0063857

DOE/RL-2001-49
Revision 1

Groundwater Sampling and Analysis Plan for the 200-BP-5 Operable Unit

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management
Pacific Northwest National Laboratory for the
U.S. Department of Energy under Contract DE-AC05-76RL01830

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

DOE/RL-2003-49
Revision 1

Groundwater Sampling and Analysis Plan for the 200-BP-5 Operable Unit

Date Published
November 2004

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management
Pacific Northwest National Laboratory for the
U.S. Department of Energy under Contract DE-AC05-76RL01830

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

Summary

This document describes groundwater sampling and analysis requirements for the 200-BP-5 Operable Unit under the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) program and the *Atomic Energy Act of 1954* (AEA). The document also presents a revised monitoring network and sampling program needed to adequately define the major groundwater plumes that are associated with B Plant past practice operations as they currently exist. The wells associated with the 200-BP-5 Operable Unit network will be sampled annually to triennially for constituents including technetium-99, tritium, uranium, iodine-129, strontium-90, cesium-137, plutonium-239/240, cobalt-60, cyanide, and nitrate. Additional data are also available from *Resource Conservation and Recovery Act* (RCRA) monitoring activities that will be used to supplement the operable unit monitoring activities as defined in this document.

A list of 91 monitoring wells comprising the 200-BP-5 Operable Unit monitoring network, including specific contaminants to be analyzed and sampling frequency, is presented in this document. The monitoring network for technetium-99 is based on a combination of geostatistical modeling and hydrogeological considerations. The text identifies the revisions made in the monitoring network for the 200-BP-5 Operable Unit from the previous version of this document. Drilling a new well is planned that will better define the distribution of technetium-99 in the area between the 200 East Area and Gable Mountain Gap. An additional well is also planned that will help define the northwestern extension of the uranium groundwater plume that originates in the vicinity of Waste Management Area BY. Also included in this document are sampling and analysis protocol, quality assurance and quality control requirements, groundwater level monitoring, and data management requirements associated with groundwater monitoring of the 200-BP-5 Operable Unit.

Contents

Figures

Tables

1.0 Introduction

The purpose of this document is to identify groundwater sampling and analysis requirements for the 200-BP-5 Operable Unit. This sampling and analysis plan describes a revised monitoring well network, constituents analyzed, sampling protocol and waste management requirements, groundwater level measurement, and reporting and quality assurance requirements associated with this activity.

Data are necessary to define groundwater contaminant plume extent and movement in the 200-BP-5 Operable Unit to meet the requirements for remediation performance monitoring (*Comprehensive Environmental Response, Compensation, and Liability Act of 1980* [CERCLA; 40 CFR 300 Subpart E]) and site-wide surveillance monitoring (*Atomic Energy Act of 1954* [AEA]). This sampling and analysis plan updates the previous version, which was prepared in response to the U.S. Environmental Protection Agency (EPA) 5-year review of groundwater remedial actions of the Hanford Site and specifically supported Action Item 200-8 (EPA 2001) and addressed CERCLA monitoring activities. This document describes an integrated monitoring program that meets the objectives of CERCLA and AEA. However, AEA information is provided for completeness and to fully integrate monitoring. Monitoring for contaminants under the AEA is implemented under DOE Order 450.1. Monitoring data are also collected within the 200-BP-5 Operable Unit in accordance with the *Resource Conservation and Recovery Act* (RCRA) as contained in 40 CFR 264-265 and administered under the *Washington Administrative Code* (WAC) 173-303. RCRA monitoring data are used as supplementary data in determining groundwater contaminant distribution in the 200-BP-5 Operable Unit.

Groundwater remediation is not currently being performed in the 200-BP-5 Operable Unit and a record of decision (ROD) is not yet in place. The sampling and analysis plan for this operable unit will be modified as applicable to effectively support CERCLA actions and decision documents for the 200-BP-5 Operable Unit.

This section provides background information about the 200-BP-5 Operable Unit, a list of the contaminants of concern (COCs), and a summary of the data quality objectives (DQOs) for groundwater monitoring in the unit as defined in *Data Quality Objectives Summary Report – Designing a Groundwater Monitoring Network for the 200-BP-5 and 200-PO-1 Operable Units* (PNNL-14049).

1.1 Background

Groundwater in the northern part of the 200 East Area and the 600 Area north of 200 East constitutes the 200-BP-5 Operable Unit (Figure 1.1). Tritium contamination extends north through the Gable Mountain Gap to the Columbia River and the 2000 pCi/L tritium contour is used in this plan to define the limits of the operable unit to the north of the 200 East Area (PNNL-14049; Figure 1.1). The Gable Mountain Pond is also included within the 200-BP-5 Operable Unit. This sampling and analysis plan addresses an area somewhat larger than the operable unit, termed the 200-BP-5 "groundwater interest area" (Figure 1.1). The Groundwater Performance Assessment project (groundwater project) has defined a series of interest areas to cover the Hanford Site for purposes of planning and interpreting groundwater data comprehensively. The defined extent of these interest areas ensure consideration of wells located between specific operable units.

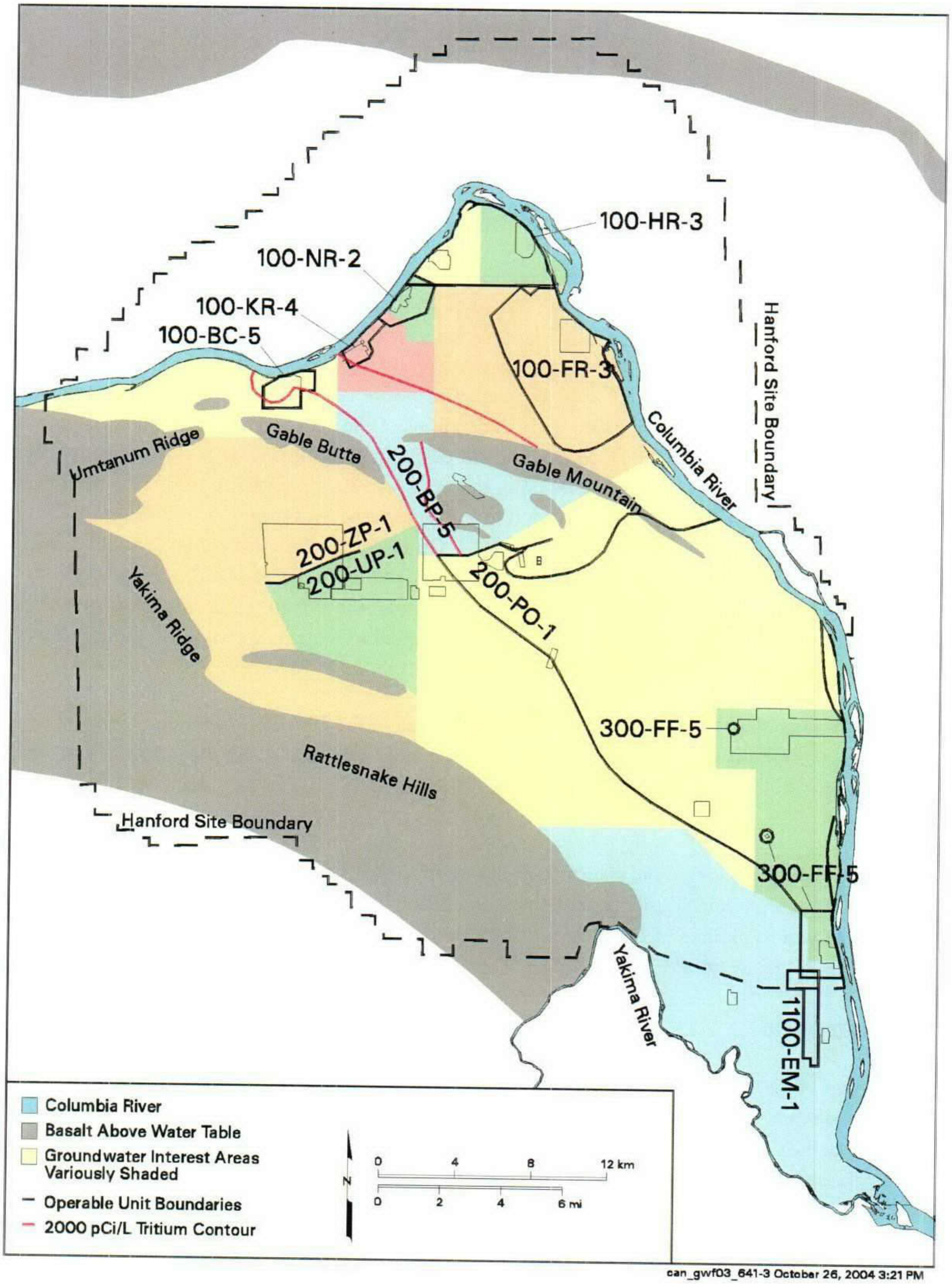

Figure 1.1. Groundwater Operable Units and Groundwater Interest Areas on the Hanford Site

The primary focus of this sampling and analysis plan is on the unconfined aquifer, because it contains most of the contamination associated with this operable unit. Selected wells associated with this unit also monitor the upper basalt confined aquifer. Activities associated with B Plant past-practice operations are the primary source of the contaminants found in the unconfined aquifer in the 200-BP-5 Operable Unit. The southeastern and eastern parts of 200 East are in the 200-PO-1 Operable Unit, where groundwater monitoring operations are directed toward contamination associated with the Plutonium-Uranium Extraction (PUREX) facility. B Plant and PUREX were used to process irradiated reactor fuel to extract plutonium between 1944 and 1990. Parts of the northern portion of the 200-BP-5 Operable Unit overlap the 100-BC-5 and 100-KR-4 Operable Units.

The 200-BP-5 Operable Unit contaminant sources include the facilities surrounding B Plant plus waste storage and disposal facilities north of the plant. B Plant was used to recover plutonium from irradiated fuel using the bismuth phosphate process from 1945 to 1956 (*Hanford Site Groundwater Monitoring for Fiscal Year 2001*, PNNL-13788; *Hanford Site Groundwater: Settings, Sources, and Methods*, PNNL-13080; *B Plant Aggregate Area Management Study Report*, DOE/RL-92-05). From 1968 to 1985, the plant was used to recover cesium-137 and strontium-90 from tank farm waste (*RCRA Facility Investigation Report for the 200-PO-1 Operable Unit*, DOE/RL-95-100). Contamination is primarily the result of waste disposal to the soil at various locations and includes effluent from process streams, cooling water, and condensate.

In 1954 and 1955, scavenged uranium recovery waste supernatant from U Plant operations was discharged to the BY Cribs (PNNL-13080). This waste contained large amounts of ferrocyanide and other chemical and radiological components. Disposal of this waste was discontinued because high levels of cobalt-60 were detected in the groundwater.

Significant waste sources for the 200-BP-5 Operable Unit are facilities associated with CERCLA and AEA monitoring activities and include the BY cribs, the 216-B-5 reverse well, and Gable Mountain Pond. Associated RCRA facilities include low-level burial grounds Waste Management Areas 1 and 2, the 216-B-63 ditch, the 216-B-3 Pond (B Pond), the Liquid Effluent Retention Facility (LERF), and the tank farm facilities at Waste Management Areas (WMAs) B-BX-BY and C (Figures 1.2 and 1.3). These facilities are primarily monitored for non-radioactive contaminants under RCRA and for radioactive contaminants under CERCLA and AEA regulations.

