aquifer in the area of the uranium and technetium-99 groundwater plumes near the B Tank Farm Complex. The technology will be further evaluated in the FS and/or 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.

Groundwater contaminant plumes of uranium, technetium-99, and other contaminants originate from source areas near 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 (DOE/RL-2010-11, *Hanford Site Groundwater Monitoring and Performance Report for 2009 Volumes 1 & 2*).

The sources of uranium and technetium-99 in the unconfined aquifer underlying the B Tank Farm Complex appear to be the overlying single-shell tanks and/or cribs. Technetium-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 OU treatability test. Chapter 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 Chapter A3, and analyzed for technetium-99 and uranium (uranium-233/234, uranium-235, uranium-238, and total uranium) in accordance with Table A-2. In addition, samples will be collected for other contaminants of interest (nitrate, iodine-129, cyanide, and tritium) on a weekly basis (Table A-2). 200-BP-5 OU groundwater investigation-derived liquid waste characterization and designation sample collection will be in accordance with the latest version of DOE/RL-2009-124. All investigation-derived liquids (development and pump test water) will be collected at the wellhead and pumped to the 200 West Groundwater Treatment Facility in accordance with the language provided in Chapter 2 of the TTP. 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. The viability of pump-and-treat technology as a remedial technology will be determined in the 200-BP-5 OU FS and/or the RD/RAWP.

Table A-2. 200-BP-5 OU Treatability Test Analytical Performance Requirements for Water Matrices

CAS No. or Constituent Identifier No.	Analyte	Survey or Analytical Method[a]	Lowest Overall RBSL	RBSL Basis	Target Detection Limits[b]	Precision Required (%)	Accuracy Required (%)
Target Analytes for Water Samples[c]							
14133-76-7	Technetium-99	Technetium-99 LSC (Low Level)	900 pCi/L	40 CFR 141.66	15 pCi/L	≤20[d]	70-130[d]
U-233/234	Uranium-233/234	Isotopic Uranium AEA	None (20 pCi/L)[e]	40 CFR 141.66	1 pCi/L	≤20[d]	70-130[d]
15117-96-1	Uranium-235	Isotopic Uranium AEA	None (24 pCi/L)[e]	40 CFR 141.66	1 pCi/L	≤20[d]	70-130[d]
U-238	Uranium-238	Isotopic Uranium AEA	None (24 pCi/L)[e]	40 CFR 141.66	1 pCi/L	≤20[d]	70-130[d]
7440-61-1	Uranium (Total)	Kinetic Phosphorescence Analysis or EPA Method 6020	30 µg/L	40 CFR 141.66	1 µg/L	≤20[d]	70-130[d]
15046-84-1	Iodine-129[f]	Chemical Separation Low-Energy Spectroscopy	1 pCi/L	40 CFR 141.66	1 pCi/L	≤20[d]	70-130[d]
10028-17-8	Tritium[f]	Tritium LSC (Mid-Level)	20,000 pCi/L	40 CFR 141.66	400 pCi/L	≤20[d]	70-130[d]
57-12-5	Cyanide[g]	EPA Methods 9010 Total Cyanide or 335.4	200 µg/L	40 CFR 141.62	20 µg/L	≤20[h]	80-120[h]
14797-55-8	Nitrate[f]	IC, EPA Methods 300.0 or 9056	10,000 µg/L	40 CFR 141.62	250 µg/L	≤20[h]	80-120[h]

Table A-2. 200-BP-5 OU Treatability Test Analytical Performance Requirements for Water Matrices

CAS No. or Constituent Identifier No.	Analyte	Survey or Analytical Method[a]	Lowest Overall RBSL	RBSL Basis	Target Detection Limits[b]	Precision Required (%)	Accuracy Required (%)

Sources: 40 CFR 141.62, "National Primary Drinking Water Regulations," "Maximum Contaminant Levels for Inorganic Contaminants."

40 CFR 141.66, "National Primary Drinking Water Regulations," "Maximum Contaminant Levels for Radionuclides."

EPA-600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples.*

SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B.*

a. For four-digit EPA methods, see SW-846. For EPA Methods 300 and 335.4, see EPA-600/R-93/100.

b. Target detection limits are based on optimal conditions in a standard fixed laboratory for radiological analyses. For cyanide and nitrate, the quantitation limit is provided. The quantitation limit is 3 to 10 times the detection limit. The quantitation limit for nitrate is provided versus nitrogen in nitrate. Interferences and matrix effects may decrease sensitivity, resulting in an increase to the values shown.

c. Samples collected will be analyzed for target analytes for water samples listed. 200-BP-5 OU groundwater investigation-derived liquid waste characterization and designation sample collection will be in accordance with the latest version of DOE/RL-2009-124, *200 West Pump and Treat Operations and Maintenance Plan.*

d. 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.

e. 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, *Hanford Site Groundwater Monitoring for Fiscal Year 2007*, Table 1.0-6).

f. Considered a groundwater co-contaminant for the 200-BP-5 OU.

g. The 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.

h. Accuracy criteria are the minimum for associated batch laboratory control sample percent recoveries. Laboratories must meet statistically based controls if they are 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.

