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Draft A

Engineering Evaluation/Cost Analysis for 200-BP-5 Operable Unit Groundwater Extraction

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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Richland, Washington 99352

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Executive Summary

This engineering evaluation/cost analysis (EE/CA) has been prepared for public and Tribal comment and evaluates the implementation of a non-time-critical removal action (NTCRA) for the extraction and treatment of groundwater in the 200-BP-5 Operable Unit (OU) in the 200 East Area of the Hanford Site (Figure ES-1) in Richland, Washington. The extracted groundwater will be from contaminant plumes in the vicinity of the B Complex Area containing elevated levels of technetium-99, uranium, and nitrate (Figure ES-2). An aquifer test to evaluate hydraulic properties of the unconfined aquifer in the vicinity of these plumes is planned to be conducted in 2015 and 2016. This EE/CA will utilize the information from the aquifer test to design and implement a groundwater extraction and treatment system for the B Complex Area. Groundwater extraction and treatment will be implemented as an NTCRA. The information in this EE/CA and results from the implementation of the selected removal action will also be used to support the 200-BP-5 OU remedial investigation (RI)/feasibility study (FS) process.

This EE/CA identifies the scope of work for the NTCRA and proposed alternatives and analyzes alternatives for effectiveness, implementability, and cost. The U.S. Department of Energy (DOE), U.S. Environmental Protection Agency (EPA), and Washington State Department of Ecology (Ecology) (also referred to collectively as the Tri-Parties) will use this EE/CA as the basis for determining the best method for control of contaminants in the groundwater to minimize potential risks to human health and the environment (HHE). This EE/CA was prepared in accordance with the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*[1] (CERCLA).

[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.

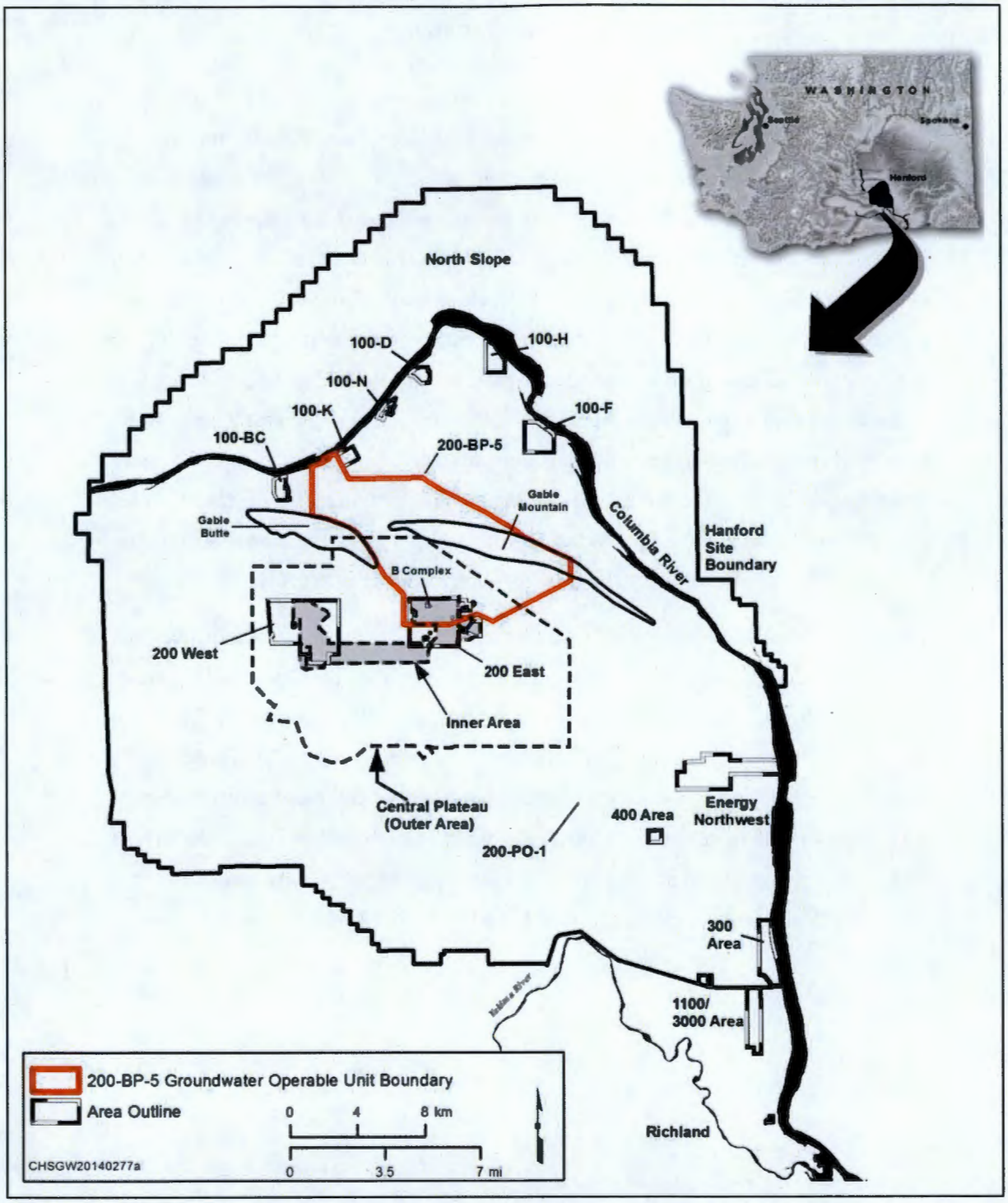

Figure ES-1. Location of the B Complex Area within the 200-BP-5 Groundwater OU

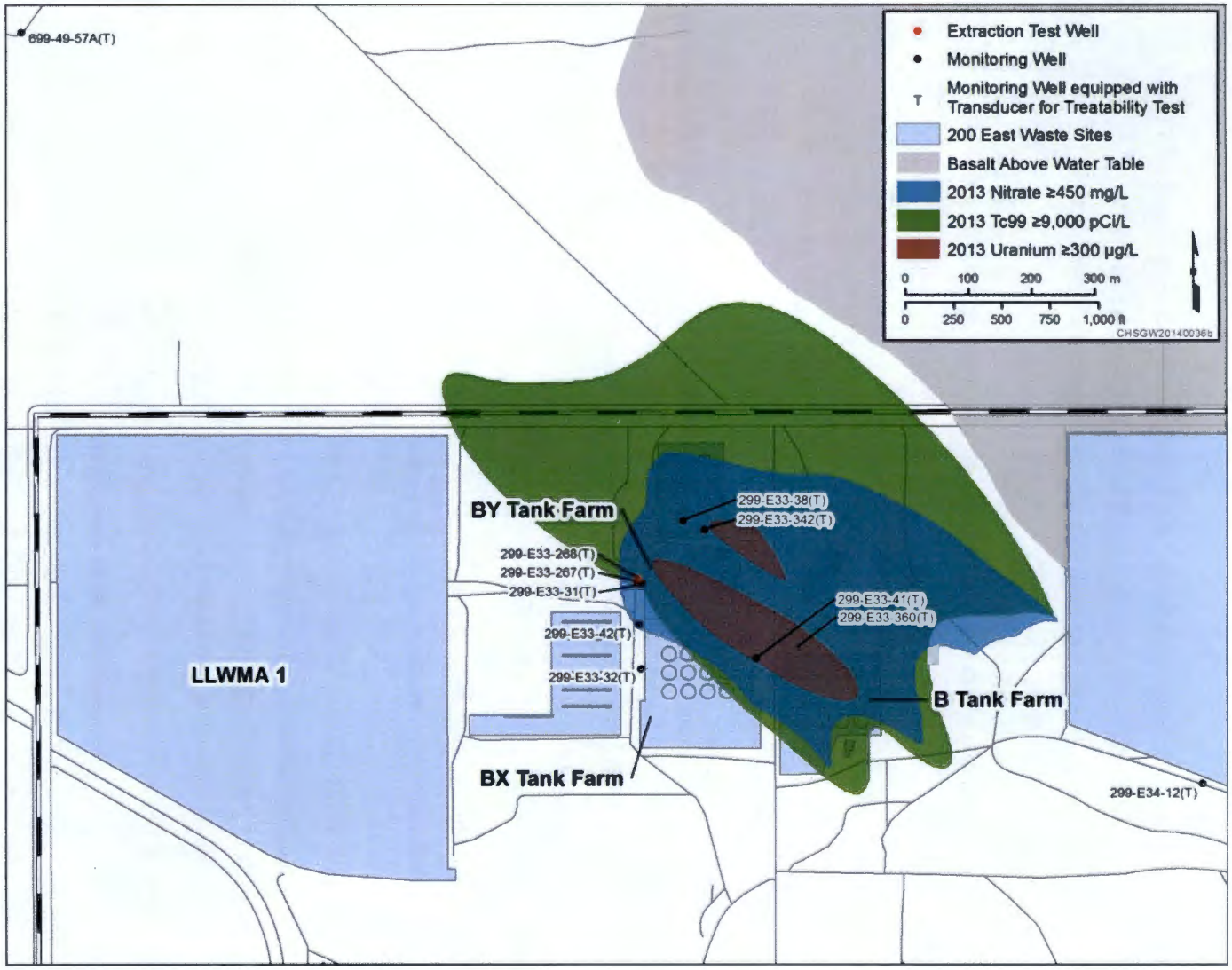

Figure ES-2. Location of the Extraction Well and Associated Groundwater Monitoring Wells for the Removal Action near Waste Management Area B-BX-BY

The removal action is consistent with the remedial action objectives (RAOs) of previous records of decision (RODs) and supports the overall cleanup objectives through the Tri-Party Agreement (Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order*[2]), as revised. This NTCRA is described herein for the 200-BP-5 Groundwater OU. Although access to the 200-BP-5 OU groundwater on the Hanford Site is controlled, contaminant levels currently exceed federal and state drinking water standards, have increasing trends, and have potential for further adverse effects on groundwater at the Hanford Site.

This EE/CA evaluates two alternatives for the groundwater plumes in the B Complex Area.

- Alternative 1: No Action
- Alternative 2: Pump contaminated groundwater from existing extraction well(s) in the vicinity of the B-BX-BY Tank Farm, and treat extracted water at the 200 West Pump and Treat Facility (200 West P&T) as an NTCRA (Figure ES-3)

Alternative 1, the No Action alternative, provides a baseline for comparing the other alternative. Under Alternative 1, it is assumed that no active measures are applied to the groundwater contaminant plumes, and that any action is deferred until completion of the 200-BP-5 RI/FS and proposed plan (PP).

Alternative 2 (pump contaminated groundwater from existing extraction well[s] in the vicinity of the B Complex Area and treat extracted water at 200 West P&T) implements an NTCRA for the groundwater plume near the B-BX-BY Tank Farm with multiple contaminants and the objective of mass removal and plume containment. This action will follow completion of aquifer testing conducted under the treatability test plan (TTP) for the 200-BP-5 OU (DOE/RL-2010-74[3]). Measurements from the treatability test will be used to establish the long-term sustainable extraction rate. The NTCRA will utilize the same extraction well and pipeline system.

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[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.

[3] DOE/RL-2010-74, 2011, *Treatability Test Plan for the 200-BP-5 Groundwater Operable Unit*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0093994.

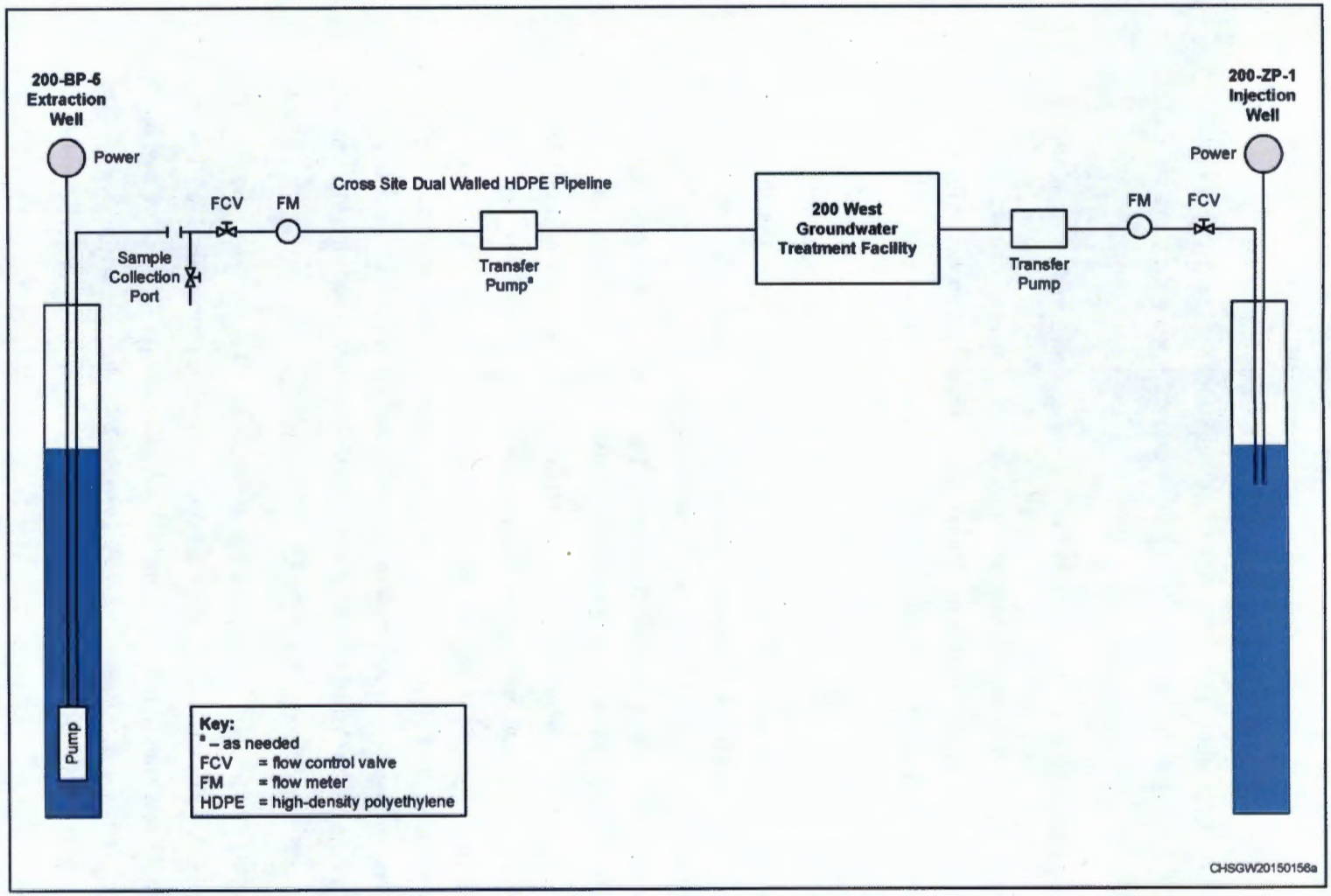

Figure ES-3. Process Flow Diagram for the 200-BP-5 OU NTCRA

Alternative 2 will utilize the 200 West P&T for treatment of the extracted groundwater. The estimated flow rates of extracted groundwater are 75 to 150 gallons per minute. These flow rates and observed contaminant concentrations are within the design capacity for the 200 West P&T. The extracted groundwater will be transferred to the 200 West P&T by pipeline. This action will utilize the existing well and pipeline installed for the TTP. The capability of the 200 West P&T to treat and inject water is evaluated in Chapter 11.

