Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

09-AMCP-0180 JUL 28 2009

Mr. D. A. Faulk, Program Manager
Office of Environmental Cleanup
Hanford Project Office
U.S. Environmental Protection Agency
309 Bradley Boulevard, Suite 115
Richland, Washington 99352

Dear Mr. Faulk:

200 WEST AREA 200-ZP-1 PUMP-AND-TREAT REMEDIAL DESIGN/REMEDIAL ACTION WORK PLAN, DOE/RL-2008-78, REVISION 0, REISSUE AND HANFORD FEDERAL FACILITY AGREEMENT AND CONSENT ORDER (TRI-PARTY AGREEMENT) CHANGE CONTROL FORM M-16-09-02

This letter transmits the 200 West Area 200-ZP-1 Pump-and-Treat Remedial Design/Remedial Action Work Plan, DOE/RL-2008-78, Revision 0, Reissue for your approval. This document is being submitted to the U.S. Environmental Protection Agency (EPA) as a primary document under the Tri-Party Agreement Action Plan, Section 9.0 "Documents and Records." Comments provided by EPA on draft versions of this document have been incorporated into Revision 0, as appropriate. Responses to EPA's comments are included for your information.

Tri-Party Agreement Change Control Form M-16-09-02 is being submitted for your review and approval. This change package establishes a Tri-Party Agreement interim milestone for the Remedial Design Report deliverable that the Parties agree is critical to the success of the project to accomplish defined cleanup goals. As defined in the Tri-Party Agreement Action Plan, Section 12.0, "Changes to the Agreement," the U.S. Department of Energy, Richland Operations Office requests that EPA act on the proposed Tri-Party Agreement change form within 14 days of receipt.

If you have any questions, please contact me, or your staff may contact Matt McCormick, Assistant Manager for the Central Plateau, on (509) 373-9971.

Sincerely,

Doug S. Shoop for

David A. Brockman
Manager

AMCP:ACT

Attachments

cc: See Page 2

cc w/attachs:
G. Bohnee, NPT
L. Buck, Wanapum
R. S. Dinicola, USGS
S. Harris, CTUIR
J. A. Hedges, Ecology
R. Jim, YN
E. Laija, EPA
S. L. Leckband, HAB
K. Niles, ODOE
Administrative Record (200-ZP-1)
Environmental Portal

cc w/o attachs:
M. E. Byrnes, CHPRC
M. H. Doornbos, CHPRC
R. H. Engelmann, CHPRC
D. L. Foss, CHPRC
R. E. Piippo, CHPRC
J. G. Vance, FFS

Change Number M-16-09-02	**Federal Facility Agreement and Consent Order** ***Change Control Form*** Do not use blue ink. Type or print using black ink.	**Date** July 13, 2009

Originator: Briant Charboneau **Phone:** (509) 373-6137

Class of Change

[] I – Signatories [X] II – Executive Manager [ ] III – Project Manager

Change Title

Operable Unit 200-ZP-1 Hanford Federal Facility Agreement and Consent Order (Agreement) Interim Remediation Milestone

Description/Justification of Change

This change package establishes a *Hanford Federal Facility Agreement and Consent Order* (HFFACO) interim milestone to track progress of the design and implementation of a pump and treat system for the remediation of groundwater in the 200-ZP-1 Operable Unit. The Record of Decision for the Hanford 200 Area, 200-ZP-1 Superfund Site identified a selected remedy that combines pump-and-treat, monitored natural attenuation, flow path control, and institutional controls as an integrated system to remediate the operable unit. The remedial design remedial action work plan (RD/RAWP) identified completion dates for major tasks and deliverables and this change package establishes a milestone for the Remedial Design Report deliverable that the Parties agree is critical to the success of the project to accomplish defined cleanup goals.

(Continued on page 2)

Impact of Change

Establish an interim milestone that will promote progress of the design and implementation of a pump and treat system for the 200-ZP-1 Operable Unit to further groundwater remediation.

Affected Documents

The Hanford Federal Facility Agreement and Consent Order, as amended and Hanford Site internal planning management, and budget documents (e. g., USDOE and USDOE contractor Baseline Change Control documents; Multi-Year Work Plan; Site Wide Systems Engineering Control Documents; Project Management Plans, and, if appropriate, Land Disposal Restrictions Report requirements).

Approvals

N/A ________________ ________ ____ Approved ____ Disapproved
Ecology Date

Doug S. Shoop ________________ 7/27/09 ✓ Approved ____ Disapproved
DOE-RL Date

________________ ________ ____ Approved ____ Disapproved
EPA Date

(Description/Justification of Change, Continued from Page 1)

Change package M-16-08-07 includes two related proposed milestones for 200-ZP-1. One milestone, proposed as M-016-122, would require beginning Phase I operation of the new 200 West pump and treat system by 12/31/11. The other milestone, proposed as M-016-123, would require the submittal of the RD/RA work plan by 3/31/09 (which has been submitted) as well as initiation of construction within 6 months of work plan approval, or as specified in the work plan schedule. These milestones have been tentatively agreed to by the Parties, subject to final approval following comment resolution.

Modifications to existing Tri-Party Agreement milestones are denoted with ~~strikeout~~; new milestone/text is denoted with shading.

M-016-124 Lead Agency: EPA	Submit 200-ZP-1 Remedial Design Report.	08/31/2010

CRPRC - REVIEW COMMENT RECORD (RCR)

1. Date 05/28/2009	2. Review No.	
3. Project No.		

5. Document Number(s)/Title(s)	6. Program/Project/Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
DOE/RL-2008-78, *200 West Area 200-ZP-1 Pump-and-Treat Remedial Design/Remedial Action Work Plan*, Draft A		EPA	U.S. EPA	

17. Comment Submittal Approval	10. Agreement With Indicated Comment Disposition(s)	11. CLOSED
Date Organization Manager (optional) (print and sign)	Reviewer/Point of Contact (print and sign) Date Author/Originator (print and sign)	Reviewer/Point of Contact (print and sign) Date Author/Originator (print and sign)

Item	Comments	Accept (A) / Reject (R)	Disposition (provide justification if **NOT** accepted)	Reviewer Concurrence Required (Y or N)
1	*General Comment:* The document states that 95% of the mass contaminant will be removed in 25 years. The design report should clearly demonstrate how this is going to be achieved as pumping progresses.	A	Preliminary calculations for the estimated mass recovery are provided in Section 3.1 Design Basis. These calculations, based upon the estimated contaminant distributions in the aquifer and as well as representative values for the various hydrogeologic parameters (e.g., Kd, porosity, etc.), predict that between 57% and 100% of the dissolved carbon tetrachloride contaminant mass will be removed in 25 years. A Performance Monitoring Plan is under development and will be submitted as part of the Operations and Maintenance Plan (see Section 2.4 Remedy Performance Monitoring). This plan will describe how the 95% contaminant mass reduction will be accomplished.	
2	Page 2-5, Section 2.4: This section states that the integrated groundwater monitoring plan is a stand-alone document. Text should be added to clarify that while we expect to create an integrated monitoring plan, actions taken in the ZP-1I OU will not be dependent on its completion. The Performance Monitoring Plan needs to be developed in time to support monitoring the ZP- 1 pump-and-treat system.	A	The integrated groundwater monitoring plan will be a stand-alone document and not tied to the implementation of the 200-ZP-1 remedy. According to the second paragraph of Section 2.4 Remedy Performance Monitoring (pg 2-5), it states: An integrated groundwater monitoring plan will also be prepared that addresses the monitoring requirements for all programs impacted by the 200 West Area pump-and-treat system. Given the necessary integration of this plan with the other groundwater monitoring programs in the 200 West Area, it will be submitted as a separate, stand-alone document.	

CRPRC - REVIEW COMMENT RECORD (RCR)	1. Date 05/28/2009	2. Review No.
	3. Project No.	

Item	Comments	Accept (A) / Reject (R)	Disposition (provide justification if **NOT** accepted)	Reviewer Concurrence Required (Y or N)
3	Page 2-7: Table 2-1. Uranium should not be listed as a COC in this table and should be removed. This is explained in the text on page 2-2, but Table 2-1 makes it appear that uranium is a COC. Revise document to state that the "design criteria" will be able to address uranium as a contaminant.	A	Uranium was deleted from Table 2-1. The system will be designed to treat the contaminants from the groundwater in the 200 West Area.	
4	Page 2-9, Section 2.4.4: It should again be emphasized that actions taken in the ZP- 1 OU will not be dependent on the completion of the integrated monitoring plan. Also, the regulatory path for the Single Shell Tank Farm does not use alternative authority for groundwater monitoring [(WAC 173-303-645(1) (e)]. Explain how the monitoring plan will address monitoring requirements for TSD units.	A	A new sentence was inserted in the first paragraph of Section 2.4.4 stating: This plan will be a stand-alone document and not tied to the implementation of the 200-ZP-1 OU remedy. The regulatory path for implementation of the integrated groundwater monitoring plan will be develop with the regulators and is not available at this time.	
5	Page 3-5, Table 3-1: Uranium should not be listed as a COC.	A	Uranium was deleted from Table 3-1.	
6	Page 3-12, 1st bullet. It states that as a functional requirement of the system, it will be designed to treat up to 189 L/min (50 gpm) of contaminated groundwater. Yet on page 3-], last paragraph it says the pump-and-treat system is designed to operate at a nominal rate of approximately 3,785 L/min (1,000 gpm). This is a large discrepancy between these values. Will Phase 1 operate at 1000 gpm with 50 gpm of that available for treatment of groundwater from the 200-UP-i OU, or will it operate at 1050 gpm total? Please clarify.	A	The first bullet on pg 3-12 is a design criterion to be able to treat 50 gpm of contaminated water from the 241-S/SX Tank Farm. This ensures that the system can accommodate contaminants, primarily technetium-99, at an influent rate of 50 gpm. The 1000 gpm is the nominal capacity for the treatment system, including contaminated water from the 200-ZP-1 OU and the 241-S/SX Tank Farm. At nominal capacity, the system should be able to treat 950 gpm from the 200-ZP-1 OU and 50 gpm from the 241-S/SX Tank Farm.	
7	Page 3-13: The substantive regulatory requirements for piping that comes from the wells into the treatment facility must meet WAC 173-303-640. Explain in the document how the pipelines will comply with these requirements. It is unclear what the alternative approach would be.	A	The bullet was revised as follows to clarify the approach: When transporting dangerous waste, piping systems from the wells to the treatment facility shall meet the requirements of WAC 173-303-640, which will consist of daily inspections for above ground pipe. An alternate approach that is equally protective of human health and the environment will be developed during the design, discussed with the regulatory agencies, and included in the RD report for approval.	
8	Page 3-13, 4th bullet: What maximum flow rate is being referred to? Please clarify.	A	A sentence was added to the end of the paragraph as follows: The design maximum flow rate for the Phase I system will be approximately 1,250 gpm.	

CRPRC - REVIEW COMMENT RECORD (RCR)	1. Date 05/28/2009	2. Review No.
	3. Project No.	

Item	Comments	Accept (A) / Reject (R)	Disposition (provide justification if **NOT** accepted)	Reviewer Concurrence Required (Y or N)
9	Page 3-16, Section 3.2.3: Make reference to the SAP for the first set of remedial action wells in 200-ZP- 1 OU. This text can be taken from Page 4-5, 1st paragraph.	A	The text from pg 4-5, 1st paragraph, was also included as the last sentence in Section 3.2 Well Network Conceptual Design for clarification.	
10	Page 5-1, Section 5. 1. 1, last sentence: Add the citation WAC 246-247.	A	The following text was added to the beginning of the sentence: To demonstrate compliance with the ARARs of WAC 246-247, …	
11	Page 6-1, Section 6.1: It is stated that the interim pump-and-treat system will continue to operate until the 200 West Area pump-and-treat system is fully operation[al]. Please clarify what constitutes "fully operation[al]" for this system. Is there a through-put that has to be met?	A	The work "fully" was removed from the sentence. The intent is to discontinue the 200-ZP-1 interim pump-and-treat system once the 200 West Area pump-and-treat system is operational.	
12	Page 7-1, Table 7- 1: The table suggests that the costs are inclusive for both the ZP-1 and UP-1 operable units. The costs for the addition of the 200-UP-1 OU will need to be separate in the ROD amendment. The costs should only reflect the costs for the 200-ZP-1 pump-and-treat system.	R	The costs provided in Table 7-1 reflect the estimated total cost for the system described in the RD/RA Work Plan, including the treatment system for the 50 gpm of technetium-99 contaminated groundwater from the 241-S/SX Tank Farm, which is identified as a requirement in section 3.1.3 Functional Requirements. It does not include the costs for any future treatment required for the 200-UP-1 OU. This future "cost savings" can be discussed in the ROD amendment and will help to explain why the pump-and-treat remedy is fairly inexpensive.	
13	Appendix A, A-9: The WAC citation needs to be changed to WAC 173-303-64620(4).	A	Thanks.	

DOE/RL-2008-78
Revision 0
REISSUE

200 West Area 200-ZP-1 Pump-and-Treat Remedial Design/Remedial Action Work Plan

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

United States
Department of Energy
P.O. Box 550
Richland, Washington 99352

DOE/RL-2008-78
Revision 0
REISSUE

200 West Area 200-ZP-1 Pump-and-Treat Remedial Design/Remedial Action Work Plan

Date Published
July 2009

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

United States Department of Energy
P.O. Box 550
Richland, Washington 99352

J. D. Aardal
Release Approval

07/15/2009
Date

Executive Summary

The *Record of Decision, Hanford 200 Area, 200-ZP-1 Superfund Site, Benton County, Washington*[1] (hereinafter referred to as the 200-ZP-1 Operable Unit [OU] Record of Decision [ROD]) presents the selected remedial action for the 200-ZP-1 Groundwater OU (hereinafter referred to as the 200-ZP-1 OU), which was chosen in accordance with the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*[2], as amended by the *Superfund Amendments and Reauthorization Act of 1986*[3]; the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement)[4]; and, to the extent practicable, the "National Oil and Hazardous Substances Pollution Contingency Plan" (40 *Code of Federal Regulations* 300[5]). This decision, based on information contained in the Administrative Record for the 200-ZP-1 OU, is desired to protect the public health or welfare, or the environment from actual or threatened releases of hazardous substances, pollutants, or contaminants into the environment.

This remedial design/remedial action (RD/RA) work plan provides the plan and schedule for implementing all of the tasks to design, install, and operate the remedy set forth in the 200-ZP-1 OU ROD. The selected remedy combines pump-and-treat, monitored natural attenuation (MNA), flow-path control, and institutional controls to meet the objective of achieving established groundwater cleanup levels for all contaminants of concern (COCs) in the 200-ZP-1 OU in 125 years. The COCs identified for the 200-ZP-1 OU are carbon tetrachloride, total chromium (trivalent [III] and hexavalent [VI]), nitrate, trichloroethylene, iodine-129, technetium-99, and tritium. An interim remedial measure pump-and-treat system is currently operating in the 200-ZP-1 OU and will continue to operate under the requirements established in the *Record of Decision for the USDOE Hanford 200-ZP-1 Operable Unit, 200 Area NPL Site Interim Remedial Measure*[6] until

1 EPA, Ecology, and DOE, 2008, *Record of Decision, Hanford 200 Area, 200-ZP-1 Superfund Site, Benton County, Washington*, 09-AMCP-0003, U.S. Environmental Protection Agency, Washington State Department of Ecology, and U.S. Department of Energy, Olympia, Washington.
2 *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*, 42 U.S.C. 9601, et seq.
3 *Superfund Amendments and Reauthorization Act of 1986*, 42 U.S.C. 11001, et seq.
4 Ecology, EPA, and DOE, 2003, *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement), 2 vols., as amended, Rev. 6, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.
5 40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," *Code of Federal Regulations*.
6 EPA/ROD/R10-95/114, 1995, *Record of Decision for the USDOE Hanford 200-ZP-1 Operable Unit, 200 Area NPL Site Interim Remedial Measure*, U.S. Environmental Protection Agency, Washington State Department of Ecology, and U.S. Department of Energy, Olympia, Washington.

the treatment system required by the 200-ZP-1 OU ROD becomes operational, which is expected to occur by December 2011.

The principal component of the 200-ZP-1 OU selected remedy is a pump-and-treat system, which includes a new central treatment facility, new groundwater extraction wells, new treated groundwater injection wells, and the required infrastructure (e.g., transfer piping and pumping stations). The design also allows for expansion of the system to include additional treatment capabilities, extraction wells, injection wells, and performance monitoring wells, as needed, to optimize remedy performance. The pump-and-treat system will be operated to extract and treat contaminated groundwater to reduce the dissolved mass of the COCs (except tritium) throughout the 200-ZP-1 OU by a minimum of 95 percent in 25 years or less following initial startup.

Natural attenuation processes including, biotic and abiotic degradation, dispersion, and sorption will be used to reduce the remaining portion of the carbon tetrachloride and nitrate not captured by the pump-and-treat system to below groundwater cleanup levels within 125 years following initial startup of the remedy. The process of natural radioactive decay will achieve the reduction in tritium concentrations to meet groundwater cleanup levels during the same 125-year period.

Monitoring of the natural attenuation processes will be employed to provide data on performance, including whether the key mechanisms are performing in a manner to satisfy the cleanup objectives and functional requirements of the selected remedy.

The flow-path control component of the selected remedy will be designed and operated to slow the eastward flow of most of the 200-ZP-1 OU groundwater to keep COCs within the capture zone, improve pump-and-treat efficiency, and increase residence for natural attenuation processes to reduce contaminant concentrations.

The institutional controls component of the selected remedy will implement and maintain the institutional and land-use controls identified in the 200-ZP-1 OU ROD to restrict groundwater use for the foreseeable future until cleanup levels are achieved.

The design, construction, and operation of the selected remedy will be executed in a phased manner to initiate groundwater treatment as soon as possible, while at the same time allowing for performance monitoring and evaluation of the remedy components' effectiveness in meeting the remedial action objectives. These evaluations will support adjustments in remedy design and operation during the phased implementation to optimize pump-and-treat capacity, treatment capabilities, and the number and location of the extraction and injection wells. The three execution phases are described briefly below. More detailed discussions are provided in Chapter 3 of this RD/RA work plan.

- **Phase I: Pump-and-Treat System Design and Construction**

During Phase I, the RD activities are completed and the pump-and-treat system is constructed. Startup of the new pump-and-treat system is scheduled to occur by December 31, 2011. The initial design and construction of the treatment facility, extraction and injection wells, and infrastructure will be for operation at a nominal capacity of approximately 3,785 L/min (1,000 gallons per minute [gpm]). The treatment facility will be designed to achieve cleanup levels for all COCs (except tritium) prior to reinjection. At the conclusion of Phase I, the extraction and injection well network will consist of approximately 14 new extraction wells and 6 new injection wells.

- **Phase II: Initial Operations, Performance Monitoring, and System Optimization**

During Phase II, the pump-and-treat system will begin initial operations. Performance monitoring and optimization of both the treatment facility and well network will be conducted during this phase to provide sufficient capacity to achieve the performance objective. Phase II is expected to last approximately 3 years, at the end of which any required expansions of the pump-and-treat system are expected to be constructed and operating at a sufficient capacity and capability to transition into long-term operations. This may include constructing additional treatment train(s) located within the central treatment facility, as well as additional extraction and injection wells to provide the necessary operating capacity. This phase also includes the addition of new compliance and performance monitoring wells that may be necessary to support long-term operations.

- **Phase III: Long-Term Operations**

During Phase III, the pump-and-treat system will continue to operate at the flow rate established during the Phase II optimization efforts. The pump-and-treat system will operate for the additional 22 years necessary to achieve the 95 percent dissolved mass reduction for the COCs, taking into account the initial 3 years of operation during

Phase II. The system will be continuously optimized, which will include system performance monitoring and system modifications, as necessary.

This RD/RA work plan provides the framework to implement the remedy described above. Chapter 1 provides the purpose, scope, site description, and background related to the selected remedy. The basis for the selected remedy is presented in Chapter 2. Chapter 3 provides the conceptual designs for the well field, radiological treatment system, and central treatment system. Chapter 4 describes the project management team, facility procurement, and construction and operational approaches to implementing the remedial action. Chapter 5 describes the environmental management controls associated with air emissions, waste management, health and safety, emergency response, and the quality assurance program. A discussion of the decontamination and decommissioning activities associated with both the interim remedial measure pump-and-treat and the selected remedy is found in Chapter 6. Chapter 7 provides an initial cost estimate for the next 4 years and a critical path schedule for Phase I of the remedial action, including preparation of the subsequent Tri-Party Agreement primary documents (RD report, and operations and maintenance plan). The compliance strategy to meet the applicable or relevant and appropriate requirements identified in the 200-ZP-1 OU ROD is presented in the appendix.

Table of Contents

Appendix

Figures

Tables

List of Terms

AEA	*Atomic Energy Act of 1954*
ALARA	as low as reasonably achievable
ARAR	applicable or relevant and appropriate requirement
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
COC	contaminant of concern
D&D	decontamination and decommissioning
DNAPL	dense nonaqueous phase liquid
DOE	U.S. Department of Energy
DQO	data quality objective
ECM	environmentally controlled media
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
FBR	fluidized bed reactor
FS	feasibility study
FY	fiscal year
GAC	granular activated carbon
HASP	health and safety plan
IRM	interim remedial measure
IX	ion-exchange
K_d	distribution coefficient
LLWMA	low-level waste management area
MCL	maximum contaminant level
MNA	monitored natural attenuation
MTCA	*Model Toxics Control Act*
N/A	not applicable
NCP	National Contingency Plan

NPL	National Priority List
O&M	operations and maintenance
OU	operable unit
QA	quality assurance
RA	remedial action
RAO	remedial action objective
RCRA	*Resource Conservation and Recovery Act of 1976*
RD	remedial design
RI	remedial investigation
RL	U.S. Department of Energy, Richland Operations Office
ROD	record of decision
SAP	sampling and analysis plan
SVE	soil vapor extraction
TBD	to be determined
TCE	trichloroethylene
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
WAC	*Washington Administrative Code*
WMA	waste management area

1 Introduction

The U.S. Department of Energy's (DOE's) Hanford Site is a 1,517-km^2 (586-mi^2) Federal facility located in southeastern Washington State along the Columbia River (see Figure 1-1). For administrative purposes, the Hanford Site was divided into four National Priority List (NPL) sites (Appendix B of 40 *Code of Federal Regulations* [CFR] 300, "National Oil and Hazardous Substances Pollution Contingency Plan" – hereinafter referred to as the "National Contingency Plan [NCP]) under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) in 1989, one of which is the 200 Areas. In anticipation of the NPL listing, DOE, the U.S. Environmental Protection Agency (EPA), and the State of Washington (through the Washington State Department of Ecology [Ecology]) entered into the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 2003) in May 1989. This agreement established a procedural framework and schedule for developing, implementing, and monitoring CERCLA response actions on the Hanford Site. The agreement also addresses *Resource Conservation and Recovery Act of 1976* (RCRA) compliance and permitting.

The 200 Area NPL site, which is commonly referred to as the Central Plateau, encompasses approximately 190 km^2 (75 mi^2) near the center of the Hanford Site and contains multiple waste sites, contaminated facilities, and groundwater contamination plumes. The CERCLA site identification number for the 200 Areas is No. WA1890090078. To facilitate cleanup, these waste sites, facilities, and groundwater plumes have been grouped by geographic areas, process types, or cleanup components into several operable units (OUs).

The 200-ZP-1 Groundwater OU is one of four groundwater OUs located on the Central Plateau. Each groundwater OU has its own plan of study and enforceable schedule and will eventually have its own record of decision (ROD) and cleanup actions as needed. The waste sites and soil above the 200-ZP-1 OU are the sources of the contamination in 200-ZP-1 OU groundwater and are (or will be) addressed as part of the cleanup of other OUs through separate CERCLA or RCRA actions.

The DOE is the lead agency for remediation of the 200-ZP-1 OU. The EPA is the lead regulatory agency for remediation of this OU, as identified in Section 5.6 and Appendix C of the Tri-Party Agreement. In accordance with the Tri-Party Agreement, Article XIV, Paragraph 54, DOE developed and proposed remedial action (RA) for the 200-ZP-1 OU through completion and approval of a remedial investigation (RI) (*Remedial Investigation Report for the 200-ZP-1 Groundwater Operable Unit* [DOE/RL-2006-24]) and feasibility study (FS) (*Feasibility Study for the 200-ZP-1 Groundwater Operable Unit* [DOE/RL-2007-28]). A 30-day public comment period for the *Proposed Plan for Remediation of the 200-ZP-1 Groundwater Operable Unit* (DOE/RL-2007-33) ran from July 21 through August 19, 2008.

The selected remedy was chosen in accordance with CERCLA, as amended by the *Superfund Amendments and Reauthorization Act of 1986*, the Tri-Party Agreement, and, to the extent practicable, the NCP (40 CFR 300). This decision was based on the information contained in the Administrative Record file for the 200-ZP-1 OU.

The *Record of Decision Hanford 200 Area 200-ZP-1 Superfund Site Benton County, Washington* (hereinafter referred to as the 200-ZP-1 OU ROD) (EPA et al. 2008) was signed by EPA, DOE, and Ecology on September 30, 2008. The selected remedy for the 200-ZP-1 OU is a combination of pump-and-treat, monitored natural attenuation (MNA), flow-path control, and institutional controls. The 200-ZP-1 OU ROD requires that a groundwater pump-and-treat system will be designed, installed, and operated in accordance with an approved remedial design/remedial action (RD/RA) work plan. In addition, monitoring will be employed in accordance with the approved RD/RA documents to evaluate the effectiveness of the pump-and-treat system and natural attenuation processes. A detailed description of each component of the selected remedy is provided in Chapter 2.

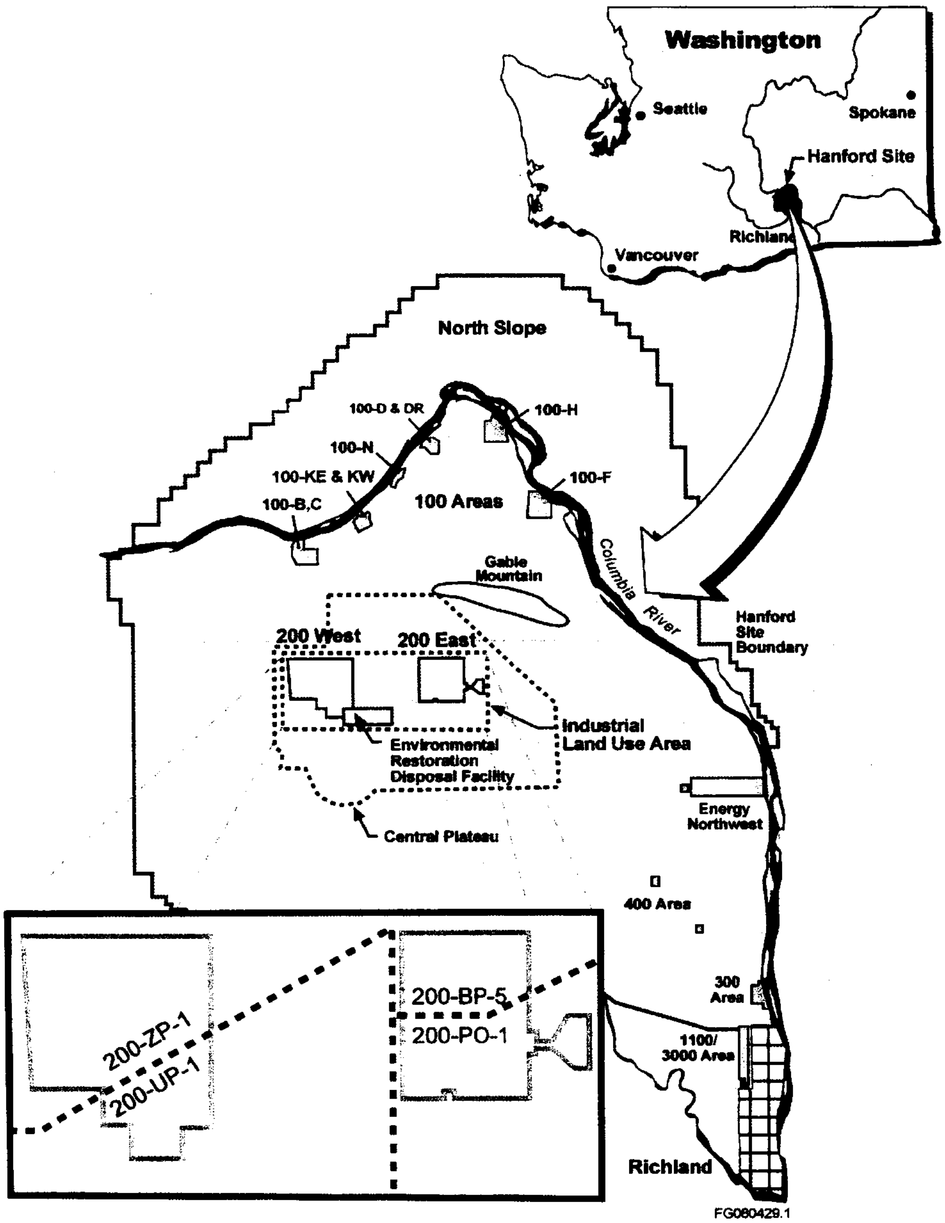

Figure 1-1. Hanford Site Map Showing the Central Plateau Groundwater Operable Units

1.1 Purpose

This RD/RA work plan describes how the 200-ZP-1 groundwater pump-and-treat system (hereinafter referred to as the 200 West Area pump-and-treat system) will be designed, installed, and operated to meet the remedial action objectives (RAOs) identified in the 200-ZP-1 OU ROD. In addition, requirements for implementation of MNA, flow-path control, and institutional controls requirements of the 200-ZP-1 ROD are also identified in this document.