AEA = alpha energy analysis

CAS = Chemical Abstracts Service

IC = ion chromatography

EPA = U.S. Environmental Protection Agency

LSC = liquid scintillation counter

MCL = maximum contaminant level

OU = operable unit

RBSL = risk-based screening level (identifies the drinking water standard)

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 subsections.

Quality objectives and project-specific measurement requirements are presented in Table A-2. In consultation with the laboratory, the 200-BP-5 Groundwater OU Manager, and/or others as appropriate, the SMR 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 A-2.

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 A-2 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 A-2 identifies the sample analytes, field parameters, and analytical performance requirements for samples collected under the scope of this SAP. Uranium and technetium-99 are the primary analytes for technical evaluation. The analytical data set will be considered incomplete if any of the target analytes for water samples listed in Table A-2 (uranium-233/234, uranium-235, uranium-238, total uranium, and technetium-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 that is commensurate with their responsibilities and that complies with applicable DOE orders and government regulations. The field team lead, in coordination with line management, will ensure that 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., CH2M Plateau Remediation Company [CHPRC] General Employee Training)
- Radiological Worker Training

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

- 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; RCTs assigned to these activities will be qualified through the prescribed training program and will undergo ongoing training and qualification activities.

Pre-job briefings will be performed to evaluate an activity and associated hazards by considering the following factors:

- 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 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 that 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.

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

- 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). Nonsignificant changes will not affect 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 items, 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 items:

- 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 hardcopy 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 (Ecology et al., 1989a) will be managed in accordance with the requirements therein.

A2.2 Data Generation and Acquisition

The following subsections address data generation and acquisition to ensure that project 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 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 ensuring that immediate corrective actions are applied to field activities.

A2.2.1 Sampling Process Design (Experimental Design)

While there is a time series component to the experimental design, the sampling design is judgmental. 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.

Samples will be collected from judgmental locations in a time series (i.e., scheduled for collection on definite days during the treatability test). With a time series sampling schedule, sample times (day 1, day 2, or day 3) can be correlated to a radial distance from the well (e.g., 0.3, 3, or 30 m [1, 10, or 100 ft]). This approach provides information regarding analyte concentration continuity within the plume, which is an important parameter in estimating contaminant mass removal rates and future contaminant concentrations based on past trends. While time series sampling is a component of systematic grid sampling, the overall experimental design, with respect to samples collected under this SAP for chemical and radiochemical analysis, is judgmental.

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 following specific information is included:

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

A2.2.3 Sample Handling and Custody

A sampling database is used to track samples from the point of collection through the laboratory analysis process. Samplers should note any anomalies (e.g., sample appears unusual or 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 the SMR organization.

Laboratory analytical results are entered and maintained in HEIS. 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 the SMR organization.

A2.2.4 Analytical Methods

Information on analytical methods is provided in Table A-2. These analytical methods are controlled in accordance with the laboratory QA plan and the requirements of this QAPjP. The primary contractor participates in overseeing offsite 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 A-2 must be approved by the SMR 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 SMR organization in coordination with the 200-BP-5 Groundwater OU Project Manager.

A2.2.5 Quality Control

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 A-3.

Table A-3. Field and Laboratory QC Requirements

Sample Type	Purpose	Frequency
	Field QC	
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] If only disposable equipment is used, then an equipment rinsate blank is not required. Otherwise, 1 per 20 samples, *per media sampled.*
	Laboratory QC[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 effect 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.*

Table A-3. Field and Laboratory QC Requirements

Sample Type	Purpose	Frequency

a. Whenever a new type of nondedicated 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 nondedicated equipment.

b. Batching across projects is allowed for similar matrices (e.g., Hanford Site groundwater). Maximum batch size is 20 samples.

QC = quality control

A2.2.5.1 Field Quality Control Samples

Field QC samples will be collected to evaluate the potential for cross-contamination and provide information pertinent to field sampling variability and laboratory performance. 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 (MDL) 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 MDL. 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 and secondary test locations).

A2.2.5.2 Laboratory Quality Control Samples

Laboratory QC samples (e.g., method blanks, laboratory control sample/blank spike, and matrix spike) are defined for the three-digit EPA methods (EPA-600/4-79-020, *Methods for Chemical Analysis of Water and Wastes*) and four-digit EPA methods (SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*) 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 A-3 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 A-2.