These alternatives were evaluated in terms of effectiveness, implementability, and cost.

Alternative 1 (the No Action alternative) would not eliminate, reduce, or control risks to HHE. Under Alternative 1, it is assumed that no active measures are applied to the groundwater plume and that any action is deferred until completion of the 200-BP-5 RI/FS and proposed plan.

Alternative 2, the recommended alternative, will meet applicable or relevant and appropriate requirements (ARARs) and is implementable. The implementation of Alternative 2, although higher in cost than Alternative 1 (No Action), will be efficient and cost effective by using existing infrastructure and treatment facilities. Alternative 2 will not require construction and operation of a stand-alone treatment facility in the 200 East Area. The proposed action is protective of HHE by removing mass and radioactivity from groundwater and preventing further migration of contaminants. This action will be implemented once aquifer testing under the TTP is completed. The extracted groundwater will be conveyed to 200 West P&T for treatment via the pipeline system installed for the TTP. Extraction and treatment of groundwater under this proposed removal action is consistent with and would not impede planned or existing remedial actions on the Central Plateau. Prevention of plume migration and achievement of cleanup levels will be evaluated in the 200-BP-5 FS and PP.

The extraction well is located on the west side of the BY Tank Farm (Figure ES-2). Two new groundwater wells were drilled and constructed for use during the 200-BP-5 OU treatability test and will be used for the NTCRA. Well 299-E33-268 will be used for pumping groundwater from the aquifer. Well 299-E33-267 is located close to the extraction well and will be used to monitor changes in groundwater elevation in response to pumping.

The detailed design of the extraction system and pipeline has been approved by DOE and Ecology, the lead regulatory agency. The well pump size and the pipeline system requirements have been developed for the extraction well to the 200 West P&T (Figure ES-4).

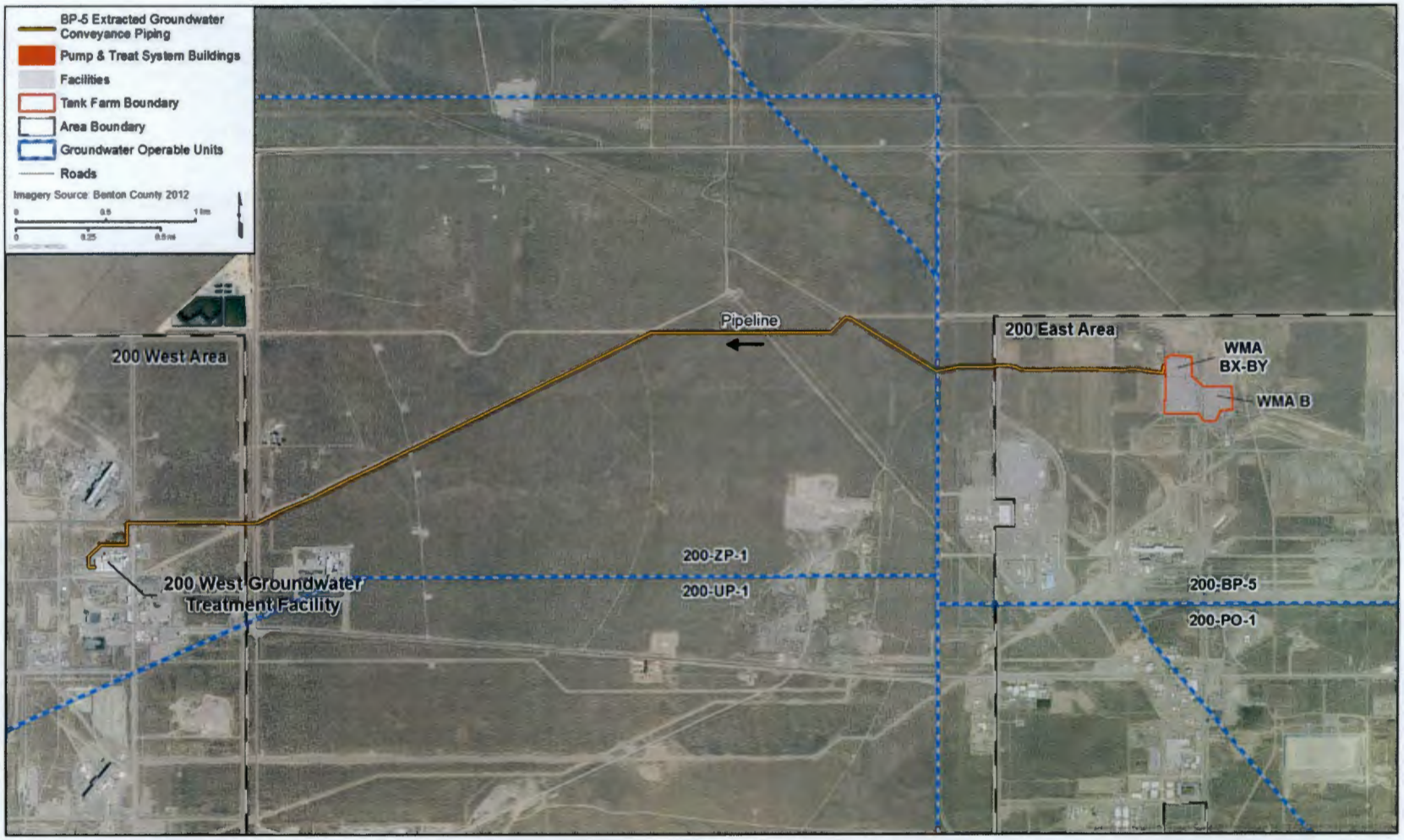

Figure ES-4. Diagram of the Conveyance Pipeline from the 200-BP-5 Extraction Well Located in the 200 East Area to the 200 West Groundwater Treatment Facility

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Terms

200 West P&T	200 West Pump and Treat Facility
AR	Administrative Record
ARAR	applicable or relevant and appropriate requirement
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
EE/CA	engineering evaluation/cost analysis
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
FBR	fluidized bed reactor
FS	feasibility study
HHE	human health and the environment
IX	ion exchange
LLWMA	low-level waste management area
NA	not applicable
MCL	maximum contaminant level
NCP	National Contingency Plan (40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan")
NPL	"National Priorities List" (40 CFR 300, Appendix B)
NTCRA	non-time-critical removal action
OU	operable unit
RAO	remedial action objective
RD/RAWP	remedial design/remedial action work plan
RI	remedial investigation
ROD	record of decision
TPA	Tri-Party Agreement
Tri-Parties	DOE, EPA, and Ecology
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
UPR	unplanned release
WMA	waste management area

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1 Introduction

This engineering evaluation/cost analysis (EE/CA) has been prepared in accordance with 40 CFR 300.415(b)(4)(i), "National Oil and Hazardous Substances Pollution Contingency Plan," hereinafter called the National Contingency Plan (NCP), "Removal Action," to assist the U.S. Department of Energy (DOE) in initiating a non-time-critical removal action (NTCRA) for remediation of contaminated groundwater in the 200-BP-5 Operable Unit (OU) located at Hanford Site in Richland, Washington (Figure 1).

This EE/CA has been prepared for public and Tribal comment and evaluates the implementation of an NTCRA for the extraction and treatment of contaminated groundwater in the 200-BP-5 OU. The extracted groundwater will be from contaminant plumes in the vicinity of the B-BX-BY Tank Farms containing elevated levels of technetium-99, uranium, and nitrate (Figure 2). An aquifer test is planned to be conducted on this plume in late 2015 and early 2016 as a treatability test (DOE/RL-2010-74, *Treatability Test Plan for the 200-BP-5 Groundwater Operable Unit*) to assess the pumping rate that can be sustained in the unconfined aquifer. This EE/CA will utilize the information from the aquifer test to design and implement groundwater extraction for the 200-BP-5 OU, which will be implemented as an NTCRA. Information in this EE/CA and results from implementing the selected removal action also will be used to support the 200-BP-5 OU remedial investigation (RI)/feasibility study (FS) process.

1.1 Purpose and Scope

This EE/CA identifies the scope of work for the NTCRA and proposed alternatives and analyzes the alternatives for effectiveness, implementability, and cost. DOE, U.S. Environmental Protection Agency (EPA), and Washington State Department of Ecology (Ecology) (also referred to collectively as the Tri-Parties) will use this EE/CA as the basis for determining the best method for control of contaminants in the groundwater to minimize potential risks to human health and the environment (HHE). This EE/CA was prepared in accordance with the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA).

The removal action is consistent with the remedial action objectives (RAOs) of previous records of decision (RODs) and supports the overall cleanup objectives through the Tri-Party Agreement (TPA), as revised (Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order*). This NTCRA is described herein for the 200-BP-5 Groundwater OU. Although access to groundwater on the Hanford Site is controlled, contaminant levels near the B Complex Area currently exceed federal and state drinking water standards, have increasing trends, and have the potential for further adverse effects on groundwater at the Hanford Site.

2 Regulatory Overview

The President of the United States is given authority by Section 104, "Response Authorities," of CERCLA, when there is a threat to public health or welfare of the United States or to the environment, to take any appropriate removal action to abate, prevent, minimize, stabilize, mitigate, or eliminate the release or threat of release of contaminants into the environment. This authority is delegated to DOE, as the CERCLA lead agency, through Executive Order 12580, *Superfund Implementation*. Expedited response actions are addressed by the TPA Action Plan (Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*), Section 7.2.4, which cites and is consistent with Executive Order 12580.