Groundwater COCs associated with the 200-BP-5 Operable Unit include tritium, nitrate, iodine-129, technetium-99, uranium, cobalt-60, cyanide, uranium, cesium-137, strontium-90, and plutonium-239/240 (Figures 1.4 – 1.13; PNNL-14049). The major sources include the following:

- Tritium, iodine-129, and nitrate contamination is widespread in the 200 East Area and is associated with both B Plant and PUREX Plant operations. Groundwater plumes of these contaminants within the 200-BP-5 Operable Unit extend to the northwest into the 600 Area toward the Gable Mountain/ Gable Butte gap and southeast toward the PUREX Plant.

- The BY cribs were important sources of technetium-99, cyanide, cobalt-60, and nitrate contamination associated with early releases and were a main contributor for plumes that moved to the northwest.

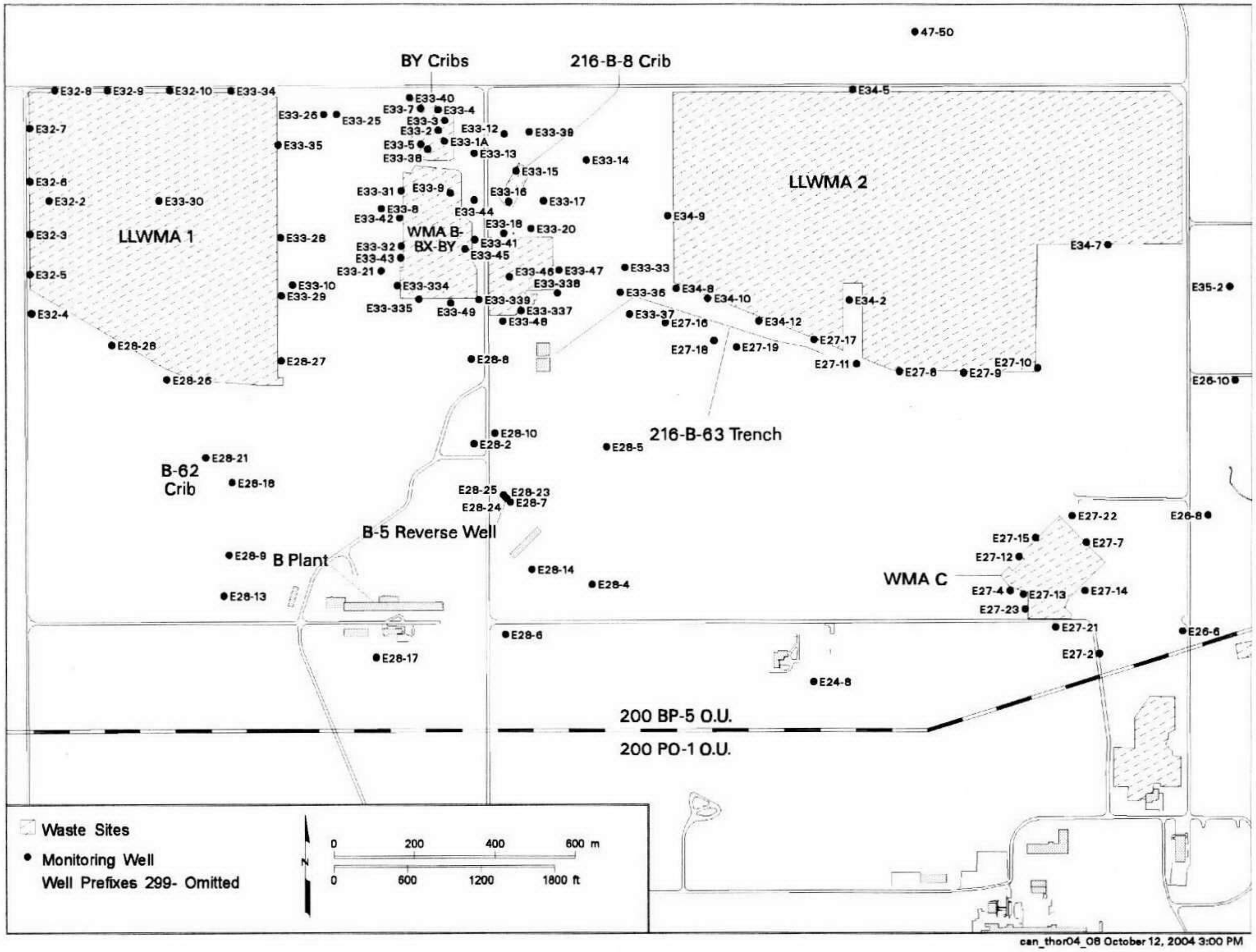

Figure 1.2. Groundwater Monitoring Wells Located in the 200-BP-5 Operable Unit (200 East Area)

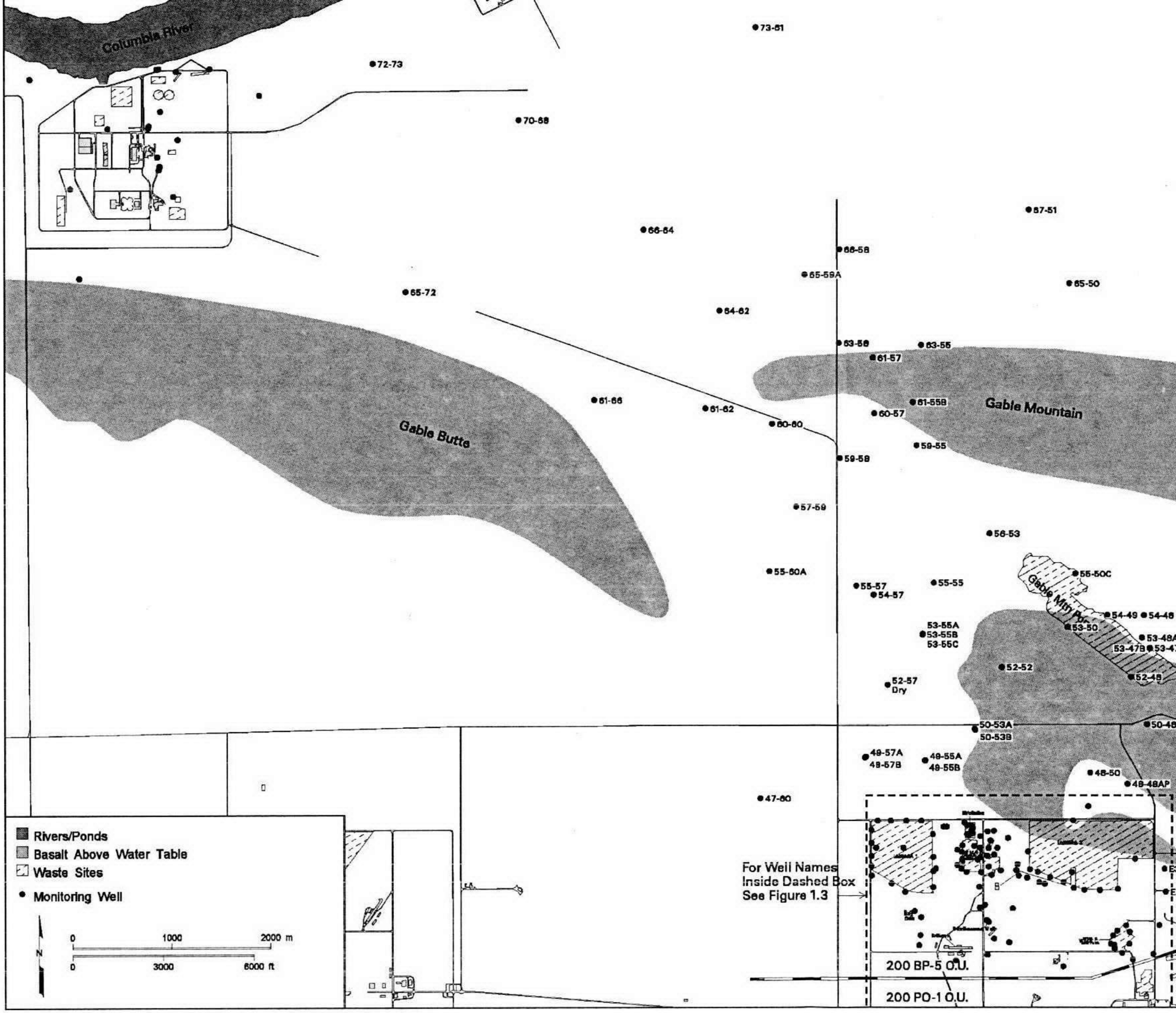

Figure 1.3. Groundwater Monitoring Wells Located in the 200-BP-5 Operable Unit (600

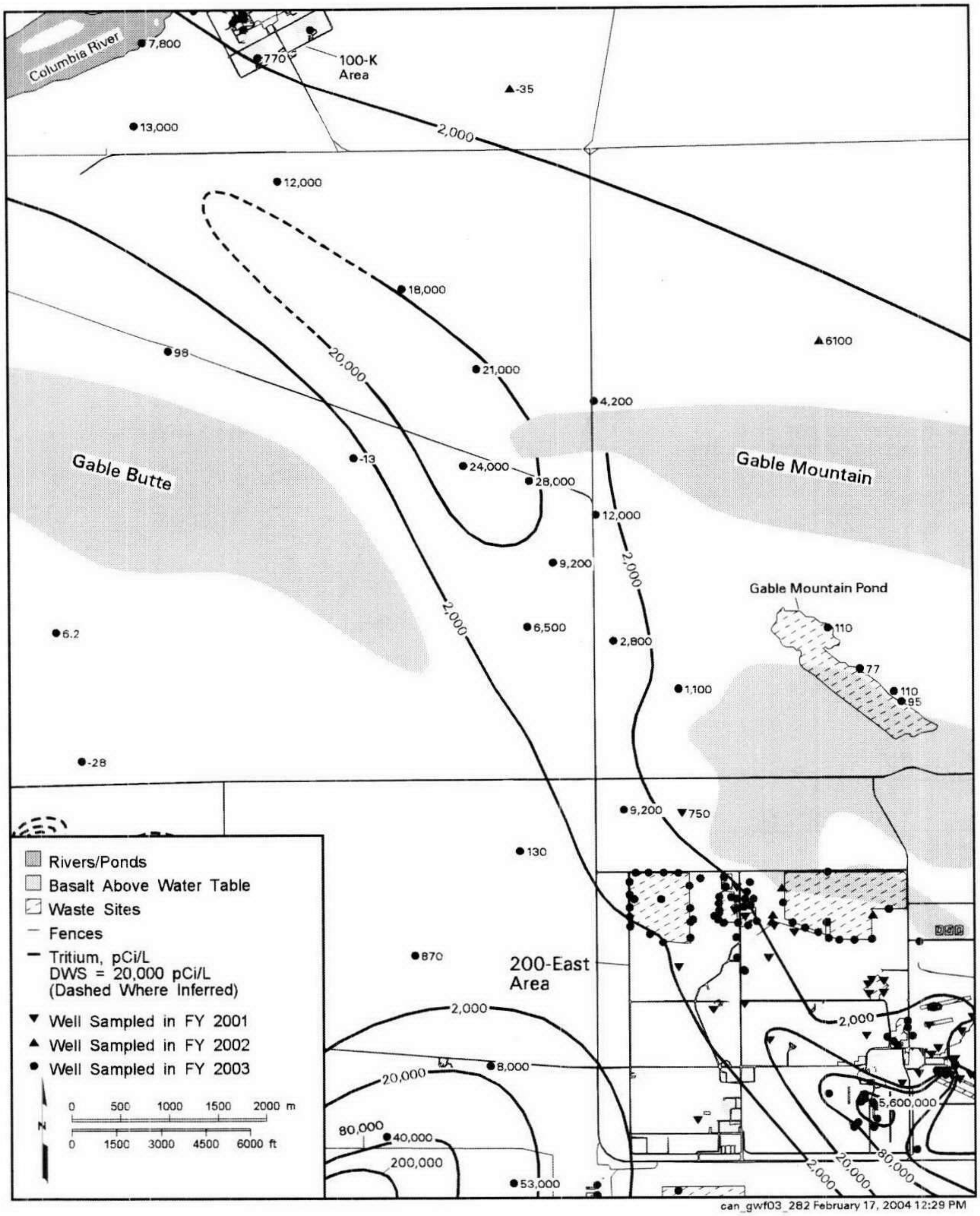

Figure 1.4. Average Tritium Concentrations in the 200-BP-5 Operable Unit and Vicinity, Top of Unconfined Aquifer