This RD/RA work plan is being submitted in accordance with Section 11.6 of the Tri-Party Agreement Action Plan, which states: "Within 180 days of ROD signature, or an alternative period designated in the ROD, an RD/RA work plan including schedule, along with a milestone change package, shall be submitted for lead regulatory agency review and approval" (Ecology et al. 2003).

As noted in the 200-ZP-1 OU ROD and Section 7.3.10 of the Tri-Party Agreement Action Plan, the RD/RA work plan is a primary document subject to EPA approval.

1.2 Scope

This RD/RA work plan provides the plan and schedule for the design, construction, operation, and monitoring activities necessary to successfully implement the remedial action selected in the 200-ZP-1 OU ROD. The selected remedy for the 200-ZP-1 OU is a combination of pump-and-treat, MNA, flow-path control, and institutional controls to address the following contaminants of concern (COCs): carbon tetrachloride, total chromium (trivalent [III] and hexavalent [VI]), nitrate, trichloroethylene (TCE), iodine-129, technetium-99, and tritium.

The waste sites and soil above the 200-ZP-1 OU are the sources of the groundwater contamination in the 200-ZP-1 OU and are being addressed under RCRA or as part of other 200 Area OUs that are following the CERCLA RI/FS process and are not within the scope of this RD/RA work plan. For the purposes of this work plan, it is assumed that these actions will be effective and that no further contaminant to the 200-ZP-1 OU groundwater will occur for these vadose zone disposal sites.

1.3 Site Description and Background

The 200-ZP-1 OU includes several groundwater contamination plumes that cover an area of approximately 10 km^2 (4 mi^2) beneath part of the 200 West Area (discussed in Section 1.3.2). The 200 West Area is approximately 8 km^2 (3 mi^2) and is located near the middle of the Hanford Site (Figure 1-1). It is about 8 km (5 mi) south of the Columbia River and 11 km (7 mi) from the nearest Hanford Site boundary. The 200 West Area is located on an elevated, flat area that is often referred to as the Central Plateau, and there are no wetlands, perennial streams, or floodplains.

The 200 West Area contains waste management facilities and former irradiated fuel reprocessing facilities. The major waste streams that contributed to groundwater contamination were associated with the plutonium concentration and recovery operations at the Z Plant facilities and the plutonium-separation operations at the T Plant facilities, both in the 200 West Area. The liquid waste disposal in the cribs and trenches near these facilities resulted in several groundwater contamination plumes in the 200-ZP-1 OU.

The following subsections briefly describe the site setting, nature, and extent of contamination within the 200-ZP-1 OU; ongoing 200 West Area interim remedial actions; and groundwater monitoring. More detailed information describing the Hanford Site, the 200 West Area, and the 200-ZP-1 OU is contained in the RI report (DOE/RL-2006-24), the FS (DOE/RL-2007-28), and the 200-ZP-1 OU ROD.

1.3.1 Physical Setting

The Hanford Site lies in a sediment-filled basin on the Columbia Plateau in southeastern Washington (Figure 1-1). The Central Plateau is a relatively flat, prominent terrace near the center of the Site. The 200-ZP-1 OU underlies the northern portion of the 200 West Area, which is on the western end of the Central Plateau.

Basalt of the Columbia River Basalt Group and a sequence of overlying sediments comprise the local geology. The overlying sediments are approximately 169 m (555 ft) thick and primarily consist of the

Ringold Formation and Hanford formation, which are composed of sand and gravel with some silt layers. Surface elevations range from approximately 200 to 217 m (660 to 712 ft).

The sediment thickness in the 200 West Area above the water table (the vadose zone) ranges from 40 to 75 m (132 to 246 ft). Sediments in the vadose zone are the Ringold Formation (the uppermost Ringold Unit E and the Upper Ringold Unit), the Cold Creek unit, and the Hanford formation. Estimates of recharge from precipitation at the Hanford Site range from 0 to 10 cm/yr (0 to 4 in./yr); artificial recharge historically occurred when effluents (e.g., cooling water and process wastewater) were disposed to the ground during the 1940s through the 1990s. Artificial recharge that continues today in the Central Plateau consists of limited onsite sanitary sewage treatment and disposal systems; leaks from potable and raw water lines; two state-approved land disposal structures; and small-volume, uncontaminated, miscellaneous waste streams.

Groundwater beneath the Hanford Site is found in an upper primarily unconfined aquifer system and in deeper confined aquifers within the basalt. The Columbia River is the primary discharge area for both the unconfined and confined aquifer. The unconfined aquifer in the 200-ZP-1 OU area of the Central Plateau occurs in the Ringold Formation. Groundwater in the unconfined aquifer flows from areas where the water table is higher (west of the Hanford Site) to areas where it is lower (the Columbia River). In general, groundwater flow through the Central Plateau occurs in a predominantly easterly direction from the 200 West Area to the 200 East Area. Historical discharges to the ground greatly altered the groundwater flow regime, especially around the 216-U-10 Pond in the 200 West Area and the 216-B-3 Pond in the 200 East Area, which deflected the water flow to the north. As drainage from these discharges has ceased, the water flow direction is expected to again flow on a more easterly course through the Central Plateau.

The depth to the water table in the 200 West Area varies from about 50 m (164 ft) in the southwest corner near the former 216-U-10 Pond to >100 m (328 ft) in the north. The groundwater flow is primarily to the east, except in the northern portion of the 200 West Area where the flow is to the east-northeast. Groundwater flow is locally influenced by the 200-ZP-1 OU interim remedial measure (IRM) pump-and-treat system and permitted effluent discharges at the State-Approved Land Disposal Site. The groundwater flow rates typically range from 0.0001 to 0.5 m/day (0.00033 to 1.64 ft/day) across the 200-ZP-1 OU. However, the water table continues to decline at a rate of approximately 0.21 m/yr (0.69 ft/yr) because the large influx of artificial recharge has ceased.

1.3.2 Nature and Extent of Contamination

In the 200-ZP-1 OU, the COCs identified are carbon tetrachloride, total chromium (trivalent [III] and hexavalent [VI]), nitrate, TCE, iodine-129, technetium-99, and tritium. The 200-ZP-1 OU has been well characterized over the years by well drilling and groundwater sampling. There are currently over 100 monitoring wells within the footprint of the 200-ZP-1 OU.

The primary cribs and trenches that contributed contaminants to the 200-ZP-1 OU groundwater through discharges from 1945 to the early 1970s included the 216-Z-1A Trench, 216-Z-9 Crib, 216-Z-18 Trench, 216-Z-19 Ditch, 216-Z-20 Crib, and 216-U-10 Crib. After effluents were discharged to these vadose zone disposal sites, more mobile contaminants migrated to the groundwater. Less mobile contaminants remain in the vadose zone and will be addressed in the source OU or other OU remedies. Data collected indicate that there is no carbon tetrachloride dense nonaqueous phase liquid (DNAPL) source term(s) in the 200-ZP-1 OU groundwater, which is documented in the *Carbon Tetrachloride Dense Non-Aqueous Phase Liquid (DNAPL) Source-Term Interim Characterization Report* (DOE/RL-2006-58) and its addendum (DOE/RL-2007-22).

As stated in the 200-ZP-1 OU ROD, contaminant distributions within the 200-ZP-1 OU can be represented by three categories:

A high-concentration zone close to the ponds, cribs, and trenches that were used to dispose the liquid wastes. Data do not indicate the presence of significant DNAPL in groundwater acting as a continuing source.

A larger, dispersed or low-concentration zone that has migrated from the discharge locations or overlies the high-concentration zone. This less contaminated groundwater can occur above the high-concentration zone where large quantities of lower concentration effluent were discharged during or after the high-concentration waste discharges.

An area of technetium-99 contamination near Waste Management Area (WMA) T and WMA TX/TY. The results from depth-discrete groundwater sampling in the newly installed wells in these areas show that the peak concentration of technetium-99 is typically found within the upper 15 m (50 ft) of the aquifer. These results will be considered in the final design and implementation of the remedy for the 200-ZP-1 OU groundwater.

Groundwater contamination is present from the top to the base of the unconfined aquifer, which is approximately 61 m (200 ft) thick. Distribution maps for the contaminants that exceed the maximum contaminant levels (MCLs) in the 200-ZP-1 OU groundwater are shown in Figures 1-2 through 1-8. Where distribution maps are available for multiple depths, the map corresponding to the maximum extent of contamination is provided. The 200-ZP-1 FS (DOE/RL-2007-28) includes additional depth-specific maps for further presentation of the existing contamination conditions. For scaling purposes, the extent of carbon tetrachloride contamination shown by the heavy line in each figure encompasses an area of approximately 10 km^2 (4 mi^2).

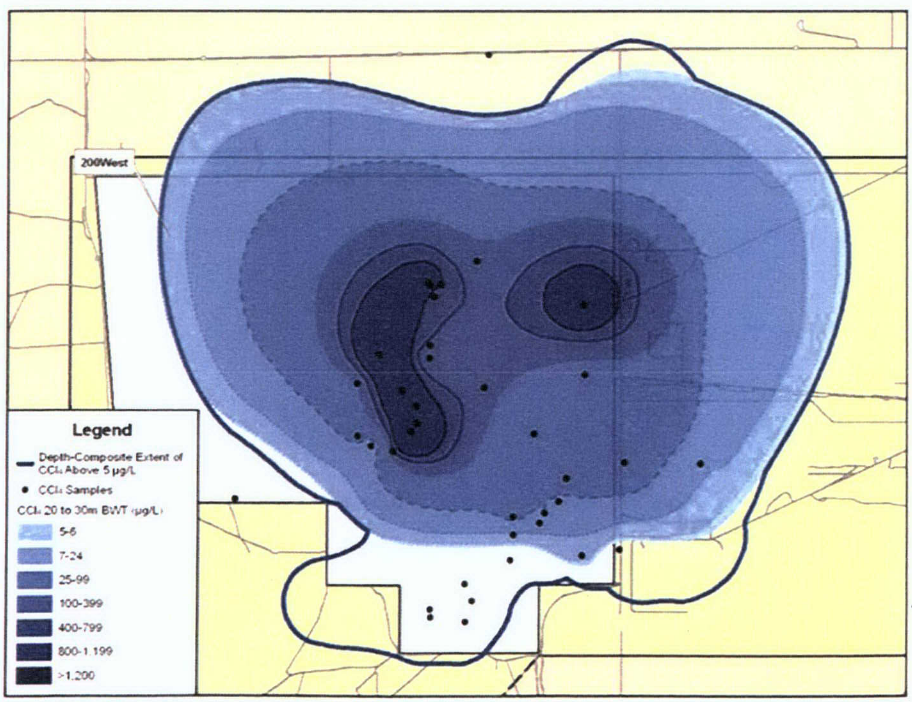

Figure 1-2. Estimated Lateral Extent of Carbon Tetrachloride at a Depth of 20 to 30 m (66 to 98 ft) Below the Water Table

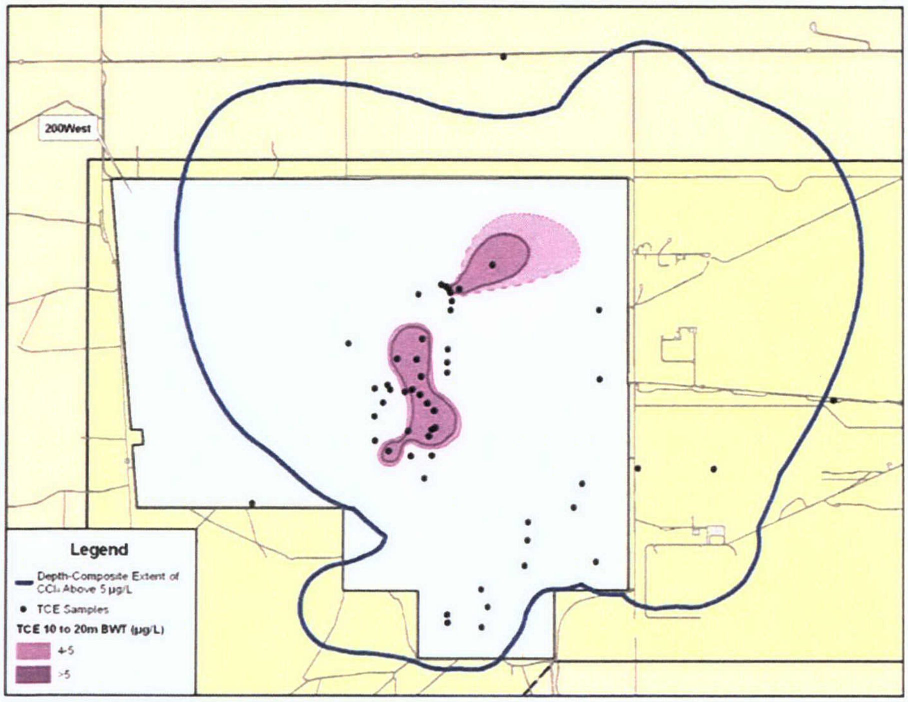

Figure 1-3. Estimated Lateral Extent of Trichloroethylene 10 to 20 m (33 to 66 ft) Below the Water Table

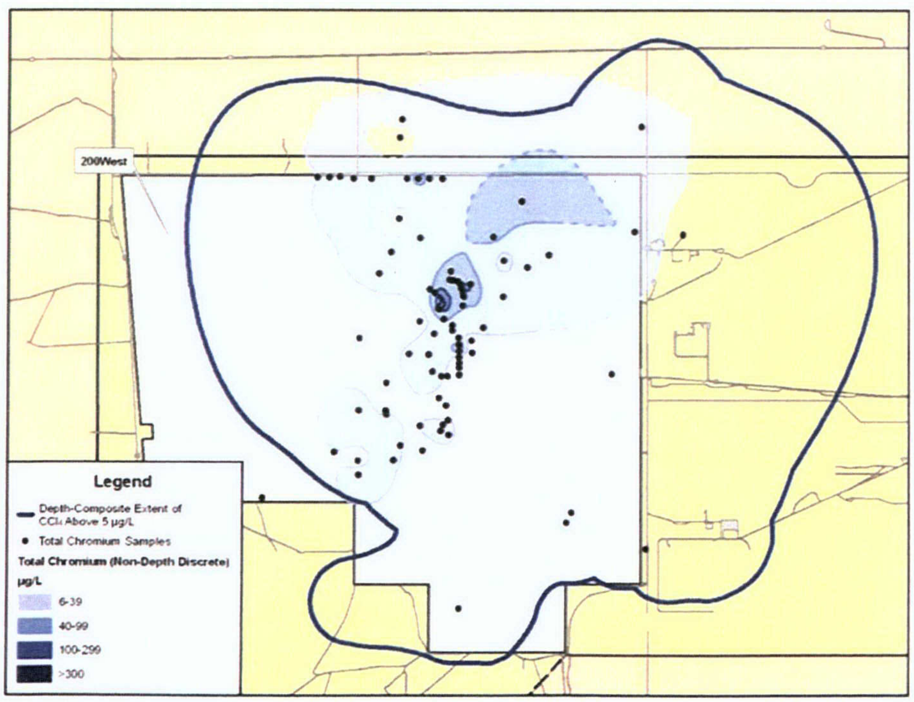

Figure 1-4. Estimated Lateral Extent of Chromium (Total) in Groundwater

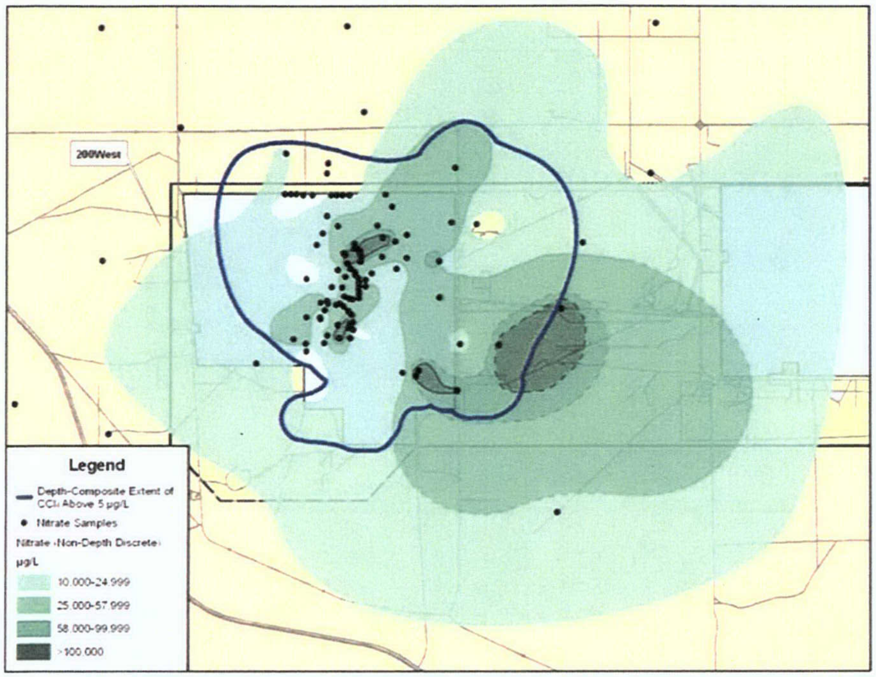

Figure 1-5. Estimated Lateral Extent of Nitrate in Groundwater

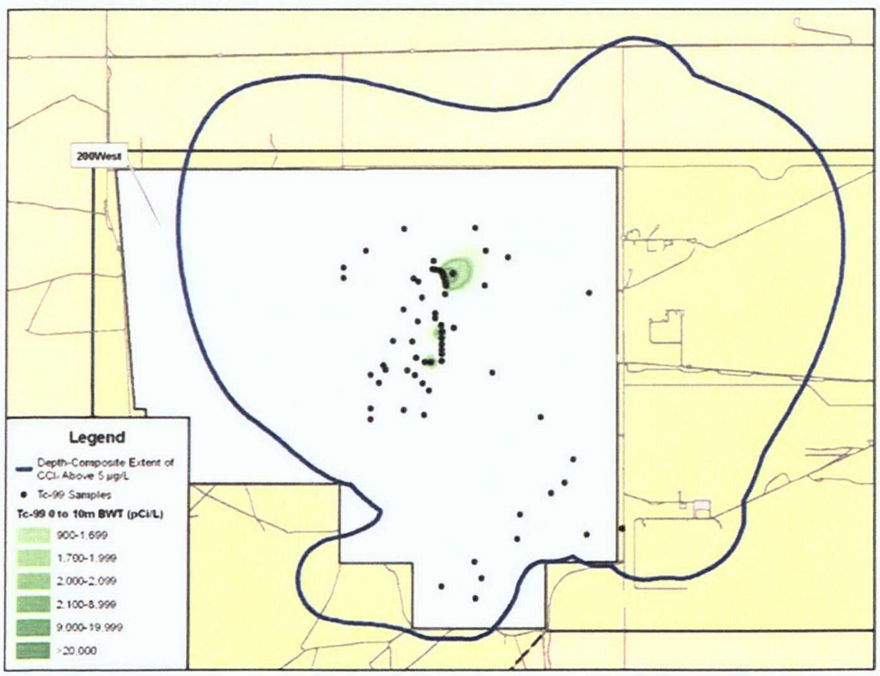

Figure 1-6. Estimated Lateral Extent of Technetium-99 0 to 10 m (0 to 33 ft) Below the Water Table

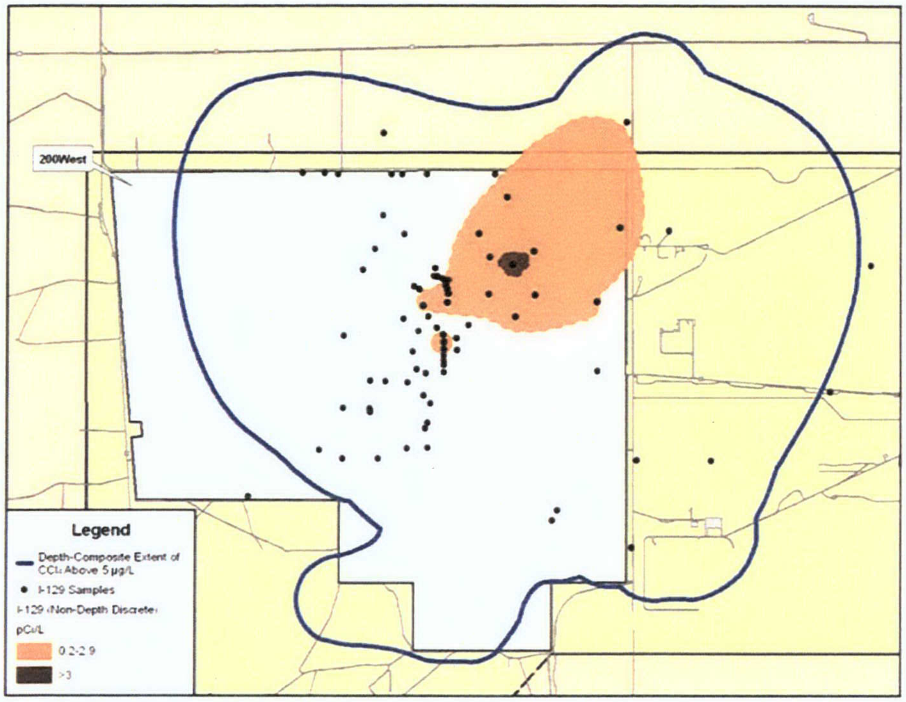

Figure 1-7. Estimated Lateral Extent of Iodine-129 in Groundwater

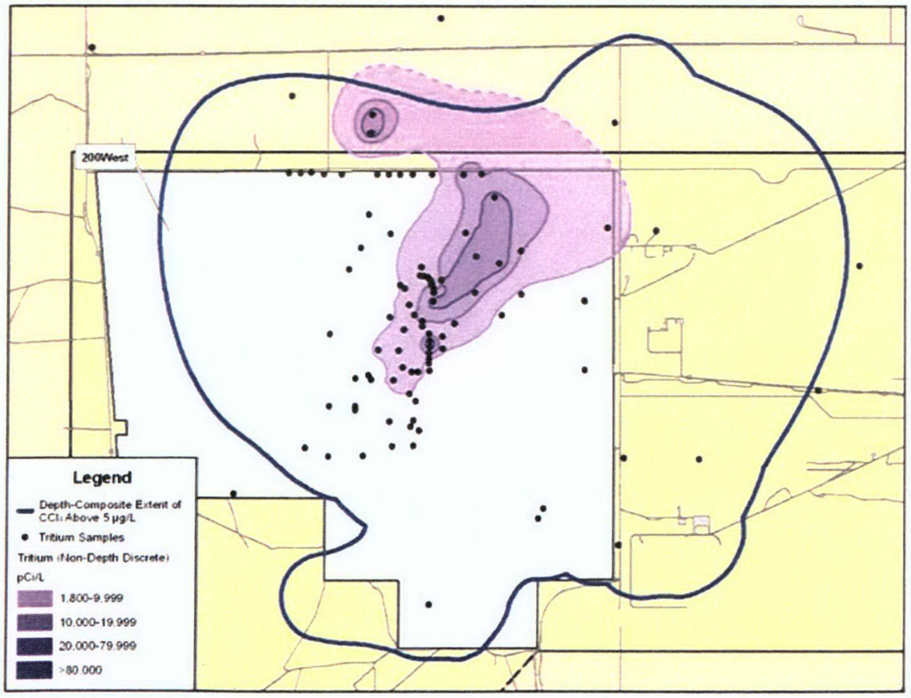

Figure 1-8. Estimated Lateral Extent of Tritium in Groundwater

1.3.3 200-ZP-1 Operable Unit Interim Remedial Measure

The DOE currently operates an IRM pump-and-treat system to minimize further migration of carbon tetrachloride, chloroform, and TCE in the 200 West Area groundwater in accordance with the *Record of Decision for the USDOE Hanford 200-ZP-1 Operable Unit, 200 Area NPL Site Interim Remedial Measure* (EPA/ROD/R10-95/114). This system has been in operation since 1994, extracting more than 4 billion L (1,057 million gal) of groundwater, removing >11,415 kg (25,165 lb) of carbon tetrachloride. Additional information on the IRM is provided in the 200-ZP-1 proposed plan (DOE/RL-2007-33) and the FS (DOE/RL-2007-28).

During IRM pump-and-treat system operations, carbon tetrachloride concentrations have decreased in the original target area (defined as the concentration within the 2,000 to 3,000 µg/L contour). The IRM pump-and-treat system was expanded by adding additional extraction wells between fiscal year 2005 (FY05) and FY08. The IRM pump-and-treat system currently includes 14 extraction wells and 5 injection wells (Figure 1-9).

The response action addressed by the 200-ZP-1 OU ROD will implement the final components of the pump-and-treat RA for the 200-ZP-1 OU. The IRM will continue to operate until such time that the new pump-and-treat system is operational. Once the new system is operational, the IRM extraction wells may be used to augment contaminant recovery performance.

1.3.4 200-PW-1 Operable Unit Interim Remedial Measure

Soil vapor extraction (SVE) was initiated in 1992 as a CERCLA interim RA to remove carbon tetrachloride from the vadose zone in the 200 West Area. The objective of the interim action, as stated in the *Action Memorandum: Expedited Response Action Proposal for 200 West Area Carbon Tetrachloride Plume* (EPA and Ecology 1992), is to mitigate the threat to site workers, public health, and the environment caused by the migration of carbon tetrachloride vapors through the soil column and into the groundwater.

1.3.4.1

The SVE system has been in operation at the three primary disposal sites that received liquid wastes containing carbon tetrachloride. The SVE system extracts contaminated soil vapor through wells that are screened in the vadose zone. The contaminated vapor is treated using aboveground canisters containing granular activated carbon (GAC), which adsorbs the carbon tetrachloride from the vapor. Between April 1991 (when the pilot test was conducted) and September 2008, the total mass of carbon tetrachloride removed from all sites was 79,400 kg (175,047 lb).