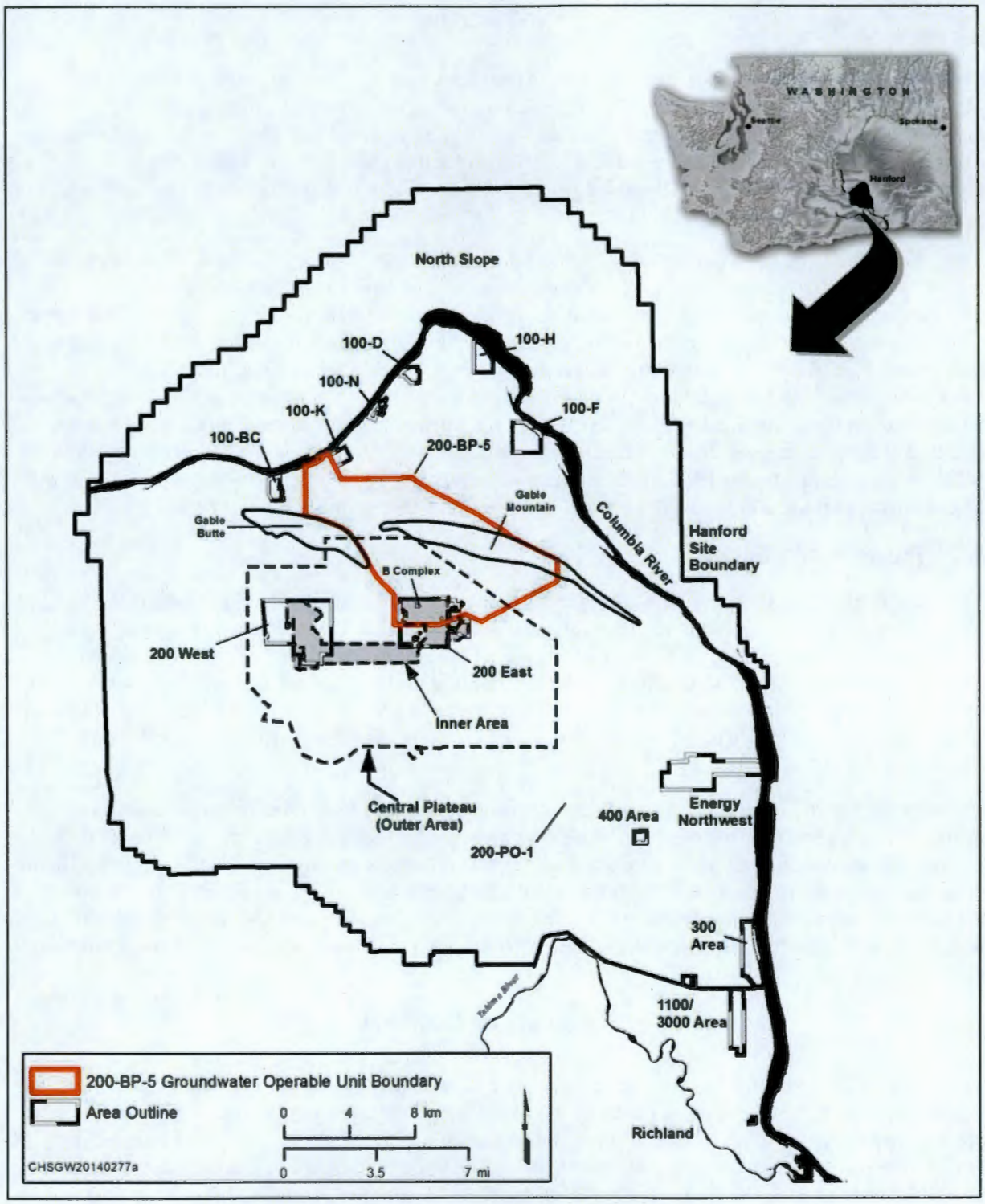


Figure 1. Location of the 200-BP-5 OU on the Hanford Site

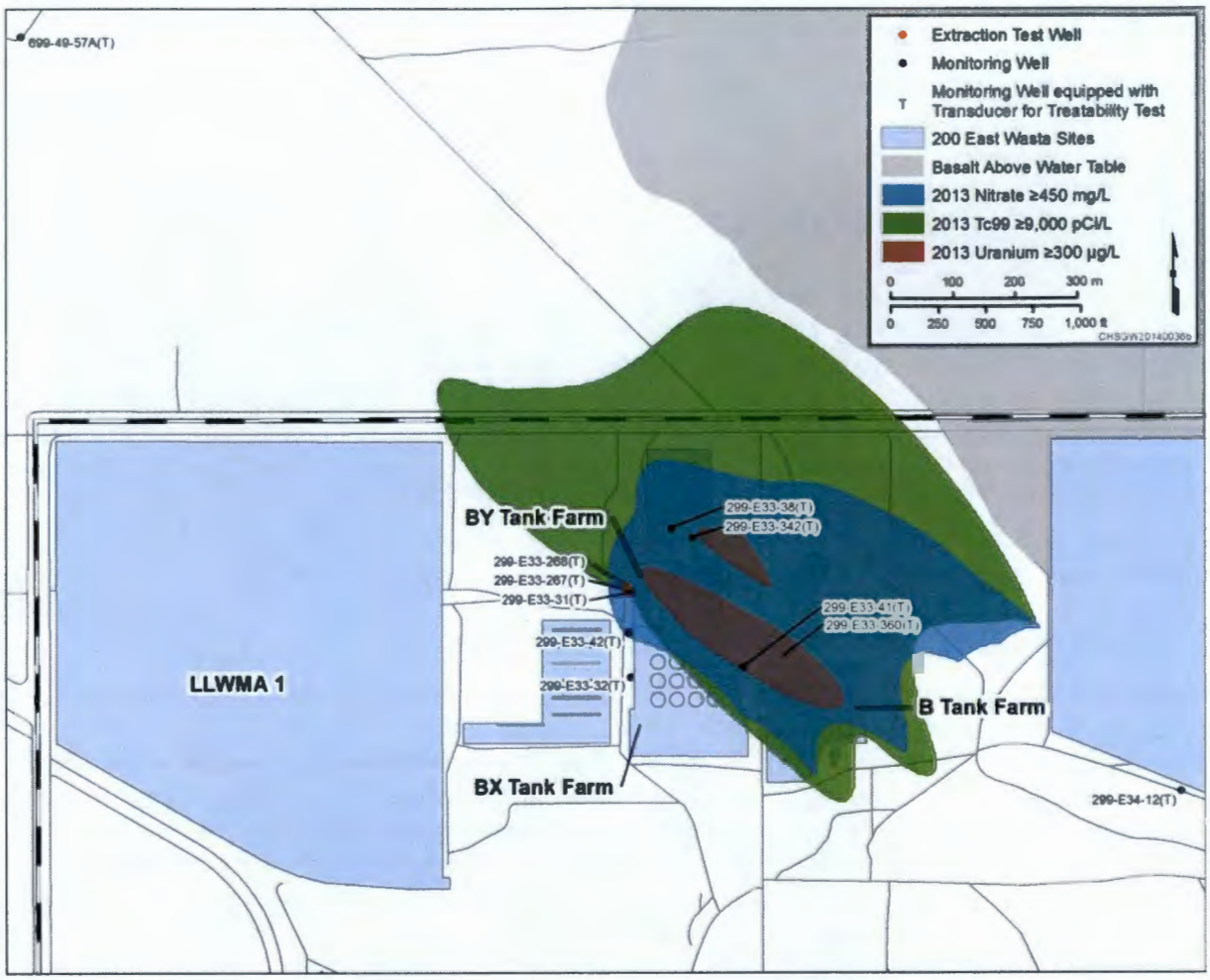


Figure 2. Location of the Extraction Well and Associated Groundwater Monitoring Wells for the Removal Action near WMA B-BX-BY

This EE/CA was prepared in accordance with CERCLA and 40 CFR 300.415 to evaluate alternative remediation actions for the groundwater. After the public has had an opportunity to comment on the alternatives and the recommended approach presented in this document, the agencies will review those comments. After public comments are considered, DOE will issue an Action Memorandum to select and authorize the removal action.

The 200 Area is listed on the NCP (40 CFR 300), Appendix B, "National Priorities List" (NPL); consequently, the 200-BP-5 OU is subject to cleanup action under CERCLA. Cleanup activities are performed in accordance with the NCP (40 CFR 300) and TPA (Ecology et al. 1989a). Appendix C of the TPA Action Plan (Ecology et al., 1989b) identifies the 200-BP-5 OU as potentially needing remedial action. The actions being proposed in this EE/CA for groundwater will, to the extent practicable, contribute to the efficient performance of any anticipated long-term remedial action as required by the NCP (40 CFR 300.415(d)).

2.1 Public Involvement

Development of this EE/CA satisfies environmental review requirements and provides for stakeholder involvement while providing a framework for alternative selection. The approach also establishes a record for documentation of the removal action, which will be referenced in the TPA (Ecology et al. 1989a) Administrative Record (AR) for the 200-BP-5 OU. Public involvement activities conducted pursuant to this EE/CA will be performed according to DOE et al., 2012 (*Hanford Federal Facility Agreement and Consent Order Hanford Public Involvement Plan)*, public participation requirements established in 40 CFR 300.415(n) ("Community Relations in Removal Actions"), and applicable DOE policies. The EE/CA will undergo a 30-day public comment period. As the agency implementing this action, DOE will consider comments received from the public and confer with EPA and Ecology on issuance of the Action Memorandum. The Action Memorandum will identify the selected alternative, whether the one recommended or the other alternative, for remediation of groundwater in the 200-BP-5 OU.

3 Site Characterization

This chapter provides information pertaining to the 200-BP-5 OU. It describes the background of the 200-BP-5 OU as well as known and potential groundwater contamination.

3.1 Site Description and Background

The Hanford Site encompasses approximately 1,517 km^2 (586 mi^2) in southeastern Washington State. The area is located just north of the confluence of the Columbia, Yakima, and Snake Rivers. Figure 1 shows the location of the Hanford Site in Washington State. The Hanford Site was selected for plutonium production in 1942 as part of the Manhattan Project, primarily because of the availability of water from the Columbia River and access to power from the Bonneville and Grand Coulee Dams. The remote location and weather conditions of the area, which allowed for nearly year-round construction, also contributed to the selection. Between 1943 and 1964, nine plutonium production reactors were built along the Columbia River in six areas: 100-BC (two reactors), 100-K (two reactors), 100-N, 100-D (two reactors), 100-H, and 100-F.

In 1989, EPA placed the 100, 200, 300, and 1100 Areas of the Hanford Site on the NPL (40 CFR 300, Appendix B), pursuant to CERCLA. The 200 Area NPL (40 CFR 300, Appendix B) site contains the 200 East and 200 West Areas, which include waste management facilities and inactive irradiated fuel-reprocessing facilities, and the 200 North Area formerly was used for interim storage and staging of irradiated fuel. The 200 Area was the center of activity for processing plutonium at the Hanford Site starting in the mid-1940s. Five general plant process groupings exist in the 200 Area, including fuel processing, plutonium isolation, uranium recovery, cesium/strontium recovery, and waste storage/treatment. The main process separation facilities overlying the OU were B Plant and Semiworks. Liquid wastes are considered the most significant type of discharge to the environment in terms of volume and numbers of constituents. Detailed information on the historical operations and waste generation mechanisms is provided in DOE/RL-2001-54, *Central Plateau Ecological Evaluation.*

The 200-BP-5 Groundwater OU extends from the 200 East Area northwest to the Columbia River and to the eastern flank of Gable Mountain (Figure 1). The 200-BP-5 OU addresses groundwater and the associated contaminant plumes beneath the northern half of the 200 East Area and adjacent portions of the surrounding 600 Area. This includes associated cribs, trenches, and unplanned releases (UPRs), which are identified as sources of contamination associated with groundwater within the 200-BP-5 OU.

DOE conducts groundwater monitoring in the 200-BP-5 OU under CERCLA. DOE also monitors six *Resource Conservation and Recovery Act of 1976* treatment, storage, and disposal (TSD) unit sites within

the OU: Waste Management Area (WMA) B-BX-BY, WMA C, 216-B-63 Trench, Low-Level Waste Management Area (LLWMA)-1, LLWMA-2, and the Liquid Effluent Retention Facility. A third requirement for groundwater monitoring at 200-BP-5 OU is *Atomic Energy Act of 1954* monitoring associated with the active burial grounds (e.g., LLWMA-1 and LLWMA-2). In the vicinity of the B Complex Area, groundwater occurs as an unconfined aquifer and as a semiconfined to confined aquifer beneath the Ringold Formation lower mud unit and between basalt flows, respectively. The unconfined aquifer is the primary aquifer impacted by past waste disposal operations and is the focus of this EE/CA. The 200-BP-5 Groundwater OU includes groundwater beneath and in the vicinity of the B-BX-BY Tank Farm Area (referred to in this document as the B Complex Area). Nitrate, technetium-99, and uranium are the primary groundwater contaminants of interest near the B Complex Area. Other contaminants (iodine-129, cyanide, tritium, strontium-90, cesium-137, and plutonium-239/240) are also present in groundwater, but to a more limited extent, and are routinely monitored in selected wells. This NTCRA focuses on the uranium, technetium-99, and nitrate groundwater plumes near the B Complex Area. These contaminants and other co-contaminants extracted as part of this NTCRA will also be treated at the 200 West Pump and Treat Facility (200 West P&T). Figure 3 shows the groundwater sampling locations for the 200-BP-5 OU.

3.2 Previous Investigations and Removal Actions

A draft RI report (DOE/RL-2009-127, *Remedial Investigation Report for the 200-BP-5 Groundwater Operable Unit*) is currently being prepared to document completion of RI activities for the OU, assess contaminant fate and transport, and evaluate potential risks to HHE. The RI activities described in DOE/RL-2007-18, *Remedial Investigation/Feasibility Study Work Plan for the 200-BP-5 Groundwater Operable Unit*, included drilling and construction of new wells, soil sampling, groundwater sampling during drilling of new wells (including seven wells near the B Complex Area), hydrologic testing, geophysical investigations, and groundwater monitoring of existing and new wells.

Perched water (saturated soils above the groundwater table), contaminated primarily with uranium, nitrate, and technetium-99, occurs beneath the B Complex Area in a sand lens at approximately 67 m (220 ft) below ground surface, and approximately 4.6 m (15 ft) above the unconfined aquifer. The lateral and vertical extent of the perched water is limited, and an underlying silt layer forms a natural barrier that slows contaminant migration from the perched water within the sand lens to the 200-BP-5 OU (DOE/RL-2014-34, *Action Memorandum for 200-DV-1 Operable Unit Perched Water Pumping/Pore Water Extraction*). Extraction of groundwater from Well 299-E33-344, using gravity to drain contaminated water into the well from the perched zone, was initiated in 2011. Approximately 3.2×10^{-2} Ci of technetium-99, 56 kg of uranium, and 523 kg of nitrate have been removed within this horizon as of March 2015.

Routine groundwater monitoring of the 200-BP-OU is performed per DOE/RL-2001-49, *Groundwater Sampling and Analysis Plan for the 200-BP-5 Operable Unit*, and associated TPA-CN-578, *Tri-Party Agreement Change Notice Form: Groundwater Sampling and Analysis Plan for the 200-BP-5 Operable Unit, DOE/RL-2001-49 Rev. 1*. Groundwater monitoring is evaluated on an annual basis and reported in annual reports (e.g., DOE/RL-2014-32, *Hanford Site Groundwater Monitoring Report for 2013*).

3.3 Source, Nature, and Extent of Contamination

The following subsections discuss the source, nature, and extent of groundwater contamination associated with areas within the B Complex Area (Figure 4) for primary contaminants of interest technetium-99, uranium, and nitrate.