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. If holding times are exceeded, effects of the holding time exceedance on results will be evaluated on a case-by-case basis. Required holding times depend on the analytical method, as specified for three-digit EPA methods (EPA-600/4-79-020) or 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 CHPRC Soil and Groundwater Remediation Project (S&GRP) 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 (e.g., DOE/RL-2014-32, *Hanford Site Groundwater Monitoring Report for 2013*).

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

Equipment used for collection, measurement, and testing should meet applicable standards (e.g., ASTM International, formerly the 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 that 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 that purchased items comply with applicable procurement specifications. Supplies and consumables are checked and accepted by users prior to use.

Supplies and consumables procured by 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 SMR organization, in coordination with the 200-BP-5 Groundwater OU Project Manager, is responsible for ensuring that analytical data are appropriately reviewed, managed, and stored in accordance with 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, hardcopies will be provided in accordance with Section 9.6 of the TPA Action Plan (Ecology et al., 1989b).

Laboratory errors are reported to the SMR 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 establish their resolution with the 200-BP-5 Groundwater OU Project Manager. Sample issue resolution forms become a permanent part of the analytical data package for future reference and 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 nonradiological measurements when this SAP is implemented. Field activities will be recorded in the field logbook. Types of documentation for field radiological data include the following examples:

- Instructions regarding the minimum requirements for documenting radiological controls information in accordance with 10 CFR 835, "Occupational Radiation Protection"
- Instructions for managing the identification, creation, review, approval, storage, transfer, and retrieval of primary contractor radiological records
- Minimum standards and practices necessary for preparing, performing, and retaining radiological-related records

- Training of personnel on the development and implementation of sample plans
- 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, the QA organization, and/or the Health and Safety organization 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 SMR 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 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

Work activities will follow documented procedures and processes for data validation and verification, summarized as follows. 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 will 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 laboratory analyses conducted.

Groundwater monitoring staff members 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 completeness, notes on condition of samples upon receipt by the laboratory, notes on problems encountered during analysis of the samples, and correct reporting of results. If data are incomplete or deficient, staff members work with the laboratory to correct the problem found during the analysis.

The data validation process provides 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 A-2) 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 members 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 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 FSP identifies the groundwater sampling activities to meet the data needs associated with the 200-BP-5 OU 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 test well site.

Groundwater samples also will be collected from the test well site during the Phase 2 constant-rate test following 1 day, 2 days, and 3 days of pumping, and weekly thereafter if testing extends past 3 days. A final 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.

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 A-5. Groundwater samples will be collected at the extraction well and at the two closest monitoring wells during the recovery phase of the Phase 2 test.

Groundwater samples collected will be analyzed for technetium-99 and uranium (uranium-233/234, uranium-235, uranium-238, and total uranium) in accordance with Table A-2. Weekly samples will be collected for co-contaminants (cyanide, iodine-129, nitrate, and tritium) at the extraction well during the first 30 days of Phase 2 testing. Additional sampling may occur at the direction of the 200-BP-5 Groundwater OU Project Manager during the treatability test.