1.3.5 Groundwater Monitoring at 200-ZP-1 Operable Unit

Groundwater monitoring is performed for two treatment, storage, or disposal units consisting of tank farm WMAs (T and TX-TY), Low-Level Waste Management Area 3 (LLWMA-3), and LLWMA-4. Groundwater at these facilities is monitored under the requirements of RCRA for hazardous waste constituents and the requirements of the *Atomic Energy Act of 1954* (AEA) for radionuclides including source, special nuclear, and by-product materials. Data for facility-specific monitoring are also integrated into the CERCLA groundwater investigations.

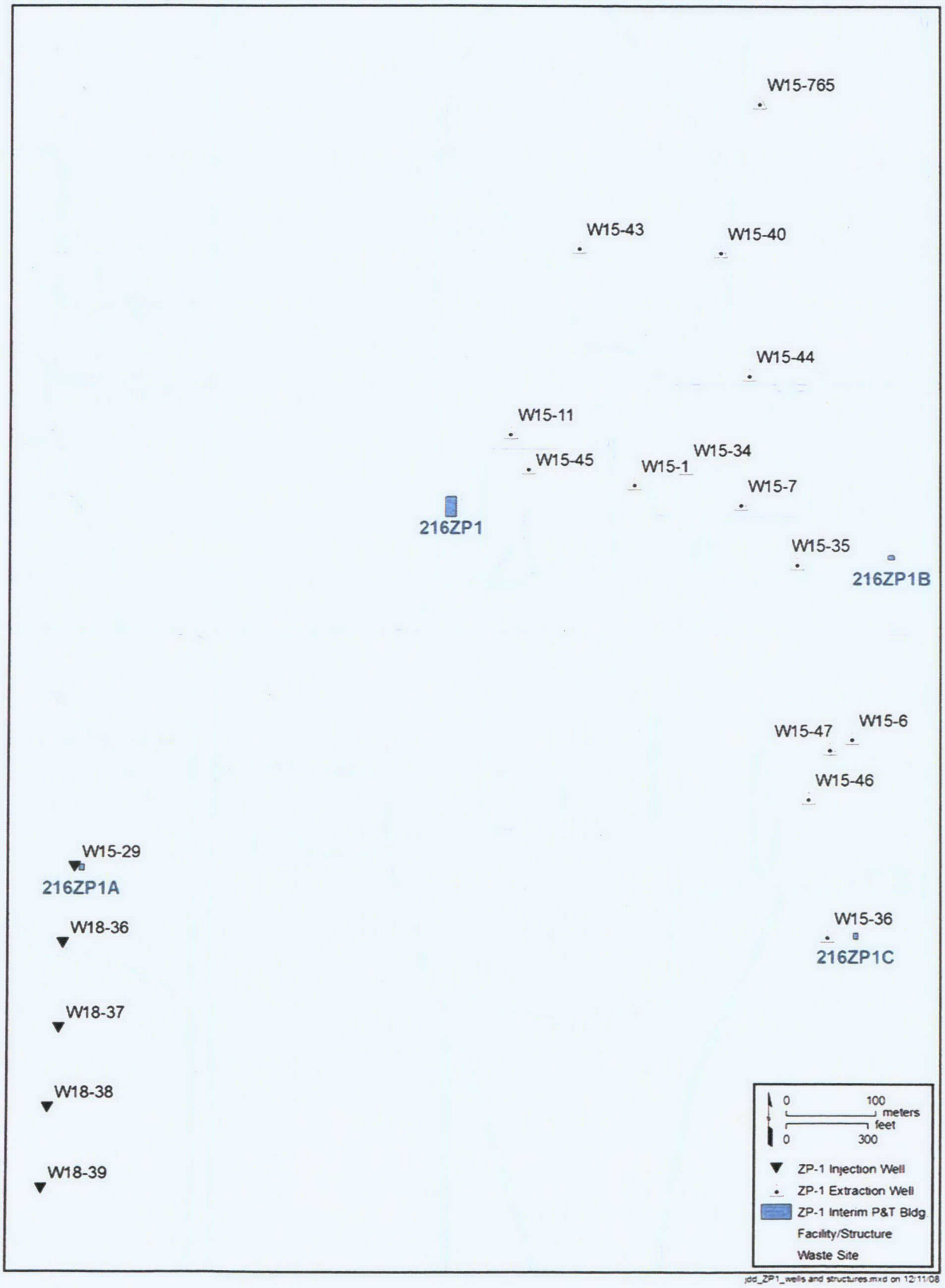

Figure 1-9. 200 West Area Interim Pump-and-Treat System

Groundwater at single-shell tank farm WMA T is monitored under RCRA interim status groundwater quality assessment requirements (40 CFR 265.93[d], "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Preparation, Evaluation, and Response," as referenced by *Washington Administrative Code* [WAC] 173-303-400, "Dangerous Waste Regulations," "Interim Status Facility Standards"). The objective for groundwater quality assessment is to assess the extent and rate of movement of dangerous waste in groundwater that has a source from the WMA. Waste constituents found in groundwater near WMA T include chromium, fluoride, and nitrate. Radioactive constituents include tritium and technetium-99.

Groundwater at single-shell tank farm WMA TX-TY is also monitored under interim status groundwater quality assessment requirements (40 CFR 265.93[d], as referenced by WAC 173-303-400). Waste constituents found in groundwater near WMA TX-TY are chromium and nitrate. Radioactive constituents include iodine-129, tritium, and technetium-99.

Groundwater at LLWMA-3 and LLWMA-4 is monitored under RCRA interim status indicator evaluation requirements (40 CFR 265.93[b], as referenced by WAC 173-303-400), and the radioactive waste management requirements of the AEA (DOE O 435.1, *Radioactive Waste Management*). Monitoring for RCRA is conducted to determine if the unit has impacted groundwater with dangerous constituents. Samples are collected for RCRA indicator and site-specific parameters. Monitoring for AEA is conducted to determine if the unit has impacted groundwater with radioactive constituents.

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2 Basis for Remedial Action

The NCP establishes a national expectation for cleanup of groundwater at CERCLA sites: "EPA expects to return useable ground waters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site" (40 CFR 300.430). The EPA generally defers to state agency definitions of useable groundwater provided under the various comprehensive state groundwater protection programs administered by the states across the country. Based on physical yield and natural water quality, the State of Washington, through its groundwater protection program, has determined that the aquifer setting for the 200-ZP-1 OU meets the WAC definition for potable groundwater and has been recognized by the state as a potential source of domestic drinking water.

Consistent with the state's beneficial use determination, the goal of this remedial action is restoration of groundwater within the 200-ZP-1 Operable Unit. For the purposes of this remedy, "beneficial use" has been defined as the use of the groundwater as a domestic drinking water source.

The 200-ZP-1 OU ROD states that a CERCLA response action is necessary for the 200-ZP-1 OU groundwater because of the following conditions.

- The cumulative excess carcinogenic risk to an individual exceeds 10^{-4} using reasonable maximum exposure assumptions for potential beneficial use of the groundwater.
- The noncarcinogenic hazard index is greater than one using reasonable maximum exposure assumptions for potential beneficial use of the groundwater.
- Chemical-specific standards (e.g., drinking water standards) that define acceptable risk levels are exceeded and exposure to contaminants above these acceptable levels is predicted for the reasonable maximum exposure for potential beneficial use of the groundwater.

2.1 Selected Remedy

A detailed analysis of possible alternatives for remediating the 200-ZP-1 OU addressing the key factors of scale, complexity, and restoration timeframe is presented in Section 10.0 of the 200-ZP-1 OU ROD. Because there is no single technology capable of meeting the cleanup levels for the 200-ZP-1 OU, the selected remedial alternative will employ multiple components (i.e., pump-and-treat, MNA, flow-path control, and institutional controls).

The primary component of the 200-ZP-1 OU remedy is the installation of a pump-and-treat system to contain and capture a large fraction of the mass of contamination (i.e., 95 percent of the dissolved mass of carbon tetrachloride) early in the remedy's lifecycle (i.e., 25 years). However, the effectiveness of the pump-and-treat system will diminish over time, whereas the effectiveness of natural attenuation is relatively constant. As a result, natural attenuation will eventually become the dominant mechanism for continued reduction of contaminant concentrations. The effectiveness of the remedy is further enhanced by controlling the direction and rate of groundwater flow throughout the 200-ZP-1 OU using strategically placed extraction and injection wells in the flow-path control component. Institutional controls provide protection from exposure to groundwater contamination for both site workers and potential future users of groundwater until cleanup levels are achieved.

The overarching requirement is to meet the groundwater cleanup levels identified in the 200-ZP-1 OU ROD within 125 years. Monitoring shall be conducted to evaluate the performance of pump-and-treat system, flow-path control, and MNA and shall be designed and operated as follows:

- To demonstrate whether the pump-and-treat system will remove at least 95 percent of the dissolved mass of carbon tetrachloride in 25 years or less and whether the RA being taken, including natural attenuation, will achieve cleanup levels for all COCs within 125 years
- To detect changes in environmental conditions (e.g., hydrogeologic, geochemical, microbiological, or other changes) that may reduce the effectiveness of the pump-and-treat system, natural attenuation processes, and the flow-path control actions
- To identify any potentially toxic and/or mobile transformation products
- To verify that the contamination is not expanding downgradient, laterally or vertically, subsequent to the period of time over which the pump-and-treat component has been functional
- To detect new releases of contaminants of concern to the environment that could impact the effectiveness of the remedy
- To verify attainment of remediation requirements.

The four major components of the 200-ZP-1 OU RA are further discussed in the following subsections.

2.1.1 Groundwater Extraction and Treatment

The primary component of the 200-ZP-1 OU remedy is installation of a groundwater pump-and-treat system that will be designed and implemented in combination with MNA to achieve cleanup levels listed in Table 11 of the ROD and Section 2.3 of this RD/RA work plan for all COCs in 125 years. The 200-ZP-1 OU ROD states that the pump-and-treat system will be designed to capture and treat contaminated groundwater to reduce the dissolved mass of carbon tetrachloride, total chromium (trivalent [III] and hexavalent [VI]), nitrate, TCE, iodine-129, and technetium-99 throughout the 200-ZP-1 OU by a minimum of 95 percent in 25 years. The 200-ZP-1 OU ROD further clarified that 95 percent of the carbon tetrachloride mass currently residing in the aquifer corresponds to groundwater concentrations >100 µg/L. Since the other COCs that require pump-and-treat remediation all reside within the carbon tetrachloride plume and are concentric (except nitrate), remediation of the carbon tetrachloride to approximately <100 µg/L is also expected to sufficiently remediate the other COCs so the cleanup levels will be achieved in 125 years.

Nitrate has a number of sources, both from within and outside of the Hanford Site, and it is widespread in Hanford groundwater. It is found within all four groundwater OUs on the Central Plateau, and each OU will address nitrate within its boundaries. Only the nitrate contamination within the portion of the carbon tetrachloride plume to be remediated is addressed under this RA. The 200-ZP-1 OU groundwater extraction and treatment component will treat the nitrate to achieve the cleanup level before returning the treated water to the aquifer through the injection wells.

There is no viable treatment technology to remove tritium from the groundwater. However, because the half-life of tritium (12.33 years) is sufficiently short, it will decay to below the cleanup standard before it leaves the industrial land-use zone.

The RD will also consider the need for treatment of other constituents (e.g., uranium) that may be captured by the 200-ZP-1 OU extraction wells. While not COCs for the 200-ZP-1 OU, such constituents may be encountered during restoration from sources related to the other adjacent groundwater OUs.

Following extraction, the treated COCs in groundwater will achieve the identified cleanup levels before being returned to the aquifer through injection wells.

2.1.2 Monitored Natural Attenuation

In addition to the pump-and-treat system, the remedy for the 200-ZP-1 OU includes natural attenuation processes to reduce concentrations to below the cleanup levels. Natural attenuation will eventually become the dominant mechanism for continued reduction of contaminant concentrations in the 200-ZP-1 OU as the effectiveness of the pump-and-treat system diminishes over time. Because there is no viable treatment technology for tritium from the groundwater in the pump-and-treat system, the short half-life of tritium will allow natural attenuation to reduce its concentration over time to meet the cleanup levels.

For the remaining portion of the carbon tetrachloride and nitrate (as well as tritium) not captured by the pump-and-treat component, natural attenuation processes will be used to reduce concentrations to the cleanup levels.

Natural attenuation processes to be relied on as part of this component include biotic and abiotic degradation, dispersion, sorption, and, for tritium, natural radioactive decay. Monitoring will be employed in accordance with an approved operations and maintenance (O&M) plan to evaluate the effectiveness of the pump-and-treat system and natural attenuation processes. Fate and transport analyses conducted as part of the FS indicate that the timeframe necessary to reduce the remaining COC concentrations to acceptable levels through MNA will be approximately 100 years. Modeling also indicates that this portion of the plume area will remain on the Central Plateau geographic area (Figure 1-1) during this timeframe.

2.1.3 Flow-Path Control

A flow-path control component is part of the 200-ZP-1 OU RA and will involve injecting the treated groundwater into the aquifer to the northeast and east of the groundwater contamination. The injected groundwater in these locations will slow the natural eastward flow of most of the groundwater and, as a result, will keep the higher concentration contamination within the capture zone, as well as increasing the time available for natural attenuation processes to reduce the contaminant concentrations not captured by the extraction wells.

Flow-path control shall also be used to minimize the potential for groundwater in the northern portion of the aquifer to flow northward through Gable Gap and toward the Columbia River. The injection wells will be located to re-direct the groundwater flow to the east, which is the longest groundwater flow path to the river (about 26 km [16 mi]).

2.1.4 Institutional Controls

The 200-ZP-1 OU ROD requires institutional controls for the 200-ZP-1 groundwater until cleanup levels are met. Institutional controls are instruments (e.g., administrative and/or legal restrictions) that are designed to control or eliminate specific pathways of exposure to contaminants. For instance, for groundwater at Hanford, institutional controls are in place prohibiting the installation and use of groundwater wells for purposes other than monitoring, characterization, and cleanup. An existing source of potable water is provided to facilities on the Central Plateau and will continue to be available, so there is no demand for groundwater. Groundwater use would be restricted until cleanup levels are achieved.

The *Sitewide Institutional Controls Plan for Hanford CERCLA Response Actions* (DOE/RL-2001-41) identifies the current institutional controls for the Hanford Site. It also describes how institutional controls are implemented and maintained, serving as a reference point for the selection of institutional controls for the future. The current plan provides a foundation from which to identify the long-term controls needed to prevent exposure during the restoration timeframe. The Sitewide institutional controls plan will be updated to include the following institutional controls required to be met as part of the remedial action selected in the 200-ZP-1 OU ROD.

The DOE shall control access to prevent unacceptable exposure of humans to contaminants in the 200-ZP-1 OU groundwater addressed in the scope of the ROD until the remedy is complete. Visitors entering any site areas of 200-ZP-1 OU will be required to be badged and escorted at all times.

- No intrusive work shall be allowed in the 200-ZP-1 OU unless EPA has approved the plan for such work and that plan is followed.
- The DOE shall prohibit well drilling in the 200-ZP-1 OU, except for monitoring, characterization, or remediation wells authorized in EPA-approved documents.
- Groundwater use in the 200-ZP-1 OU is prohibited, except for limited research purposes, monitoring, and treatment authorized in EPA-approved documents. The Sitewide institutional controls plan will contain the institutional controls and implementing details prohibiting well drilling and groundwater use in the 200-ZP-1 OU, as defined in the ROD.
- The DOE shall post and maintain warning signs along pipelines conveying untreated groundwater that caution site visitors and workers of potential hazards from the 200-ZP-1 OU groundwater.
- In the event of any unauthorized access to the site (e.g., trespassing), DOE shall report such incidents to the Benton County Sheriff's Office for investigation and will consider administrative debarment of the trespasser as well as prosecution in State or Federal court as deemed appropriate.
- Activities that would disrupt or lessen the performance of the pump-and-treat, MNA, and flow-path control components of the remedy are to be prohibited.
- The DOE shall prohibit activities that would damage the pump-and-treat, MNA, and flow-path control components (e.g., extraction wells, injection wells, piping, treatment plant, and monitoring wells).
- The DOE shall report on the effectiveness of institutional controls for the 200-ZP-1 OU remedy in an annual report, or on an alternative reporting frequency specified by EPA. Such reporting may be for this OU alone or may be part of a Hanford Sitewide report.
- Most of the land within the 200-ZP-1 OU has been designated by DOE, through a long-term land use planning document, for industrial use for the foreseeable future. Because it contains facilities which will have long-term responsibility for disposal or storage of hazardous substances, the possibility that this property could qualify for transfer of title out of the Federal government is remote, especially in light of the exacting requirements of CERCLA Section 120(h) for transfers of contaminated Federal land. Because the 200 Area was principally withdrawn from the Public Domain, if the land ever became surplus to the needs of DOE, Federal law requires that it be turned over to the Bureau of Land Management. Nevertheless, as a general policy to ensure continuity of Institutional Controls that have been selected as part of any remedial action at the Hanford Site, DOE has made the following commitments to EPA Region 10. The DOE will provide noticc to EPA at least 6 months prior to any transfer or sale of the any land above the 200-ZP-1 OU so EPA can be involved in discussions to ensure that appropriate provisions are included in the transfer terms or conveyance documents to maintain effective institutional controls. If it is not possible for DOE to notify EPA at least 6 months prior to any transfer or sale, then DOE will notify EPA as soon as possible but no later than 60 days prior to the transfer or sale of any property subject to institutional controls. In addition to the land transfer notice and discussion provisions above, DOE further agrees to provide EPA with similar notice, within the same timeframes, as to Federal-to-Federal transfer of property. The DOE shall provide a copy of executed deed or transfer assembly to EPA.

- The DOE will prevent the development and use of property above the 200-ZP-1 OU for residential housing, elementary and secondary schools, childcare facilities, and playgrounds.
- Land-use controls will be maintained until cleanup levels are achieved and the concentrations of hazardous substances in groundwater are at such levels to allow for unrestricted use and exposure and EPA authorizes the removal of restrictions.

2.2 Remedial Action Objectives

This section presents the RAOs for the 200-ZP-1 OU groundwater, as identified in the 200-ZP-1 OU ROD. The RAOs are site-specific objectives that define the extent of cleanup necessary to achieve the specific level of remediation at the site.

- RAO #1: Return 200-ZP-1 OU groundwater to beneficial use (restore groundwater to achieve domestic drinking water levels) by achieving the cleanup levels (provided in Table 11 of the 200-ZP-1 OU ROD). This objective is to be achieved within the entire 200-ZP-1 OU groundwater plumes. The estimated timeframe to achieve cleanup levels is within 150 years[1].
- RAO #2: Apply institutional controls to prevent the use of groundwater until the cleanup levels (provided in Table 11 of the 200-ZP-1 OU ROD) have been achieved. Within the entire OU groundwater plumes, institutional controls must be maintained and enforced until the cleanup levels are achieved, which is estimated to be within 150 years[1].
- RAO #3: Protect the Columbia River and its ecological resources from degradation and unacceptable impact caused by contaminants originating from the 200-ZP-1 OU. This final objective is applicable to the entire 200-ZP-1 OU groundwater plume. Protection of the Columbia River from impacts caused by 200-ZP-1 OU contaminants must last until the cleanup levels are achieved, which is estimated to be within 150 years[1].

2.3 Cleanup Levels

The final cleanup levels for the 200-ZP-1 OU COCs are listed in Table 2-1. These cleanup levels were developed using Federal MCLs; the criteria and equations in the *Model Toxics Control Act* (MTCA) Method B cleanup levels for potable groundwater (WAC 173-340-720[4][b][iii][A] and [B], and WAC 173-340-720[7][b]); and the Federal and state water standards for radionuclides.

2.4 Remedy Performance Monitoring

Monitoring will be conducted to evaluate the effectiveness of the RA to attain the cleanup levels identified in the 200-ZP-1 OU ROD. This monitoring will address the different components associated with the RA, including the treatment system, extraction well network, and monitoring well network. The details for this monitoring plan will be developed during the design and will be included in the O&M plan.

An integrated groundwater monitoring plan will also be prepared that addresses the monitoring requirements for all programs impacted by the 200 West Area pump-and-treat system. Given the necessary integration of this plan with the other groundwater monitoring programs in the 200 West Area, it will be submitted as a separate, stand-alone document. The approach and goals of the performance monitoring plan and the integrated groundwater monitoring plan are described in the following subsections.

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1 The RAOs identify the estimated timeframe to achieve cleanup levels as 150 years. Further requirements in the 200-ZP-1 OU ROD identify this timeframe as 125 years, which is more conservative than the RAO.

2.4.1 Treatment System Performance Monitoring

Performance monitoring of the treatment system will be designed to evaluate COC removal and compliance with the final cleanup levels for the 200-ZP-1 OU groundwater. The design will include both hydraulic and chemical monitoring of the treatment system. Hydraulic monitoring will consist of measuring flow rates and total flow at the treatment system influent. This monitoring, along with the contaminant concentrations of the influent and effluent water, will be used to determine the contaminant mass reduction from the treatment system.

Chemical monitoring will consist of treatment system influent and effluent sampling for the COCs specified in the 200-ZP-1 OU ROD. The goals are to determine whether the treatment system is reducing contaminant concentrations to levels below final cleanup levels for 200-ZP-1 groundwater and to ensure compliance with these standards. Initially, monthly sampling frequency will be performed for all COCs. Real-time monitoring of the most abundant COCs (nitrate and carbon tetrachloride) may be performed if current technology can cost effectively achieve the necessary detection limits.

Table 2-1. Final Cleanup Levels for 200-ZP-1 Operable Unit Groundwater

				Model Toxics Control Act Method B Cleanup Levels		
COC	90th Percentile Concentration	Federal MCL	State MCL	Non-Carcinogens	Carcinogens at 10^{5} Risk Level	Final Cleanup Level
Carbon tetrachloride	2,900	5	5	5.6	3.4	3.4
Chromium (total)	130	100	100	24,000	-	100
Hexavalent chromium	203	N/A[a]	N/A[a]	48	-	48
Nitrate	81,050	10,000	10,000	25,600	-	10,000[b]
Trichloroethylene (TCE)	10.9	5	5	2.4	1[c]	1[d]
Iodine-129	1.2	1	1	-	-	1
Technetium-99	1,442	900	900	-	-	900
Tritium	36,200	20,000	20,000	-	-	20,000

a. There is no MCL specific to hexavalent chromium.

b. Nitrate may be expressed as total nitrate (NO_3) or as nitrogen (N). The MCL for nitrate as NO_3 is 45,000 µg/L, and the same concentration expressed as N is 10,000 µg/L.

c. The *Model Toxics Control Act* Method B cleanup levels for carbon tetrachloride and TCE are from Ecology's Cleanup Levels and Risk Calculations (CLARC) table current as of September 25, 2008.

d. The DOE will clean up COCs for the 200-ZP-1 OU subject to WAC 173-340, "Model Toxics Control Act – Cleanup" (carbon tetrachloride and TCE), so the excess lifetime cancer risk does not exceed 1 x 10^{-5} at the conclusion of the remedy.

Table 2-1. Final Cleanup Levels for 200-ZP-1 Operable Unit Groundwater

				Model Toxics Control Act Method B Cleanup Levels		
COC	**90th Percentile Concentration**	**Federal MCL**	**State MCL**	**Non-Carcinogens**	**Carcinogens at 10^{-5} Risk Level**	**Final Cleanup Level**

The content of this table was taken directly from Table 11 of the *Record of Decision, Hanford 200 Area, 200-ZP-1 Superfund Site, Benton County, Washington* (EPA et al. 2008).

Units are "µg/L" for nonradionuclides and "pCi/L" for radionuclides.

Federal MCL values from 40 CFR 141, "National Primary Drinking Water Regulations," with iodine-129 and technetium-99 values from EPA's *Implementation Guidance for Radionuclides* (EPA 816-F-00-002).

State MCL values from WAC 246-290, "Public Water Supplies."

CFR = *Code of Federal Regulations*
COC = contaminant of concern
DOE = U.S. Department of Energy
Ecology = Washington State Department of Ecology
EPA = U.S. Environmental Protection Agency
MCL = maximum contaminant level
N/A = not applicable
OU = operable unit
TBD = to be determined
WAC = *Washington Administrative Code*

2.4.2 Extraction Well Network Performance Monitoring

Performance monitoring of the extraction well network will be designed to evaluate contaminant mass removal from the 200-ZP-1 OU aquifer. The design will include both hydraulic and chemical monitoring of the extraction wells. Hydraulic monitoring will consist of measuring flow rates, total flow, and water levels for each extraction well.

The flow measurements will be used in conjunction with the chemical monitoring data to calculate the rate of contaminant mass removal and the total contaminant mass removed by each extraction well. The calculated mass removal rates will be used to evaluate whether the extraction well field is capable of removing the required contaminant mass within the 25-year operational period. Extraction well field operation will be modified as needed on the basis of this evaluation.

Water-level measurements will be used to evaluate whether the extraction and injection wells are operating within their design criteria. Well discharge rates may be adjusted on the basis of this data to optimize the drawdown in each extraction well. The water-level measurement data will not be used to evaluate hydraulic capture of the contaminant plumes by the extraction wells. Due to well inefficiencies and losses, extraction well water levels are not expected to be representative of the aquifer and typically over-estimate hydraulic capture.

Chemical monitoring will consist of extraction well discharge sampling for the COCs specified in the 200-ZP-1 OU ROD. The chemical monitoring program will also sample for biological and abiotic degradation products of carbon tetrachloride (e.g., chloroform and dichloromethane). As previously discussed, the extraction well analytical data will be used in conjunction with the flow monitoring data to calculate the rate of contaminant mass removal and total contaminant mass removed by each extraction well. During startup, monthly sampling frequency will be performed for all COCs and degradation products. Once contaminant concentration trends have been identified, the sampling frequency will be reduced.

2.4.3 Monitoring Well Network Performance Monitoring

Performance monitoring of the well network will ensure that the appropriate data are being collected to evaluate remedy performance in the aquifer. There are more than 100 monitoring wells in the 200-ZP-1 OU that will be evaluated for use during performance monitoring. The monitoring well network developed for site characterization activities will form the initial basis for the performance monitoring. However, characterization wells installed with the objective of defining the nature and extent of contamination may not be sufficient to evaluate active remediation sites. Due to this potential concern, the existing monitoring well network will be evaluated using a statistical evaluation tool to help identify redundancies or deficiencies in the monitoring network, identify essential monitoring locations, determine an optimum sampling frequency, and assess the relative importance of individual monitoring points. This effort may result in the identification of additional monitoring well locations for aquifer monitoring.

The performance monitoring well network is expected to include areas near the source, contaminated zones of highest concentration and mobility, areas immediately downgradient of active waste management units, plume fringes or distal areas exhibiting low contaminant concentrations, and plume boundaries or other compliance boundaries. Once an appropriate monitoring well network has been established to evaluate the objectives, performance monitoring activities will be implemented. The design will include both hydraulic and chemical monitoring of the monitoring well network. A baseline will be established for the well network prior to the startup of the pump-and-treat component of the selected remedy.

Hydraulic monitoring will consist of measuring water levels at each monitoring well. The water-level data will be used to generate a potentiometric surface for the unconfined aquifer at the OU. Using the groundwater flow model and particle-tracking analysis, this information will be used to evaluate groundwater capture by the extraction well field and flow-path control by the injection well field.

Chemical monitoring will consist of sampling monitoring wells for COCs, potential degradation byproducts (e.g., chloroform and dichloromethane), and geochemical parameters to support the evaluation of natural attenuation. The geochemical groundwater parameters used in the natural attenuation evaluation of chlorinated solvents and nitrate are presented in *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water* (EPA 600/R-98/128). In addition to these parameters, site-specific parameters may be identified to better understand the ability of natural attenuation process given the conditions in the 200 West Area.