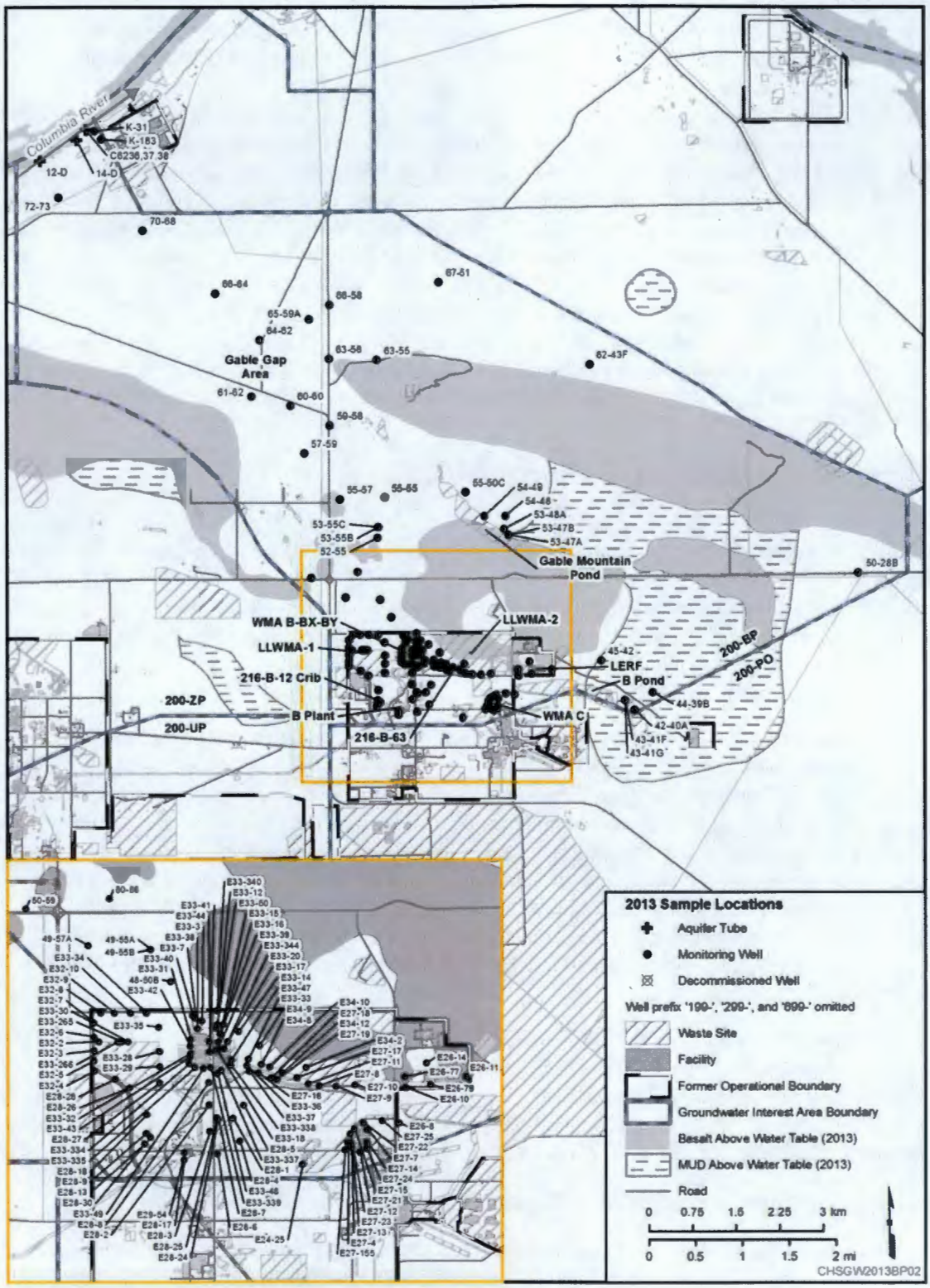
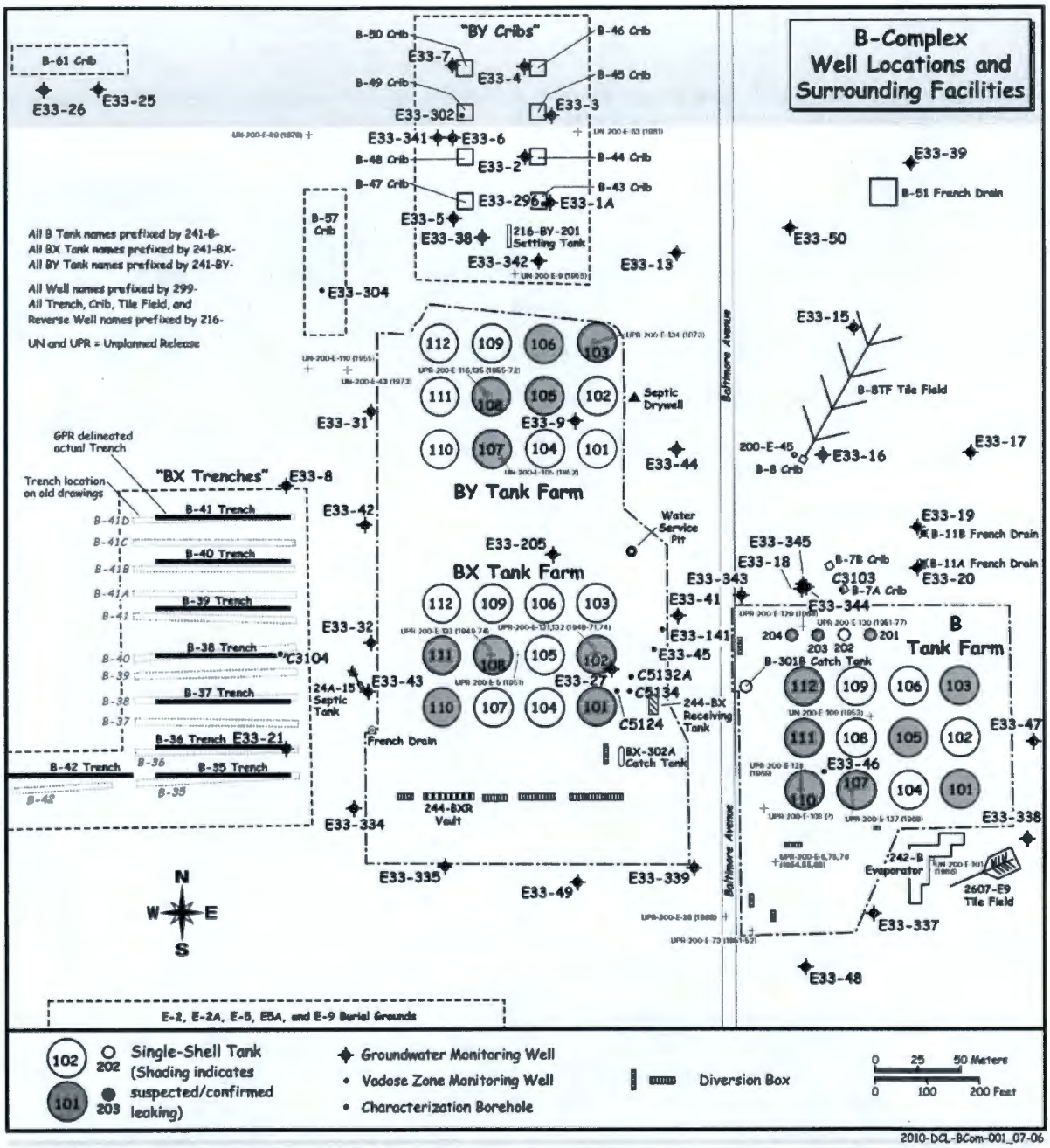


Figure 3. 200-BP-5 OU 2013 Groundwater Monitoring Locations



Source: PNNL-19277, *Conceptual Models for Migration of Key Groundwater Contaminants Through the Vadose Zone and Into the Unconfined Aquifer Below the B-Complex.*

Figure 4. Map of the B Complex Area

3.3.1 B Complex Area Technetium-99

Within the B Complex Area, identified sources of technetium-99 groundwater impacts include BY Cribs, 216-B-7A&B Cribs, 216-B-8 Crib, 241-BX-102 UPR, and the B Tank Farm.

3.3.1.1 BY Cribs

Technetium-99 in 200-BP-5 OU groundwater is primarily from disposal of liquid waste associated with the BY Cribs, which received between approximately 14 and 25.5 Ci of technetium-99 (Appendix C of RPP-26744, *Hanford Soil Inventory Model, Rev. 1*). Groundwater concentrations of technetium-99 increased between the mid-1990s and 2009. During this time, plumes primarily migrated north and northwest of this site consistent with the groundwater flow direction. Since 2009, concentrations have declined up to 17,000 pCi/L beneath the BY Cribs and now range between 20,000 to 28,000 pCi/L. The decrease is attributed to the observed change in groundwater flow direction to the southeast compared to the northwest in previous years. Because of the southeast flow direction, the technetium-99 plume is now inferred to be migrating to the southeast as depicted in Figures 5 and 6.

3.3.1.2 241-BX-102 Unplanned Release and 216-B-7A&B Cribs

The highest technetium-99 activity in 200-BP-5 was located at Well 299-E33-18, with a 2012 maximum of 35,100 pCi/L. The technetium-99 to nitrate ratio associated with this hotspot is different than the other plumes because of greater technetium-99 activity and lower nitrate concentration than beneath other source sites. This is consistent with the type of waste released (i.e., metal waste from Tank 241-BX-102). By comparison, the technetium-99 to nitrate ratio in perched Well 299-E33-344 is much lower because of mixing with 216-B-7A&B waste. Two other small plumes of technetium-99, located along the south boundary of the 241-B and BX Tank Farms at Wells 299-E33-337 and 299-E33-339, may be related to the 241-BX-102 UPR; however, technetium-99 to nitrate ratios at Wells 299-E33-337 and 299-E33-339 are different from Wells 299-E33-18 and 299-E33-343, which are considered sourced by the 241-BX-102 UPR. Other sources within the 241-B and BX Tank Farms are currently under assessment as discussed in DOE/RL-2012-53, *Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area B-BX-BY*.

3.3.2 B Complex Area Uranium

Uranium found in the B Complex Area groundwater primarily originated from large disposal inventories to the 216-B-12 Crib and the 241-BX-102 UPR. The uranium inventory disposed to these sites exceeded 10,000 kg (22,000 lb), which is at least an order of magnitude greater than other waste sites overlying the 200-BP-5 OU. A summary of the 241-BX-102 UPR and associated groundwater contamination within the B Complex Area is provided in the following subsections.

3.3.2.1 216-BX-102 Unplanned Release

Rough order of magnitude calculations indicated that 1,050 kg (2,310 lb) of water-extractable uranium might reside at a perched water interval approximately 3 m (10 ft) above the aquifer. This estimate was based on sample results from three boreholes that characterize the perched water zone. Well 299-E33-18 had the greatest groundwater uranium concentration (4,470 µg/L) in the B Complex Area in 2012. This well is located 39 m (128 ft) east of Well 299-E33-343, which had the greatest groundwater uranium results from 2008 (when it was drilled as part of the 200-BP-5 RI) to 2011. The maximum result at Well 299-E33-343 was 5,500 µg/L in June 2009. Migration of the high-concentration portion of this plume is attributed to the groundwater flow direction change from the northwest to the southeast. Results of this flow change are seen by comparing the spatial distribution of the uranium plume from summer 2011 (Figure 7), when the flow change was initiated, and summer 2012 (Figure 8).

3.3.3 B Complex Area Nitrate

Near the B Complex Area, identified sources of nitrate groundwater impacts include BY Cribs, 216-B-7A&B Cribs, 216-B-8 Crib, 241-BX-102 UPR, releases from the B Tank Farm, 216-B-12 Crib, 216-B-5

Injection Well, and 216-B-2-2 Ditch. A summary of the source releases and associated groundwater contamination within the B Complex Area is provided in the following subsections.

3.3.3.1 BY Cribs

Nitrate inventories received at the BY Cribs in the past have migrated and continue to migrate through approximately 70 m (230 ft) of vadose zone to groundwater. Well 299-E33-15, located approximately 350 m (1,150 ft) southeast of the BY Cribs, had the maximum nitrate result (1,570 mg/L) in April 2012. This is less than the historical maximum observed at Well 299-E22-4 (i.e., 17,800 mg/L in 2008 before the well went dry). Past releases from this source are the prime reason for the plumes to the north and northwest of this site. Because of the southeast flow direction change in 2011, a concentrated plume from this source is now inferred to be migrating to the southeast as depicted in Figures 9 and 10 (Summer 2011 and Summer 2012, respectively).

3.3.3.2 B Tank Farm

The second-highest nitrate concentration (1,540 mg/L) within the B Complex Area was observed in Well 299-E33-47. The source of this isolated plume was determined to be associated with a UPR within the 241-B Tank Farm, as discussed in DOE/RL-2012-53. The plume extent is shown in the summer 2012 depiction (Figure 10). Contamination is increasing rapidly in this well, even though the flow rate increased. Continued southeast migration of this plume is expected.

3.3.3.3 241-BX-102 Unplanned Release and 216-B-7A&B Cribs

Contaminated pore water within a perched water horizon, located approximately 3 m above the unconfined aquifer is sourced from both the 241-BX-102 UPR and 216-B-7A&B Cribs. The perched horizon is monitored by Well 299-E33-344. Nitrate at Well 299-E33-344 has ranged between 326 and 810 mg/L since installation in 2007. Nitrate removed through extraction at Well 299-E33-344 is 523 kg (1,151 lb) through March 2015. Continued pumping at this well is planned for the foreseeable future.

3.3.4 Other Constituents of Interest for the B Complex Area

Technetium-99, uranium, and nitrate are the primary contaminants for this NTCRA for the B Complex Area. Additional contaminants of interest include iodine-129, tritium, and cyanide. All of these contaminants will be extracted and treated as part of NTCRA under this EE/CA. Table 1 provides a summary of the average, maximum, and minimum concentrations for the constituents for the B Complex Area.

Table 1. B Complex Area Constituents of Interest Concentrations

B Complex Area Groundwater Concentration Data for Constituents of Interest from 42 Wells (2012 and 2013)					
	Average	Maximum	Minimum	MCL	Units
Technetium-99	10,038	34,000	28	900	pCi/L
Uranium	131	1,680	2.1	30	µg/L
Nitrate (NO_3)	554	1,680	1.9	45*	mg/L
Iodine	2.3	4.7	Non-detect	*	pCi/L
Cyanide	292	1,520	Non-detect	200	µg/L
Tritium	9,787	31,000	Non-detect	20,000	pCi/L

* 45 mg/L (expressed as the as the NO_3 ion) is an equivalent concentration to the federal drinking water standard for nitrate of 10 mg/L (expressed as NO_3-N). To convert nitrate as the NO_3 ion requires the NO_3-N drinking water standard value to be multiplied by 4.43.