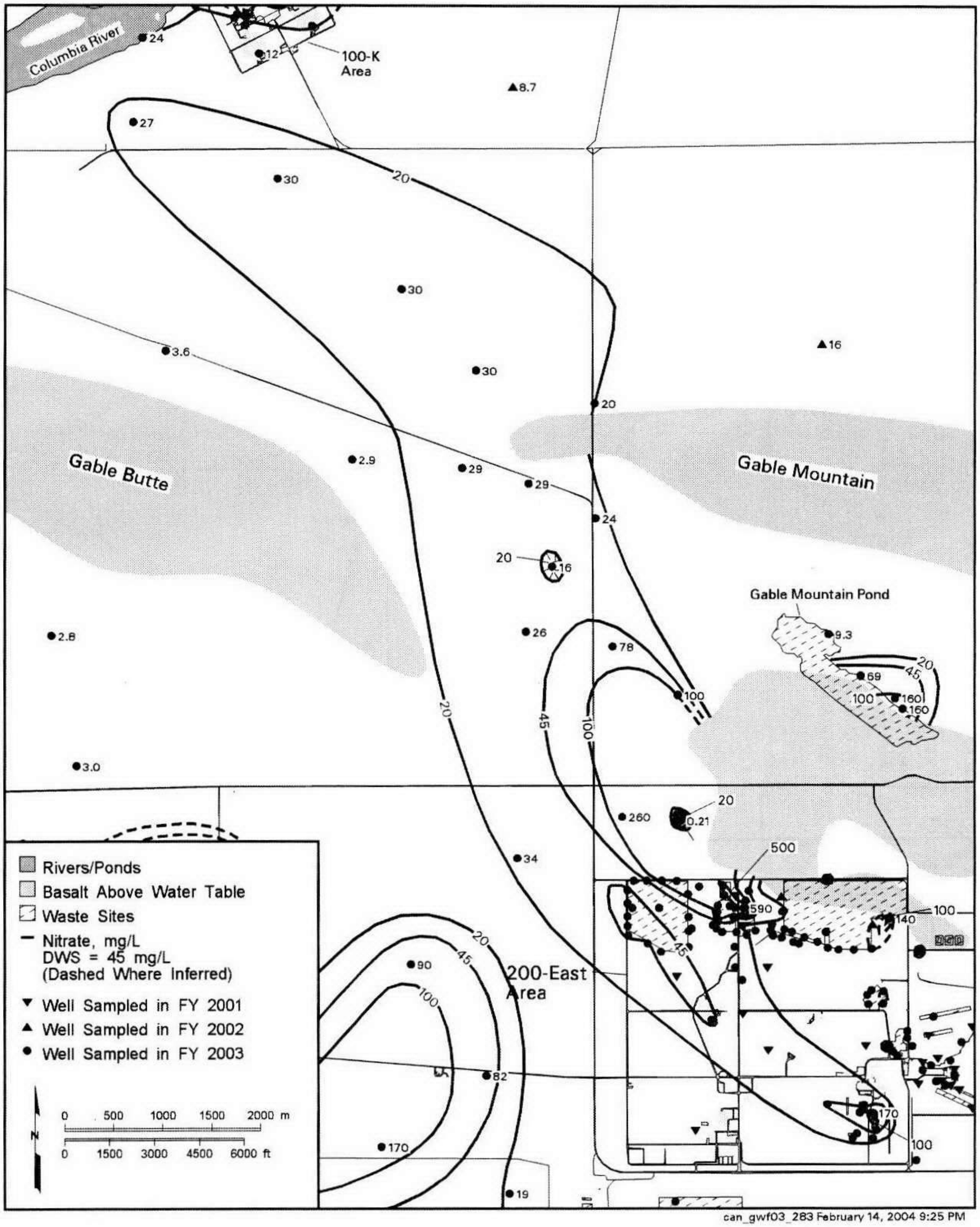

Figure 1.5. Average Nitrate Concentrations in the 200-BP-5 Operable Unit and Vicinity, Top of Unconfined Aquifer

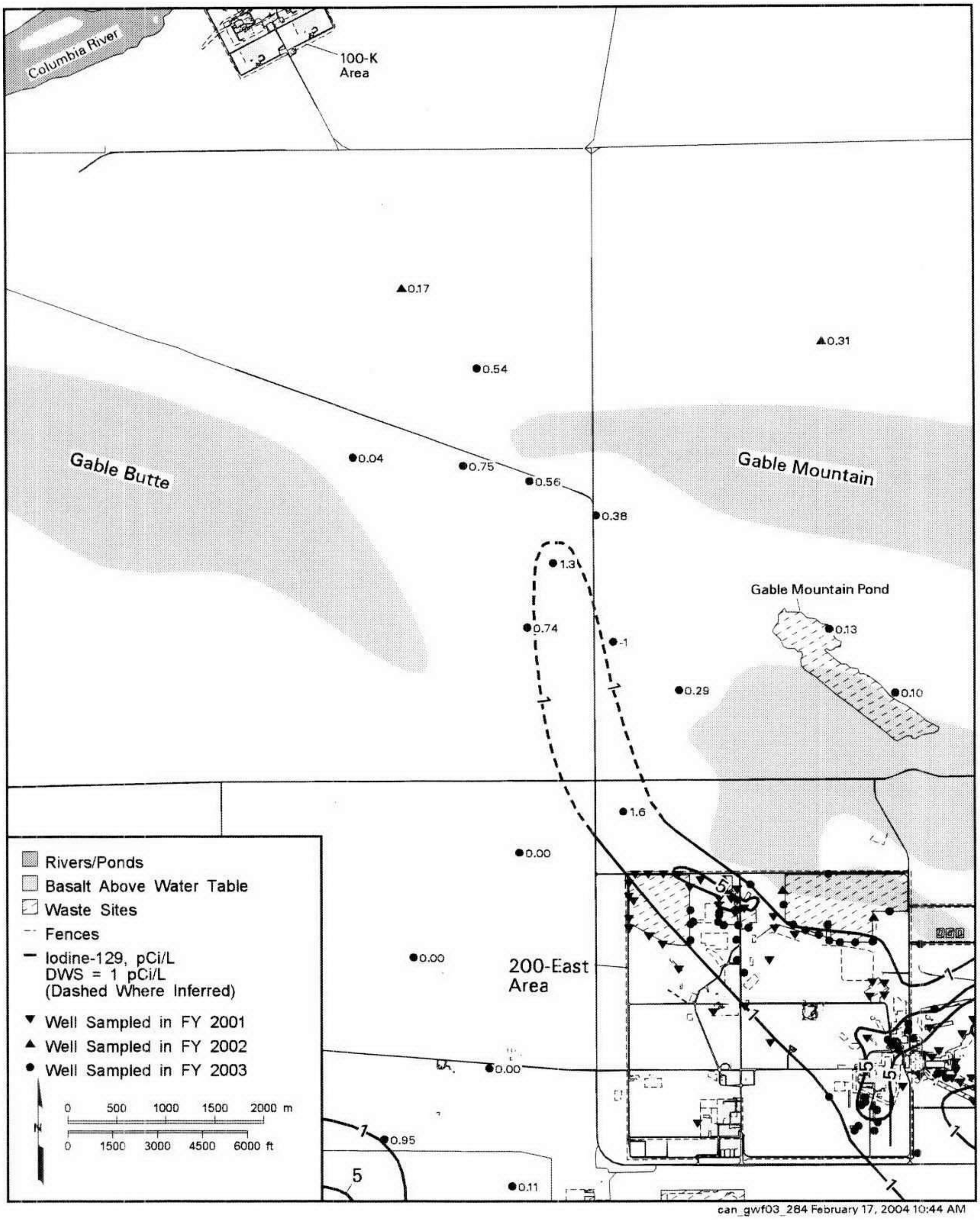

Figure 1.6. Average Iodine-129 Concentrations in the 200-BP-5 Operable Unit and Vicinity, Top of Unconfined Aquifer