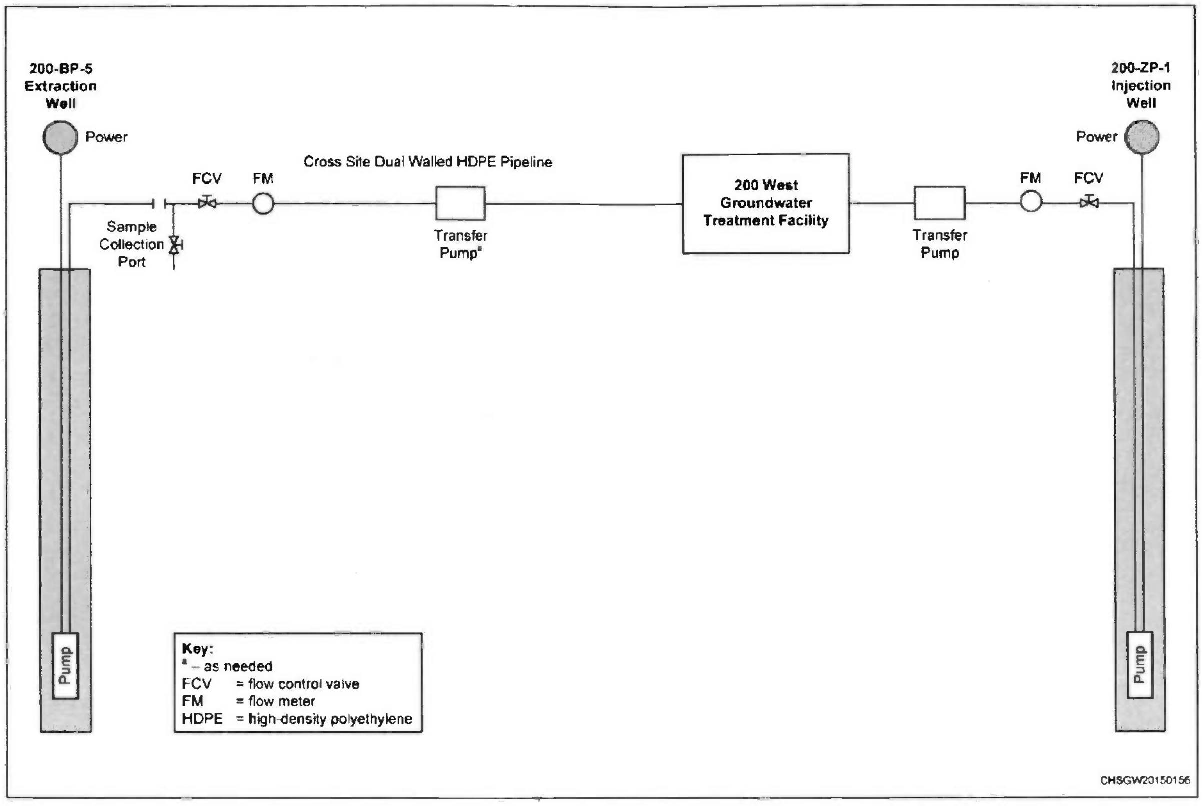

Figure A-5. Conceptual Diagram of Extracted Groundwater Process Flow

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 A-4.

Table A-4. Groundwater Sample Container, Preservation, and Holding Time Guidelines

Method Name*	Bottle Type	Volume (mL)	Preservation Requirement	Holding Time
Isotopic Uranium AEA	G/P	1,000	Nitric Acid to pH <2	6 months
Technetium-99–LSC Low Level	G/P	1,000	Hydrochloric Acid to pH <2	6 months
Tritium–LSC Mid-Level	G	60	None	6 months
Chemical Separation Low-Energy Spectroscopy	G/P	2,000	None	6 months
Uranium Kinetic Phosphorescence Analysis or EPA 6020	G/P	500	Nitric Acid, pH <2, Cool 6°C	6 months

Table A-4. Groundwater Sample Container, Preservation, and Holding Time Guidelines

Method Name*	Bottle Type	Volume (mL)	Preservation Requirement	Holding Time
EPA 9010 or 335.4	G/P	1,000	Sodium Hydroxide to pH >/= 12, Cool 6°C	14 days
EPA 300.0 or 9056	P	120	Cool 6°C	48 hours

Note: 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.

* 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, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B. Equivalent methods may be substituted. For EPA Method 300.0 or 335.4 see EPA/600/R-93/100, Methods for the Determination of Inorganic Substances in Environmental Samples.

48 hours = 48 hours for nitrate

14 days/40 days = 14 days collection to analysis

AEA = alpha energy analysis

EPA = U.S. Environmental Protection Agency

G = glass

LSC = liquid scintillation counter

P = plastic

A3.2.1 Decontamination of Sampling Equipment

Sampling equipment will 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, information recorded on data forms must follow the same requirements as those for logbooks. The data forms must be referenced in the logbooks.

The following information is to be recorded in logbooks:

- Purpose of activity
- Day, date, time, and weather conditions
- Names, titles, and 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, and 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 manufacturer operating instructions, internal work requirements and processes, and/or work packages that provide direction for equipment calibration or verification of accuracy by analytical methods. Results from all instrument calibration activities are recorded in logbooks and/or work packages. Either hardcopy 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 a nationally recognized standard agency source or measurement system.

A3.5 Sample Handling

This section describes sample handling methods.

A3.5.1 Packaging

Certified clean 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 SMR organization) can send smaller volumes to the laboratory. Preliminary container types and volumes are identified in Table A-4.

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

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 maintenance of sample integrity throughout the analytical process. Chain-of-custody procedures will be followed throughout sample collection, transfer, analysis, and disposal to ensure that 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 SMR 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 171, "General Information, Regulations, and Definitions," through 49 CFR 177, "Carriage by Public Highway," 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, *Waste Control Plan for the 200-BP-5 Operable Unit.* Pursuant to 40 CFR 300.440, "National Oil and Hazardous Substances Pollution Contingency Plan," "Procedures for Planning and Implementing Offsite Response Actions," approval from the CERCLA DOE-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 S&GRP 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. 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.

A5 References

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