MCL = maximum contaminant level

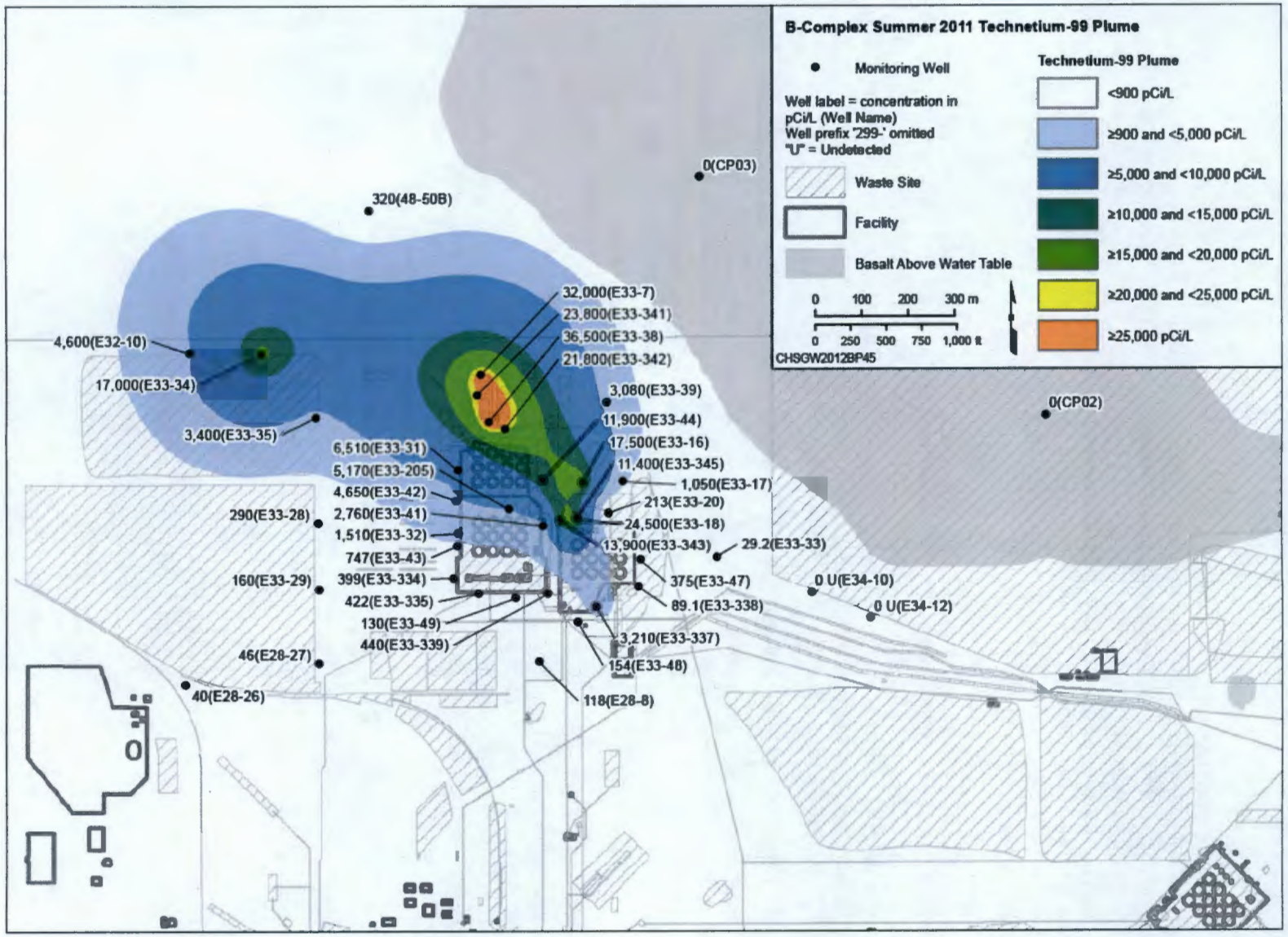


Figure 5. Technetium-99 near BY Cribs (Summer 2011)

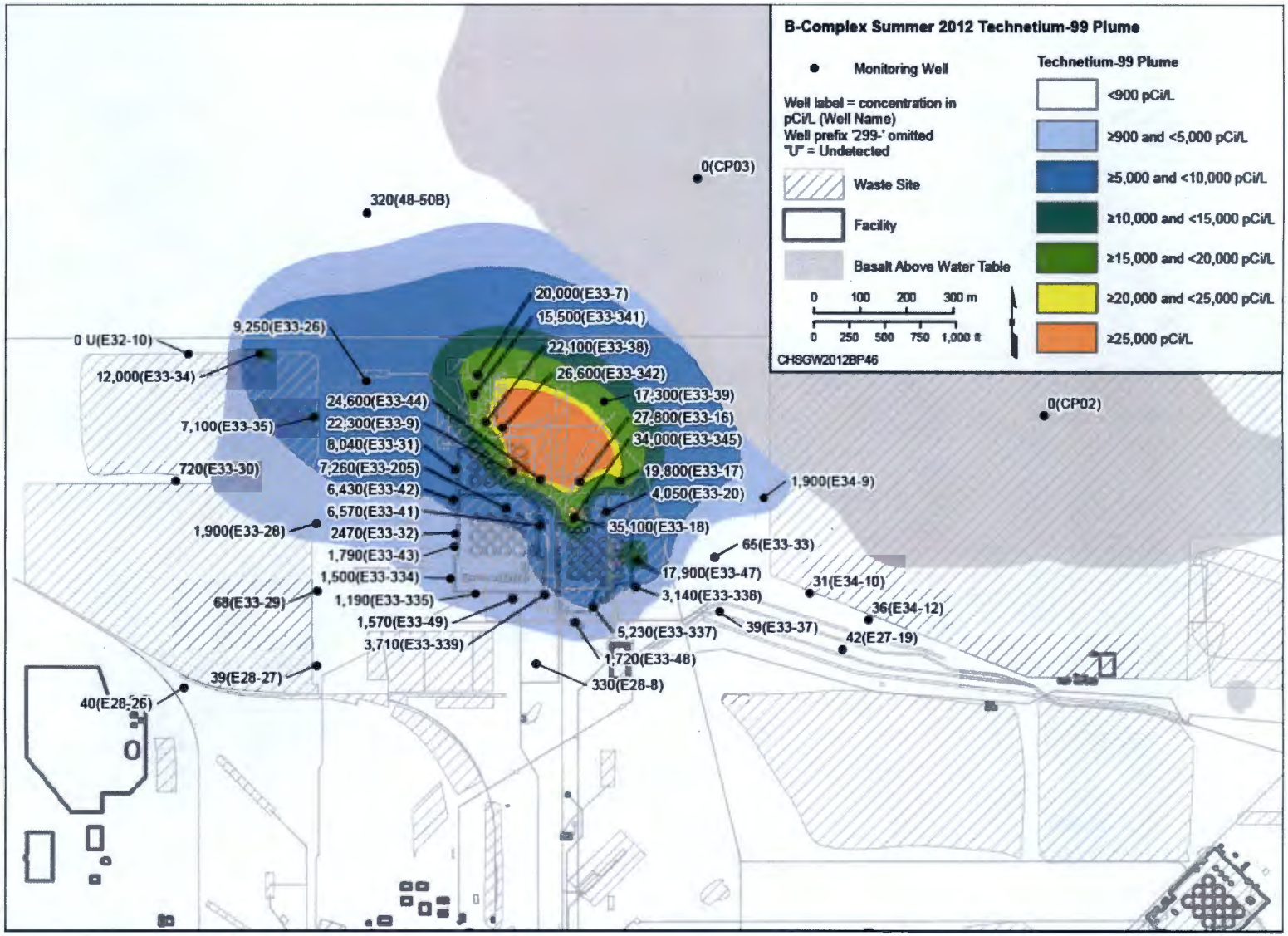


Figure 6. Technetium-99 near BY Cribs (Summer 2012)

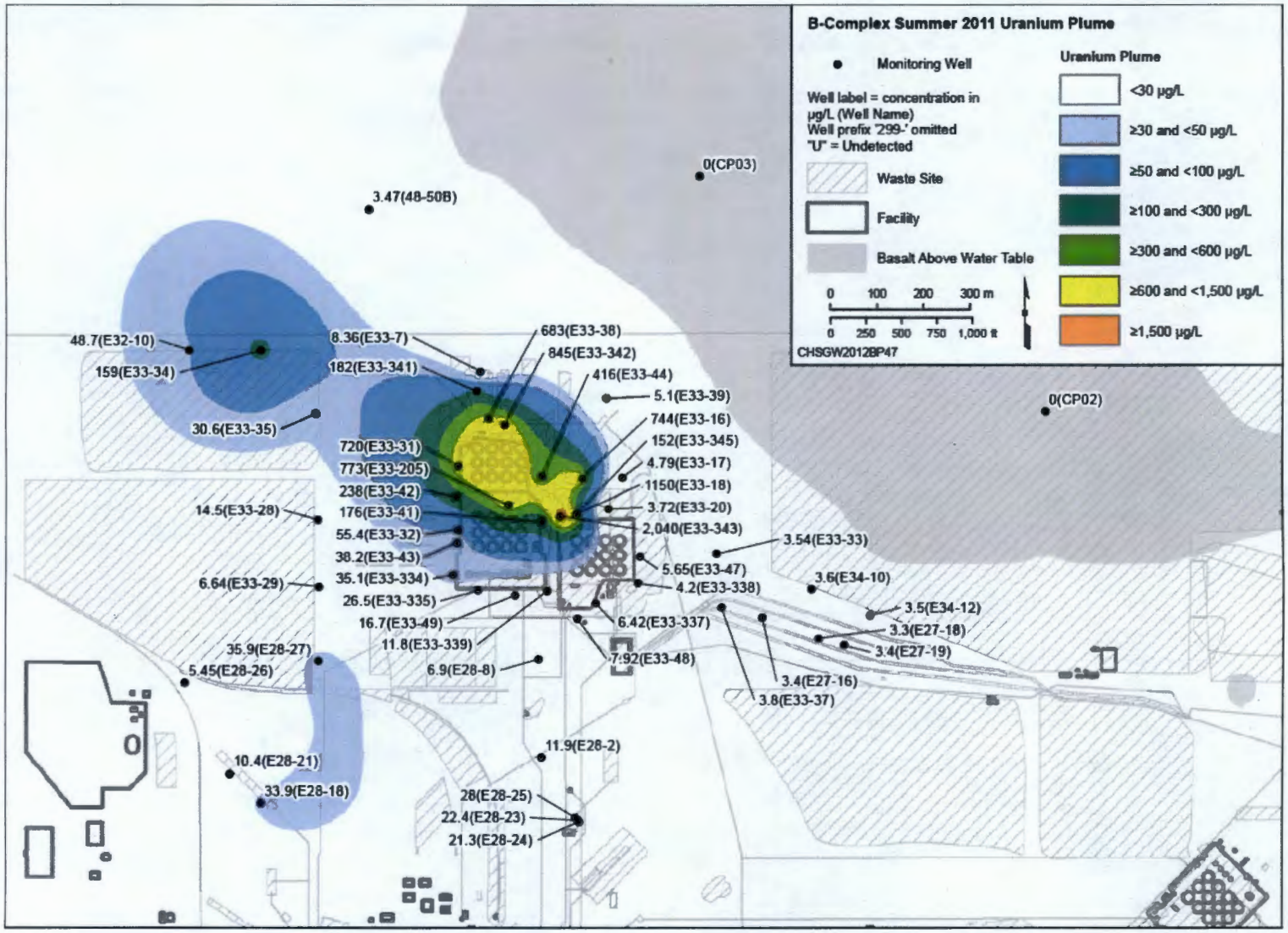


Figure 7. Uranium near WMA B-BX (Summer 2011)

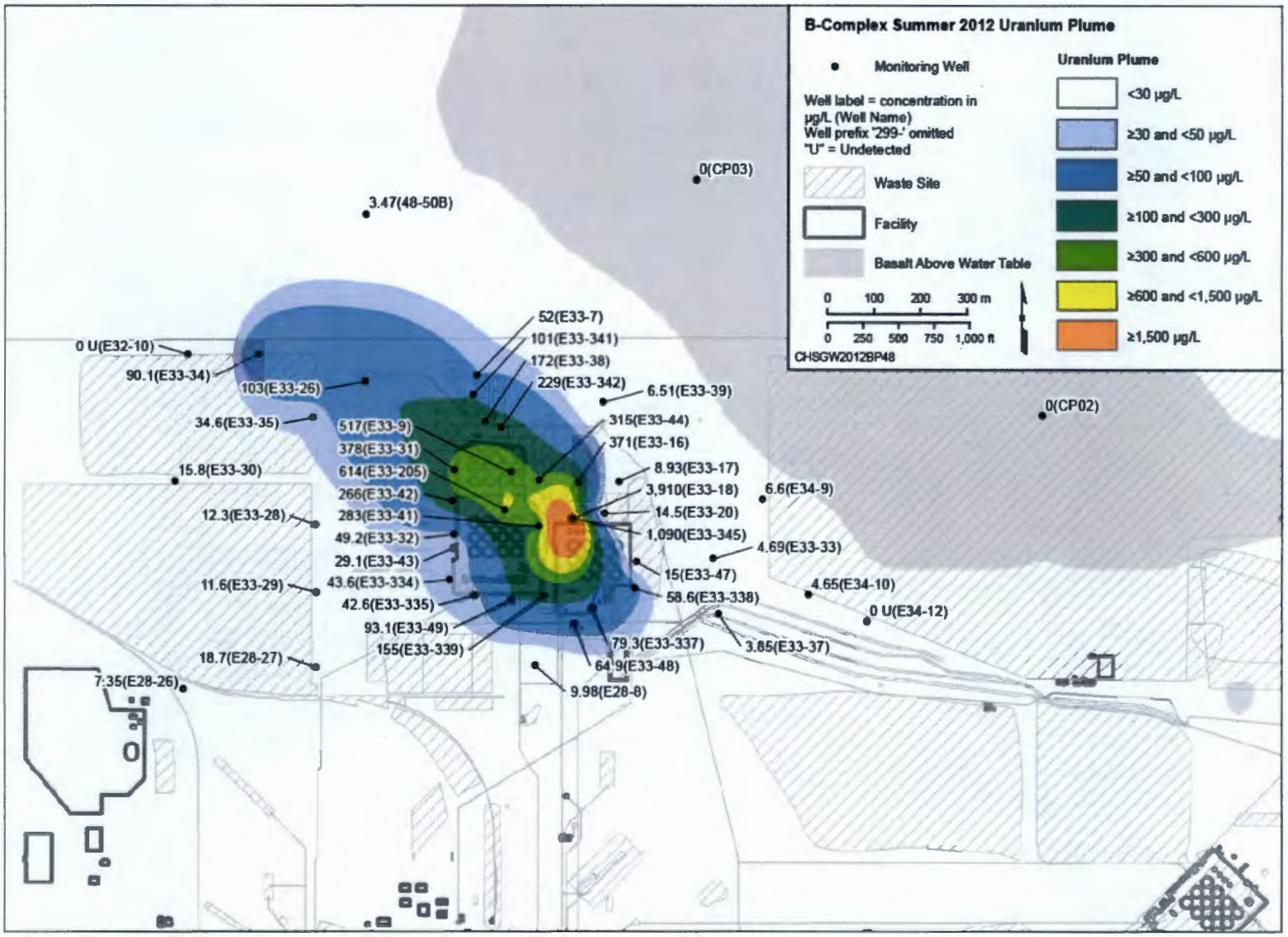


Figure 8. Uranium near WMA B-BX (Summer 2012)