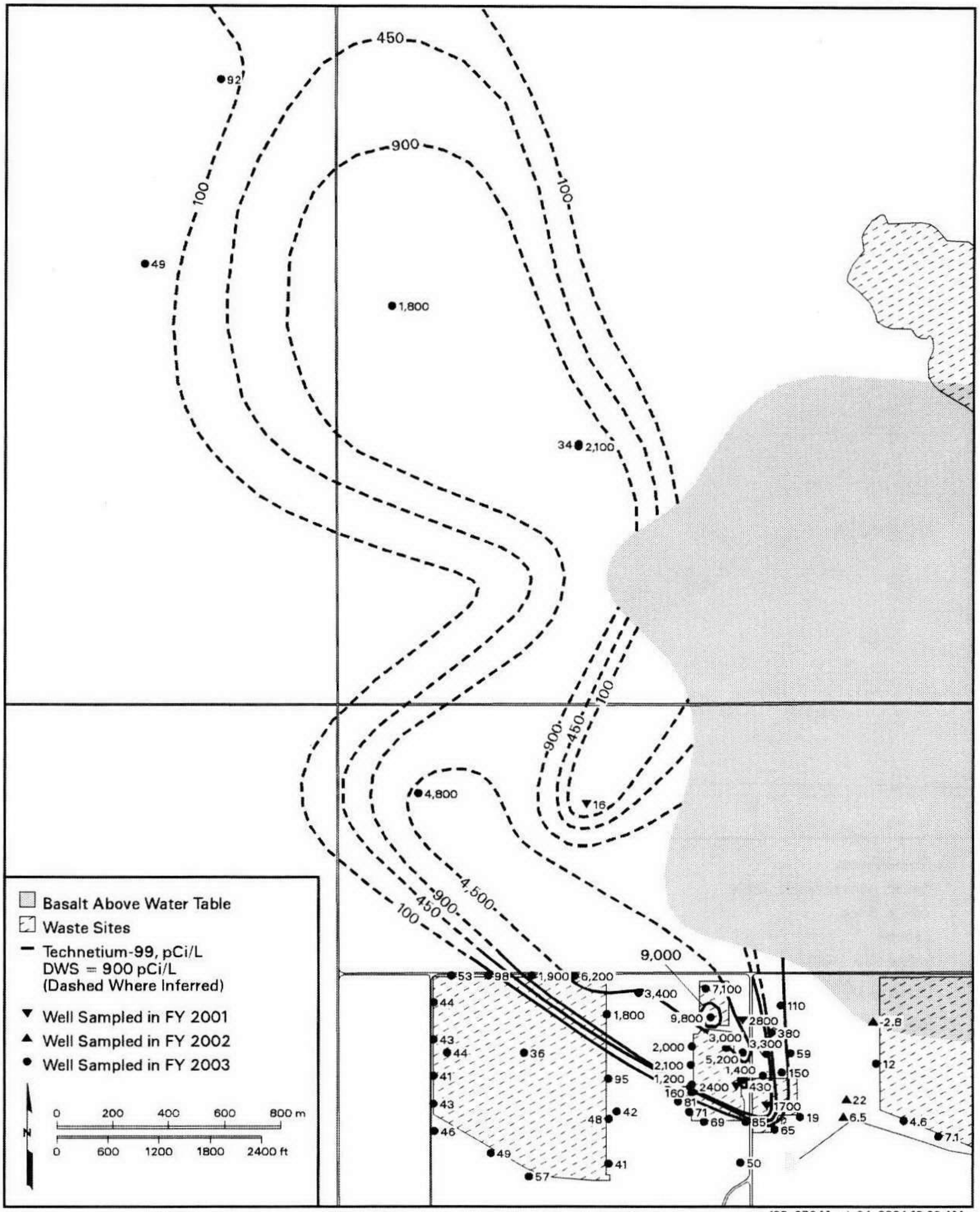

Figure 1.7. Average Technetium-99 Concentrations in the North 200 East Area and Gable Gap, Top of Unconfined Aquifer

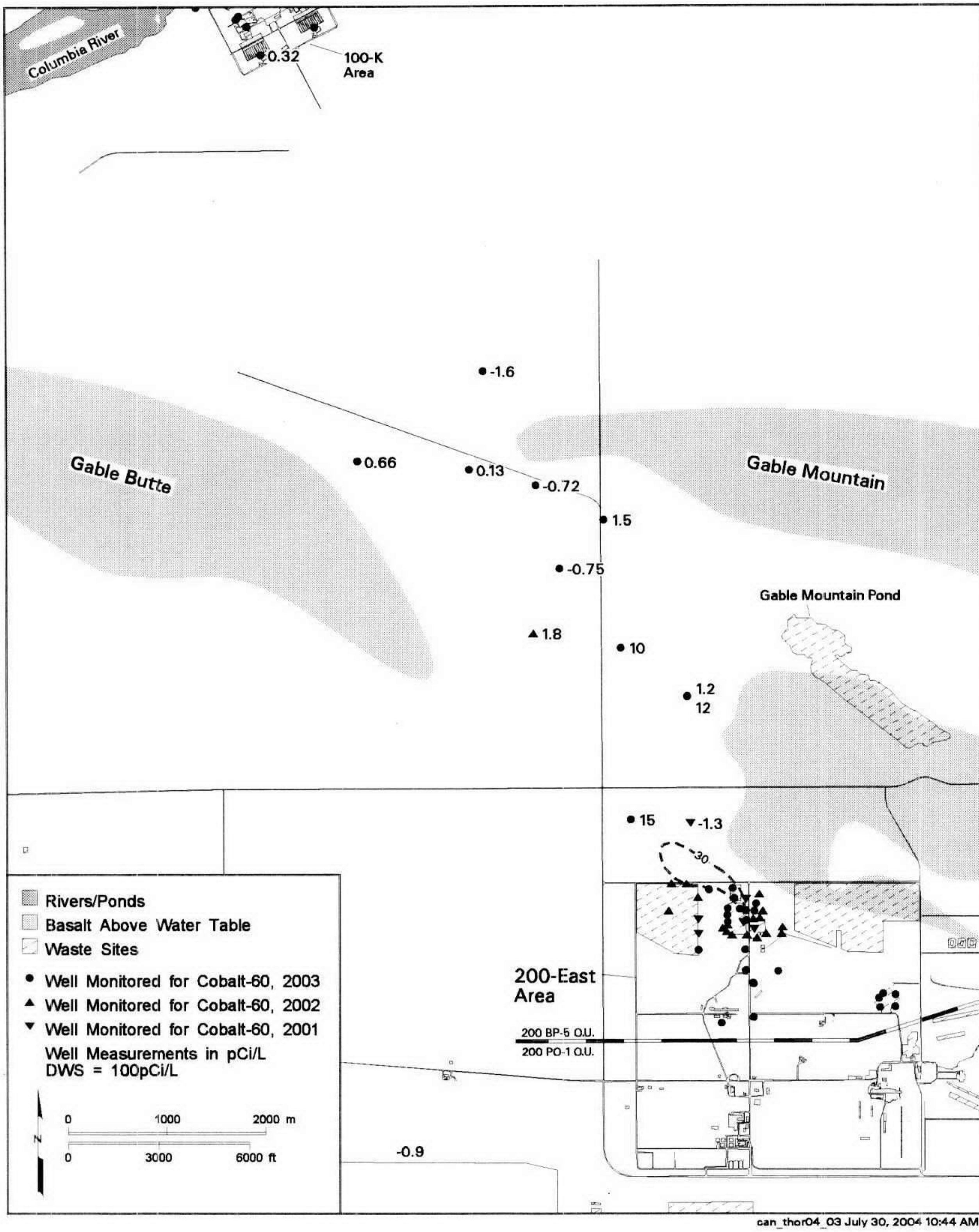

Figure 1.8. Average Cobalt-60 Concentrations in the 200-BP-5 Operable Unit and Vicinity, Top of Unconfined Aquifer

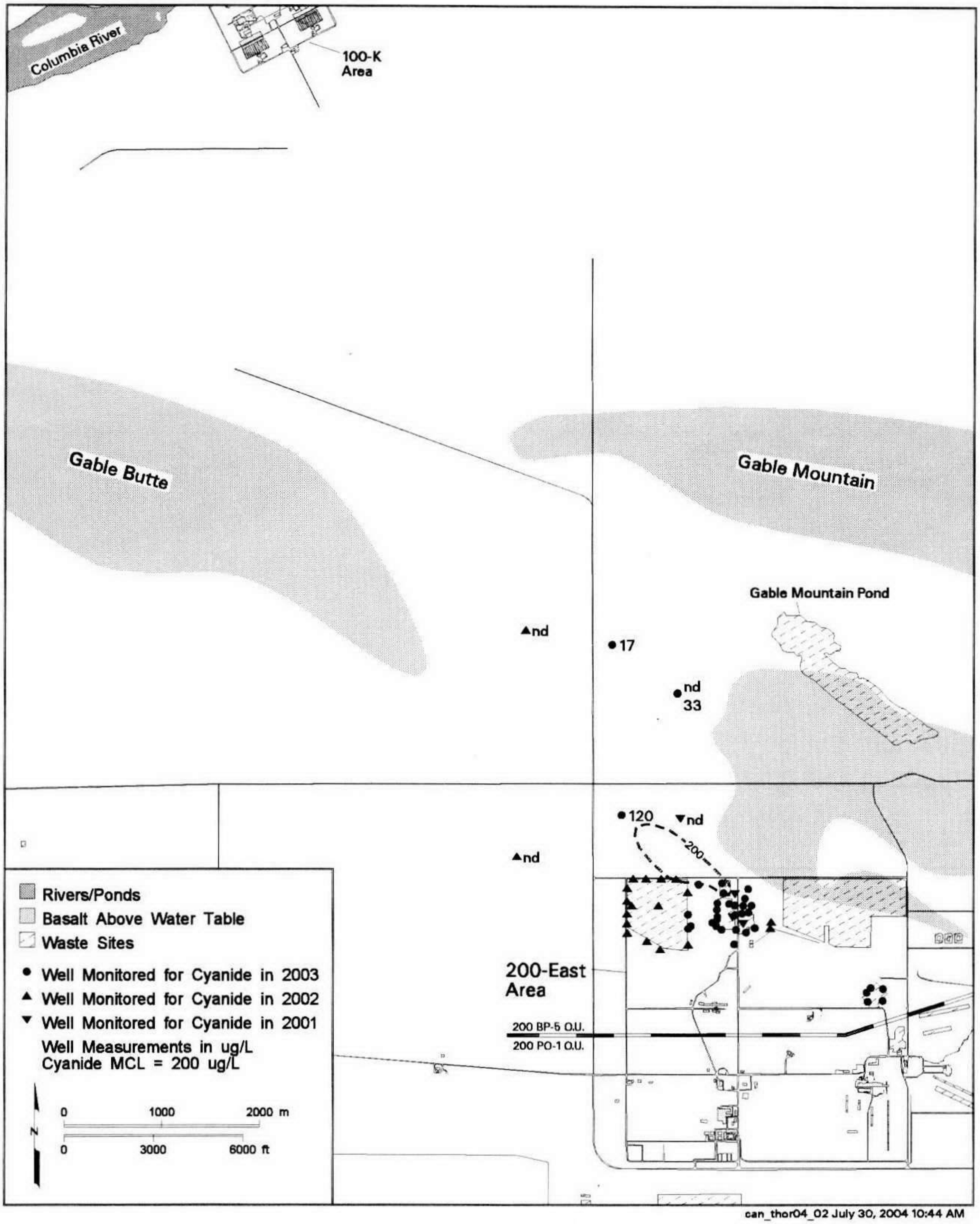

Figure 1.9. Average Cyanide Concentrations in the 200-BP-5 Operable Unit and Vicinity, Top of Unconfined Aquifer