Monitoring frequency is anticipated to be quarterly during the baseline sampling of the selected wells. Once contaminant concentration trends have been established, the sampling frequency will be reduced during the operation period of the RA.

2.4.4 Integrated Groundwater Monitoring

An integrated groundwater monitoring plan will be developed for all monitoring programs within the 200 West Area to address changing hydrologic and contaminant plume conditions due to the 200 West Area pump-and-treat system. This plan will be a stand-alone document and not tied to the implementation of the 200-ZP-1 OU remedy. It will ensure that monitoring activities meet the requirements for remediation performance monitoring under CERCLA, groundwater monitoring under RCRA, and sitewide surveillance monitoring under the AEA. Ecology will either determine that the monitoring plan meets HWMA requirements for regulated units as alternative requirements under WAC 173-303-645(1)(e) and are satisfactory to serve as monitoring for other treatment storage disposal (TSD) units, or Ecology will impose required unit monitoring through conditions in the Sitewide Permit.

Consistent with the state's acceptance of the 200-ZP-1 OU ROD and the *Hanford Site Groundwater Strategy – Protection, Monitoring, and Remediation* (DOE/RL-2002-59), the objective of this effort is to develop a single, integrated monitoring plan that achieves the following:

- Satisfies regulatory requirements
- Integrates RCRA, CERCLA, and AEA requirements by using CERCLA monitoring wells to satisfy the TSD Unit monitoring and post-closure monitoring required by RCRA and the environmental monitoring required by the AEA and implementing DOE Orders
- Minimizes duplication and reduce inconsistencies for monitoring that arise from the multiple regulations
- Supports groundwater cleanup decisions in a timely, effective, and efficient manner.

Ultimately, it is expected that a single monitoring plan will be developed that satisfies the monitoring requirements for all programs within the 200 West Area. The integrated monitoring plan will be referenced in the appropriate regulatory document while the active pump-and-treat remediation is in progress.

The approach for developing the integrated monitoring plan will follow the data quality objective (DQO) process, as described in the *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA/240/B-06/001). First, only those programs impacted by the 200 West Area pump-and-treat system will be included in the integrated monitoring plan. Programs that are not impacted will be acknowledged but not carried further in the evaluation. Second, it is critical to have significant DOE and regulatory agency involvement during development of the DQO summary requirements for each program that will establish the basis for the DQO summary report. An important aspect of this effort will be to develop a strategy on how the integrated monitoring plan will be implemented for each regulatory program. Finally, a long-term approach to groundwater monitoring needs to be developed that addresses the continually changing conditions in the 200 West Area due to impacts from the pump-and-treat system.

The development of the DQO summary requirements and implementation strategy will begin directly following approval of the 200-ZP-1 RD/RA work plan. It is expected that the draft DQO summary report will coincide with the 60 percent design and will be provided to DOE and the regulatory agencies for review at that time. The DQO summary report will then be issued and the sampling and analysis plan (SAP) for the 200 West Area integrated groundwater monitoring will be prepared. A schedule for the development of the integrated groundwater monitoring plan is provided in Chapter 7.

2.5 Applicable or Relevant and Appropriate Requirement Compliance

The applicable or relevant and appropriate requirements (ARARs) implementation strategy for the 200-ZP-1 OU RA is provided in the appendix.

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3 Remedial Design Approach

3.1 Design Basis

3.1.1 Phased Implementation Approach

Implementation of the 200 West Area pump-and-treat system will be performed in a phased manner to initiate groundwater treatment as soon as possible, while at the same time allowing efficient construction of the entire system and still providing a high probability of achieving the performance objective to reduce 95 percent of the dissolved mass of carbon tetrachloride within 25 years. A preliminary evaluation of the potential pump-and-treat performance to meet this objective was completed using groundwater modeling (see Section 3.1.2) and suggests that it can be achieved through phased implementation. Using these results as a guide, the RA will be implemented in the following three phases:

- System Construction (Phase I):
  - Interim pump-and-treat system remains operational
  - New facility startup by December 31, 2011
- Initial Operations/Performance Monitoring/System Optimization (Phase II):
  - Initial treatment facility operations
  - Interim pump-and-treat system shutdown
  - Performance monitoring
  - System optimization (including expansion), as required
- Long-Term Operations (Phase III):
  - Long-term treatment facility operations
  - Performance monitoring
  - System optimization (including expansion), as required.

This phased approach allows optimization of the system based on data from contaminant distribution and aquifer properties collected during construction and performance data from the initial operations. A flow chart illustrating the 200-ZP-1 pump-and-treat phased implementation is provided in Figure 3-1, with the major aspects for each phase described in the following subsections. Adjustments to the system design and operating parameters will occur throughout the lifecycle of this project and will be based on actual system performance against the RAO.

In anticipation of future expansion, the 200 West Area groundwater treatment system will also be capable of treating some of the contaminated groundwater from the 200-UP-1 OU. Initially, the system will be able to treat up to 189 L/min (50 gpm) of contaminated groundwater from the 241-S/SX Tank Farm. Following initial operations, it is anticipated that the system will be expanded to provide the necessary treatment capabilities for the contaminated groundwater in the 200-UP-1 OU following a final decision.

3.1.1.1 System Construction (Phase I)

Phase I includes the design and construction of the treatment facility, extraction and injection wells, and associated infrastructure to support initial operations. Based on the preliminary modeling, the system will be designed to operate at a nominal rate of approximately 3,785 L/min (1,000 gpm). Components of the treatment system such as buildings, piping, power, etc., may also be sized to allow future expansion without requiring significant modifications.

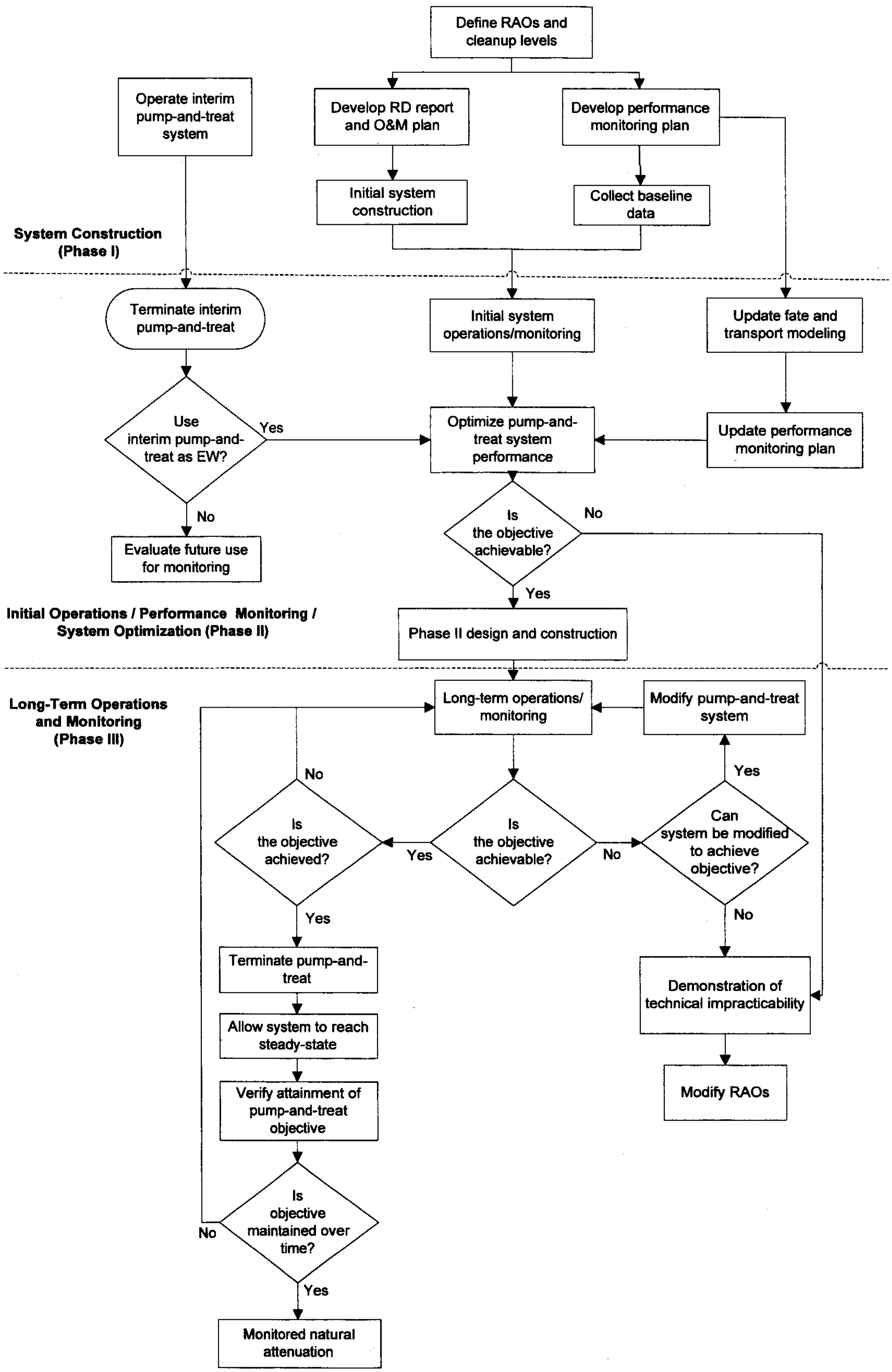


Figure 3-1. Phased Implementation Approach for the 200 West Area Pump-and-Treat System

The treatment system will be designed to achieve cleanup levels for all COCs (except tritium) prior to reinjection. A separate treatment system for iodine-129 will not be provided during this phase due to the expected low concentrations of the influent water (see Section 3.1.2.4) and the ability of the planned treatment system to deal with this contaminant. A decision whether a separate system for iodine-129 treatment is necessary will be made during Phase II, based on the iodine-129 concentrations from the extraction wells and the results from initial operations.

Sufficient extraction and injection wells will be installed to achieve the required treatment capacity. The current conceptual design for the pump-and-treat system at the end of Phase I construction calls for 14 new extraction wells and 6 new injection wells. The initial extraction wells will be located within the carbon tetrachloride plume having the highest estimated mass removal. The placement of subsequent extraction wells will be based on results from the aquifer testing and baseline groundwater data collected from the previously installed wells. The initial injection wells will be located to the east to slow contaminant migration in that direction. Additional injection wells will be added based on their performance.

Phase I includes further development of a groundwater flow and contaminant transport model, as well as the development of contaminant plume shells for use in predictive simulations for remedy design. Flow modeling combined with particle tracking will help to identify well locations and pumping rates necessary to target achieving the performance objective. The groundwater model will be updated as necessary to improve the well field configuration as new information becomes available.

A performance monitoring plan will be developed during Phase I and included with the O&M plan. This plan will identify the compliance and performance monitoring wells that will be used to monitor system performance, including whether additional monitoring wells will be required. If additional monitoring wells are required, the wells will be installed during Phase II. This plan will identify the baseline sampling requirements with the expectation that the existing monitoring well network will be used to the maximum extent possible. Baseline sampling of the existing monitoring wells will be completed during Phase I and will provide the basis to evaluate system performance and input for system optimization during the following phase.

3.1.1.2 Initial Operations/Performance Monitoring/System Optimization (Phase II)

Phase II includes initial system operation, performance monitoring, and optimization of both the treatment system and well network to provide sufficient capacity to target achieving the performance objective. This phase is expected to last approximately 3 years, with the first year dedicated to system monitoring and evaluation; the second year primarily associated with optimization, design, and long-lead procurements; and the third year for construction of system expansion, as necessary. By the end of this phase, the system should be installed and operating at sufficient capacity to transition into long-term operations. Current conceptual design at the end of Phase II calls for a total of 20 extraction wells and 16 injection wells.

The optimization effort will use the baseline sampling and testing performed during the construction, combined with the system performance, to (1) establish the necessary pump-and-treat capacity; (2) determine whether the existing treatment capabilities are sufficient for all COCs (except tritium); (3) determine whether the existing treatment system capabilities require upgrading to treat other groundwater contaminants captured by the pump-and-treat system (e.g., uranium treatment); and (4) identify the optimum number and location of the extraction and injection wells. Significant system upgrades will be documented in revisions to the RD report and O&M plan.

Construction during this phase will include additional treatment train(s), as well as additional extraction and injection wells (as necessary), to provide sufficient capacity to target achieving the performance objective. Depending on the iodine-129 concentrations in the extraction wells and the existing treatment system efficiency, construction may also include a separate system for iodine-129 treatment. Phase II also includes the installation of any new compliance and performance monitoring wells that were identified during development of the performance monitoring plan.

At the end of this phase, the performance monitoring plan will be revised to incorporate the information collected to date. The groundwater flow and contaminant transport model will be updated to identify (1) COC concentration versus time at each extraction well, (2) COC mass recovery versus time for the system, and (3) fate of the contaminants not treated, as well as the contaminants in the reinjected water. This information will then be used to identify performance monitoring metrics to gauge the effectiveness of the system during long-term operations.

3.1.1.3 Long-Term Operations (Phase III)

Long-term operations will continue the operation of the pump-and-treat system as optimized during Phase II. System performance will continue to be monitored against the metrics established in the performance monitoring plan. Deviations from these metrics will be evaluated on a case-by-case basis and the system will be adjusted as necessary. Reporting of the long-term performance will coincide with the CERCLA 5-year review.

3.1.2 Contaminant Distribution and Design Basis Concentrations

This section summarizes the results of the preliminary fate-and-transport modeling that was performed to identify the initial well locations and extraction rates that may achieve the pump-and-treat performance objective to reduce the dissolved mass of carbon tetrachloride in the 200-ZP-1 OU by 95 percent in 25 years. This modeling was performed to support the conceptual design by helping to guide the initial placement of the well field and establish initial input concentrations for the treatment system. The final report describing this modeling effort and development of the design basis concentrations will be available as part of the 30 percent design.

3.1.2.1 Contaminant Distribution

The initial contaminant distributions were determined by using the concentration data measured from the existing wells and then approximating the concentrations between the wells using the following two estimation methods:

- An ordinary kriging method that produces a single depiction of the likely extent of a COC. This method was used to prepare initial conditions for all COCs.
- A multi-Gaussian (i.e., stochastic) simulation approach that produces multiple "realizations" of the likely extent of a COC, which are consistent with the spatial statistics of that COC. This method was used to prepare initial conditions for the most widespread COCs (i.e., carbon tetrachloride, nitrate, and technetium-99).

The differing mapping methods provide an indication of the potential impact of uncertainties in the distribution of the COCs. For the purposes of the RD, however, the COC depictions prepared using the ordinary kriging method are considered to be the "best estimate" of the distribution and were used in calculating the design basis concentrations. The COC depictions prepared using the stochastic simulation approach are considered to present an alternate (and typically higher) potential COC distribution, leading to a corresponding "potential" influent concentration at each extraction well.

When a single porosity value is used in simulations of contaminant migration and fate, the value plays two important roles: (1) as the porosity decreases, the calculated dissolved mass decreases and the estimated migration rate of contaminants decreases; (2) while as the porosity increases, the calculated dissolved mass increases, and the estimated migration rate of contaminants increases. To accommodate uncertainty in the value of a representative area-wide porosity, groundwater simulations and estimates of the mass of carbon tetrachloride were conducted using two values for the mobile porosity (0.13 and 0.18). The values of 0.13 and 0.18 are considered to represent approximate average and upper-bound mobile porosities, respectively, based on summarizes provided in previous and related studies, including *Spatial Analysis of Contaminants in the 200 West Area in Support of the 200-ZP-1 Operable Unit Pre-Conceptual Remedy Design* (PNNL-18100) and the 200-ZP-1 FS (DOE/RL-2007-28, Appendix D). As such, these two porosity values are considered to span a range that represents an approximate mean-valued porosity through to an approximate upper-bound-valued mobile porosity.

The estimated dissolved-phase contaminant masses/activities for each COC, which were calculated using an upper-bound aquifer porosity of 18 percent (0.18) and the two interpolation methods, are provided in Table 3-1. For carbon tetrachloride, the estimated dissolved-phase mass is also provided based on an average porosity of 13 percent (0.13). The variability in these two estimation methods is largely attributed to uncertainties in the point sample data (e.g., well design, sample coordinates, sample results, etc.) and the uncertain distribution of the contaminants in locations without sample data. Even in light of this uncertainty, reasonable agreement was achieved for the initial mass estimates of carbon tetrachloride and nitrate (differing by less than a factor of three). The mass of technetium-99 illustrates more variability between the two estimation techniques, with the lower mass estimate appearing to be more representative of the system based upon historical records.

Table 3-1. Estimated Dissolved-Phase Contaminant Mass/Activity

COC	Estimation Method	Dissolved Mass/ Activity
Carbon tetrachloride (Average porosity = 13%)	Kriging	35,281 kg
	Stochastic simulation (EAvg)	67,566 kg
Carbon tetrachloride (Upper-bound porosity = 18%)	Kriging	47,150 kg
	Stochastic simulation (EAvg)	93,500 kg
Nitrate (as NO_3)	Kriging	1.5E+7 kg
	Stochastic simulation (EAvg)	4.2+7 kg
Technetium-99	Kriging	27 Ci
	Stochastic simulation (EAvg)	230 Ci
Chromium (total)	Kriging	1,750 kg
Iodine-129	Kriging	0.03 Ci
Trichloethylene (TCE)	Kriging	228 kg
Tritium	Kriging	1,886 Ci

COC = contaminant of concern

The *Revised Geostatistical Analysis of the Inventory of Carbon Tetrachloride in the Unconfined Aquifer in the 200 West Area of the Hanford Site* (PNNL-18118) estimated the average total mass of carbon tetrachloride in the study area to be 120,093 kg (264,759 lb), of which 95.1 percent was found at aqueous concentrations of 100 µg/L or greater. This report also indicates that approximately 52.8 percent of this total mass is due to aqueous (dissolved) carbon tetrachloride, equating to about 63,400 kg (139,773 lb). This estimate for the dissolved carbon tetrachloride mass is bounded by the dissolved masses calculated by the two methods described above.

3.1.2.2 Groundwater Modeling Approach

The flow-and-transport simulations described in the 200-ZP-1 FS (DOE/RL-2007-28) and proposed plan (DOE/RL-2007-33) were used as the starting point to evaluate well configurations that would recover groundwater contaminated above 100 µg/L carbon tetrachloride and provide a hydraulic barrier to further eastward migration of these contaminants. A concentration of 100 µg/L was selected based on calculations performed as part of the FS (DOE/RL-2007-28) and PNNL-18100, which suggest that about 95 percent of the mass of carbon tetrachloride lies above a concentration of about 100 µg/L.

The groundwater flow model was calibrated to historic groundwater elevations throughout the 200-ZP-1 OU. The flow model calibration resulted in relatively good agreement between (1) simulated and measured changes in groundwater elevations at monitoring wells, and (2) contoured simulated and measured groundwater elevations and corresponding hydraulic gradients. Manual and automated parameter estimation techniques were used to adjust model parameter values during the calibration.

The contaminant transport simulations were completed for carbon tetrachloride, technetium-99, iodine-129, nitrate, TCE, chromium, tritium, and uranium using (Modular 3-D Transport Multi-Species *[MT3DMS] v5.2 Supplemental User's Guide* [Zheng and Wang 1999]; *A Modular Three-Dimensional Multi-Species Transport Model for Simulation of Advection, Dispersion, and Chemical Reactions of Contaminants in Groundwater Systems; Documentation and User's Guide* [Zheng 2006]). This is a three-dimensional, multi-species transport model for the simulation of advection, dispersion, and chemical reactions in groundwater that was developed specifically for use with MODFLOW. The transport parameters used for carbon tetrachloride are primarily based upon values provided in the FS (DOE/RL-2007-28). The parameters for the remaining COCs were based upon values provided in the FS; and on values presented in *Hanford Contaminant Distribution Coefficient Database and Users Guide* (PNNL-13895); and in *Geochemical Data Package for the Hanford Immobilized Low-Activity Tank Waste Performance Assessment (ILAW PA)* (PNNL-13307).

3.1.2.3 Preliminary Mass Reduction Estimates

Figures 3-2 through 3-4 depict the configuration of extraction and injection wells simulated for each of the following three phases of implementation, respectively.

- System Construction (Phase I): A 3-year period of continued operation of the existing interim pump-and-treat system. The current system, based on FY08 rates, consists of 14 extraction wells and 6 injection wells, with a total extraction/injection rate of about 1,332 L/min (352 gpm).
- Initial Operations/Performance Monitoring/System Optimization (Phase II): A 3-year period based upon the conceptual design for the initial operations. Initial operations includes 14 new extraction wells and 6 new injection wells, with a total extraction/injection rate of approximately 3,785 L/min (1,000 gpm) (which equates to about 272.5 L/min [72 gpm] at each extraction well and 632 L/min [167 gpm] at each injection well).
- Long-Term Operations (Phase III): A 22-year period consisting of 20 extraction wells and 16 injection wells, with a total extraction/injection rate of about 7,571 L/min (2,000 gpm) (equates to

about 378.5 L/min [100 gpm] at each extraction well and 473 L/min [125 gpm] at each injection well).

The rationale for the initial 14 new extraction wells is to (1) maximize carbon tetrachloride recovery, (2) initiate recovery of technetium-99, (3) use the existing interim pump-and-treatment system for the proposed aquifer test in EW-1, and (4) provide some containment on the eastern extent of the plume. The rationale for placement of the initial injection wells is to establish flow-path control to reduce eastern contaminant migration. As shown in Figure 3-4, it is currently planned that long-term operations will augment the existing well field installed with an additional 6 extraction wells and 10 injection wells.

Using this phased approach, the estimated amount of the initial dissolved mass of carbon tetrachloride that may be recovered in 25 years (i.e., extracted and treated) ranges from 57 percent to 100 percent, depending on the actual site conditions assumed (Table 3-2). These simulations are believed to represent the range in uncertainty in the site conditions, namely associated with the initial dissolved contaminant mass, distribution coefficient (range from 0.01 to 0.06), and porosity (range from 13 percent to 18 percent).

The simulations suggest that under suitable conditions, the remedy could recover a mass of carbon tetrachloride equivalent to or exceeding 95 percent of the corresponding initial (i.e., current) estimate of the dissolved mass. The simulations also suggest that the further the conditions encountered in the field deviate from these conditions, the less likely that the performance objective can be achieved with the proposed well configuration.

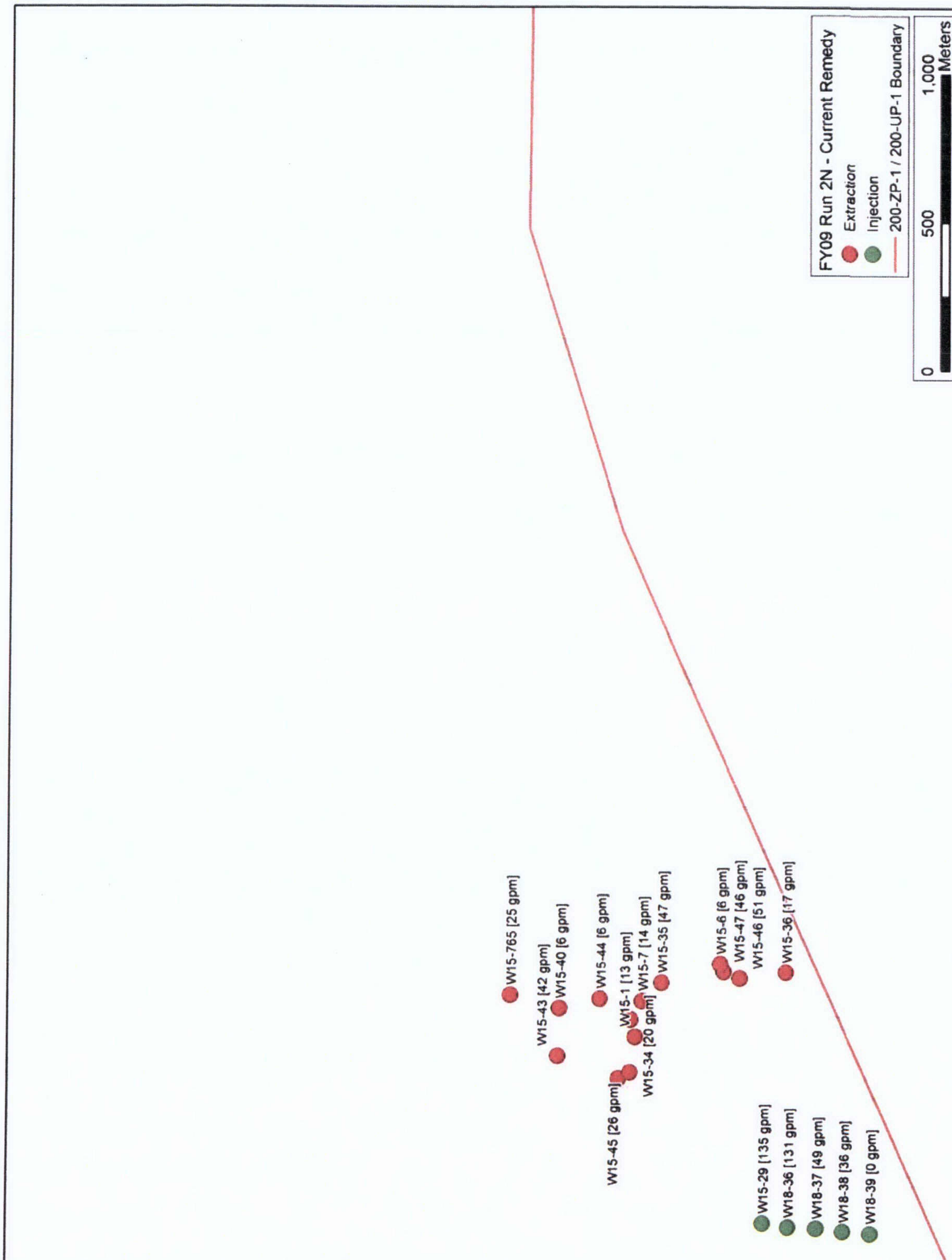


Figure 3-2. Modeled Well Configuration and Pumping Rates for the Existing Interim Pump-and-Treat System