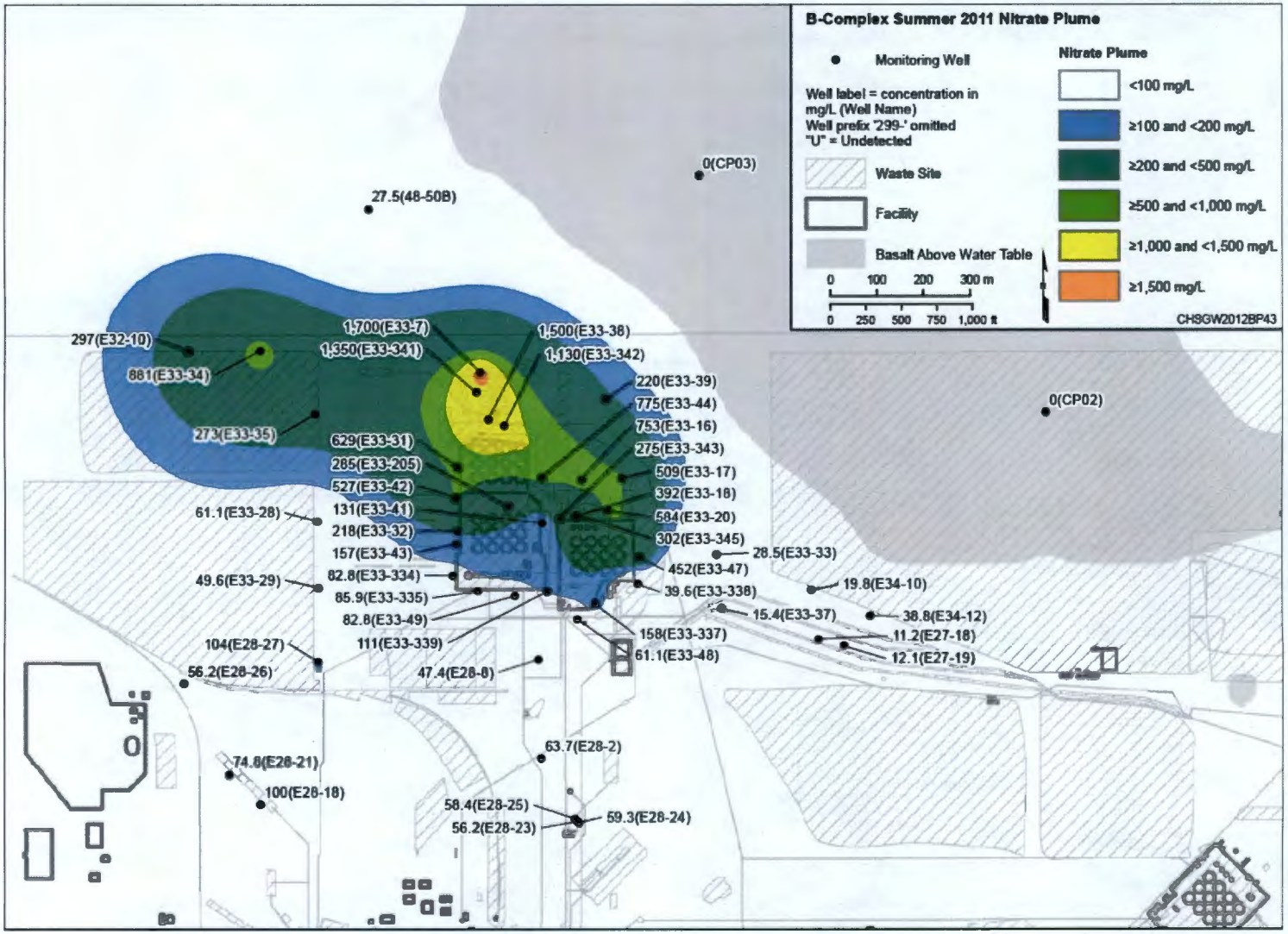


Figure 9. Nitrate near BY Cribs (Summer 2011)

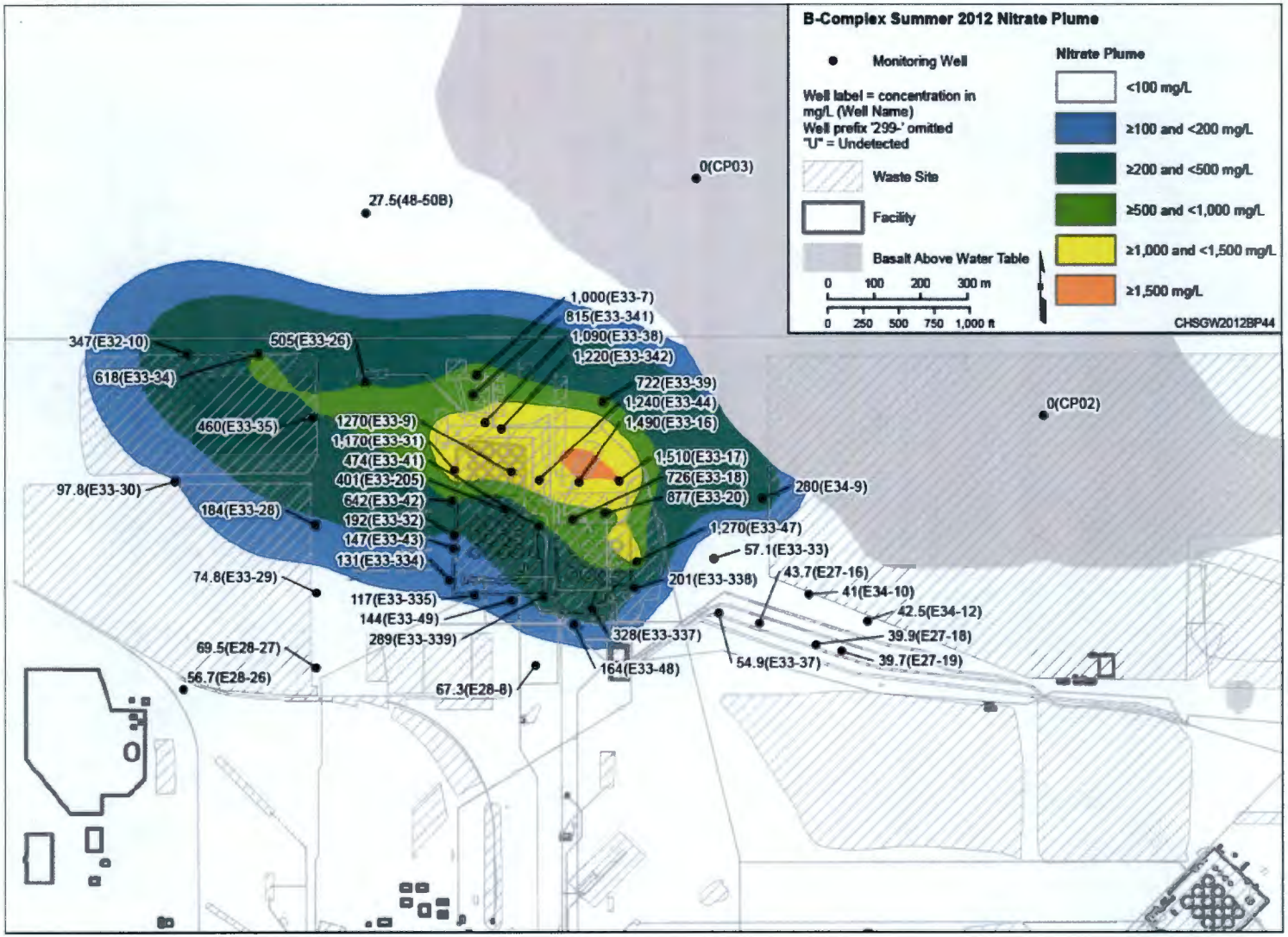


Figure 10. Nitrate near BY Cribs (Summer 2012)

4 Removal Action Objectives

Key objectives of the NTCRA are as follows:

- Protect human receptors from potential exposure to contaminants that exceed acceptable risk levels for drinking water.
- Remove contaminant mass, reduce groundwater contaminant migration, and support evaluation of groundwater remedial alternatives for the 200-BP-5 OU.
- Apply institutional controls to prevent human exposure to contaminants.

5 Applicable or Relevant and Appropriate Requirements

Section 121, "Cleanup Standards," of CERCLA requires the responsible CERCLA implementing agency to ensure that the substantive standards of applicable laws will be incorporated into the federal agency's design and operation of its long-term remedial actions and into its more immediate removal actions. DOE is the implementing agency for this NTCRA. In accordance with the NCP (40 CFR 300.415(d)), removal actions will, to the extent practicable, contribute to the efficient performance of any anticipated long-term remedial action with respect to the release concerned. Three factors are applied to determine whether compliance with applicable or relevant and appropriate requirement (ARARs) is practicable in a particular removal action situation: exigencies of the situation, scope of the removal action to be taken, and effect of ARAR attainment on the statutory limits for removal action duration and cost. Appendix A provides ARARs for the identified alternatives.

6 Identification of Alternatives

The removal action for the groundwater must be protective of HHE and must meet the RAOs. Based on these considerations, the removal action alternatives are discussed in detail in the following sections.

6.1 Alternative 1: No Action

It is assumed that no extraction of groundwater would be conducted from the B Complex Area as an NTCRA. Implementation of any remedial actions would not proceed until completion of the RI/FS, proposed plan, and ROD for the 200-BP-5 OU. As a result, Alternative 1 would delay remedial actions for the B Complex Area groundwater plumes, would not remove mass, would mitigate plume migration, and would not provide information to support the 200-BP-5 OU decisions. Initial risks of Alternative 1 are minimal, but risks over time are anticipated to increase. This alternative does not meet the EE/CA RAOs and is used as a baseline for comparison only.

6.2 Alternative 2: B Complex Area Groundwater Extraction

Alternative 2 will meet ARARs and is implementable. The cost associated with implementing Alternative 2, although higher in cost than Alternative 1 (No Action), will be efficient and cost effective by using existing infrastructure and treatment facilities. Alternative 2 will not require construction and operation of a stand-alone treatment facility in the 200 East Area. The proposed action is necessary to protect HHE by preventing further migration of groundwater contaminants and to avoid a foreseeable threat. This EE/CA will be implemented once aquifer testing under the treatability test plan is completed.