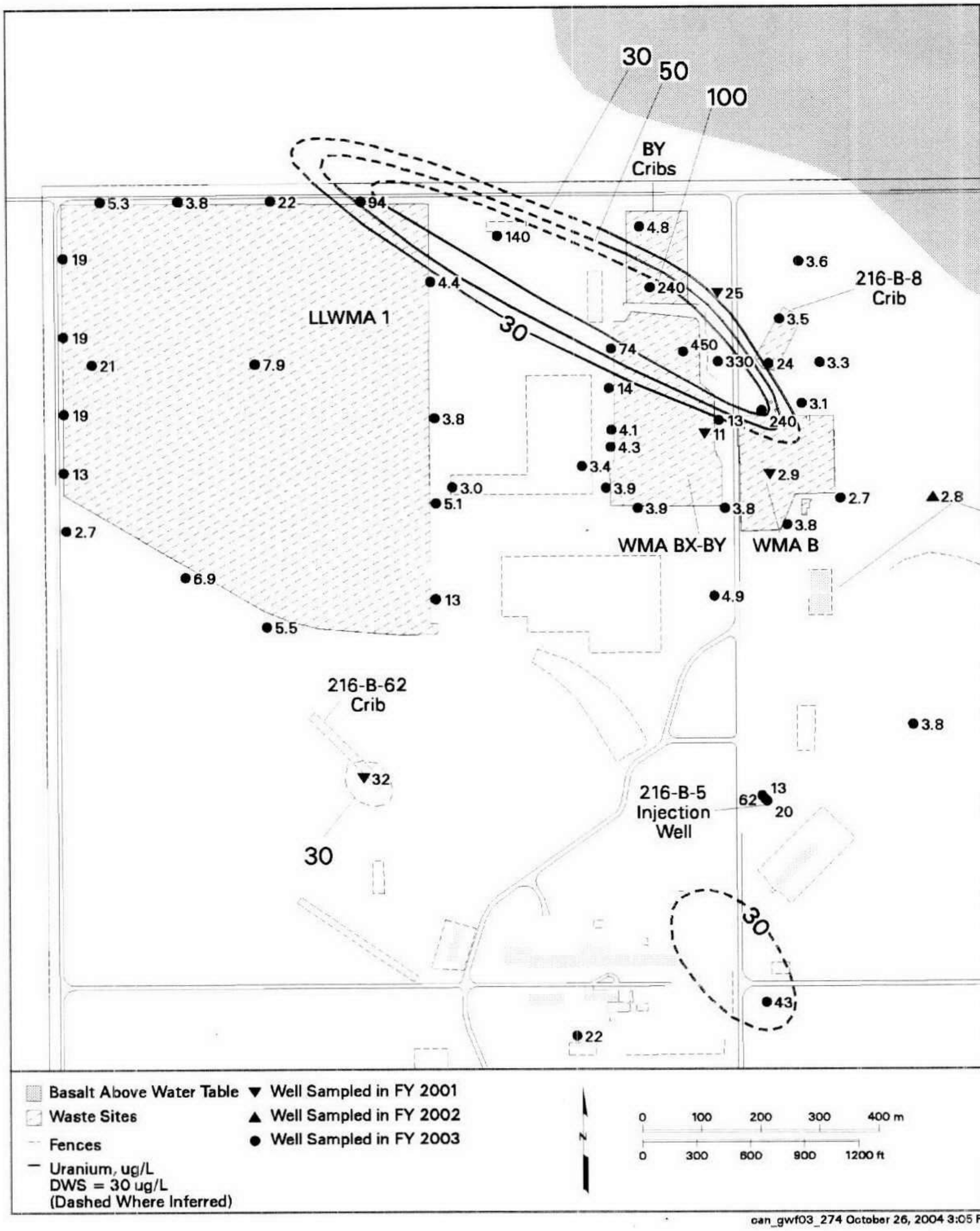

Figure 1.10. Average Uranium Concentrations in the Vicinity of BY Cribs, Top of Unconfined Aquifer

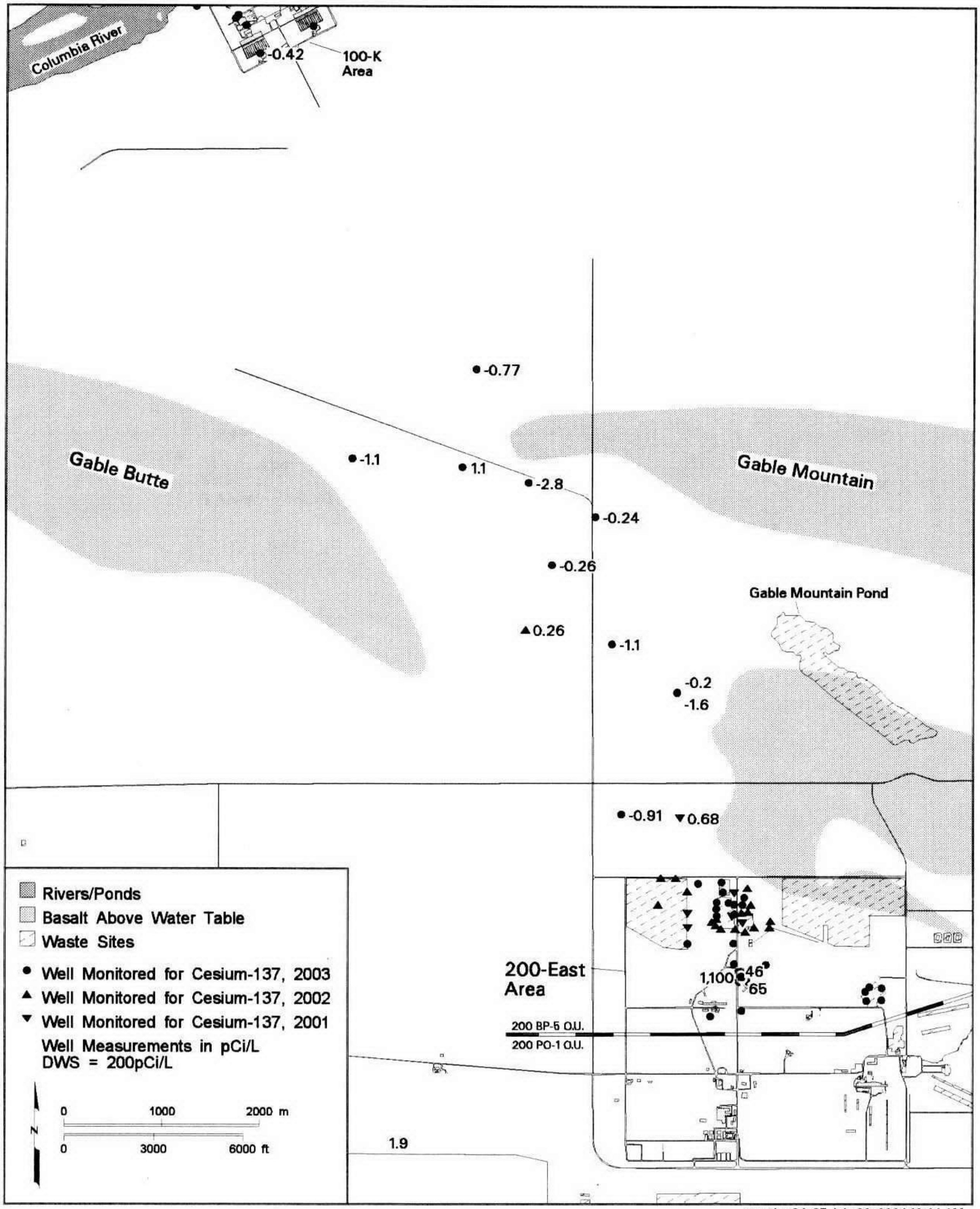

Figure 1.11. Average Cesium-137 Concentrations in the 200-BP-5 Operable Unit and Vicinity, Top of Unconfined Aquifer

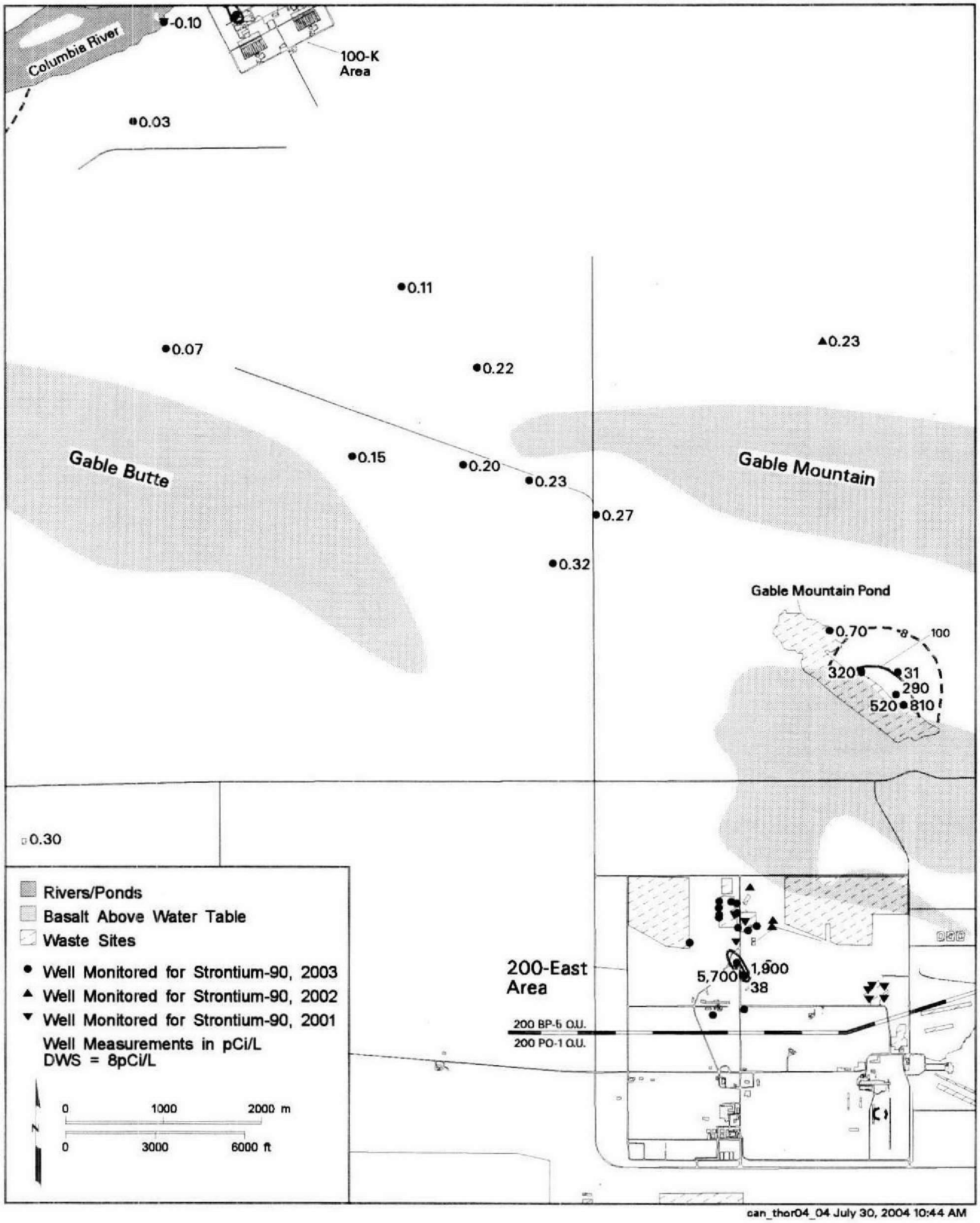

Figure 1.12. Average Strontium-90 Concentrations in the 200-BP-5 Operable Unit and Vicinity, Top of Unconfined Aquifer