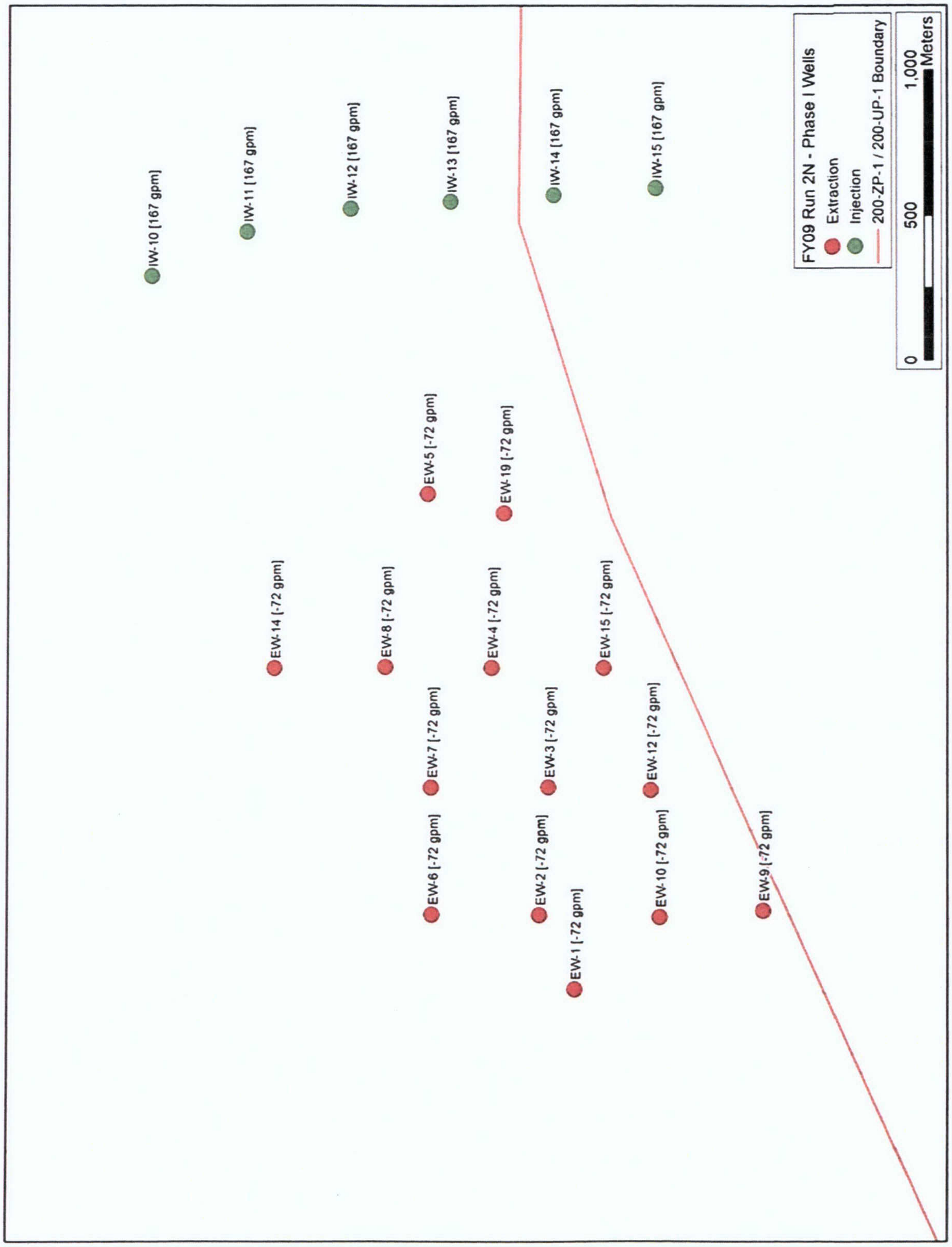


Figure 3-3. Modeled Well Configuration and Pumping Rates for the Initial Operations

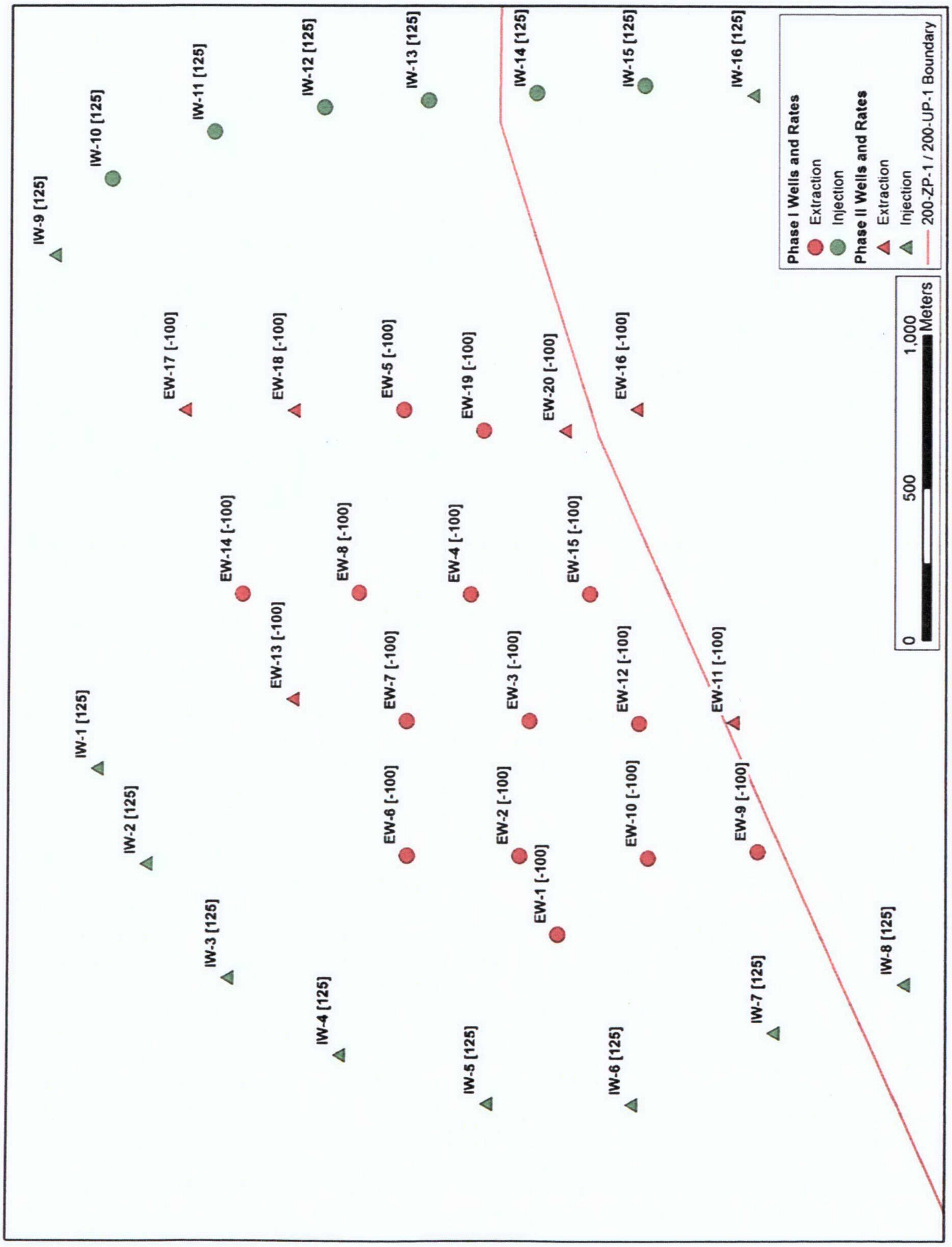


Figure 3-4. Modeled Well Configuration and Pumping Rates for the Long-Term Operations

Table 3-2. Estimated Recovery of Dissolved-Phase Carbon Tetrachloride Mass in 25 Years

Run	Initial Condition	K_d	Porosity	Calculated R	Initial Mass (kg) Dissolved	Initial Mass (kg) Sorbed	Initial Mass (kg) Total	Mass Extracted (kg)	Mass Decayed (kg)	Mass Remediated (kg)	% Dissolved Mass Remediated at 25 Years
1	Kriging	0.011	0.180	1.105	47,127	4,954	52,080	36,831	4,879	41,710	89%
2	Stochastic	0.011	0.180	1.105	93,553	9,834	103,387	40,738	12,998	53,736	57%
3	Kriging	0.011	0.130	1.146	35,281	3,708	38,990	30,688	3,164	33,852	96%
4	Stochastic	0.011	0.130	1.146	67,566	9,833	77,400	35,563	8,891	44,454	66%
5	Kriging	0.060	0.180	1.573	47,127	27,019	74,146	45,463	5,609	51,071	100%*
6	Stochastic	0.060	0.180	1.573	93,554	53,637	147,191	47,880	14,084	61,963	66%

* The model predicted a dissolved mass recovery of 108 percent due to limited recovery of the sorbed mass.

K_d = distribution coefficient

3.1.2.4 Design Basis Concentrations

The groundwater model was used to provide preliminary estimates of the COC concentrations that would be expected from each of the extraction wells over time. The model results indicate that the concentrations generally decrease with time, but the rate and extent to which the contaminants decrease varies by well. From these model-predicted concentrations, a blended influent concentration was determined assuming the same flow rate for each well. This blended influent concentration was estimated for the initial operations based upon the results from the first 14 extraction wells. A refined estimate for the remainder of the wells will be made based upon the additional data collected during the RA.

Since the maximum concentrations from each extraction well were typically achieved during the first year of operation, the highest concentration observed during that year was used as the preliminary design concentration for the treatment system. The design concentrations for the radiological treatment system based on the elevated technetium-99 concentrations from the 200-ZP-1 OU and the 241-S/SX Tank Farm are provided in Table 3-3. The design concentrations for the central treatment system based on the water quality from the initial 14 extraction wells and the 241-S/SX Tank Farm are provided in Table 3-4.

3.1.3 Functional Requirements

This section provides the high-level functional requirements for the 200 West Area pump-and-treat system that will help guide the design effort. It is intended to document the project team's approach to accomplish the RA and is not intended to provide the detailed technical criteria and design requirements based on codes, standards, and DOE orders. These requirements are documented in internal design documents and provide the basis for the subsequent design effort.

Table 3-3. Assumed Influent Water Quality for the 200-ZP-1 Operable Unit Radiological Treatment System[a]

Parameter	Water Quality Peak Value
Carbon tetrachloride[b]	876 µg/L
Nitrate as nitrogen[b]	70 mg/L
Hexavalent chromium[b]	104 µg/L
Trichloroethylene (TCE)[b]	5.0 µg/L
Iodine-129[b]	0.5 pCi/L
Technetium-99[b]	8,200 pCi/L
Tritium[b]	20,200 pCi/L
Uranium[b]	2.3 µg/L
Chromium (total)[c]	89 µg/L
Alkalinity (as $CaCO_3$)[c]	108 mg/L
Calcium[c]	81 mg/L
Chloride[c]	20 mg/L
Chloroform[c]	0.028 mg/L
Fluoride[c]	0.36 mg/L
Iron (dissolved)[c]	0.20 mg/L
Magnesium[c]	26 mg/L
Manganese (dissolved)[c]	0.053 mg/L
Potassium[c]	6 mg/L
Sodium[c]	24 mg/L
Sulfate[c]	39 mg/L
Total organic carbon[c]	1.5 mg/L
Total suspended solids[c]	2.6 mg/L
Total dissolved solids[c]	384.mg/L
pH[c]	7.7

a. Influent chemistry based on blended concentrations of wells having elevated technetium-99

b. Maximum credible value

c. Average value

The following three major subsystems are addressed by the design requirements:

- The treatment facility, which will be located in a central location and will house all the process treatment equipment, as well as control systems for the project
- The balance of plant, which includes the piping, associated transfer buildings, and booster pumps as necessary to pump the extracted groundwater to the treatment facility, as well as treated groundwater from the treatment facility to the injection wells
- The injection and extraction wells.

Table 3-4. Assumed Influent Water Quality for the 200-ZP-1 Operable Unit Central Treatment System[a]

Parameter	Water Quality Peak Value
Carbon tetrachloride[b]	738 µg/L
Nitrate as nitrogen:[c]	--
Phase I value	36 mg/L
Phase II value	40 mg/L
Hexavalent chromium[b]	27 µg/L
Trichloroethylene (TCE)[b]	3.7 µg/L
Iodine-129[b]	0.15 pCi/L
Technetium-99[b]	102 pCi/L
Tritium[b]	8,200 pCi/L
Uranium[b]	3.6 µg/L
Chromium (total)[d]	27 µg/L
Alkalinity (as $CaCO_3$)[d]	112 mg/L
Calcium[d]	70 mg/L
Chloride[d]	20 mg/L
Chloroform[d]	0.042 mg/L
Fluoride[d]	0.35 mg/L
Iron (dissolved)[d]	0.26 mg/L
Magnesium[d]	21 mg/L
Manganese (dissolved)[d]	0.086 mg/L
Potassium[d]	5 mg/L
Sodium[d]	21 mg/L
Sulfate[d]	39 mg/L
Total organic carbon[d]	1.6 mg/L
Total suspended solids[d]	1.7 mg/L

Table 3-4. Assumed Influent Water Quality for the 200-ZP-1 Operable Unit Central Treatment System[a]

Parameter	Water Quality Peak Value
Total dissolved solids[d]	319 mg/L
pH[d]	7.7

a. Influent chemistry based on blended concentrations of wells from 200-ZP-1 Operable Unit and 241-S/SX Tank Farm

b. Maximum credible value

c. Maximum sustained average value

d. Average value

The functional requirements are as follows.

- The system will be designed to treat up to 189 L/min (50 gpm) of contaminated groundwater from the 200-UP-1 OU, namely groundwater from the 241-S/SX Tank Farm.
- The system shall be designed for continuous operation, 24 hours/day, 7 days/week. Control system(s) providing automated notification during an unexpected shutdown will be identified during the design.
- The nominal design life is 25 years. Replacement of process equipment and infrastructure is anticipated to occur during this period.
- System redundancy is not required.
- Solid wastes created by the treatment system shall be packaged for disposal at the Environmental Restoration Disposal Facility (ERDF).
- The treatment system shall be designed in accordance with the following:
  - Treated water shall have neutral pH (6.5 to 8.5) and be essentially particulate- and foulant-free to avoid scaling or plugging the injection wells.
  - The treatment process shall have the capacity to operate continuously at any flow rate between the maximum flow rate and 40 percent of the maximum flow rate to accommodate variations in well pump operation. The design maximum flow rate for the Phase I system will be approximately 1,250 gpm.
  - The treatment facility floor will be curbed with low point drains to collect any leaks and instrumented to alarm and stop the process if a leak is detected.
- When transporting dangerous waste, piping systems from the wells to the treatment facility shall meet the requirements of WAC 173-303-640, which will consist of daily inspections for above ground pipe. An alternate approach that is equally protective of human health and the environment will be developed during the design, discussed with the regulatory agencies, and included in the RD report for approval.
- Extraction and injection well requirements shall be identified in the individual SAPs that describe the drilling, construction, and testing.
- Warning signs will be posted where pipelines carrying contaminated water intersect roads. These signs will caution site visitors and workers that the pipelines contain contaminated groundwater.

3.2 Well Network Conceptual Design

The selection of the proposed extraction and injection well locations (Figure 3-5) was based on the dissolved carbon tetrachloride concentrations in the aquifer, groundwater flow and transport modeling, analytical capture zone calculations, and consideration of existing right-of-ways within the 200 West Area. These locations may be adjusted as new information is collected during implementation of the RA, with the final well locations being provided in the associated SAP. The first set of wells is included in the *Sampling and Analysis Plan for the First Set of Remedial Action Wells in the 200-ZP-1 Operable Unit* (DOE/RL-2008-57).

3.2.1 Extraction Well Placement

The proposed extraction well locations were chosen to maximize carbon tetrachloride mass removal by extracting groundwater from portions of the aquifer with the highest contaminant concentrations and to provide some degree of plume containment. The initial well field also includes two extraction wells within the technetium-99 plume to initiate contaminant recovery. Finally, one extraction well is located near the existing interim pump-and-treat system to use its capability to treat water generated during the aquifer test. The final location of these wells may be adjusted and will be a process that builds upon the information collected from the previous wells. Following installation of these initial wells, the remaining extraction wells will be located based on the data collected from actual system performance. When the extraction well field is fully implemented, it is expected to include approximately 20 extraction wells that are broadly aligned north-south within the 200-ZP-1 OU.

3.2.2 Injection Well Placement

In accordance with the 200-ZP-1 OU ROD, injection well locations were selected to optimize the flow-path control component of the selected remedy. The proposed well field includes 16 injection wells divided into two well groups: one group upgradient line comprising 9 wells, and one group downgradient line comprising 7 wells. Both well lines are curved (1) on the basis of the depicted contaminant footprint, and (2) to produce convergent groundwater flow that directs the contaminated groundwater toward the capture zone of the extraction well field. Based on the aquifer hydraulic properties and anticipated well screen lengths, it is estimated that each injection well will have an injection capacity of at least 454 L/min (120 gpm).

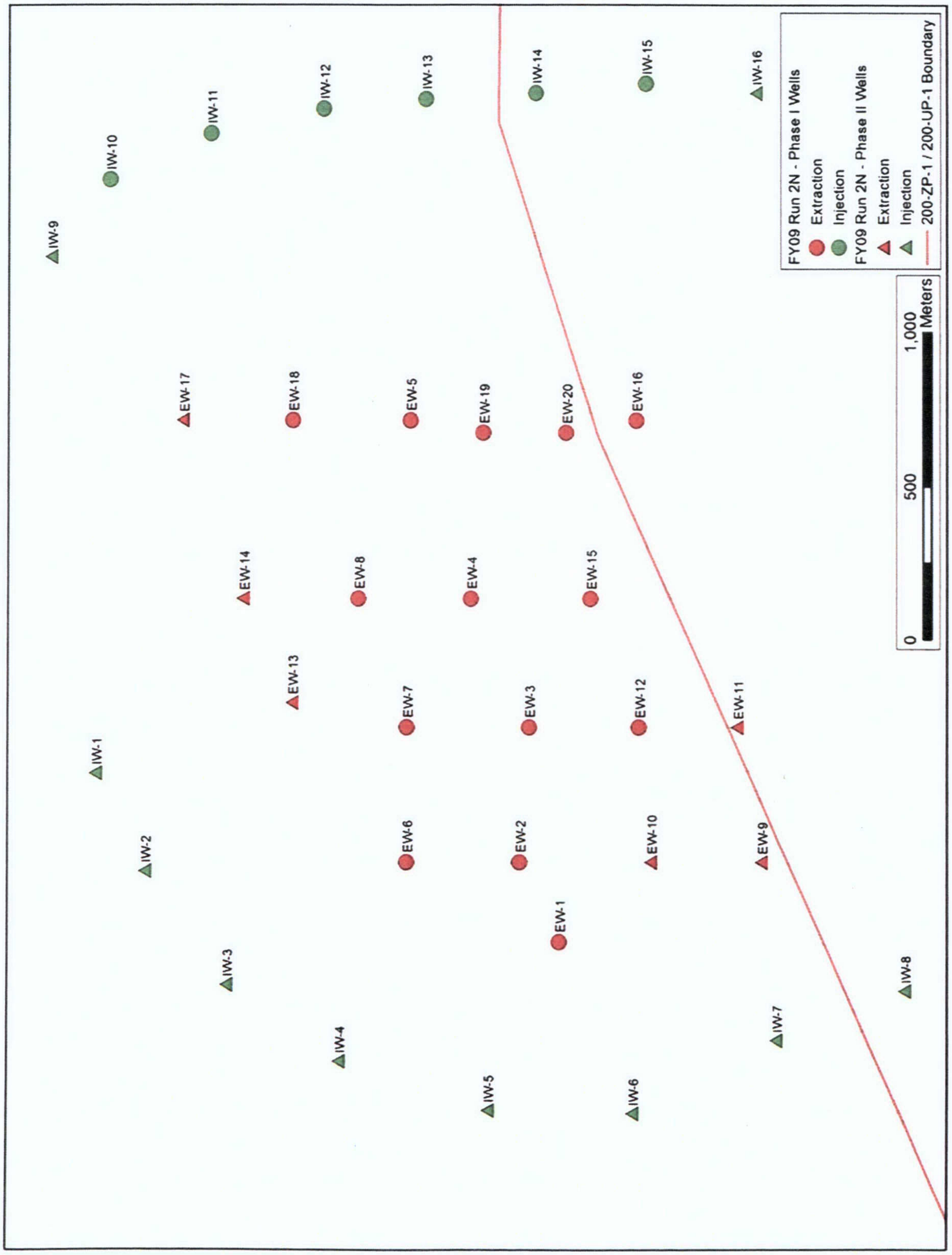


Figure 3-5. Proposed Extraction and Injection Well Locations for the 200 West Area Pump-and-Treat System

The Phase I effort will install six injection wells along the eastern line and downgradient from the plume to reduce, and locally reverse, the natural eastward hydraulic gradient in the aquifer. The mounding of groundwater in the aquifer from these wells is expected to hydraulically contain carbon tetrachloride groundwater concentrations >100 µg/L. Additionally, groundwater mounding near the northernmost downgradient injection wells is expected to minimize the potential for contaminated groundwater migration through Gable Gap toward the Columbia River.

The upgradient or western line of injection wells was located to direct the flow of contaminated groundwater toward the extraction well field. This western line of injection wells is located upgradient of the suspected contaminant source areas, facilitating the flushing of residual contamination present in the aquifer beneath these areas. The upgradient injection of treated groundwater will increase the hydraulic gradient in the aquifer toward the extraction well field, resulting in accelerated transport of contaminated groundwater to the extraction wells. The reinjection of treated groundwater upgradient of the contaminant plumes is also expected to mitigate dewatering of the aquifer during pump-and treat operations.

3.2.3 Well Design

The well designs are specific to their function in the selected remedy. Therefore, extraction wells will have a different design than injection wells. Site-specific design considerations for the extraction wells include the following:

- Vertical contaminant distribution encountered within the aquifer during drilling
- Anticipated well yield
- Grain-size analyses of the recovered aquifer matrix.

Recent investigations in the 200-ZP-1 OU identified the presence of contaminated groundwater from the top to the base of the unconfined aquifer in the Ringold Formation (*Hanford Site Groundwater Monitoring for Fiscal Year 2007* [DOE/RL-2008-01]). However, depth-discrete groundwater sampling has indicated that the vertical distribution of contamination in the aquifer varies considerably. Because of the presence of contamination throughout the entire thickness of the unconfined aquifer, extraction wells will be designed with long, potentially fully penetrating well screens to capture contaminated groundwater.

Due to the variability in the contaminant vertical distribution, well-screen sections may be separated by one or two blank casing sections. This type of well construction facilitates isolation and preferential extraction of grossly contaminated groundwater where it may be overlain or underlain by more dilute contamination. This approach will maximize contaminant mass removal from the aquifer while operating within the design flow rates of the treatment system. Extraction well screen intervals will be determined in the field based on groundwater contaminant vertical profiles of the extraction well borehole. Well screens will be installed in all sections of the extraction well borehole exhibiting groundwater carbon tetrachloride concentrations >100 µg/L. Extraction well screen lengths are expected to range from approximately 30.5 to 61 m (100 to 200 ft), depending on the contaminant concentrations observed in the aquifer. Based on the aquifer hydraulic properties and the anticipated well screen lengths, it is estimated that each extraction well will be capable of producing approximately 379 L/min (100 gpm) on a sustained basis.

3.2.4 Balance of Plant

A conceptual layout of the balance of plant (consisting of the necessary piping and structures to connect the extraction and injection wells to the treatment facility) is shown in Figure 3-6. Water from each extraction well will be piped to a transfer building where it will be collected in an equalization tank.

The water will then be transferred to the central treatment facility via one or two pipelines, depending on the flow.

At each extraction transfer building, piping from each extraction well will have sample ports for the collection of groundwater samples. Downstream of the sample ports, the piping will be connected to an equalization tank. The equalization tank will be equipped with transfer pumps to relay the water to the central treatment facility.

Transfer piping will be single-wall, high-density polyethylene installed above grade to the maximum extent possible. Leak detection for dangerous waste in the above-grade piping will be provided either through daily inspections, or an equally protective measure that is provided in the RD report.

For groundwater having elevated technetium-99 concentrations that require treatment, the extraction transfer building may be equipped with a separate transfer system for the radionuclide-contaminated water. This transfer system will provide a dedicated piping system to allow treatment of the elevated technetium-99 contamination at the treatment facility. Depending on the number of wells requiring technetium-99 treatment, smaller treatment systems may be installed at the well head or in the transfer building rather than at the central treatment facility.

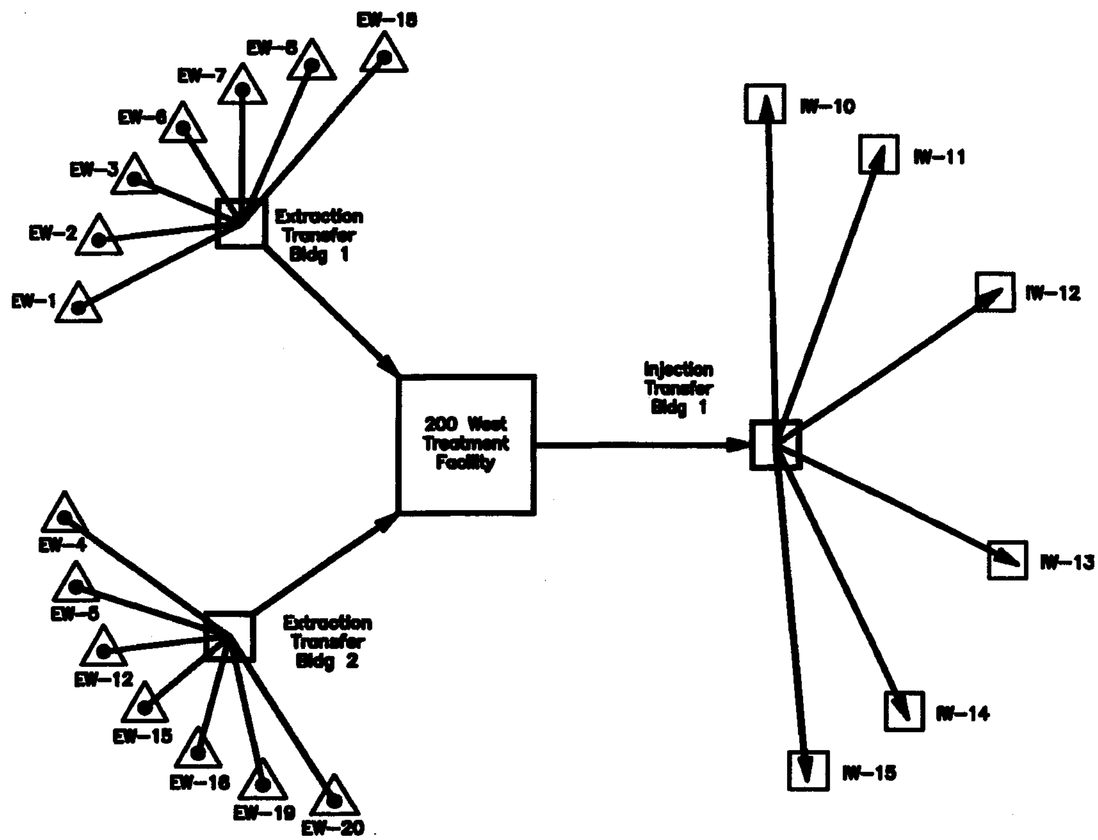


Figure 3-6. Conceptual Layout for the Initial Fourteen Extraction Wells and Six Injection Wells

3.3 Treatment System Conceptual Design

3.3.1 Radiological Treatment Process Description

Groundwater from wells containing elevated concentrations of technetium-99 are planned to be pre-treated separately with ion-exchange (IX) resins to reduce the concentrations below the cleanup levels for reinjection. A preliminary process flow diagram illustrating the conceptual radiological treatment process is provided in Figure 3-7. As illustrated in the diagram, the incoming groundwater will be sent through a filter to remove fine particulate matter. The filtered water will then flow to an IX column with resin to reduce the technetium-99 concentration. The final selection of the number of columns and resin type will be determined during the design process and identified in the RD report. The IX effluent will then be pumped to the centralized treatment system for further treatment.