This EE/CA will utilize an extraction well (299-E33-268) used in the aquifer test and possibly one or two other existing wells that can be converted to extraction wells in the area. Connection of the additional wells will be evaluated as part of the removal action work plan. The extracted groundwater will be conveyed to 200 West P&T for treatment via the pipeline system installed for the TTP. Extraction and treatment of groundwater under this proposed removal action is consistent with and would not impede

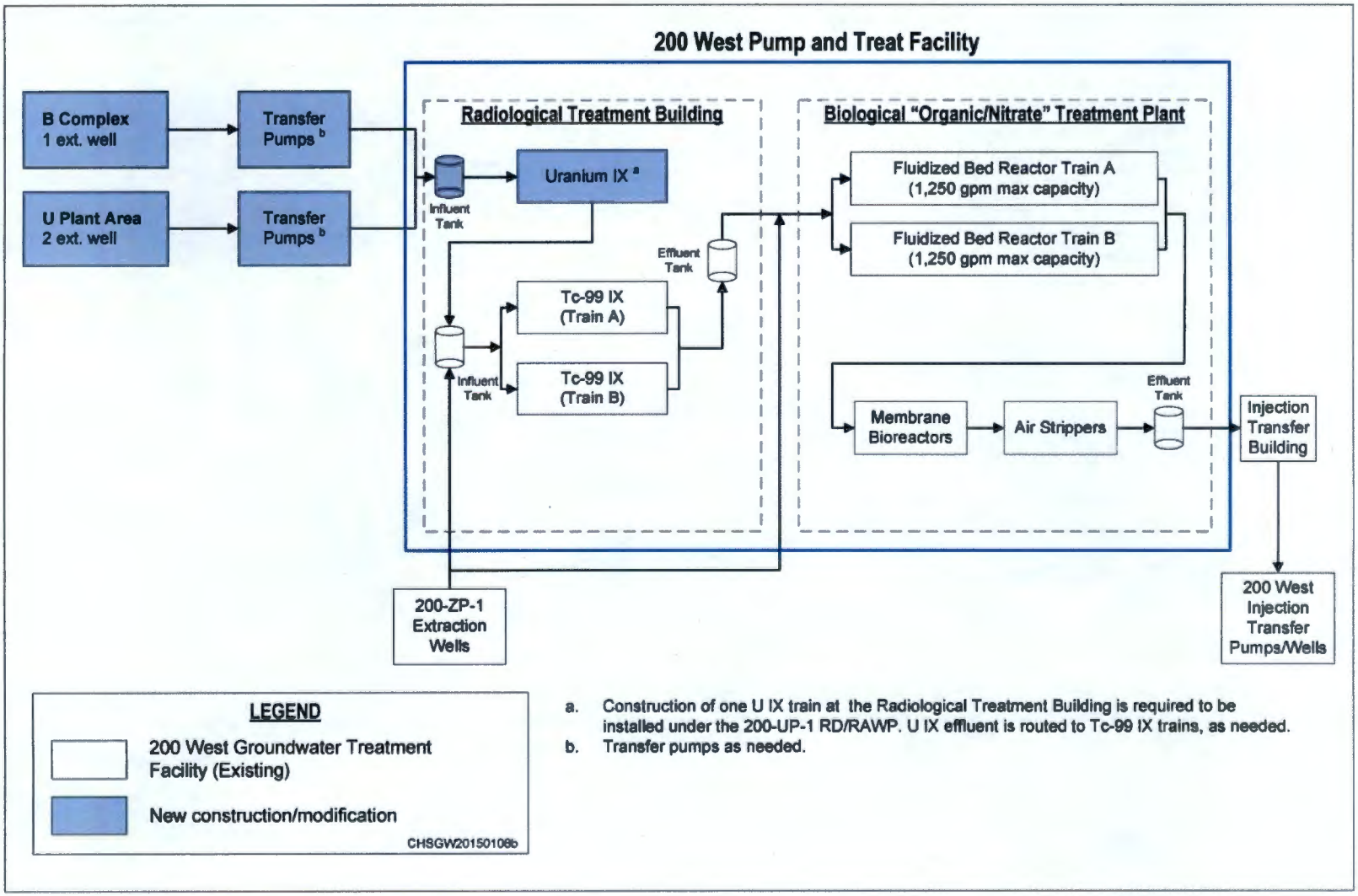
planned or existing remedial actions on the Central Plateau. Extraction and treatment of groundwater under this NTCRA will support the 200-BP-5 RI/FS process.

Alternative 2 will utilize the 200 West P&T for treatment of the extracted groundwater. The estimated flow rates of extracted groundwater are 280 to 570 L/min (75 to 150 gpm). These flow rates are within the design capacity for the 200 West P&T. The extracted groundwater will be transferred to the 200 West P&T by pipeline (Figure 11). Figure 12 provides a process flow diagram for the extraction and treatment of groundwater at the 200 West P&T. This action will utilize the existing well and pipeline from the treatability test, so a separate treatment facility in the 200 East Area would not be needed.

The 200 West P&T was constructed in 2012 and designed for cleanup of the 200-ZP-1 Groundwater OU located in the 200 West Area. The 200 West P&T is designed to capture and treat contaminated groundwater to reduce the mass of carbon tetrachloride, total chromium (trivalent and hexavalent), nitrate, trichloroethylene, iodine-129, and technetium-99. The system design also includes treatment of groundwater from the 200-UP-1 OU, including removal of uranium. It is expected that the uranium treatment capability will be installed at the 200 West P&T by the end of 2015. The treatment capacity of the system is 9,450 L/min (2,500 gpm) of extracted groundwater. From a volume perspective, the flow rate from B Complex Area extracted groundwater can be accommodated by the 200 West P&T. An evaluation of the capability of the 200 West P&T to meet treatment requirements for 200-BP-5 OU groundwater is provided in Chapter 10.

The extraction well (299-E33-268) was installed near Well 299-E33-31, located adjacent to the west side of the BY Tank Farm (Figure 13). This location was selected based on capture zone numerical simulations (ECF-200BP5-10-0254, *Initial Evaluation of Extraction Well Location Alternatives with B-BX-BY Local-Scale Groundwater Model*), the unconfined aquifer's saturated thickness of approximately 2.4 m (8 ft), proximity of existing wells for use as monitoring wells, and proximity of the defined uranium and technetium-99 plumes (Figure 14). Placing the well outside the tank farm boundary facilitated construction and overall operation because the land area in the B Tank Farm 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 11. Diagram of Conveyance Pipeline from the 200-BP-5 OU Test Extraction Well Located in the 200 East Area to the



a. Construction of one U IX train at the Radiological Treatment Building is required to be installed under the 200-UP-1 RD/RAWP. U IX effluent is routed to Tc-99 IX trains, as needed.
b. Transfer pumps as needed.

Note: RD/RAWP refers to the remedial design/remedial action work plan (DOE/RL-97-36, *200-UP-1 Groundwater Remedial Design/Remedial Action Work Plan*).

Figure 12. Process Flow Diagram for Extraction and Treatment of Groundwater at 200 West P&T

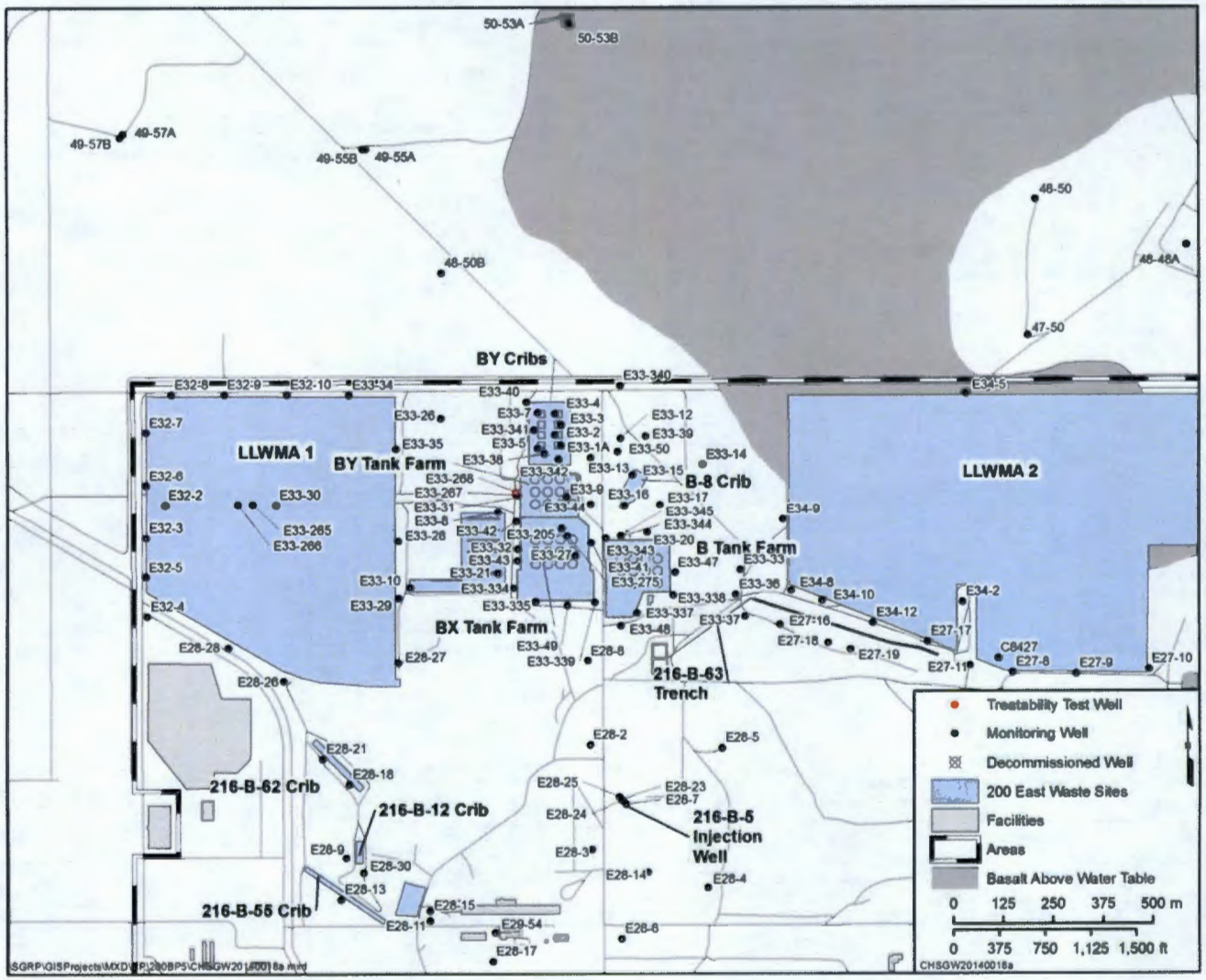
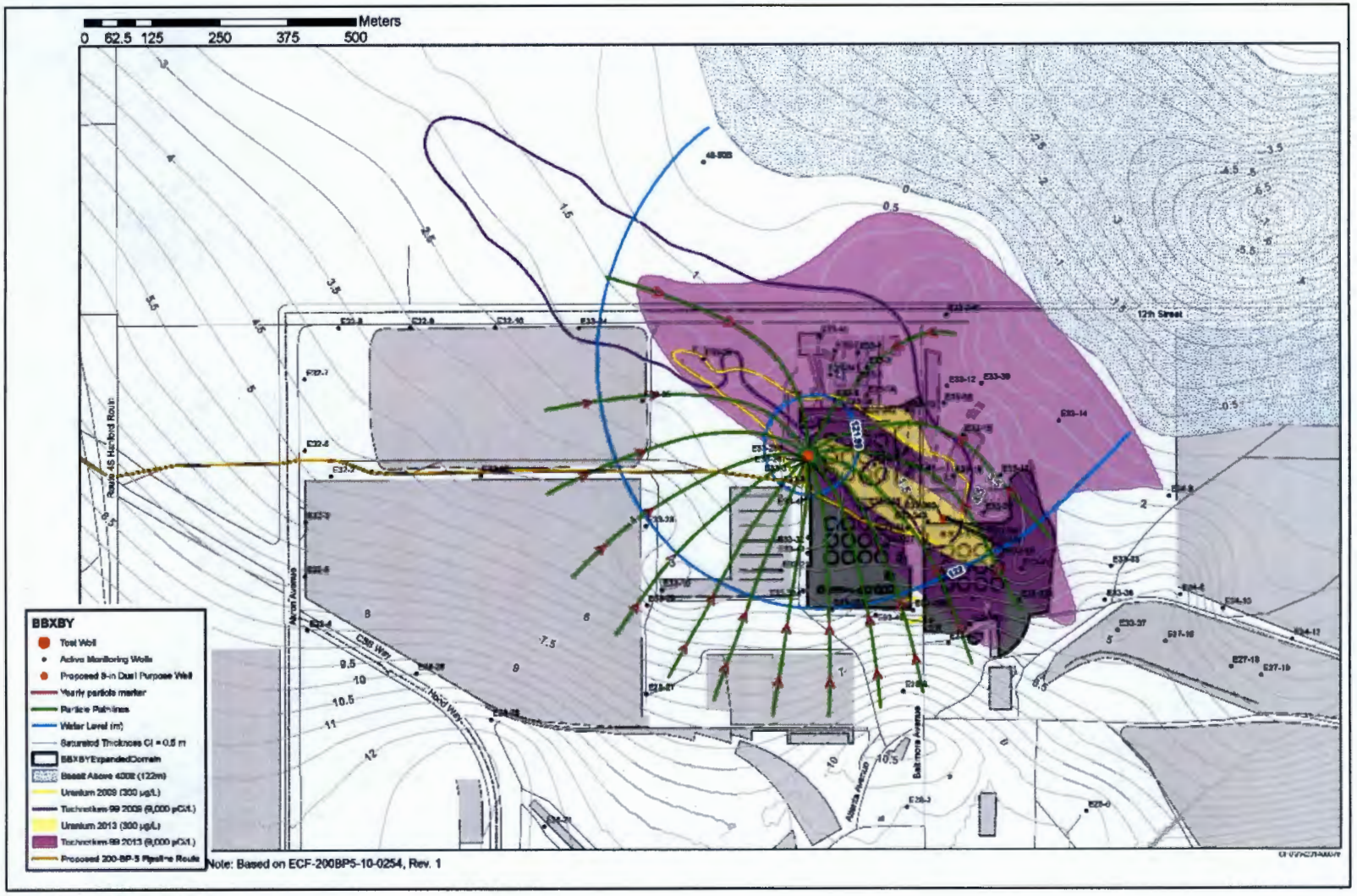


Figure 13. Location of Extraction Well 299-E33-268 (Red) within the B Complex Area and Other Groundwater Monitoring Wells



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

Figure 14. Location of Aquifer Groundwater Extraction Test Well and the Inferred Capture Zone at 190 L/min (50 gpm)

7 Analysis of Removal Action Alternatives

As required by CERCLA, the NTCRA alternatives identified in Chapter 6 will be evaluated against three criteria: effectiveness, implementability, and cost (EPA 540-R-93-057, *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA*).

Effectiveness includes two subcriteria: protectiveness and the ability to meet the removal action objectives. Implementability is evaluated based on technical feasibility; availability of equipment, personnel, services, and disposal facilities; and administrative feasibility. Costs are estimated, including capital costs, operations and maintenance costs, and net present worth costs.

Chapters 8 and 9 address the criteria for evaluating protectiveness and the ability to meet ARARs.

8 Overall Protection of Human Health and the Environment

Protection of HHE (a CERCLA threshold requirement) is the primary objective of a removal action. Protectiveness is a threshold criterion that must be met to recommend an alternative. This chapter addresses the protectiveness for the public and the environment for each of the alternatives being evaluated. This criterion was used to evaluate whether implementation of an alternative achieves adequate protection of risks to HHE through the likely exposure pathways.

Under Alternative 1, the No Action Alternative, no active actions would be taken to address potential threats to HHE posed by the contaminants of interest present. Alternative 1 cannot meet the RAOs and will not be protective of HHE; therefore, Alternative 1 will not be further considered.