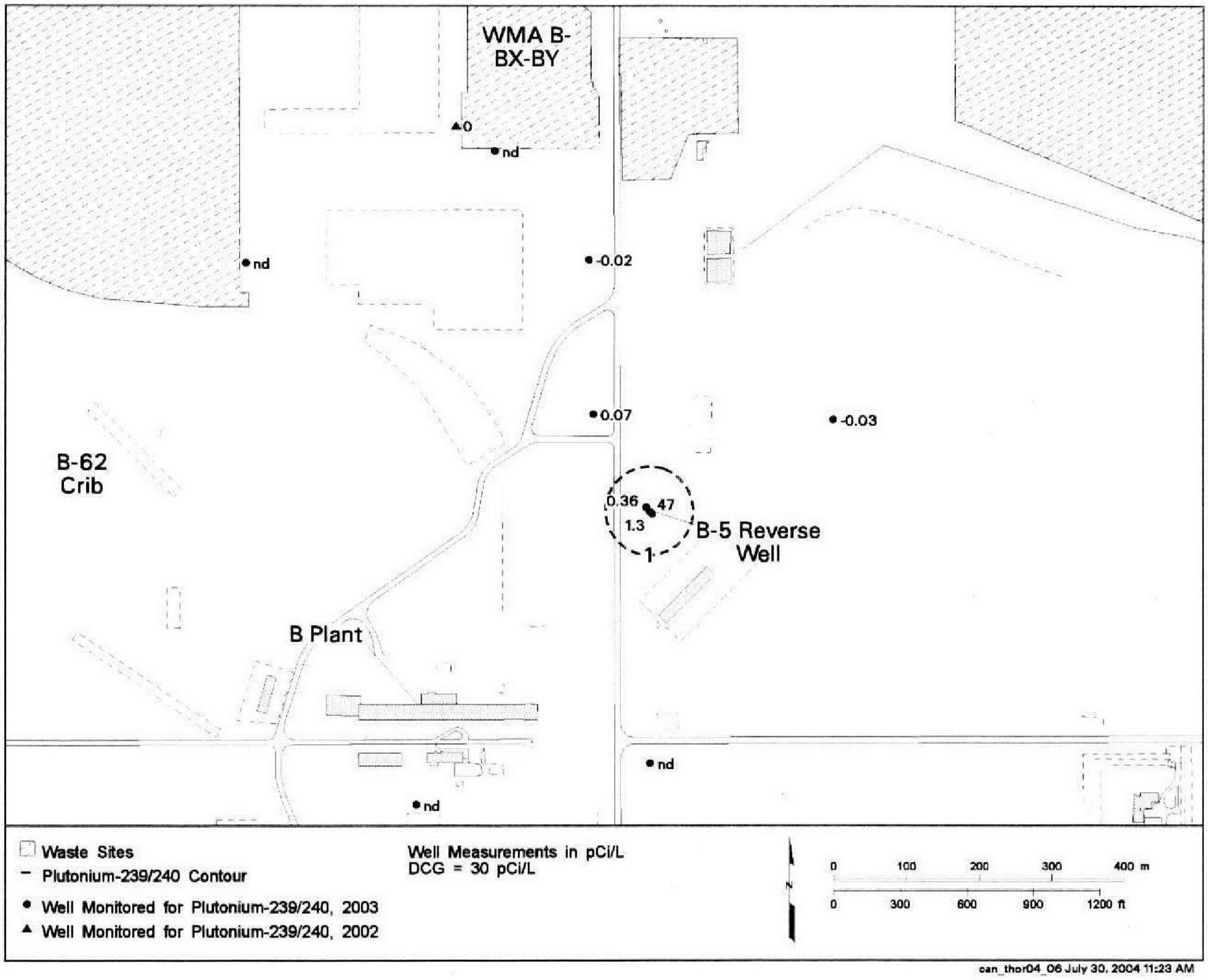

Figure 1.13. Average Plutonium-239/240 Concentrations in the 200-BP-5 Operable Unit, Top of Unconfined Aquifer

- Waste Management Area B-BX-BY appears to have contributed nitrate, technetium-99, and uranium that has migrated from the vadose zone into groundwater (*Results of Phase I Groundwater Quality Assessment for Single-Shell Tank Waste Management Areas B-BX-BY at the Hanford Site*, PNNL-11826).

- Monitoring in the vicinity of the 216-B-8 Crib indicates that it has contributed nitrate to the groundwater locally.

- Waste Management Area C appears to have contributed technetium-99, nitrate, and low concentrations of cyanide to groundwater. Four new wells have been added to provide further information regarding the contaminant source (*Hanford Site Groundwater Monitoring for Fiscal Year 2003*, PNNL-14548).

- Groundwater monitoring at the 216-B-62 Crib, located west of B Plant, also indicates that this crib was a contributor of uranium locally.

- Monitoring wells associated with the 216-B-5 Reverse Well have had detectable concentrations of strontium-90, cesium-137, plutonium-239 and -240, and uranium in groundwater samples.

- Localized plumes of strontium-90 and nitrate in the vicinity of Gable Mountain Pond are also being monitored.

Groundwater remediation in the 200-BP-5 Operable Unit is dictated by CERCLA regulations as provided in 40 CFR 300, Subpart E. Two groundwater extraction treatability tests were performed in the 200-BP-5 Operable Unit during the period from August 29, 1994, to May 29, 1995 (*Operable Unit Treatability Test Report*, DOE/RL-95-59). The location of one test was near the 216-B-5 Reverse Well; the second was located just north of the northwestern corner of the 200 East Area in an area of contamination probably originating in the BY Cribs. Treatability testing results indicated that groundwater remediation by current pump and treat technology would not be practical in this area (*Hanford Sitewide Groundwater Remediation Strategy*, DOE/RL-94-95). However, technetium-99, cobalt-60, cyanide, and nitrate groundwater contamination believed to be sourced in the BY Cribs will naturally dissipate. Because of high sorption coefficients and inclusion in relatively insoluble solid phases, plutonium, strontium-90, and cesium-137 in the 216-B-5 Reverse Well plume are not considered to pose a threat outside of the 200 East Area. Strontium-90 associated with the Gable Mountain Pond plume, though further to the north, is expected to decay to acceptable levels before the plume migrates a significant distance.

1.2 Contaminants of Concern

Table 1.1 identifies COCs for the 200-BP-5 Operable Unit as determined by the U.S. Department of Energy (DOE), EPA, and Pacific Northwest National Laboratory (PNNL) staff. This list was developed on the basis of historical process operations as indicated in the DQO summary report (PNNL-14049). Table 1.1 also indicates how the contaminants arrived at the site and the fate and transport mechanisms (e.g., groundwater) that may have impacted their distribution. Dense non-aqueous phase liquids (chlorinated solvents) are not present in the 200-BP-5 Operable Unit; thus no contaminant is identified in Table 1.2 as being distributed in a heterogeneous manner. Several contaminants are largely dissolved in groundwater (e.g., nitrate and tritium) and thus are homogeneously distributed, while others are dissolved in groundwater and sorbed onto aquifer sediments (e.g., strontium-90) and are semi-homogeneously distributed.

This revision of the sampling and analysis plan does not identify any changes to the contaminants of concern for the operable unit.

1.3 Data Quality Objectives

The groundwater project used *Guidance for the Data Quality Objectives Process*, EPA/600/R-96/055 (QA/G-4), as revised, to develop this sampling and analysis plan. The DQO process is a strategic planning approach for defining the criteria that a data collection design should satisfy. Using the DQO process ensures that the type, quantity, and quality of environmental data used in decision-making will be appropriate for the intended application.

Table 1.1. Distribution of Contaminants of Concern

Media	Contaminant	How COC Arrived at Site	Fate and Transport Mechanisms	Expected Subsurface Distribution (Heterogeneous/ Homogeneous)
200-BP-5 Operable Unit				
Groundwater	Technetium-99	Ferrocyanide waste liquids released to BY Cribs from U Plant process operations	Groundwater and soil moisture	Semi-homogeneous[a]
	Cobalt-60	Ferrocyanide waste liquids released to BY Cribs from U Plant process operations	Groundwater and soil moisture	Semi-homogeneous[b]
	Cyanide	Ferrocyanide waste liquids released to BY Cribs from U Plant process operations	Groundwater and soil moisture	Semi-homogeneous[a]
	Uranium	Injection of waste liquids into the B-5 reverse well; monitored in wells near the WMA B-BX-BY tank farms (source uncertain)	Groundwater and soil moisture	Semi-homogeneous[b]
	Nitrate	Various sites in the operable unit	Groundwater and soil moisture	Semi-homogeneous[a]
	Cesium-137	Injection of waste liquids into the B-5 reverse well	Groundwater and soil moisture	Semi-homogeneous[b]
	Strontium-90	Injection of waste liquids into the B-5 reverse well; Gable Mountain Pond	Groundwater and soil moisture	Semi-homogeneous[b]
	Iodine-129	Associated with various sites in the operable unit	Groundwater and soil moisture	Semi-homogeneous[a]
	Tritium	Associated with various sites in the operable unit	Groundwater and soil moisture	Semi-homogeneous[a]
	Plutonium-239/240	Injection of waste liquids into the B-5 reverse well.	Groundwater and soil moisture	Semi-homogeneous[b]

(a) Dissolved in groundwater.
(b) Dissolved in groundwater and sorbed on aquifer sediment.

This section presents only a summary of the key outputs resulting from the DQO process. For additional details, refer to PNNL-14049.

1.3.1 Statement of the Problem

The shape and concentration of the COC plumes within the 200-BP-5 Operable Unit have changed over time as a result of natural groundwater flow, source term variability, and natural attenuation. Therefore, the network of wells used to monitor known COCs in groundwater and the associated sampling frequency and analytical methods need to be reassessed to determine if the requirements of the CERCLA and AEA monitoring programs are being met. The current design of the 200-BP-5 Operable Unit

Table 1.2. Inputs Needed to Develop Decision Rules and Action Levels

DS #	Parameters of Interest	Units of Measurement	Scale of Decision Making	Action Level (MCL)	Alternative Actions
1	Tc-99	pCi/L	Concentration of COC in groundwater within the perimeter of the 200-BP-5 compliance boundary over the next year.	900 pCi/L	1) No action. 2) Select a new monitoring well network from existing wells to better define plume extent. 3) Drill and install new monitoring wells to supplement existing or new monitoring well network.
	Co-60	pCi/L		100 pCi/L	
	Cs-137	pCi/L		200 pCi/L	
	Cyanide	µg/L		200 µg/L	
	Sr-90	pCi/L		8 pCi/L	
	Pu 239/240	pCi/L		1.2 pCi/L	
	Uranium	µg/L		30 µg/L	
	Tritium	pCi/L		20,000 pCi/L	
	I-129	pCi/L		1 pCi/L	
	Nitrate	µg/L		45,000 µg/L as NO_3	
2	Water level	m or ft	Groundwater level within the perimeter of the 200-BP-5 compliance boundary over the next year.	No prescribed action level	1) No action. 2) Select a new monitoring well network from existing wells to better define water table elevations. 3) Drill and install new monitoring wells to supplement existing or new monitoring well network. 4) Use other methods to define flow directions.
3	Sampling frequency	Samples/year	Number of groundwater samples for wells within the perimeter of the 200-BP-5 compliance boundary over the next year.	No prescribed action level	1) No action (maintain current sampling frequencies) 2) Revise sample frequencies in some or all wells to better define plume movement.

network is based primarily on expert judgment provided by DOE, EPA, and PNNL staff and to a limited extent on geostatistical modeling results. Per *Data Quality Objectives Process for Hazardous Waste Site Investigations*, EPA/600/R-00/007 (QA/G-4HW), "A nonprobabilistic sampling (judgmental sampling) design is developed when the site manager (or technical expert) selects the specific sampling locations based on the investigator's experience and expert knowledge of the site." Groundwater flow direction is difficult to assess in the 200 East Area because of a low hydraulic gradient and, thus, an accurate definition of the water-table elevation is needed. In addition, a number of wells are anticipated to go dry as water levels drop locally and their replacements, if possible, need to be planned.

1.3.2 Decision Rules

The decision rules for each decision statement identified in the DQO summary report (PNNL-14049) are summarized below. These "IF…THEN…" statements describe what action will be taken based on the results of the data collected. Comments on changes or updates are indicated by italicized text. The inputs used to develop the decision rules and the defined action levels are presented in Table 1.2.