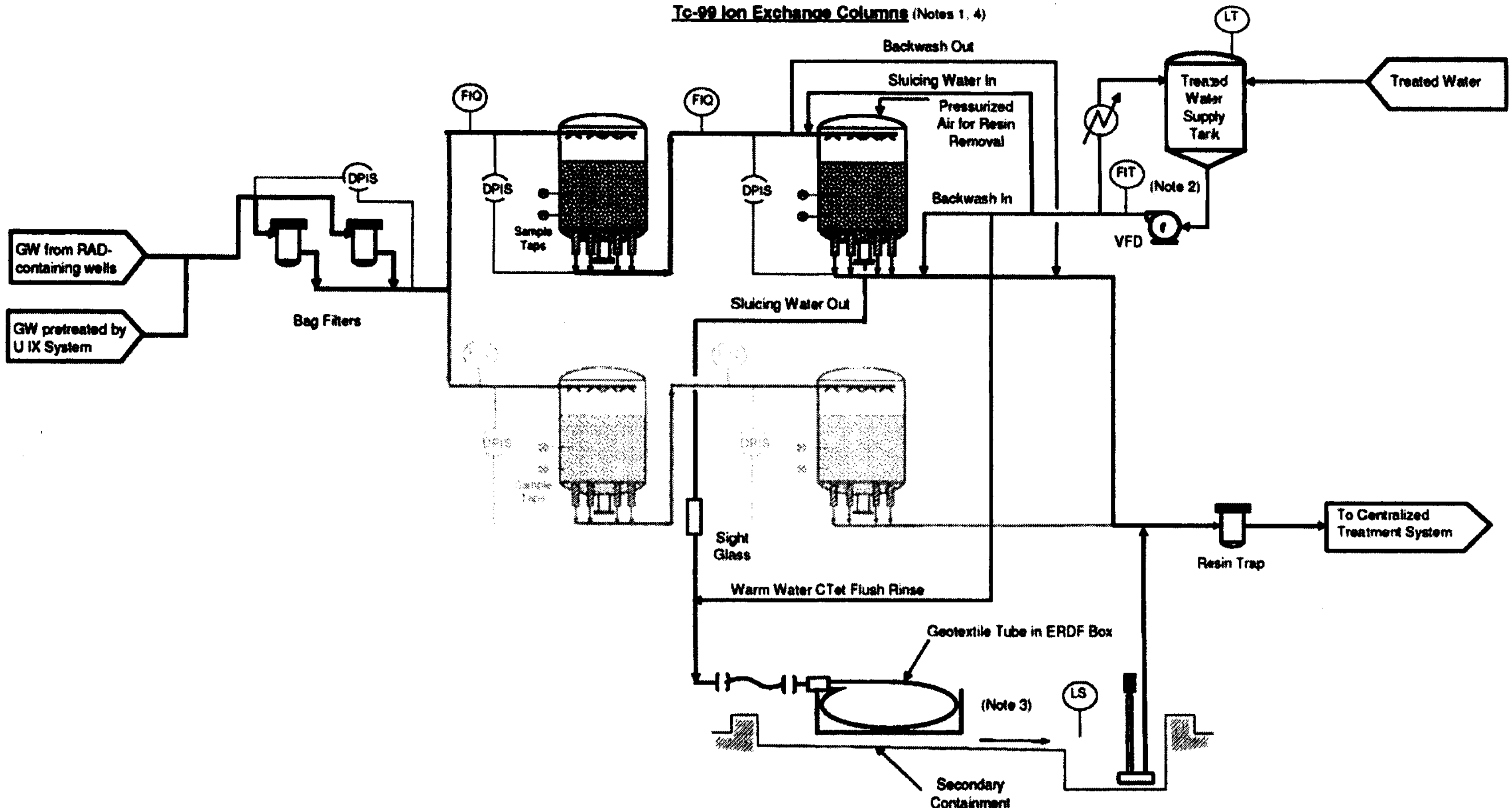
Radionuclide concentrations in the IX effluent will be monitored to detect breakthrough. When column effluent exceeds predetermined radionuclide concentration limits or the resin has been in service for a predetermined amount of time, the resin will be removed and regenerated or replaced. It will be removed from the vessel by sluicing it with treated water from the centralized treatment system into a geotextile tube placed in a container to allow drainage. Free liquid will be drained from the geotextile tube and either sent to the centralized treatment system (if the technetium-99 concentrations are below the cleanup levels) or reprocessed through the IX columns. The geotextile tubes may require multiple rinses if carbon tetrachloride is weakly adsorbed to the resin. A bench-scale test is planned to determine whether carbon tetrachloride will adsorb to the resin and require additional rinses.

In anticipation of future use of the 200 West Area pump-and-treat system, the RD will also evaluate options for the treatment of groundwater contaminated with uranium that may be captured by the extraction wells. This evaluation, which will be available during the 30 percent design, will include (1) the estimated influent concentrations, (2) recommended treatment technology (or technologies), and (3) design considerations.

3.3.2 Central Treatment Process Description

A preliminary process flow diagram illustrating the central treatment process is provided in Figure 3-8. The treatment process for carbon tetrachloride and nitrate removal will have an initial treatment capacity to accommodate flow ranges from 2,460 to 4,732 L/min (650 to 1,250 gpm). The extracted groundwater will be initially pumped to the equalization tank. Water from the equalization tank will then be pumped to a covered fluidized bed reactor (FBR) for nitrate treatment and potentially carbon tetrachloride removal. The FBR vessels contain an integral fluidization and effluent collection system designed to enhance uniform flow distribution for anoxic and anaerobic microbial growth. The water is pumped into the bottom of the FBR, creating upflow to suspend the GAC media. The FBR will initially be seeded with microbes that are suitable for denitrification and possibly carbon tetrachloride degradation.

The effluent from the FBR will then flow into a covered aeration tank to remove the residual carbon substrate, total suspended solids, and biomass. The tank will have an aeration zone, followed by a zone with submerged membranes for filtration. The aerobic zone will diffuse air into the tank to ensure that sufficient oxygen is available to maintain the biological process reducing the residual carbon substrate. There will also be a blower for the membrane zone for air scouring to remove accumulated organic debris from the membrane surface to maintain permeability. In the membrane zone, there will be modules of vertically or horizontally strung membrane fibers. Water will be filtered through these membrane fibers to remove the solids.



NOTES:
1. Phase 1 system shall be two columns in series and an additional two columns (parallel pairs of 2 in series) for Phase II construction.
2. Common treated water supply for backwashing, resin removal sluicing, and warm wate· CTet rinsing of spent resin. Piping only shown for one column for clarity.
3. ERDF box to allow Geotextile Tube draining. Use same box for final ERDF disposal of spent resin.
4. Resin loading shall be via Supersacks using overhead hoist into top manway.

Figure 3-7. Preliminary Process Flow Diagram for the Radiological Treatment System

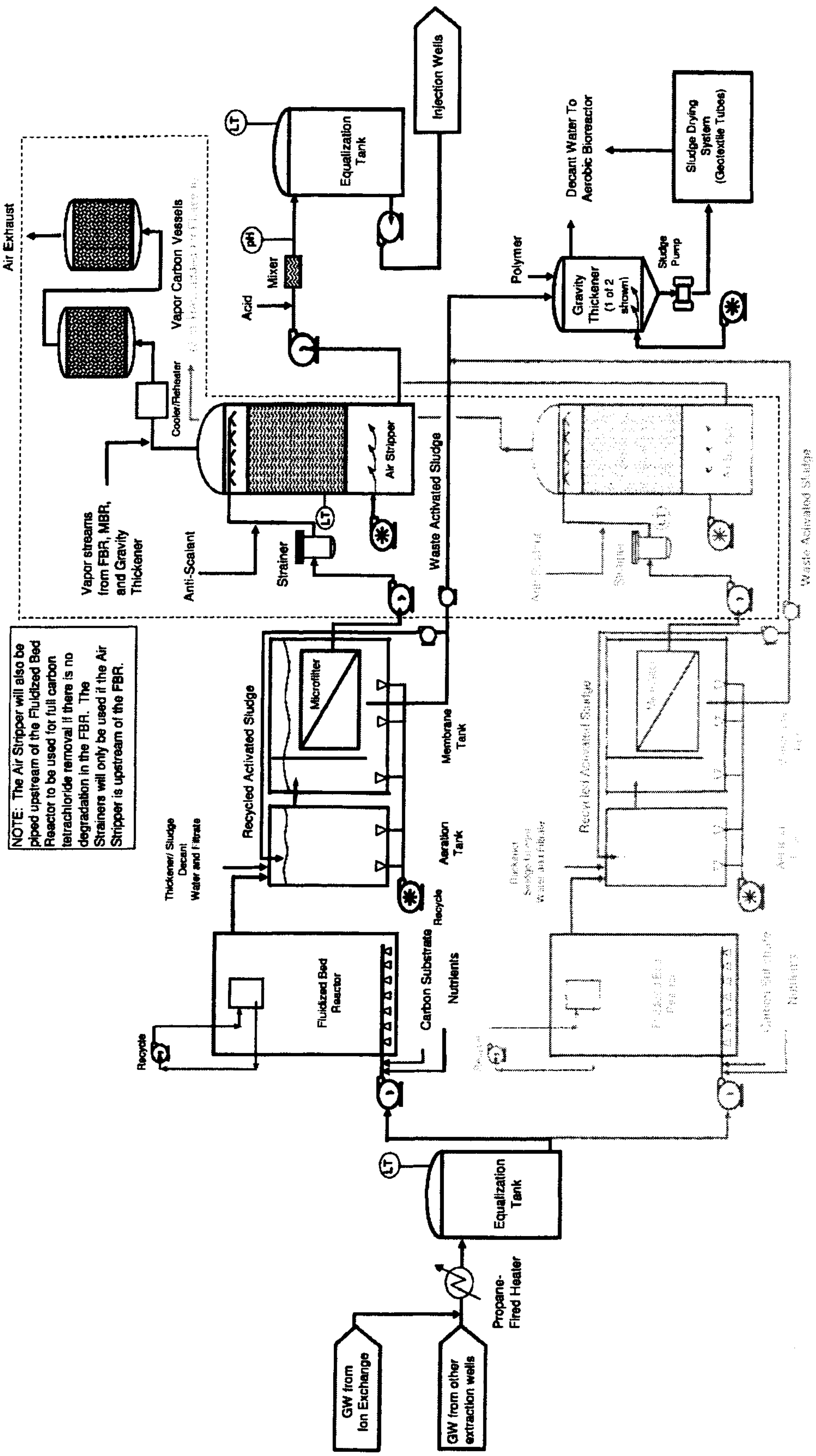


Figure 3-8. Preliminary Process Flow Diagram for the Central Treatment System

The biosolids and particles remaining in the aeration tank will concentrate. A portion of the concentrate will be recycled to the aerobic zone to maintain the biomass concentration (i.e., mixed liquor volatile suspended solids) needed to reduce the biological oxygen demand. To prevent fouling of the membranes, maintenance cleanings will be required, which will involve removing the membrane modules from the tank and soaking them in a separate cleaning solution. The solution is then drained and the chemical residues flushed with treated wastewater before returning the membranes to the tank.

The treated water from the membranes will be pumped to a packed-bed tower air stripper to remove the remaining carbon tetrachloride and other volatile organic compounds. Off-gas from the stripper, FBR, aeration basin, and sludge thickener will be combined and treated by GAC. The treated water will either be pumped to an effluent tank or directly to the injection well field. An effluent tank may be incorporated into the design to allow for limited surge capacity during startup and upset conditions.

The air-stripper towers will also be piped so the air-stripper treatment can occur before the FBR treatment. For this scenario, the water from the initial equalization tank will be pumped through strainers to remove larger particles before going into the air strippers. It is not known how much carbon tetrachloride degradation will occur in the FBRs. The specific conditions will be tested for the first few months of operation to assess the carbon tetrachloride degradation.

The handling and disposal method for excess solids will be evaluated during the design. Currently, the following two options are being considered.

- Use a gravity thickener, followed by a sludge-drying system consisting of Geotubes®. This is the method shown in the process flow diagrams.
- Use rotary drum thickener(s) and centrifuge(s) to provide mechanical dewatering.

The optimum method for dealing with the excess solids will be identified during the 30 percent design.

3.3.3 Central Treatment Facility Conceptual Layout

The treatment facility is planned to be located near the center of the 200-ZP-1 OU to minimize the amount of piping for the extraction and injection wells. As shown in Figure 3-9, the treatment facility will be located near wells EW-3 and EW-7, and directly to the west of well EW-4. This location is in a previously disturbed area with the necessary utilities located nearby.

A conceptual layout of the central treatment facility is shown in Figure 3-10. It is anticipated that a separate building will be constructed to house the radiological treatment equipment (e.g., filters, IX column, etc.). An area adjacent to the radiological treatment facility will be established for the resin drying system (Geotubes). This area will be provided with secondary containment for the collection of free liquids during the dewatering process.

A separate building is currently planned for the central treatment facility. Several major components (e.g., aeration/microfilter pumps, gravity thickener, carbon substrate tank, etc.) will be located within the building. Where required, the building floor will be equipped with a sump and secondary containment for handling dangerous waste. Adjacent to the central treatment building will be a pad equipped with a containment curb and sump to provide secondary containment. It is anticipated that treatment components (e.g., equalization tank, FBR, aeration tanks/microfiltration, etc.) will be located on this pad.

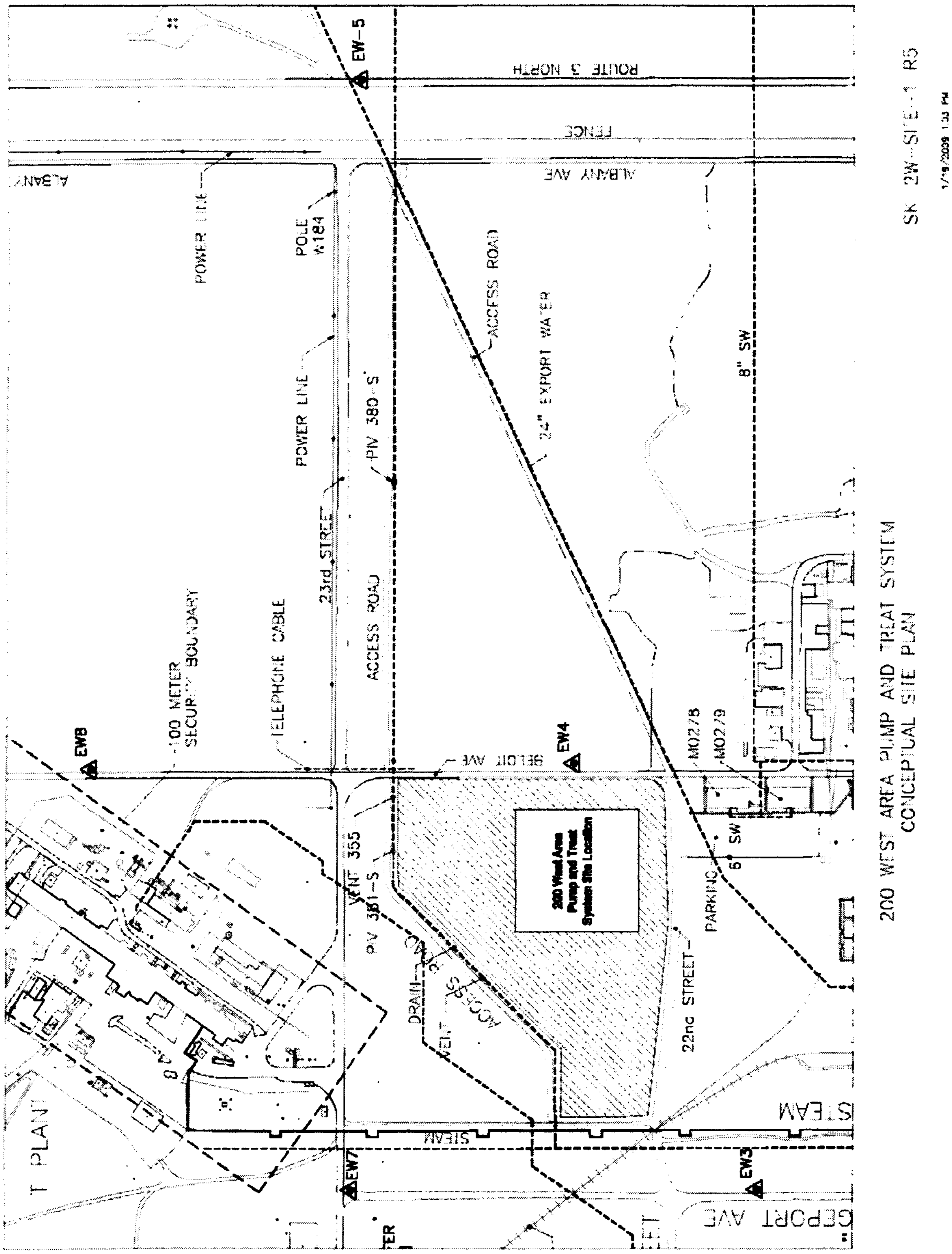


Figure 3-9. Treatment Facility Conceptual Location

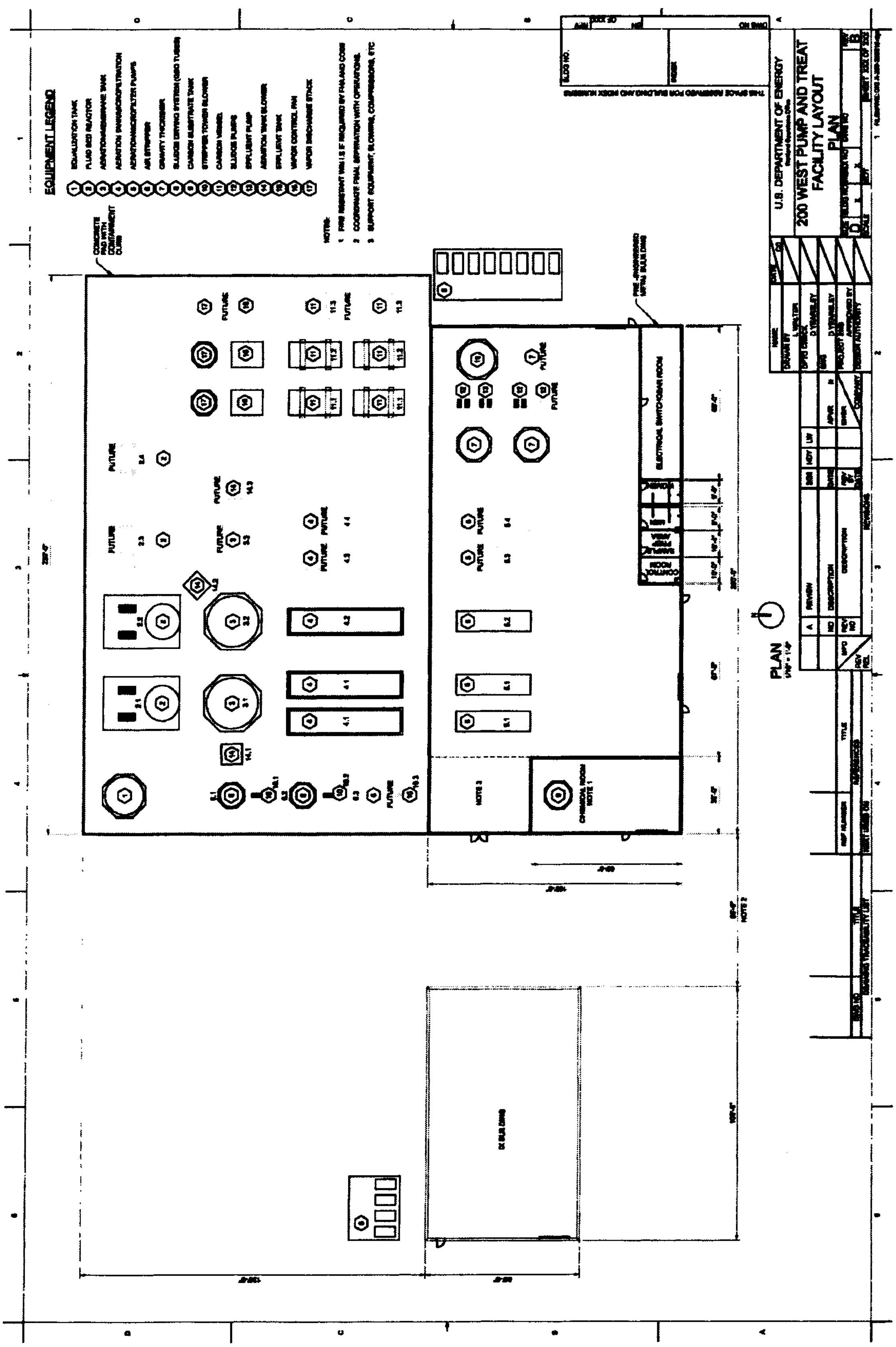


Figure 3-10. Conceptual Layout of the Central Treatment System

A separate sludge handling system will be located in an area that is not routinely accessed by workers. This area will be provided with secondary containment as required for the collection of free liquids during the sludge dewatering process, with the liquid being routed to the equalization tank for processing. The optimum layout of the facility will be established during design process, with the final layout provided in the RD report.

3.4 Aquifer Testing

To optimize siting of the extraction wells, an aquifer recovery test is planned for the new extraction well (EX-1) located southwest of the 241-TX Tank Farm. This test consists of shutting down the nearby extraction wells currently in operation from the interim pump-and-treat system, monitoring the recovery response at these wells, and then pumping the new extraction well while monitoring the surrounding aquifer response. To aid the evolution, slug testing and dynamic electromagnetic borehole flow meter surveys will be conducted on the new extraction well. The slug tests, electromagnetic borehole flow meter survey, and aquifer recovery test from the new extraction well will provide additional data on the aquifer characteristics that will be used to support capture zone analysis and future positioning of the extraction wells. A report of the data collection, analyses, and aquifer property derivations will be prepared following testing, with the results being used to help determine the location of future wells.

3.5 Design Approach

3.5.1 Remedial Design Report

Given the complexity of this project, the design process includes a 30 percent design, 60 percent design, and 90 percent final design, with the latter being included in the RD report. Upon completion of the 30 percent design, EPA will be briefed on the progress of the RD and solicit informal comments to be incorporated into subsequent design efforts. A briefing will also be held with EPA at approximately the 60 percent design to update progress and solicit comments to be incorporated into the 90 percent design.

Consistent with Section 7.3.9 of the Tri-Party Agreement Action Plan, DOE will submit a RD report to EPA once a 90 percent design has been reached for the remedy. The RD report, which is a primary document under the Tri-Party Agreement, will include the following items:

- Design drawings
- Specification of materials of construction
- Construction budget estimate
- Construction schedule.

The RD report will be submitted to the EPA for review as a primary document in accordance with Tri-Party Agreement, Section 9.2.1. The EPA will be provided with a briefing of the system design within 10 days of document submittal to help expedite their review.

3.5.2 Operations and Maintenance Plan

An O&M plan will be prepared that describes the 200 West Area pump-and-treat operations. This plan will include the following:

- O&M of the pump-and-treat system
- Remedy compliance monitoring
- Remedy performance monitoring
- Air monitoring

- Environmental controls
- Waste management.

The O&M plan is a primary document as described in Section 7.3.11 of the Tri-Party Agreement Action Plan and will be submitted concurrently with the RD report to EPA for review and approval. Similar to the RD report, EPA will be provided with a briefing of the O&M plan within 10 days of document submittal to help expedite their review.

4 Remedial Action Approach and Management

This section describes implementation of the RA to accomplish the goals set forth in the 200-ZP-1 OU ROD. It includes a discussion of the management team, facility procurement and construction approach, and the operational approach. A description of the actual operation of the 200 West Area pump-and-treat system will be prepared concurrently with the design and included in the O&M plan.

4.1 Project Team

The term "project team" includes the individuals working to accomplish the 200-ZP-1 OU RA. Accordingly, the project team includes the lead regulatory agency; the DOE, Richland Operations Office (RL); and the remediation contractor.

4.1.1 Lead Agency (U.S. Department of Energy)

The DOE is the lead agency under CERCLA, delegated by Executive Order 12580 the primary authority under Section 104 and 121 to conduct removal and remedial actions on DOE facilities. DOE is responsible for the RAs throughout the Hanford Site and, as such, has assigned remedial project managers to each main area and task involved with remediation activities. The lead agency is responsible for managing the assigned activities, which include scope, budget, schedule, quality, personnel, communication, risk/safety, contracts, and regulatory interface, and works under EPA oversight in accordance with CERCLA Section 120, as implemented through the Tri-Party Agreement. It obtains Congressional funding for these functions.

4.1.2 Lead Regulatory Agency (U.S. Environmental Protection Agency)

The EPA is the lead regulatory agency for the CERCLA remediation activities at the 200-ZP-1 OU. The lead regulatory agency is responsible for overseeing activities to verify that applicable regulatory requirements are met. Lead regulatory agency approval will be required on all SAPs and Tri-Party Agreement primary documents (e.g., this RD/RA work plan, RD report, and O&M plan).

4.1.3 Remediation Contractor (CH2M HILL Plateau Remediation Company)

On October 1, 2008, CH2M HILL Plateau Remediation Company (CHPRC) assumed the contract with DOE to perform remedial actions at the 200-ZP-1 OU. CHPRC performs work under direction of the DOE Remedial Project Manager, assisted by other DOE personnel, as outlined in the following descriptions and Figure 4-1.

4.1.3.1 Groundwater Remediation Manager

The groundwater remediation manager provides oversight for all activities and coordinates with RL, the regulators, and primary contractor management in support of remediation activities. In addition, support is provided to the 200-ZP-1 OU project manager to ensure that work is performed safely and cost effectively.

4.1.3.2 Project Manager

The 200-ZP-1 OU project manager is responsible for direct management of sampling documents and requirements, field activities, and subcontracted tasks. The project manager ensures that the field construction manager, environmental compliance officer, sampling coordinator, and others responsible for implementation of regulatory documents are provided with current copies of these documents and any revisions thereto. The project manager also works closely with the Quality Assurance (QA) organization, the Health and Safety organization, and the field construction manager to integrate these and the other lead disciplines in planning and implementing the workscope. The project manager also coordinates with and reports to RL, the regulators, and remediation contractor management on all remediation activities.

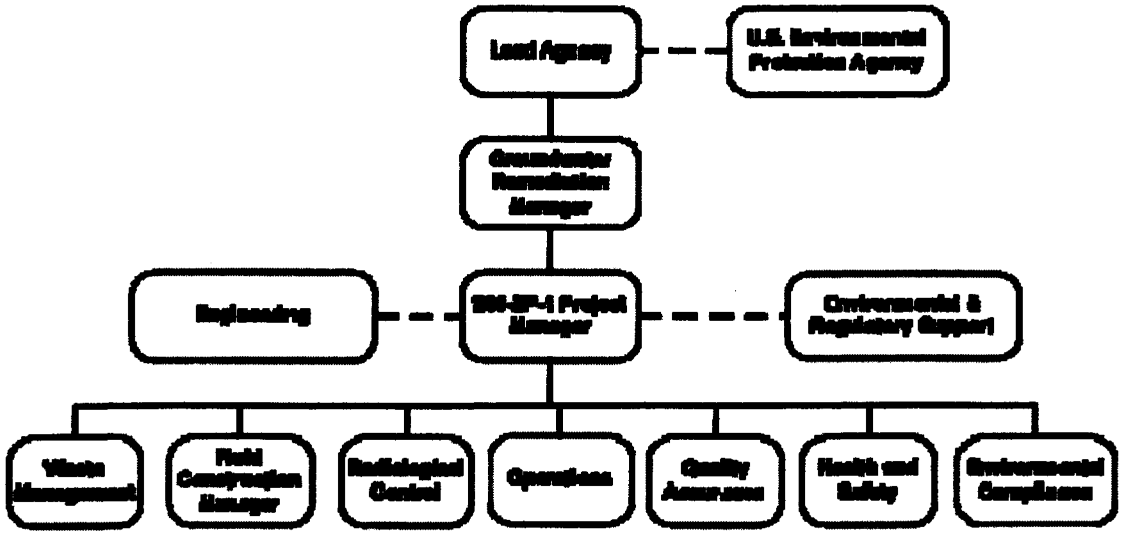


Figure 4-1. Project Organization

4.1.3.3 Engineering

All engineering and design work will be performed by qualified engineering staff in accordance with remediation contractor engineering procedures (or equivalent standards) using a graded approach. The design will be documented in the RD report.