Alternative 2 is protective of HHE by preventing exposure to contaminated groundwater, controlling groundwater contamination near the sources, and removing contaminant mass from the groundwater.

9 Overall Ability to Achieve ARARs

Evaluation of the developed alternatives against the identified ARARs is mandatory in order to determine whether they meet the requirements. ARARs are substantive environmental regulations that have been evaluated as potentially pertinent to the removal action. Removal actions are required to comply with ARARs to the extent practicable. This chapter presents the evaluation of the alternatives against the key ARARs addressed in this EE/CA. The ARARs will be documented in the CERCLA Action Memorandum.

Alternative 2 meets the ARARs as identified in Appendix A.

10 Implementability of Alternatives

This criterion addresses the technical and administrative feasibility of implementing the alternatives and the availability of required services and materials.

Alternative 2 will utilize the 200 West P&T for treatment of the extracted groundwater. The estimated flow rates of extracted groundwater are 280 to 570 L/min (75 to 150 gpm). These flow rates are within the design capacity for the 200 West P&T. The extracted groundwater will be transferred to the 200 West P&T by pipeline (Figure 11) for treatment. Contaminants identified in the 200-BP-5 OU groundwater are provided in Table 1. The 200 West P&T is capable of treating these contaminants to meet cleanup criteria. Ion exchange (IX) resins are used to remove radionuclides (technetium-99 and uranium), and the fluidized bed reactor (FBR) reduces or removes nitrate, metals, and organics. Alternative 2 is readily implementable. Injection of treated groundwater in the 200 East Area may be evaluated as part of the

remedial design/remedial action work plan (RD/RAWP) (DOE/RL-97-36, *200-UP-1 Groundwater Remedial Design/Remedial Action Work Plan*).

The treated water will be conveyed through pipelines from the 200 West P&T to associated injection wells in the 200 West Area (Figure 11). Injection of the treated groundwater to the aquifer at the 200 West P&T 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 (i.e., Environmental Restoration Disposal Facility [ERDF]) by Section 104(d)(4) of CERCLA):

> *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.*

Table 2 summarizes the changes in contaminant influent concentrations for the 200-BP-5 flow stream in comparison to the treatment capacity of the uranium, technetium-99, and biological (for nitrate) treatment trains in the 200 West P&T, assuming a 200-BP-5 OU flow rate of 150 gpm. This table illustrates that the contaminant concentrations from the additional 200-BP-5 OU flow are within the treatment capacities of the 200 West P&T.

11 Recommended Alternative

The recommended removal action is Alternative 2: Extraction of water from the 200-BP-5 OU and treatment at the 200 West P&T. Alternative 1 (No Action) does not meet protectiveness criteria and is not considered further. Alternative 2 satisfies the three CERCLA evaluation criteria for NTCRAs: effectiveness, implementability, and cost.

For contaminated solid wastes generated in support of Alternative 2, ERDF would be the recommended disposal location for wastes meeting ERDF waste acceptance criteria (WCH-191, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*). The recommended alternative is protective of HHE, meets ARARs, is cost effective, and is consistent with planned or existing remedial actions on the Central Plateau.

Based on the comparative analyses of the removal action alternatives, the recommended removal action is extraction of water from the 200-BP-5 OU with treatment at the 200 West P&T.

Table 2. 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 uranium plume (U-Plant area) extraction system flows at 568 L/min (150 gpm). Concentrations 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 flow rate of 568 L/min (150 gpm). 200-BP-5 concentrations 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, Nov 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 ion-exchange train. Water from uranium ion exchange is blended with flow from existing 200-ZP-1 extraction system at 1,703 L/min (450 gpm). 200-ZP-1 water concentrations into the technetium-99 ion-exchange 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 ion-exchange train. Effluent from uranium ion exchange system is blended with flow from existing 200-ZP-1 extraction system at 1,230 L/min (325 gpm). 200-ZP-1 water concentrations into the technetium-99 ion-exchange 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 extraction wells does not contain significant concentrations of uranium that warrants treatment by the uranium ion exchange treatment train and is fed directly to the technetium-99 ion exchange treatment train.

e. Assumes conditions in note c. Effluent from technetium-99 ion exchange system is blended with flow from existing 200-ZP-1 extraction system at 6,435 L/min (1,700 gpm). 200-ZP-1 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 ion exchange system is blended with flow from existing 200-ZP-1 extraction system at 6,340 L/min (1,675 gpm). 200-ZP-1 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.

N/A = not applicable, not treated by train

12 References

40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol27/xml/CFR-2010-title40-vol27-part300.xml.

40 CFR 300.415, "National Oil and Hazardous Substances Pollution Contingency Plan," "Removal Action," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol27/xml/CFR-2010-title40-vol27-sec300-415.xml.

40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," Appendix B, "National Priorities List," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol27/xml/CFR-2010-title40-vol27-part300-appB.xml.

Atomic Energy Act of 1954, as amended, 42 USC 2011, Pub. L. 83-703, 68 Stat. 919. Available at: http://epw.senate.gov/atomic54.pdf.

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.

Section 104, "Response Authorities."

Section 121, "Cleanup Standards."

DOE, Ecology, and EPA, 2012, *Hanford Federal Facility Agreement and Consent Order Hanford Public Involvement Plan*, U.S. Department of Energy, Richland Operations Office; Washington State Department of Ecology; and U.S. Environmental Protection Agency, Richland, Washington. Available at: http://www.hanford.gov/files.cfm/FacAgreementand-Consent-Order_FINAL.pdf.

DOE/RL-97-36, 2010, *200-UP-1 Groundwater Remedial Design/Remedial Action Work Plan*, Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=1003100445.

DOE/RL-2001-49, 2004, *Groundwater Sampling and Analysis Plan for the 200-BP-5 Operable Unit*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D7005024.

DOE/RL-2001-54, 2005, *Central Plateau Ecological Evaluation*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2007-18, 2008, *Remedial Investigation/Feasibility Study Work Plan for the 200-BP-5 Groundwater Operable Unit*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0901220536.

DOE/RL-2009-127, 2014, *Remedial Investigation Report for the 200-BP-5 Groundwater Operable Unit*, Draft A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2010-74, 2011, *Treatability Test Plan for the 200-BP-5 Groundwater Operable Unit*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0093994.

DOE/RL-2012-53, 2012, *Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area B-BX-BY*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0091056.

DOE/RL-2014-32, 2014, *Hanford Site Groundwater Monitoring Report for 2013*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0084842.

DOE/RL-2014-34, 2014, *Action Memorandum for 200-DV-1 Operable Unit Perched Water Pumping/ Pore Water Extraction*, Draft A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.ECF-200BP5-10-0254, 2010, *Initial Evaluation of Extraction Well Location Alternatives with B-BX-BY Local-Scale Groundwater Model*, Rev. 1, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0084145.

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.

Ecology, EPA, and DOE, 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*, 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=82.

EPA 540-R-93-057, 1993, *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA*, OSWER Directive 9360.0-32, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C.

Executive Order 12580, 1987, *Superfund Implementation*, Ronald W. Reagan, January 23. Available at: http://www.archives.gov/federal-register/codification/executive-order/12580.html.

PNNL-19277, 2010, *Conceptual Models for Migration of Key Groundwater Contaminants Through the Vadose Zone and Into the Unconfined Aquifer Below the B-Complex*, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/pdf.cfm?accession=0084238.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq. Available at: http://www.epa.gov/epawaste/inforesources/online/index.htm.

RPP-26744, 2005, *Hanford Soil Inventory Model, Rev. 1*, Rev. 0, prepared by R.A. Corbin, B.C. Simpson, M.J. Anderson (Nuvotec), W.F. Danielson III (Advanced Imaging Technologies), J.G. Field, T.E. Jones (CH2M HILL Hanford Group, Inc.), and C.T. Kincaid (Pacific Northwest National Laboratory) for the U.S. Department of Energy, Richland, Washington.

TPA-CN-578, 2013, *Tri-Party Agreement Change Notice Form: Groundwater Sampling and Analysis Plan for the 200-BP-5 Operable Unit, DOE/RL-2001-49 Rev. 1*, dated August 13, U.S. Department of Energy, Richland Operations Office, and Washington State Department of Ecology, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=1310160532.

WCH-191, 2010, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*, Rev. 2, Washington Closure Hanford, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0084183.

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Appendix A

Applicable or Relevant and Appropriate Requirements

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Terms

ARAR	applicable or relevant and appropriate requirement
OU	operable unit
TBC	to be considered

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A1 Compliance with Applicable or Relevant and Appropriate Requirements

The applicable or relevant and appropriate requirements (ARARs) that potentially are pertinent to this removal action are listed in Table A-1 (federal ARARs and to be considered [TBC] criteria), Table A-2 (state ARARs), and Table A-3 (TBC criteria). Onsite activities, such as this removal action, must comply with ARARs but only need to comply with the substantive parts of those requirements.

Table A-1. Identification of Federal ARARs and TBCs

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 removal action 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 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—	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	Substantive requirements of this act are applicable if threatened or endangered species are identified in areas where removal action will occur. This is a location-specific requirement.

Table A-1. Identification of Federal ARARs and TBCs

ARAR Citation	ARAR or TBC	Requirement	Rationale for Use
Endangered Species Act of 1973, as Amended"		species, mitigation measures must be taken to protect the resource.	
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
OU = operable unit
TBC = to be considered

Table A-2. Identification of State ARARs

ARAR Citation	ARAR	Requirement	Rationale for Use
WAC 173-303, "Dangerous Waste Regulations"			
"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 removal action 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 removal action, if a solid waste, would be subject to the requirements for solid wastes. This requirement is action specific.
"Designation of Dangerous Waste" WAC 173-303-070(3)	ARAR	Establishes whether a solid waste is, or is not, a dangerous waste or an extremely hazardous waste.	Substantive requirements of these regulations are applicable to materials generated during the removal action.

Table A-2. Identification of State ARARs

ARAR Citation	ARAR	Requirement	Rationale for Use
			Specifically, solid waste that is generated during this removal action, 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, "Department of Ecology Cleanup Authority").	This regulation is applicable to the removal action in the 200-BP-5 Groundwater OU should wastes identified in WAC 173-303-071 be generated. 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 removal action. 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 removal action. 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 removal action. Eligible recyclable materials can be recycled and/or conditionally excluded from certain dangerous waste requirements. This requirement is action specific.
"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 removal action. Specifically, dangerous/mixed waste that is generated during the removal action would be subject to the relevant and appropriate substantive land disposal restrictions. The offsite treatment, disposal, or management of such waste

Table A-2. Identification of State ARARs

ARAR Citation	ARAR	Requirement	Rationale for Use
			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 removal action. 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 removal action. For purposes of this removal action, 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 WAC 173-303-630-640 by reference. This requirement is action specific.

ARAR = applicable or relevant and appropriate requirement
OU = operable unit

Table A-3. Identification of TBC Criteria

Criteria TBC	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.

OU = operable unit
TBC = to be considered

A2 References

36 CFR 60, "National Register of Historic Places," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title36-vol1/xml/CFR-2010-title36-vol1-part60.xml.

36 CFR 65, "National Historic Landmarks Program," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title36-vol1/xml/CFR-2010-title36-vol1-part65.xml.

36 CFR 800, "Protection of Historic Properties," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title36-vol3/xml/CFR-2010-title36-vol3-part800.xml.

40 CFR 268, "Land Disposal Restrictions," *Code of Federal Regulations*. Available at: http://www.access.gpo.gov/nara/cfr/waisidx_09/40cfr268_09.html.

43 CFR 10, "Native American Graves Protection and Repatriation Regulations," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title43-vol1/xml/CFR-2010-title43-vol1-part10.xml.

50 CFR 402, "Interagency Cooperation—Endangered Species Act of 1973, as Amended," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2009-title50-vol7/xml/CFR-2009-title50-vol7-part402.xml.

Archeological and Historic Preservation Act of 1974, 16 USC 469a-1–469a-2(d). Available at: http://www.nps.gov/history/local-law/fhpl_archhistpres.pdf.

DOE/RL-2009-124, 2013, *200 West Pump and Treat Operations and Maintenance Plan*, Rev. 2, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0085737.

Endangered Species Act of 1973, Pub. L. 93-205, as amended, 7 USC 136, 16 USC 1531, et seq. Available at: http://www.nmfs.noaa.gov/pr/pdfs/laws/esa.pdf.

EPA, Ecology, and DOE, 2008, *Record of Decision Hanford 200 Area 200-ZP-1 Superfund Site Benton County, Washington*, U.S. Environmental Protection Agency, Washington State Department of Ecology, and U.S. Department of Energy, Olympia, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=00098825.

Migratory Bird Treaty Act of 1918, 16 USC 703-712, Ch. 128, July 13, 1918, 40 Stat. 755, as amended. Available at: http://www.animallaw.info/statutes/stusmba.htm.

National Historic Preservation Act of 1966, 16 USC 470, et seq. Available at: http://www.achp.gov/docs/nhpa%202008-final.pdf.

Native American Graves Protection and Repatriation Act of 1990, 25 USC 3001, et seq. Available at: http://www.nps.gov/history/local-law/FHPL_NAGPRA.pdf.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303.

303-016, "Identifying Solid Waste."

303-017, "Recycling Processes Involving Solid Waste."

303-050, "Department of Ecology Cleanup Authority."

303-070, "Designation of Dangerous Waste."

303-071, "Excluded Categories of Waste."

303-077, "Requirements for Universal Waste."

303-120, "Recycled, Reclaimed, and Recovered Wastes."

303-140, "Land Disposal Restrictions."

303-170, "Requirements for Generators of Dangerous Waste."

303-200, "Accumulating Dangerous Waste On-Site."

303-573, "Standards for Universal Waste Management."

303-630, "Use and Management of Containers."

303-640, "Tank Systems."

303-960, "Special Powers and Authorities of the Department."

303-9906, "Special Waste Bill of Lading."