1. IF the results from the evaluation of the current monitoring networks indicate that they adequately define the extent of the COC groundwater plumes THEN no action is required; otherwise, select new monitoring well networks from existing wells based on expert judgment and/or drill and install new monitoring wells to supplement the existing or new monitoring well networks. *One new well is planned for installation in FY 2005. Several wells have gone dry and have been eliminated from the network. Substitutes have been identified when possible.*

2. IF the results from the evaluation of the current monitoring networks indicate that they define water table elevations and groundwater flow direction THEN no action is required; otherwise, select a new monitoring well network from existing wells and/or drill and install new monitoring wells to supplement the existing or new monitoring well network, and/or apply another method to define groundwater flow direction. *The current water table network adequately defines flow. The network has not been changed from the previous plan other than to identify wells previously associated with AEA monitoring.*

3. IF the current frequencies permit tracking of plume movement, THEN no action is required; otherwise, select a new frequency that will permit tracking of plume. *Frequencies have not been changed in this revised plan.*

1.4 Changes from the Previous Plan

This document revises the previous sampling and analysis plan (DOE/RL-2001-49, Rev. 0), which was published in March 2003. The monitoring network for the 200-BP-5 Operable Unit needs to be reviewed and, if necessary, revised periodically owing to changes in plume geometry and the current status of well networks in the 200 East Area. This is particularly true for the northwestern part of 200 East and adjacent 600 Area, where a low hydraulic gradient exists and groundwater flow direction is somewhat uncertain and appears to be changing (PNNL-14548). In addition, many wells cannot be sampled because groundwater levels have declined below the well screen (i.e., gone dry) owing to decreased effluent releases in the 200 East Area. Additional wells are expected to become unsuitable for sampling purposes in the near future as groundwater levels continue to drop. Alternative wells will be used, if available, or new wells may be proposed, when possible, to address this problem and to increase monitoring coverage where required. Appendix A, Sampling Interval Information for Wells Located in the 200-BP-5 Operable Unit, provides open interval and water-level information for wells that are currently being monitored or that potentially could be used for groundwater monitoring activities. This information can be used to identify replacements for dry wells and to predict when specific wells will go dry.

Specific changes in the monitoring network for the 200-BP-5 Operable Unit are described in Section 2. These changes include

- AEA monitoring has been integrated into the CERCLA monitoring activities described in the previous version of this plan and it considers monitoring over a larger "interest area."

- Four wells formerly associated with the CERCLA monitoring network have been removed from the network because they cannot be sampled (Section 2.2).
- Various constituents have been added or removed from the sampling schedule (Section 2.3).

In addition, the installation of a new monitoring well described in the previous version of this plan has recently been added to the Tri-Party Agreement (TPA) (Ecology et al. 1989) Milestone M-24 priority list and is scheduled for drilling in calendar years 2005 or 2006. This new well will help better define the distribution of technetium-99 in the Gable Gap Area. An additional well has also recently been identified to be drilled that will help define the northwestern extension of the uranium groundwater plume that originates in the vicinity of Waste Management Area BY. This second well will be included in Milestone M-24 negotiations and the location and year of installation specified in a future revision of this sampling and analysis plan.

2.0 Field Sampling Plan

This section identifies the wells to be monitored under this sampling and analysis plan, sampling frequency, and constituents to be measured. Protocol for sampling, analysis, and related activities are summarized.

2.1 Sampling Objectives

The objective of the field sampling plan is to clearly identify project sampling and analysis activities. Analysis of groundwater samples provides information regarding concentrations of the contaminants of concern plus selected supporting constituents. The primary use of this information is to define the extent of contaminant plumes and provide the basis for assessment of groundwater quality in the operable unit. This information serves to further develop our ability to track concentration trends near contaminant sources and interpret groundwater flow characteristics in the 200-BP-5 Operable Unit.

2.2 Sampling Locations and Frequency

The complete set of wells associated with the modified 200-BP-5 Operable Unit network are presented in Table 2.1. This revised network consists of 91 wells, which includes many wells also co-sampled to meet RCRA objectives. This list includes the wells identified for technetium-99 monitoring south of the gap plus several wells located in the area north of the gap to the Columbia River and several wells at WMA C. Additional wells are also presented in Table 2.1 that are needed for monitoring of the other COC plumes. The locations of these wells are presented in Figures 1.3 and 1.4.

The overall change in the revised monitoring network relative to the previous network can be seen by comparing the list of wells for the previous and the revised network presented in Table 2.1. The primary change has been the inclusion of 23 AEA surveillance wells into the 200-BP-5 Operable Unit network, which previously contained only wells that were sampled under the CERCLA program. The wells previously associated with the surveillance program are designated as Regional CERCLA/AEA wells in Table 2.1.

Other changes to the network involve removal of several wells, as indicated in Table 2.1. Well 699-50-53A, located in the Gable Gap north of the 200 East Area, has gone dry (i.e., the bottom of the well screen is above the water table) and, thus, has been removed from the network. This further reduces the number of wells available for monitoring in the Gable Gap. Well 699-43-40 has also gone dry. This well is located east of the B Pond. Wells 699-45-42 and 699-44-39B are located nearby and will continue to be used for monitoring of tritium and iodine-129, however. Gable Mountain Pond monitoring well 699-53-48B is also now dry, but the network in that area is still considered to be adequate for definition of the local nitrate and strontium-90 groundwater contaminant plumes (Figures 1.5 and 1.12). Finally, well 299-E33-46 at WMA BX cannot be sampled because it is currently being used as a vadose zone monitoring well and has been removed from the network. This well is not critical from the standpoint of defining the regional distribution of contamination in the 200-BP-5 Operable Unit, however. No changes have occurred with respect to monitoring of the 216-B-5 Reverse Well site, the 216-B-62 Crib, or WMA C as defined in the previous version of this plan.

Table 2.1. Groundwater Monitoring Wells Associated with the 200-BP-5 Monitoring Network

Wells in Previous Network	Wells in Revised Network	Monitoring Objective, Well Status
	299-E24-8	Regional CERCLA/AEA
	299-E26-10	Regional CERCLA/AEA
	299-E26-11	Regional CERCLA/AEA
	299-E27-10	Regional CERCLA/AEA
299-E27-14	299-E27-14	WMA C
299-E27-15	299-E27-15	WMA C
	299-E27-17	Regional CERCLA/AEA
	299-E27-18	Regional CERCLA/AEA
299-E27-7	299-E27-7	WMA C
	299-E28-13	Regional CERCLA/AEA
299-E28-17	299-E28-17	216-B-5 Reverse Well and B-Plant
299-E28-18	299-E28-18	216-B-62 Crib
299-E28-2	299-E28-2	216-B-5 Reverse Well and B-Plant
299-E28-21	299-E28-21	216-B-62 Crib
299-E28-23	299-E28-23	216-B-5 Reverse Well and B-Plant
299-E28-24	299-E28-24	216-B-5 Reverse Well and B-Plant
299-E28-25	299-E28-25	216-B-5 Reverse Well and B-Plant
299-E28-26	299-E28-26	216-BY Cribs and WMA B-BX-BY
299-E28-27	299-E28-27	216-B-5 Reverse Well and B-Plant
	299-E28-28	Regional CERCLA/AEA
299-E28-5	299-E28-5	216-B-5 Reverse Well and B-Plant
299-E28-6	299-E28-6	216-B-5 Reverse Well and B-Plant
299-E28-8	299-E28-8	216-B-5 Reverse Well and B-Plant
299-E32-10	299-E32-10	216-BY Cribs and WMA B-BX-BY
	299-E32-2	Regional CERCLA/AEA
299-E32-4	299-E32-4	216-BY Cribs and WMA B-BX-BY
	299-E32-5	Regional CERCLA/AEA
299-E32-6	299-E32-6	216-BY Cribs and WMA B-BX-BY
	299-E32-7	Regional CERCLA/AEA
	299-E32-8	Regional CERCLA/AEA
299-E32-9	299-E32-9	216-BY Cribs and WMA B-BX-BY
299-E33-12	299-E33-12	216-BY Cribs and WMA B-BX-BY, Confined aquifer
299-E33-13	299-E33-13	216-BY Cribs and WMA B-BX-BY
299-E33-15	299-E33-15	216-B-8 Crib
299-E33-16	299-E33-16	216-B-8 Crib

Table 2.1. (contd)

Wells in Previous Network	Wells in Revised Network	Monitoring Objective, Well Status
299-E33-18	299-E33-18	216-BY Cribs and WMA B-BX-BY
299-E33-26	299-E33-26	216-BY Cribs and WMA B-BX-BY
299-E33-28	299-E33-28	216-BY Cribs and WMA B-BX-BY
	299-E33-29	Regional CERCLA/AEA
299-E33-30	299-E33-30	216-BY Cribs and WMA B-BX-BY
	299-E33-32	Regional CERCLA/AEA
	299-E33-33	Regional CERCLA/AEA
	299-E33-334	Regional CERCLA/AEA
	299-E33-335	Regional CERCLA/AEA
299-E33-338	299-E33-338	216-BY Cribs and WMA B-BX-BY
299-E33-34	299-E33-34	216-BY Cribs and WMA B-BX-BY
299-E33-35	299-E33-35	216-BY Cribs and WMA B-BX-BY
	299-E33-37	Regional CERCLA/AEA
299-E33-38	299-E33-38	216-BY Cribs and WMA B-BX-BY
299-E33-39	299-E33-39	216-BY Cribs and WMA B-BX-BY
299-E33-41	299-E33-41	216-BY Cribs and WMA B-BX-BY
299-E33-42	299-E33-42	216-BY Cribs and WMA B-BX-BY
299-E33-43	299-E33-43	216-BY Cribs and WMA B-BX-BY
299-E33-44	299-E33-44	216-BY Cribs and WMA B-BX-BY
299-E33-46		Currently used for vadose zone monitoring
299-E33-7	299-E33-7	216-BY Cribs and WMA B-BX-BY
	299-E34-2	Regional CERCLA/AEA
	299-E34-5	Regional CERCLA/AEA
	299-E34-7	Regional CERCLA/AEA
	299-E34-9	Regional CERCLA/AEA
699-43-40		Dry well
	699-44-39B	Regional CERCLA/AEA
699-45-42	699-45-42	216-B-3 Pond
699-47-60	699-47-60	216-BY Cribs and WMA B-BX-BY
699-49-55A	699-49-55A	216-BY Cribs and WMA B-BX-BY
699-49-57A	699-49-57A	216-BY Cribs and WMA B-BX-BY
699-49-57B	699-49-57B	216-BY Cribs and WMA B-BX-BY, Confined aquifer
699-50-53A		Dry well
699-53-47A	699-53-47A	Gable Mountain Pond

Table 2.1. (contd)