4.1.3.4 Operations

Operations include the operating personnel, field engineering, procurement and maintenance. Operations ensure that the facility and systems are operated and maintained in accordance with applicable requirements and procedures while safely meeting production goals. Responsibilities include the pump-and-treat system operations, process control, sampling, configuration and work control, modification to systems/facilities, corrective and preventive maintenance, waste management, and support to new system/facility construction, testing, and startup.

4.1.3.5 Quality Assurance

The QA lead is matrixed to the 200-ZP-1 OU project manager and is responsible for QA issues on the project. Responsibilities include overseeing implementation of the project QA requirements; reviewing project documents, including DQO summary reports, SAPs, and the QA project plan; and participating in QA assessments on sample collection and analysis and other remediation activities, as appropriate.

4.1.3.6 Health and Safety

The Health and Safety organization's responsibilities include coordinating industrial safety and health support within the project as carried out through health and safety plans (HASPs), job hazard analyses, and other pertinent safety documents required by Federal regulations or by remediation primary contractor work requirements. In addition, assistance is provided to project personnel in complying with applicable health and safety standards and requirements. Personnel protective clothing requirements are coordinated with Radiological Controls lead.

4.1.3.7 Field Construction Manager

The field construction manager has the overall responsibility for supporting the safety, environmental, QA, sampling, waste management, and radiological control staff in the planning, coordination, and execution of field remediation activities. Responsibilities also include directing training, mock-ups, and practice sessions with field personnel to ensure that the field actions are understood and can be performed as specified. The field construction manager communicates with the 200-ZP-1 OU project manager to identify field constraints that could affect the remediation activities.

4.1.3.8 Environmental and Regulatory Support

The Environmental and Regulatory Support lead is responsible for developing required regulatory documents. Responsibilities include developing and documenting the sampling DQOs, SAPs, and RD/RA work plans. The Environmental and Regulatory Support lead also supports the data quality assessment process and develops the final verification plan or RA report at the conclusion of the remediation activity.

4.1.3.9 Environmental Compliance

The environmental compliance officer 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 environmental compliance officer also reviews plans, procedures, and technical documents to ensure that all environmental requirements have been addressed, identifies environmental issues that affect operations and develops cost effective solutions, and responds to environmental/regulatory issues or concerns raised by RL and/or regulatory agency staff.

4.1.3.10 Radiological Control

The Radiological Control lead is responsible for the 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, radiological hazards are identified and appropriate controls are implemented to maintain worker exposures to hazards at ALARA levels (e.g., personal protective equipment). Radiological Controls interfaces with the project health and safety representative and plans and directs the radiological control technician support for all activities.

4.1.3.11 Waste Management

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. Other responsibilities include identifying waste management sampling/ characterization requirements to ensure regulatory compliance and interpreting the characterization data to generate waste designations, profiles, and other documents that confirm compliance with waste acceptance criteria.

4.2 Change Management

There are three types of changes in the 200-ZP-1 OU RA that could affect compliance with the requirements in the 200-ZP-1 OU ROD: (1) a nonsignificant or minor change, (2) a significant change to a component of the remedy, and (3) a fundamental change to the overall remedy.

A nonsignificant or minor change does not impact the remedy identified in the 200-ZP-1 OU ROD. An example of a nonsignificant change may include modifications to the RA schedule that do not impact an agreed-upon milestone. These minor changes should be documented in the appropriate post-decision project file (e.g., through interoffice memoranda or logbooks).

It may be determined that a significant change to the selected remedy as described in the 200-ZP-1 OU ROD is necessary. Significant changes are defined as changes that significantly modify the scope, performance, or component cost for the remedy as presented in the ROD. All significant changes will be addressed in an explanation of significant difference. Examples of significant changes may include, but are not limited to, the following:

- A significant increase or decrease in the total cost of site remediation (greater than +50 percent or more than –30 percent)
- A significant delay in the point in time when the RA or objectives are met.

A fundamental change is a change that does not meet the requirements set forth in the 200-ZP-1 OU ROD or that incorporates remedial activities not defined in the scope of the ROD. Should the situation arise, the ROD must be amended. Significant changes that fundamentally alter the remedy occur when the following situation arises.

- The addition of contaminated groundwater for RA under the 200-ZP-1 OU ROD that requires additional RA above that identified in the ROD.

Determining whether a change is significant or fundamental is the lead regulatory agency's responsibility. The project manager is responsible for tracking all changes and obtaining appropriate reviews by staff. The project manager will discuss the changes with the lead agency, followed by discussions with EPA.

4.3 Facility Procurement and Construction

4.3.1 Procurement Approach

This RA involves construction of the treatment facility structure, pre-treatment and treatment trains, extraction and injection wells, and the necessary infrastructure to transport water from the extraction wells through the treatment system and finally to the injection wells. This workscope will be accomplished using the most efficient combination of onsite resources and procurements to outside vendors.

It is anticipated that the civil site work, treatment facility structure, and utilities will use a "design/build" procurement process to an outside vendor. The technical specification and procurement packages for these items will be released for bid and award around the 60 percent design. For the treatment trains located within the treatment facility structure, it is anticipated that a "design/bid/build" procurement process will be used. The selected subcontractor will be provided the long-lead procurement items as government-furnished equipment and be responsible for the balance of the procurement, construction, and testing of the treatment trains.

The remaining construction will be evaluated on a case-by-case basis for a "design/bid/build" or a "design/ self-performance" approach. The decision will be based on cost and the ability to meet the project schedule.

4.3.2 Long-Lead Procurement

To maintain schedule, several long-lead items are anticipated to be procured prior to the RD report and provided as government-furnished equipment to the subcontractor awarded the treatment process system installation. Procurement of these items will be in accordance with an engineering specification, which will identify the requirements for each piece of equipment. The equipment specification will be included in a procurement package sent to qualified vendors to supply the particular piece of equipment. The bids received from qualified vendors will be evaluated and a purchase order will be released to the selected vendor. A list of the anticipated long-lead items is as follows:

- FBR system
- IX system
- Aeration/microfiltration system
- Air-stripper system
- Sludge handling system
- Pump/tanks system.

4.3.3 Construction

Facility construction will be performed in accordance with the drawings and specifications provided in the RD report. Remediation contractor oversight will be onsite during all construction activities to ensure compliance with the drawings/specifications and to address field questions from the vendor. Changes to the design will be documented using construction change control and discussed with RL and EPA during regular status meetings.

The construction effort will be managed using a detailed, critical path schedule that is based upon the schedule provided in the RD report. To meet the schedule, several long-lead items will be procured early (discussed in Section 4.3.2) and construction of the treatment facility and the balance of plant will be performed in parallel. To install the necessary extraction and injection wells for Phase I, well drilling will begin early during the remedial action and be performed in accordance with approved SAPs. The first set of wells is included in the *Sampling and Analysis Plan for the First Set of Remedial Action Wells in the 200-ZP-1 Operable Unit* (DOE/RL-2008-57). This SAP will be revised to include the installation of additional wells.

A mobilization period will be used to prepare subcontractors, site workers, and support personnel for construction. This period will include the subcontractor providing insurance certificate and proof of bonding, as well as providing other documentation certifying compliance with training, medical, safety, and quality requirements. The mobilization period will be used by subcontractors, site workers, and support personnel to prepare for construction activities, and include such activities as the following:

- Identification of work zones, lay down areas, and staging areas
- Erection of fences, signs, and postings
- Delivery and storage of construction materials and equipment.

Construction of the treatment facility will begin with performing the civil site work (e.g., site preparation, grading and compaction, running utilities, etc.). This will be followed by construction of the treatment facilities and surrounding pads, utility connections, and installation of process equipment systems. Construction acceptance testing will be performed to ensure proper system operation.

The balance of plant construction includes erecting the transfer buildings (three currently planned), installing the process equipment in the transfer buildings, and installing the transfer lines from the extraction wells to the transfer buildings to the treatment system and finally, to the injection wells. This work will begin following approval of the design in the RD report. Following construction, compliance with the design requirements will be performed as part of the construction acceptance testing.

4.3.4 Construction Acceptance Testing

The 200 West Area pump-and-treat facility project will have numerous systems (e.g., FBR, aeration tanks, air stripper, etc.) with major equipment, including automated operational components and software. A comprehensive and detailed construction acceptance testing plan will be developed and finalized during the design phase. This plan will be executed after construction is complete and will provide documentation that all systems and major equipment have performed as intended. Upon successful construction acceptance testing, the systems will be turned over to operations.

4.4 Operational Approach

4.4.1 Facility Startup

Upon completion of the construction acceptance testing, the facility will be formally turned over to groundwater remediation operations. The first activity during initial operations will be to complete the actions identified in the operational testing plan. These actions will include final operability testing and system interface with facility operators. During this phase, all facets of the system will be cyclically started, operated, and shut down for training purposes. Procedures that were drafted prior to turnover will be used and refined. Preventive maintenance procedures (also developed prior to turnover), including equipment and instrument calibrations, will be performed where necessary and procedures refined as needed.

Facility operators and maintenance personnel will spend considerable time in the facility familiarizing themselves with the equipment, systems, procedures, and interfaces. It is expected that minor modifications and maintenance will be necessary as the equipment and systems are run-in. Safety, radiation control, and waste management programs will be implemented and verified as operational. Upon completion of operational testing, the facility will transition to long-term operations and the 200-ZP-1 IRM pump-and-treat system will be turned off.

4.4.2 Operations

Operation of the pump-and-treat system includes the O&M, engineering, and support functions that will continue throughout the life of the remedy. Operations activities include the operation and control of facility systems, the training and qualification of operators to ensure depth of trained personnel, sample collection, emergency response, continuous improvement through lessons learned, and control of access. Preventive, corrective, and modification maintenance will continue throughout this phase. Engineering evaluations and plant/system optimization will be an ongoing activity to continuously improve efficiency, reliability, and maintainability. Radiation control, industrial safety and hygiene, and waste management programs for long-term surveillance, oversight, and stewardship of the facility will be implemented and continuously updated as conditions change or new activities warrant. Continuous feedback using tools such as management assessments, independent assessments, QA, and RL oversight will be in place throughout the lifecycle of the project.

Operation of the pump-and-treat system is expected to be dynamic to optimize contaminant recovery and system performance. As such, operations will adjust flow rates from individual wells as necessary based on performance, which may include eliminating extraction wells that have already achieved the target concentrations or identifying alternate extraction wells. Operational changes will be documented in the operations log and discussed with RL and EPA during regular status meetings. Any new wells that require drilling and installation will be identified in the appropriate SAP.

4.5 Data Use and Interpretation

4.5.1 System Monitoring Reports

System monitoring reports will be prepared to demonstrate the effectiveness of the treatment system and the need for modifications or changes to the system. System monitoring reports will be produced annually for the first 2 years after startup because it is anticipated that numerous adjustments and minor changes to the system will be made in order to achieve consistent and efficient operation. Thereafter, system monitoring reports will be made biannually for the next three reports and will primarily serve to confirm performance efficiency and effectiveness. Thereafter, system monitoring reports will be produced every 5 years and will correspond with the CERCLA 5-year review. These longer time periods will capture more major changes to the system, if necessary, over the long-term operation of the treatment system.

4.5.2 Remedy Performance Reports

Remedy performance reports will demonstrate the progress in remediating the aquifer to meet the cleanup goals set forth in the 200-ZP-1 OU ROD. Remedy performance report will be produced annually for the first 2 years, corresponding with the system monitoring reports. The first report will serve as a baseline and template for further reports. Biannual remedy performance reports will then be prepared for the next three reports, also corresponding with submittal of the system monitoring reports. Following this period, a decision will be made with respect to the frequency of further performance reports. If there appears to be continuing rapid decreases or changes in concentrations of contaminants, then the biannual report frequency will be maintained. If the decrease in contaminant concentration appears to be gradual, then the frequency of reports will be decreased to every 5 years and will correspond with the CERCLA 5-year review.

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5 Environmental Management and Controls

5.1 Air Emissions

5.1.1 Radiological Air Emissions

The proposed remedial activity will be evaluated with respect to determining the potential-to-emit radionuclides from any point source or diffuse/fugitive source. To accomplish this, the total unabated potential release (in curies) will be determined and the annual dose to the maximally exposed individual will be calculated using *Calculating Potential-to-Emit Radiological Releases and Doses* (DOE/RL-2006-29), or modeled using the CAP-88PC computer model. To demonstrate compliance with the ARARs of WAC 246-247, control and monitoring requirements for potential radiological air emissions will be based on the calculated/modeled value of the potential-to-emit.

5.1.2 Nonradiological Air Emissions

To demonstrate compliance with the ARARs of WAC 173-400, "General Regulations for Air Pollution Sources," and WAC 173-460, "Controls for New Sources of Toxic Air Pollutants," an acceptable source impact analysis will be completed. The analysis will demonstrate that, after application of toxic best available control technology, the new source's maximum incremental ambient air impact levels do not exceed the WAC 173-460 Class A or Class B acceptable source impact levels; or, if applicable, the new source toxic air pollutant emission rates do not exceed the small quantity emission rates specified in WAC 173-460.

5.2 Waste Management

Table 5-1 presents a summary of the projected waste streams and volumes expected during well drilling and development, and Table 5-2 provides the project waste streams and volumes expected during construction and operations. The specific requirements for waste identification, characterization, segregation, packaging, labeling, storage, and inspections prior to construction of the 200 West Area pump-and-treat facility (e.g., well drilling and groundwater sampling) will be managed under the *Waste Management Plan for the Expedited Response Action for 200 West Area Carbon Tetrachloride Plume and the 200-ZP-1 and 200-PW-1 Operable Units* (DOE/RL-2000-40) and the waste management specialist-provided waste packaging labeling instruction sheet. Waste generation activities associated with the 200 West Area pump-and-treat facility will be managed under a new waste management plan that will be included in the O&M plan.

5.3 Cultural/Ecological

Protection of cultural resources is addressed in the *Archeological and Historic Preservation Act of 1974*, the *National Historic Preservation Act of 1966*, and the *Native American Graves Protection and Repatriation Act of 1990*. These Federal acts mandate the identification and protection of archeological objects and historic data including human remains, funerary objects, sacred objects, and objects of cultural significance. Prior to disturbing the earth (e.g., drilling, surface grubbing, and excavating), a survey will be completed and documented by Pacific Northwest National Laboratory. The survey will look for culturally significant items and will document those with respect to the areas included in this RA where there would be disturbance of the earth. Any restrictions regarding disturbance of the earth or otherwise will be identified in a letter report.

Table 5-1. Summary of Projected Waste Streams and Volumes (Well Drilling/Well Development)

General Waste Stream Description	Hazard Classifications Anticipated	Container Options	Estimated Annual Volumes	Disposal Pathway Options	Hazard Source
Drill cuttings (dry soils and saturated slurries; sample returns)	Mixed waste (ECM/ hazardous)	Roll-on/roll-off boxes Drums	300 to 400 tons	ERDF	CERCLA
Liquids, but not limited to the following: decontamination liquids; purgewater generated during well installation, development, testing, sampling and decant from drilling slurries	ECM	Purgewater trucks Temporary transfer drums	TBD	200 Area Effluent Treatment Facility	CERCLA
Miscellaneous solid waste, but not limited to the following: personal protective equipment, cloth, plastic, wipes, wood, equipment, tools, pumps, wire, metal casing, plastic piping, sample returns, etc.	Mixed waste (ECM/ hazardous)	4 ft by 4 ft by 8 ft wood box Drums	TBD	ERDF	CERCLA
Spent/ excess chemicals/ reagents and used oils	Hazardous dangerous, nonregulated	Drums	TBD	Offsite	RCRA
Decommissioning debris such as, but not limited to, concrete, wood, rebar, metal/plastic pipes and screens, wire, bentonite, sand, gravels, equipment, pumps, tanks etc.	Nonregulated, (nondangerous, nonhazardous) for non-groundwate r contact Mixed waste for groundwater contact	Drums Pallets Boxes	TBD	ERDF	CERCLA
General construction debris, office/lunch waste	Nonregulated (nondangerous, nonhazardous)	Trash bags	TBD	Contractor provided dumpster, destined to municipal landfill	

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CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*

ECM = environmentally controlled media

ERDF = Environmental Restoration Disposal Facility

RCRA = *Resource Conservation and Recovery Act of 1976*

TBD = to be determined (based upon final design)

Table 5-2. Summary for Projected Waste Stream and Volumes, Pump-and-Treat (Construction and Operations)

General Waste Stream Description	Hazard Classifications Anticipated	Container Options	Estimated Annual Volumes	Disposal Pathway Options	Hazard Source
Sludge, from end of process	Mixed (radiological/ hazardous)	Roll-on/roll-off boxes Drums	300 to 400 tons	ERDF	CERCLA
Spent resins	Mixed (radiological/ hazardous)	4 ft x 4 ft by 8 ft wood box	315 ft^3 or 6 tons	ERDF	CERCLA
Miscellaneous solid waste, but not limited to the following: filter paper, filter socks, wipes, personal protective equipment, cloth, plastic, wood, equipment, tools, pumps, wire, metal and plastic piping, air-stripper tower packing, materials from cleanup of unplanned release	Mixed (ECM/ hazardous)	4 ft x 4 ft by 8 ft wood box Drums	384 ft^3 or 2.3 tons	ERDF	CERCLA
Liquids from sample analysis and screening	Mixed waste	Drums	110 gal	ETF	CERCLA
Spent/ excess chemicals/ reagents and used oils	Hazardous dangerous nonregulated	Drums	TBD	Offsite	RCRA
General construction debris, office/ lunch waste	Nonregulated (nondangerous, nonhazardous)	Roll-on/roll-off boxes	TBD	Offsite (Basin Disposal Inc.)	CERCLA

CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
ECM = environmentally controlled media
ERDF = Environmental Restoration Disposal Facility
ETF = Effluent Treatment Facility
RCRA = *Resource Conservation and Recovery Act of 1976*
TBD = to be determined (based upon final design)

5.4 Safety and Health Program

The remediation contractor's 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 HASP will be developed in accordance with the health and safety program to define the chemical, radiological, and physical hazards and 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 will address the health and safety hazards of each phase of site operation and 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 construction area 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 construction area.

5.5 Emergency Response

During operations, emergency response for the 200 West Area pump-and-treat activities will be covered by the site-specific HASP. The HASP contains primary emergency response actions for site personnel, area alarms, implementation of the emergency action plan, emergency equipment at the task site, emergency coordinators, emergency response procedures, and spill containment. A copy of the HASP will be kept in the 200 West Area control room.

Emergency actions are primarily governed by the HASP. However, when emergencies arise that are beyond the limitations of the HASP, *RL Emergency Plan Implementing Procedures* (DOE-0223) will govern the response, as specified in the HASP.

5.6 Quality Assurance Program

Overall QA for the RD/RA work plan will be planned and implemented in accordance with 10 CFR 830, Subpart A, "Quality Assurance Requirements"; *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5 (EPA/240/B-01/003); and *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods* (SW-846). The QA activities will use a graded approach based on the potential impact on the environment, safety, health, reliability, and continuity of operations. The QA for compliance and performance monitoring will be discussed in the O&M plan.

All prepared SAPs that support the 200-ZP-1 OU RA will contain a QA project plan, which will be used to support the sampling and characterization activities. Other specific activities will include QA implementation, responsibilities and authority, document control, QA records, and audits.

6 Decontamination and Decommissioning

Decontamination efforts associated with 200-ZP-1 OU RA are grouped into two activities: (1) those activities that are involved with the IRM pump-and-treat system, and (2) those activities that are associated with final shutdown and decommissioning of the 200 West Area pump-and-treat system.

6.1 Interim Action Decommissioning

The 200-ZP-1 interim pump-and-treat system will continue to operate until the 200 West Area pump-and-treat system is operational and, at that time, the system will be shut down and the facility evaluated for future use. All components (e.g., structures, wells, equipment, etc.) of the interim pump-and-treat system will be evaluated for future use in the new system during the RD and again as part of the optimization effort. The components that have no foreseeable use will undergo decontamination and decommissioning (D&D). Ultimately, a D&D plan will be prepared that directs the tanks, containers, piping, and equipment to be flushed with clean water to remove as much contamination as possible. The system will then be dismantled and made ready for decontamination. Components that can be decontaminated will be released for use in other systems or will be disposed as industrial waste. The wells that are used in conjunction with the interim pump-and-treat system will be evaluated for continued use or for monitoring in accordance with an approved monitoring plan. If a well is no longer needed, it will be decommissioned in accordance with applicable regulations.

6.2 Final Decontamination and Decommissioning

Final D&D of the 200 West Area pump-and-treat system will be addressed after RL and EPA determine that the treatment system is no longer required to support the remedial action. The D&D of the system will be performed in accordance with the CERCLA process.

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7 Cost and Schedule

7.1 Cost Estimate

A cost estimate for the 200 West Area pump-and-treat system for the next 4 years is provided in Table 7-1. This timeframe includes the upfront planning and design, system construction, startup, and initial operations. A cost estimate for the entire RA will be included in the RD report once the design is finalized and the operational approach is described in the O&M plan. The cost estimate included in the RD report will also be compared to the original estimate in the 200-ZP-1 OU ROD.

Table 7-1. 200 West Area Pump-and-Treat Cost Estimate

WBS Title	FY09 ($ in 1000's)	FY10 ($ in 1000's)	FY11 ($ in 1000's)	FY12 ($ in 1000's)	Total ($ in 1000's)
Remedial Design/Remedial Action Work Plan	$469	$0	$0	$0	$469
Requirements Development/Preliminary Design	$789	$1,001	$0	$0	$1,790
Remedial Action Design - Process Facility	$1,618	$946	$0	$0	$2,564
Remedial Action Design - Balance of Plant	$1,881	$952	$0	$0	$2,833
Long-Lead Procurements	$660	$8,993	$0	$0	$9,652
Regulatory Permitting/Safety	$515	$428	$242	$39	$1,224
Construct Process Facility	$0	$13,284	$18,090	$0	$31,374
Construct Balance of Plant	$0	$36	$31,267	$0	$31,302
Operations	$0	$137	$434	$179	$750
Project Management	$839	$764	$776	$274	$2,266
Install Extraction and Injection Wells	$1,809	$10,059	$0	$0	$2,266
Grand total	$8,579	$36,600	$50,809	$493	$96,480

FY = fiscal year

WBS = work breakdown structure

7.2 Schedule

Figure 7-1 provides the critical path project schedule through system construction (Phase I). A critical path schedule for initial operations, optimization, system upgrade, and long-term operations will be provided in the O&M Plan.

ZP-1 Summary Schedule

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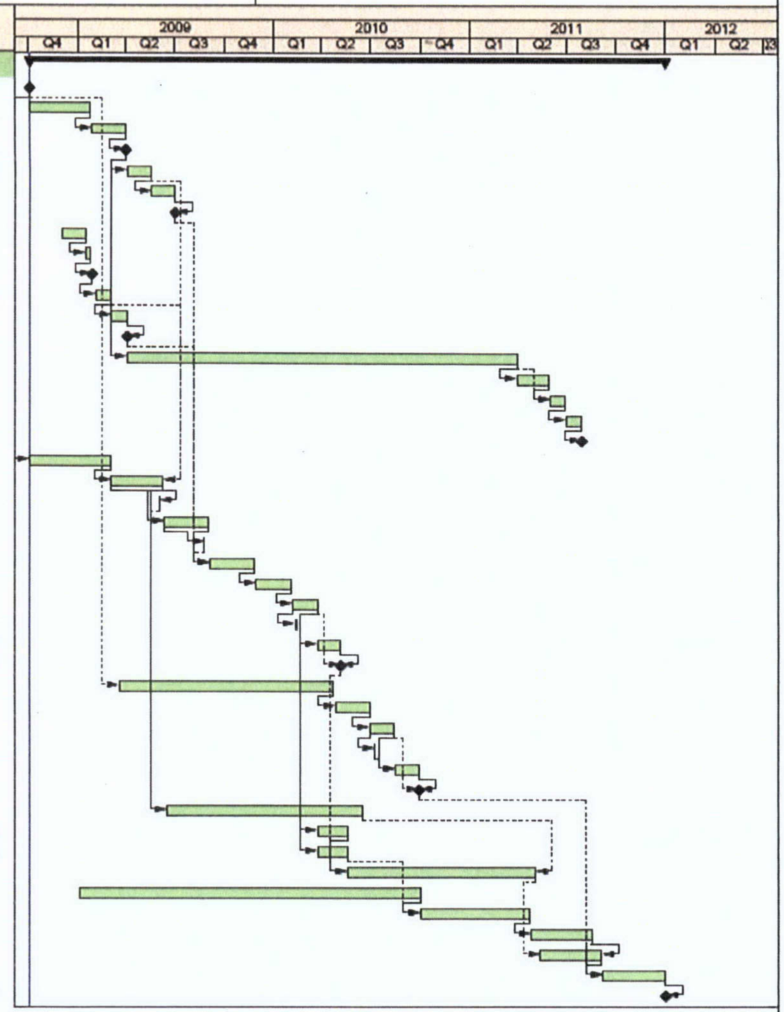
Lir N.	Activity ID	Activity Name	RD	Start	Finish
		ZP-1 Pump and Treat Construction	817	01-Oct-08	30-Dec-11
	Z0000	Start 200 Area West Pump-And-Treat System Project	0	01-Oct-08	
	Z1020	Prepare RD/RA WP	77	01-Oct-08	22-Jan-09
	Z1030	PRC/RLReview/Revise RD/RA WP	46	26-Jan-09	31-Mar-09
	Z1040	Submit RD/RA WP to Regulators	0		31-Mar-09
	Z1050	EPA Review and Comment on RD/RA WP (45 Days)	33	01-Apr-09	15-May-09
	Z1060	Incorporate EPA Comments on RD/RA WP (45 Days)	32	18-May-09	01-Jul-09
	Z1070	Issue RD/RA WP	0		01-Jul-09
	Z1110	Prepare Institutional Control (IC) Plan	28	02-Dec-08*	13-Jan-09
	Z1120	PRC/RLReview/Revise IC Plan	7	14-Jan-09	22-Jan-09
	Z1130	Submit IC Plan to Regulators	0		26-Jan-09
	Z1140	EPA Review and Comment on IC Plan (30 Days)	21	02-Feb-09	03-Mar-09
	Z1150	Incorporate EPA Comments on IC Plan (30 Days)	22	04-Mar-09	02-Apr-09
	Z1160	Issue IC Plan	0		02-Apr-09
	Z1220	Prepare Integrated Monitoring Plan	503	01-Apr-09	30-Mar-11
	Z1225	PRC/RL Review/Revise Integrated Monitoring Plan	42	31-Mar-11	27-May-11
	Z1230	Agency Review Integrated Monitoring Plan	21	31-May-11	28-Jun-11
	Z1240	Incorporate Agency Comments on Integrated Monitoring Plan	21	29-Jun-11	28-Jul-11
	Z1250	Issue Integrated Monitoring Plan	0		28-Jul-11
	Z2010	Develop Functional Design Criteria and Preliminary Requirem...	103	01-Oct-08	02-Mar-09
	Z2020	Prepare 30% Remedial Action Design	70	03-Mar-09	09-Jun-09
	Z2021	30% Remedial Action Design Presentation to EPA/RL	1	02-Jun-09	02-Jun-09
	Z2030	Prepare 60% Remedial Action Design (as needed)	60	10-Jun-09	02-Sep-09
	Z2031	60% Remedial Action Design Presentation to EPA/RL	1	26-Aug-09	26-Aug-09
	Z2040	Prepare 90% Remedial Action Design	59	03-Sep-09	25-Nov-09
	Z2050	PRC/RLReview/Revise 90% Remedial Report Design	46	30-Nov-09	04-Feb-10
	Z2060	EPA Review Draft A Remedial Design Report (45 Days)	32	05-Feb-10	23-Mar-10
	Z2061	RD Report Presentation to EPA/RL	1	12-Feb-10	12-Feb-10
	Z2080	Incorporate Comments to Remedial Design Report (45 Days)	32	24-Mar-10	06-May-10
	Z2090	Issue Final Remedial Action Design Report	0		06-May-10
	Z3010	Prepare O&M Plan	278	19-Mar-09*	23-Apr-10
	Z3020	PRC/RLReview/Revise O&M Plan	46	26-Apr-10*	29-Jun-10
	Z3030	EPA Review Draft A O&M Plan (45 Days)	32	30-Jun-10*	13-Aug-10
	Z3031	O&M Plan Presentation to EPA/RL	1	08-Jul-10	08-Jul-10
	Z3040	Incorporate Comments to O&M Plan (45 Days)	32	16-Aug-10	29-Sep-10
	Z3050	Issue Final O&M Plan	0		29-Sep-10
	Z4010	Procure Long Lead Equipment Systems - Process Facility	252	17-Jun-09	16-Jun-10
	Z5010	Prepare Construction Bid Pkgs/Award Contract - Process Facility	40	24-Mar-10	18-May-10
	Z5020	Prepare Construction Bid Pkgs/Award Contract - Balance of Pl...	40	24-Mar-10	18-May-10
	Z5030	Construct Process Facility	241	19-May-10	03-May-11
	Z5040	Well Drilling	442	02-Jan-09*	30-Sep-10
	Z5050	Construct Balance of Plant	140	01-Oct-10	22-Apr-11
	Z5060	Perform Construction Acceptance Test - Balance of Plant	80	25-Apr-11	16-Aug-11
	Z5070	Perform Construction Acceptance Test - Process Facility	80	12-May-11	02-Sep-11
	Z5080	Perform Operational Testing	80	06-Sep-11	30-Dec-11
	Z5099	Turn ZP-1 Final Treatment System Over to Operations	0		30-Dec-11*



Actual Work | Critical Remaining ... | Remaining Work ◆ | ◆ Milestone

200 West Area Pump & Treat Construction

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Figure 7-1. 200 West Area Pump-and-Treat Critical Path Schedule

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Appendix

Applicable or Relevant and Appropriate Requirements Compliance

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Table A-1. Implementation Strategy for Applicable and Appropriate Requirements for the 200-ZP-1 Groundwater Operable Unit

Regulation	Type	Regulatory Requirements	Implementation/Action Strategy
		Groundwater	
40 CFR 141.61, "Maximum Contaminant Levels for Organics" 40 CFR 141.62, "Maximum Contaminant Levels for Inorganics" 40 CFR 141.66, "Maximum Contaminant Levels for Radionuclides" WAC 173-340-720(4)(b)(iii)(A) and (B), "Standard Method B Potable Groundwater Cleanup Levels" WAC 173-340-720(7)(b), "Adjustments to Cleanup Levels"	Chemical-specific	The final cleanup levels identified in the ROD for the 200-ZP-1 OU groundwater are Federal and state drinking water MCLs and state groundwater cleanup standards (where more stringent than MCLs). These cleanup levels were developed using Federal MCLs and the criteria and equations in the MTCA Method B cleanup levels for potable groundwater and the Federal and state water standards for radionuclides.	Groundwater sampling of monitoring wells will be performed to collect data to monitor the progress of cleaning contaminated groundwater to achieve final cleanup levels. Monitoring will begin during the early stages of construction and will continue throughout treatment and closeout to ensure that cleanup levels have been met. Groundwater sampling of extraction wells will occur to provide data regarding the operation of the treatment plant. Following extraction, the COCs in groundwater (except tritium) will be treated to achieve the cleanup levels. The treated groundwater will then be returned to the aquifer through injection wells. Biological degradation products of organic COCs will be treated as part of the pump-and-treat component of the remedy and through the MNA remedy.

COC	Final Cleanup Level
Carbon tetrachloride	3.4
Chromium (total)	100
Hexavalent chromium	48
Nitrate (measured and expressed as total nitrogen)	10,000
Trichloroethylene (TCE)	1
Iodine-129	1
Technetium-99	900
Tritium	20,000

Units are "µg/L" for nonradionuclides and "pCi/L" for radionuclides.

Table A-1. Implementation Strategy for Applicable and Appropriate Requirements for the 200-ZP-1 Groundwater Operable Unit

Regulation	Type	Regulatory Requirements	Implementation/Action Strategy
Groundwater – Underground Injection			
42 U.S.C. 6939b, Sec. 3020(b), Interim Control of Hazardous Waste Injection WAC 173-218-040 "UIC Well Classification Including Allowed and Prohibited Wells" WAC 173-218-120, "Decommissioning Injection Wells"	Action-specific	Establishes requirements to allow injection of groundwater that contains hazardous waste back into the aquifer during implementation of the CERCLA remedy. EPA OSWER Directive 9234.1-06, Applicability of Land Disposal Restrictions to RCRA and CERCLA Ground Water Treatment Injection Superfund Management Review: Recommendation No. 26, provides guidance on issues regarding whether LDRs apply to injection of groundwater. In general, this guidance states that EPA construes the provisions of RCRA Section 3020 to be applicable instead of LDR provisions. RCRA Section 3020(b) exempts injection of treated contaminated ground water withdrawn from an aquifer, if the following criteria are met: (1) the injection is a CERCLA Section 104 or 106 response action or part of a RCRA corrective action intended to clean up the contamination, (2) the contaminated ground water is treated to substantially reduce hazardous constituents prior to such injection, and (3) the response action or corrective action is sufficient to protect human health and the environment upon completion. In Washington State, Class IV wells reinjecting treated ground water into the same formation from where it was drawn is authorized as part of a removal or remedial action if such injection is approved by EPA in accordance with CERCLA and RCRA.	Injection wells used in the 200-ZP-1 OU to return treated groundwater to the aquifer meet the classification criteria of a Class IV well. Extracted groundwater will be treated to achieve cleanup levels before returning it to the aquifer through the injection wells. Injection wells will be decommissioned in a manner that prevents movement of fluid containing any contaminant into the groundwater. Any soil, gravel, sludge, liquids or other materials removed from or adjacent to the wells will be disposed in accordance with these requirements.
Groundwater - Minimum Standards for Construction and Maintenance of Wells			
WAC 173-160-161	Action-specific	Identifies well planning and construction requirements.	All monitoring, injection and extractions wells completed for the 200-ZP-1 OU remediation activities will meet the substantive requirements of these regulations. Well construction will be
WAC 173-160-171		Identifies the requirements for locating a well.	

Table A-1. Implementation Strategy for Applicable and Appropriate Requirements for the 200-ZP-1 Groundwater Operable Unit

Regulation	Type	Regulatory Requirements	Implementation/Action Strategy
WAC 173-160-181		Identifies the requirements for preserving natural barriers to groundwater movement between aquifers.	consistent with the *Sampling and Analysis Plan for the First Set of Remedial Action Wells in the 200-ZP-1 Groundwater Operable Unit* (DOE/RL-2008-57), approved by EPA.
WAC 173-160-400		Identifies the minimum standards for resource protection wells and geotechnical soil borings.	
WAC 173-160-420		Identifies the general construction requirements for resource protection wells.	
WAC 173-160-430		Identifies the minimum casing standards.	
WAC 173-160-440		Identifies the equipment cleaning standards.	
WAC 173-160-450		Identifies the well sealing requirements.	
WAC 173-160-460		Identifies the decommissioning process for resource protection wells.	
Air – Radiation/Radionuclides			
WAC 246-247-035(1)(a)(ii), "National Emissions Standards Adopted by Reference for Sources of Radionuclide Emissions"	Action-specific	Incorporates requirements of 40 CFR 61, Subpart H by reference. Requires that emissions of radionuclides to the ambient air from DOE facilities shall not exceed amounts that would cause any member of the public to receive in any year an effective dose equivalent of >10 mrem/yr.	This is a risk-based standard for the purposes of protecting human health and the environment. The regulations require a comparison of potential emissions from remedial point sources to the emission threshold. The 200-ZP-1 remediation will be evaluated with respect to determining its potential-to-emit radionuclides form any point source or diffuse/fugitive source. To accomplish this, the total unabated potential release (in curries) will be determined and the annual dose to the maximally exposed individual calculated using the DOE guide, *Calculating Potential-to-Emit Radiological Releases and Doses* (DOE/RL-2006-29), or modeled using the CAP-88PC computer model. Control and monitoring requirements for potential radiological air emissions will be based on the calculated/modeled value of the potential-to-emit.

Table A-1. Implementation Strategy for Applicable and Appropriate Requirements for the 200-ZP-1 Groundwater Operable Unit

Regulation	Type	Regulatory Requirements	Implementation/Action Strategy
WAC 246-247-040, "General Standards," WAC 246-247-040(3) WAC 246-247-040(4) WAC 246-247-075 (1)(2)(3)(4)(8), "Monitoring, Testing and Quality Assurance"		Requires that emissions be controlled to assure radiation emission standards are not exceeded. New construction and significant modifications of emission units. Existing emission units and non-significant modifications. Establishes the monitoring, testing, and quality assurance requirements for radioactive air emissions.	These regulations require an evaluation of potential radiation emissions from new remedial sources using best available radionuclide control technology or from existing sources using as low as reasonably achievable control technology. Following evaluation of potential emissions, an air monitoring plan specifying any required monitoring for non-point and fugitive radioactive airborne emissions will be documented in and issued with the O&M Plan. The total unabated potential release (in curries) will be determined, and the annual dose to the maximally exposed individual calculated using the DOE guide, *Calculating Potential-to-Emit Radiological Releases and Doses* (DOE/RL-2006-29), or modeled using the CAP-88PC computer model. Control and monitoring requirements for potential radiological air emissions will be based on the calculated/modeled value of the potential-to-emit. The PTE calculation, emissions controls, and monitoring will be described in the air emissions section of the O&M plan.
WAC 173-480-050(1), "General Standards for Maximum Permissible Emissions" WAC 173-480-070(2), "Emission Monitoring and Compliance Procedures"	Action-specific	Determine compliance with the public dose standard by calculating exposure at the point of maximum annual air concentration in an unrestricted area where any member of the public may be. This state regulation is as (or more) stringent than the equivalent Federal program requirement.	The total unabated potential release (in curries) will be determined, and the annual dose to the maximally exposed individual calculated using the DOE guide, *Calculating Potential-to-Emit Radiological Releases and Doses* (DOE/RL-2006-29), or modeled using the CAP-88PC computer model. Control and monitoring requirements for potential radiological air emissions will be based on the calculated/modeled value of the potential-to-emit. The PTE calculation, emissions controls and monitoring will be described in the air emissions section of the O&M plan.

Table A-1. Implementation Strategy for Applicable and Appropriate Requirements for the 200-ZP-1 Groundwater Operable Unit

Regulation	Type	Regulatory Requirements	Implementation/Action Strategy
		Air- General Regulations for Air Pollution Sources	
WAC 173-400-040 WAC 173-400-113, "General Regulations for Maximum Emissions"	Action-specific	Requires all sources of air contaminants to meet emission standards for visible, particulate, fugitive, odors, and hazardous air emissions. Requires use of reasonably available control technology. This state regulation is as (or more) stringent than the equivalent Federal program requirement.	If remedial actions in the 200-ZP-1 OU result in visible, particulate, fugitive, and hazardous air emissions and odors then applicable control technology is required. This will be described in the air emissions section of the O&M plan.
		Air- Controls for New Sources of Toxic Air Pollutants	
WAC 173-460, "Controls for New Sources of Toxic Air Pollutants" Specific subsections: WAC 173-460-030 WAC 173-460-060 WAC 173-460-070, "Ambient Impact Requirement"	Action-specific	Requires that new sources of air emissions meet emission requirements identified in this regulation. This state regulation is as (or more) stringent than the equivalent Federal program requirement. The owner/operator of a new toxic air pollutant source that is likely to increase toxic air pollutant emissions shall demonstrate that emissions from the source are sufficiently low to protect human health and safety from potential carcinogenic and/or other toxic effects. This state regulation is as (or more) stringent than the equivalent Federal program requirement.	If there is the potential for toxic air pollutants to become airborne as a result of remedial activities, the applicable emission standards must be met. To demonstrate compliance with applicable and relevant or appropriate requirements of WAC 173-400 and WAC 173-460, an acceptable source impact analysis will be completed. The analysis will demonstrate that, after application of T-BACT, the new source's maximum incremental ambient air impact levels do not exceed the WAC 173-460 Class A or Class B acceptable source impact levels at the nearest site boundary; or, if applicable, that the new source toxic air pollutant emission rates do not exceed the small quantity emission rates specified in WAC 173-460 at the stack.

Table A-1. Implementation Strategy for Applicable and Appropriate Requirements for the 200-ZP-1 Groundwater Operable Unit

Regulation	Type	Regulatory Requirements	Implementation/Action Strategy
Solid Waste - Minimum Functional Standards for Solid Waste Handling and Management			
WAC 173-304, "Minimum Functional Standards for Solid Waste Handling" Specific subsections: WAC 173-304-190, WAC 173-304-200(2) WAC 173-304-460 RCW 70.95, "Solid Waste Management – Reduction and Recycling"	Action-specific	Establishes requirements for the onsite storage of solid wastes that are not radioactive or dangerous wastes.	Nondangerous, nonradioactive solid wastes that are stored onsite will be managed in leak proof containers that meet the requirements of this standard. Wastes destined for solid waste landfills shall also meet applicable requirements.
WAC 173-350-300, "On-site Storage, Collection and Transportation Standards"	Location-specific	Establishes the requirements for managing temporary storage of solid waste in onsite containers and the collection and transportation of solid waste.	Safe and sanitary storage of all containerized solid wastes accumulated at the site is required.
Solid Waste – Dangerous Waste Regulations			
WAC 173-303-016 , "Identifying Solid Waste"	Action-specific	Identifies criteria for determining if materials are solid wastes.	Waste materials generated during the 200-ZP-1 OU remedial action will be compared to these criteria. Those that are determined to be solid waste and that are also dangerous waste will be subject to applicable and substantive waste management requirements of WAC 173-303.
WAC 173-303-017, "Recycling Process Involving Solid Waste"	Action-specific	Identifies materials that are and are not solid wastes when recycled.	Waste materials generated during the 200-ZP-1 OU remedial action will be compared to these criteria. Those categories of wastes that are not solid wastes are not subject to these requirements. If any meet this requirement and are also solid wastes, they are subject to requirements of WAC 173-303.

Table A-1. Implementation Strategy for Applicable and Appropriate Requirements for the 200-ZP-1 Groundwater Operable Unit

Regulation	Type	Regulatory Requirements	Implementation/Action Strategy
WAC 173-303-070(3), "Designation of Dangerous Waste"	Action-specific	Establishes whether a solid waste is, or is not, a dangerous waste or an extremely hazardous waste.	The designation procedures to determine if a solid waste meets any dangerous waste criteria applies to remediation wastes generated from 200-ZP-1 OU remediation activities. Remediation wastes including media and treatment residuals generated from the 200-ZP-1 OU will be designated according to the procedures identified in WAC 173-303. The generator will determine if waste is a characteristic or listed dangerous waste by applying knowledge or by testing material. The following approach shall be applied to identify possible F-listed waste codes for groundwater, vadose zone soil, and treatment residuals. The COCs that may be extracted/ encountered during remediation include carbon tetrachloride, 1,1,1-trichloroethane, 2-methylphenol (cresol o-), 4-methylphenol (cresol p-), tetrachloroethene, trichloroethylene (TCE), acetone, and methylene chloride. 1. Carbon tetrachloride will be designated based on available knowledge and EPA guidance. A generator evaluation will be conducted to determine if the F001 dangerous waste listed code should be applied to carbon tetrachloride - solid wastes and media. The generator will review available information to ascertain if the source was from "large-scale degreasing processes" intended by EPA for the F001 listing. If the solid waste or media is determined to not be F001, then the concentrations of carbon tetrachloride will be compared to the TCLP maximum threshold of 0.5 mg/L (500 µg/L). Exceedances of the TCLP threshold and will be identified as dangerous waste #D019.

Table A-1. Implementation Strategy for Applicable and Appropriate Requirements for the 200-ZP-1 Groundwater Operable Unit

Regulation	Type	Regulatory Requirements	Implementation/Action Strategy
			2. For the other COCs that may represent listed wastes codes, the generator shall review validated analytical data to review detected concentrations, method detection limits, and possible laboratory interferents to confirm the presence or absence of the COC of interest. Breakdown products, possible source areas, and available facility/process documentation shall also be evaluated to make the determination a COC may be from a listed waste source. If the generator cannot make a good-faith determination the waste or media is a listed dangerous waste because documentation or other evidence is inconclusive, then consistent with EPA guidance[1], the generator may assume the waste or media is not listed dangerous waste provided the material does not exhibit a characteristic of dangerous waste. If the generator determines the waste is a listed dangerous waste, it must be managed accordingly. 3. Waste residuals and media that designate as listed dangerous waste must be treated to meet UTS or meet alternative treatment standards for RCRA hazardous soils (e.g., from soil borings). Media with concentrations below health-based standards (i.e., MTCA Method B cleanup, levels) may be eligible for a contained-out determination subject to EPA approval.

1 *Management of Remediation Waste Under RCRA*, EPA 530-F-98-026, dated October 1998.

Table A-1. Implementation Strategy for Applicable and Appropriate Requirements for the 200-ZP-1 Groundwater Operable Unit

Regulation	Type	Regulatory Requirements	Implementation/Action Strategy
WAC 173-303-071, "Excluded Categories of Waste"	Action-specific	Describes those categories of wastes that are excluded from the requirements of WAC 273-303 (excluding WAC 173-303-050), because they are generally not dangerous or are regulated under other state and federal programs or are recycled in ways that do not threaten public health or the environment.	Wastes generated from the 200-ZP-1 OU remedial action (e.g., laboratory and treatability samples) will be reviewed against the categories identified in WAC 173-303-071.
WAC 173-303-073, "Conditional Exclusion of Special Wastes"	Action-specific	Establishes the conditional exclusions and the management requirements of special wastes, as defined in WAC 173-303-040.	Wastes generated during the remedial action (i.e., wastes that are state-only dangerous waste and that are solid [non-liquid, nonaqueous, nongaseous]) will be reviewed against these exclusions. For example, wastes that are corrosive waste or toxic waste with Category D toxicity may be eligible for this conditional exclusion
WAC 173-303-077, "Requirements for Universal Waste"	Action-specific	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.	Wastes generated from the 200-ZP-1 OU remedial action will be reviewed against universal waste criteria. For example, if batteries, thermostats, fluorescent lamps, and mercury-containing equipment are generated, their handling, accumulation, labeling, shipping, and management will comply with the requirements provided in WAC 173-303-573.
WAC 173-303-120, "Recycled, Reclaimed, and Recovered Wastes" Specific subsections: WAC 173-303-120(3) WAC 173-303-120(5)	Action-specific	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.	Wastes generated from the 200-ZP-1 OU remedial action will be reviewed against the requirements for recyclable materials. If recyclable materials (e.g., spent refrigerants, antifreeze, lead-acid batteries, and used oil) are generated, they will managed according to the requirements of WAC 173-303-120(3). Eligible recyclable materials can be recycled and/or conditionally excluded from certain dangerous waste requirements.

Table A-1. Implementation Strategy for Applicable and Appropriate Requirements for the 200-ZP-1 Groundwater Operable Unit

Regulation	Type	Regulatory Requirements	Implementation/Action Strategy
WAC 173-303-140(4), "Land Disposal Restrictions"	Action-specific	This regulation establishes state standards for land disposal of dangerous waste and incorporates, by reference, the Federal restrictions of 40 CFR 268 that are relevant and appropriate to solid waste that is designated as dangerous or mixed waste. The requirements prohibit the placement of restricted RCRA hazardous waste in land-based units such as landfills surface impoundments, and waste piles until treated to standards considered protective for disposal. Specific treatment standards are included in requirements.	200-ZP-1 remediation dangerous waste destined for onsite land disposal will be managed in accordance with these restrictions. **Cuttings** generated as a result of well installation will be tested for indicator COCs. If soil characterizes as dangerous waste for RCRA-listed and/or characteristic criteria, it will be compared to corresponding LDRs/UTS. Soil (e.g., from borings) that designate as listed dangerous waste must be treated to meet UTS or meet alternative treatment standards for RCRA hazardous soils. Generator certification is required verifying that the treatment standard has been achieved and the waste has not been diluted. Media with concentrations below health-based standards (i.e., MTCA Method B cleanup, levels) may be eligible for a contained-out determination subject to Ecology approval. **Treatment residuals** (e.g., spent resin and tank sludge) will be tested for indicator COCs and will be compared to LDR treatment standards prior to land disposal. If waste exceeds applicable LDRs/UTS, it must be treated using the technology specified in 40 CFR 268.40 prior to disposal. If restricted waste is shipped to ERDF or to an offsite treatment, storage, or disposal facility, notification must accompany the waste. Generator certification is required verifying that the treatment standard has been achieved and the waste has not been diluted.

Table A-1. Implementation Strategy for Applicable and Appropriate Requirements for the 200-ZP-1 Groundwater Operable Unit

Regulation	Type	Regulatory Requirements	Implementation/Action Strategy
WAC 173-303-170, "Requirements for Generators of Dangerous Waste"	Action-specific	Establishes the requirements for dangerous waste generators. For purposes of this remedial 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 -640 by reference.	These requirements include the substantive portions of WAC 173-303-630 ("Use and Management of Containers") and WAC 173-303-640 ("Tank Systems"). Dangerous waste will be treated by the selected remedy, thus the substantive portions of WAC 173-303-640(4), "Containment and Detection of Releases (from Tank Systems)," apply to key design and operational requirements: Secondary containment for new tank systems and ancillary equipment which includes the collection piping must be provided with secondary containment **<u>except for</u>** the following: - Aboveground piping that is visually inspected for leaks daily - A variance from daily inspections may be obtained per the requirements of WAC 173-304-640 (4)(g) and as approved by EPA.
WAC 173-303-64620 (4), "Corrective Action"		Establishes requirements for corrective action for releases of dangerous wastes and dangerous constituents including releases from solid waste management units.	Investigative and remediation of dangerous wastes and dangerous constituents from solid waste management units and spill sites. Washington's RCRA-authorized *Hazardous Waste Management Act* and dangerous waste regulations give Ecology corrective action jurisdiction over the 200-ZP-1 OU concurrent with CERCLA. As documented in the ROD, Ecology supports and accepts the 200-ZP-1 OU remedy under the Tri-Party Agreement and the CERCLA program as satisfying corrective action requirements.

Table A-1. Implementation Strategy for Applicable and Appropriate Requirements for the 200-ZP-1 Groundwater Operable Unit

Regulation	Type	Regulatory Requirements	Implementation/Action Strategy
		Special Historic and Ecological Resources	
Endangered Species Act of 1973, 16 U.S.C. 1531(a), et seq. 16 U.S.C. 1536(c)	Location-specific	Prohibits actions by Federal agencies that are likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of habitat critical to them. Mitigation measures must be applied to actions that occur within critical habitats or surrounding buffer zones of listed species in order to protect the resource.	Siting the treatment facility, extraction wells, and aboveground piping shall be coordinated with available ecological site data and surveys to ensure that adverse impacts to critical habitats will not occur. Prior to disturbing the earth (e.g., drilling, surface grubbing, and excavating), a survey will be completed and documented by PNNL. The survey will look for threatened or endangered species and critical habitat and document such with respect to the areas included in this remedial action where there would be disturbance of the earth. Any restrictions regarding disturbance of the earth or otherwise will be identified in a letter report from PNNL to CHPRC.
Native American Graves Protection and Repatriation Act, 25 U.S.C. 3001, et seq.	Location-specific	Establishes Federal agency responsibility for discovery of human remains, associated and unassociated funerary objects, sacred objects, and items of cultural patrimony. Requires Native American Tribal consultation in the event of discovery.	In 1987 and 1988, a comprehensive archaeological resources review of the Central Plateau was conducted that included an examination of samples collected from undisturbed portions of the 200 West Area. The inventory reported no significant surface archaeological sites were encountered. Remedial actions and facilities' siting shall be coordinated with available site data and surveys and consultants to ensure adverse impacts do not occur. Prior to disturbing the earth (e.g., drilling, surface grubbing, and excavating), a survey will be completed and documented by PNNL. The survey will look for culturally significant items and document such with respect to the areas included in this remedial action where there would be disturbance of the earth. Any restrictions regarding disturbance of the earth or otherwise will be identified in a letter report from PNNL to CHPRC.

Table A-1. Implementation Strategy for Applicable and Appropriate Requirements for the 200-ZP-1 Groundwater Operable Unit

Regulation	Type	Regulatory Requirements	Implementation/Action Strategy
Archaeological and Historic Preservation Act, 16 U.S.C. 469 aa-mm, et seq.	Action-specific	Requires that remedial actions at the 200 –ZP-1 OU do not cause the loss of any archaeological or historic data. T his act mandated preservation of data and does not require protection of the actual historical sites	In 1987 and 1988, a comprehensive archaeological resources review of the Central Plateau was conducted that included an examination of samples collected from undisturbed portions of the 200 West Area. The inventory reported no significant surface archaeological sites were encountered. Remedial actions and facilities' siting shall be coordinated with available site data and surveys and consultants to ensure adverse impacts do not occur. Prior to disturbing the earth (e.g., drilling, surface grubbing, and excavating), a survey will be completed and documented by PNNL. The survey will look for culturally significant items and document such with respect to the areas included in this remedial action where there would be disturbance of the earth. Any restrictions regarding disturbance of the earth or otherwise will be identified in a letter report from PNNL to CHPRC.
National Historic Preservation Act of 1966, 16 U.S.C. 470, Section 106, et seq.	Location-specific	Requires Federal agencies to consider the impacts of their undertaking on cultural properties through identification, evaluation, and mitigation processes.	In 1987 and 1988, a comprehensive archaeological resources review of the Central Plateau was conducted that included an examination of samples collected from undisturbed portions of the 200 West Area. The inventory reported no significant surface archaeological sites were encountered. Remedial actions and facilities' siting shall be coordinated with available site data and surveys and consultants to ensure adverse impacts do not occur. Prior to disturbing the earth (e.g., drilling, surface grubbing, and excavating), a survey will be completed and documented by PNNL. The survey will look for culturally significant items and document such with respect to the areas included in this remedial action where there would be disturbance of the earth. Any restrictions regarding disturbance of the earth or otherwise will be identified in a letter report from PNNL to CHPRC.

Table A-1. Implementation Strategy for Applicable and Appropriate Requirements for the 200-ZP-1 Groundwater Operable Unit

Regulation		Type	Regulatory Requirements		Implementation/Action Strategy
CERCLA	=	*Comprehensive Environmental Response, Compensation and Liability Act of 1980*	MTCA	=	Model Toxics Control Act
			OU	=	operable unit
CFR	=	Code of Federal Regulations	PNNL	=	Pacific Northwest National Laboratory
CHPRC	=	CH2M HILL Plateau Remediation Company	RCRA	=	Resource Conservation and Recovery Act of 1976
COC	=	contaminant of concern	RD/RA	=	remedial design/remedial action
DOE	=	U.S. Department of Energy	ROD	=	Record of Decision
Ecology	=	Washington State Department of Ecology	TCLP	=	toxicity characteristic leaching procedures
EPA	=	U.S. Environmental Protection Agency	Tri-Party Agreement	=	Hanford Federal Facility Agreement and Consent Order (Ecology et al. 2003)
LDR	=	land disposal restriction			
MCL	=	maximum contaminant level	UTS	=	universal treatment standard
MNA	=	monitored natural attenuation	WAC	=	Washington Administrative Code

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40 CFR 141.66, "Maximum Contaminant Levels for Radionuclides," *Code of Federal Regulations.*

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40 CFR 141.61, "Maximum Contaminant Levels for Organics," *Code of Federal Regulations.*

Archaeological and Historic Preservation Act, U.S.C. 469aa-mm, et seq.

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