Wells in Previous Network	Wells in Revised Network	Monitoring Objective, Well Status
699-53-47B	699-53-47B	Gable Mountain Pond
699-53-48A	699-53-48A	Gable Mountain Pond
699-53-48B		Dry well
699-53-55A	699-53-55A	216-BY Cribs and WMA B-BX-BY
699-53-55B	699-53-55B	216-BY Cribs and WMA B-BX-BY
699-53-55C	699-53-55C	216-BY Cribs and WMA B-BX-BY
699-54-45A	699-54-45A	Gable Mountain Pond
699-54-45B	699-54-45B	Gable Mountain Pond
699-54-48	699-54-48	Gable Mountain Pond
699-54-49	699-54-49	Gable Mountain Pond
699-55-50C	699-55-50C	Gable Mountain Pond
699-55-57	699-55-57	216-BY Cribs and WMA B-BX-BY
699-55-60A	699-55-60A	216-BY Cribs and WMA B-BX-BY
699-57-59	699-57-59	216-BY Cribs and WMA B-BX-BY, guard well
699-59-58	699-59-58	216-BY Cribs and WMA B-BX-BY, guard well
699-60-60	699-60-60	216-BY Cribs and WMA B-BX-BY, guard well
699-61-62	699-61-62	216-BY Cribs and WMA B-BX-BY, guard well
699-61-66	699-61-66	216-BY Cribs and WMA B-BX-BY, guard well
699-64-62	699-64-62	216-BY Cribs and WMA B-BX-BY, guard well
699-65-50	699-65-50	216-BY Cribs and WMA B-BX-BY
699-65-72	699-65-72	216-BY Cribs and WMA B-BX-BY
699-66-58	699-66-58	216-BY Cribs and WMA B-BX-BY
699-66-64	699-66-64	216-BY Cribs and WMA B-BX-BY
699-70-68	699-70-68	216-BY Cribs and WMA B-BX-BY
699-72-73	699-72-73	216-BY Cribs and WMA B-BX-BY
699-73-61	699-73-61	216-BY Cribs and WMA B-BX-BY

As indicated previously, monitoring of Gable Gap is restricted owing to the limited number of wells and their rather large spacing. In particular, geostatistical modeling results presented in the previous version of this plan suggested that new wells south of the gap would be useful in better defining the 900 pCi/L contour for technetium-99 (Appendix A of DOE/RL-2001-49, Rev. 0). Several proposed locations were eliminated on the basis of hydrogeological considerations. It was concluded in the previous plan, however, that it is feasible to install a new well at a location north of the 200 East Area that can provide additional information regarding the distribution of technetium-99. In addition, it will provide information regarding groundwater flow (based on the gradient of the water table) and will help to better define the elevation of the top of basalt. This information is needed to assess contaminant plume movement into Gable Gap. The installation of the new well has recently been added to the TPA Milestone M-24 priority list.

It should be noted that the revised monitoring network constitutes the minimum number of wells and samples/analytes needed to define the extent of groundwater contaminant plumes in the unconfined aquifer associated with the 200-BP-5 Operable Unit and for monitoring of basalt-confined aquifers as established by the DQO process. Many additional wells and constituents in the area are sampled in support of RCRA groundwater monitoring objectives. These wells are listed in Appendix B. Data from these wells will be available as supplemental information to that obtained from the 200-BP-5 Operable Unit monitoring network as defined in this plan.

2.3 Constituents to be Monitored

As indicated in Section 1 and in Table 2.2, the contaminants of concern for the 200-BP-5 Operable Unit are technetium-99, tritium, nitrate, iodine-129, cyanide, cobalt-60, uranium, strontium-90, cesium-137, and plutonium-239/240. Additional supporting constituents include alkalinity, americium isotopes (americium-241), arsenic, gross alpha and beta, filtered metals, neptunium-237, and oxygen and redox potential. Field parameters are also measured during each sampling event and include pH, temperature, specific conductance, and turbidity.

The level of variability in technetium-99 and other contaminant concentrations in the 200-BP-5 Operable Unit indicates that annual sampling is adequate to define regional trends. Wells should be sampled in the same quarter, if possible, to minimize variability. In some cases, wells are scheduled for sampling on a 3-year basis if a long history is available indicating little variability in contaminant concentrations.

The primary change in this revised plan is the inclusion of wells formerly monitored for AEA into the operable unit network. Uranium isotopes were formerly measured in some wells monitored under AEA. This measurement has been discontinued because total uranium can now be analyzed accurately by chemical means. A reduction of the number of analyses for arsenic, americium-241, neptunium-237, and gross alpha and beta conducted under AEA monitoring has also occurred in this plan. Arsenic was formerly monitored in 31 wells but will be monitored under only 15 wells in this plan because the level of arsenic appears to be similar in all of these wells and under the drinking water standard of 10 µg/L. Americium-241 and neptunium-237 have been monitored in six wells in the past. These isotopes have been observed at detectable levels in only the three wells nearest the 216-B-5 reverse well, however. Thus, monitoring will be restricted to these three wells (299-E28-23, 299-E28-24, and 299-E28-25). The number of wells which will be sampled for gross alpha and beta analyses have been reduced from 29 to 23. Gross alpha and beta analyses are primarily utilized as a screening tool in certain wells which are not analyzed for specific alpha or beta emitters or in other wells (i.e., guard wells) as a means of ensuring that unknown radioactive constituents are not present. Analysis of gross alpha and beta will be discontinued in six wells where the primary radionuclide constituents have been identified and are currently being monitored for.

Table 2.2. Sample Analytes and Frequency for 200-BP-5 Operable Unit Monitoring Wells

Well Name	Contaminants of Concern										Supporting Constituents/Measurements									
	Tc-99	Tritium	Nitrate[c]	I-129	Cyanide	Co-60	Uranium	Sr-90	Cs-137	Pu-239/240	Water Level[a,b]	Field Parameters[a,f]	Alkalinity	Am-241	Arsenic	Gross alpha/beta	Metals (filtered)[d]	Np-237	TOC/TOX	Oxygen and Redox[a]
299-E24-8		3-07	3-07	3-07		3-07			3-07			3-07			3-07	3-07				3-07
299-E26-10		A	A	A								A								A
299-E26-11		3-07	3-07	3-07								3-07			3-07					3-07
299-E27-10		3-07	3-07	3-07								3-07			3-07					3-07
299-E27-14	A	A	A	A							A	A								A
299-E27-15	A		A								A		A				A			A
299-E27-17		3-07	3-07	3-07								3-07			3-07					3-07
299-E27-18		3-07	3-07	3-07								3-07			3-07					3-07
299-E27-7	A	A	A	A							A	A			A					A
299-E28-13		3-07	3-07	3-07			3-07	3-07				3-07				3-07				3-07
299-E28-17			A				A	A	A	A	A	A								
299-E28-18		A	A	A			A				A	A			A	A				A
299-E28-2	A	A	A	A				A	A	A	A	A	A			A	A			A
299-E28-21							A					A								
299-E28-23							A	A	A	A	A	A		A		A		A		A
299-E28-24		A					A	A	A	A	A	A		A		A		A		A
299-E28-25		A	A	A			A	A	A	A	A	A		A	A	A		A		A
299-E28-26	A	3-07	A	3-07			A				A	A			3-07					3-07
299-E28-27	A	3-07	A	A			A	A	A	A	A	A								3-07
299-E28-28		3-07	3-07	3-07								3-07								3-07
299-E28-5		3-07	3-07	3-07			A	A	A	A	A	A			3-07	3-07				3-07
299-E28-6		3-07	3-07	3-07		A	A	A	A	A	A	A			3-07	3-07				3-07

Table 2.2. (contd)

Well Name	Contaminants of Concern										Supporting Constituents/Measurements									
	Tc-99	Tritium	Nitrate[c]	I-129	Cyanide	Co-60	Uranium	Sr-90	Cs-137	Pu-239/240	Water Level[a, b]	Field Parameters[a, f]	Alkalinity	Am-241	Arsenic	Gross alpha/beta	Metals (filtered)[d]	Np-237	TOC/TOX	Oxygen and Redox[a]
299-E28-8	A						A	A	A	A	A	A								
299-E32-10	A	3-07	3-07	3-07	A	A	A				A	A			3-07					3-07
299-E32-2		3-07	3-07	3-07								3-07								3-07
299-E32-4	A	A	A	A							A	A								A
299-E32-5		3-07	3-07	3-07			3-07					3-07								3-07
299-E32-6	A	3-07	A	3-07			3-07				A	3-07								3-07
299-E32-7		3-07	3-07	3-07								3-07								3-07
299-E32-8		3-07	3-07	3-07								3-07								3-07
299-E32-9		3-07	A	A	3-07						A	3-07								3-07
299-E33-12	3-07										A	A								
299-E33-13					A		A				A	A								
299-E33-15	A		A								A	A								
299-E33-16	A		A	A			A				A	A								
299-E33-18	A		A	A			A				A	A								
299-E33-26	A	3-07	3-07	3-07	A	A	A				A	A				3-07				3-07
299-E33-28	A		A								A	A								
299-E33-29	3-07	3-07	3-07	3-07								3-07								3-07
299-E33-30	A		A								A	A								
299-E33-32	3-07	3-07	3-07	3-07								3-07								3-07
299-E33-33		3-07	3-07	3-07			3-07					3-07			3-07					3-07
299-E33-334	A		A				A					A								A
299-E33-335	A									A		A								A
299-E33-338	A						A				A	A								

Table 2.2. (contd)

Well Name	Contaminants of Concern										Supporting Constituents/Measurements									
	Tc-99	Tritium	Nitrate[c]	I-129	Cyanide	Co-60	Uranium	Sr-90	Cs-137	Pu-239/240	Water Level[a, b]	Field Parameters[a, f]	Alkalinity	Am-241	Arsenic	Gross alpha/beta	Metals (filtered)[d]	Np-237	TOC/TOX	Oxygen and Redox[a]
299-E33-34	A	A	A	A	A	A	A				A	A								3-07
299-E33-35	A	3-07	A	3-07	A	3-07	A		3-07		A	A								3-07
299-E33-37		3-07	3-07	3-07								3-07								3-07
299-E33-38	A	A	A	A	A	A	A	A		A	A	A			A	A				A
299-E33-39	A	A	A	A	A		A				A	A								A
299-E33-41	A	3-07	3-07	3-07	3-07	3-07	A		3-07		A	A								3-07
299-E33-42	A			A			A				A	A								
299-E33-43	A			A			A				A	A								
299-E33-44	A					A	A				A	A								
299-E33-7	A	A	A	A	A	A	A		A		A	A				A				A
299-E34-2		A	A	A								A								A
299-E34-5		3-07	3-07	3-07								3-07								3-07
299-E34-7		A	A									A				A				A
299-E34-9		3-07	3-07	3-07								3-07								3-07
699-44-39B		3-07	3-07	3-07								3-07								3-07
699-45-42		3-07	3-07	3-07							A	A								3-07
699-47-60	A	A	A	A							A	A								
699-49-55A	A	A	A	A	A	A	A	A	A	A	A	A				A				
699-49-57A	A	A	A	A	A	A	A		A		A	A			A					A
699-49-57B	A	A	A	A	A	A			A		A	A								A
699-53-47A		A	A					A			A	A				A				A
699-53-47B			3-06					3-06			A	A								

Table 2.2. (contd)

Well Name	Contaminants of Concern										Supporting Constituents/Measurements									
	Tc-99	Tritium	Nitrate[c]	I-129	Cyanide	Co-60	Uranium	Sr-90	Cs-137	Pu-239/240	Water Level[a, b]	Field Parameters[a, f]	Alkalinity	Am-241	Arsenic	Gross alpha/beta	Metals (filtered)[d]	Np-237	TOC/TOX	Oxygen and Redox[a]
699-53-48A		A	A	A				A			A	A				A	A			A
699-53-55A	A	A	A		A	A					A	A								A
699-53-55B	A	A	A		A	A					A	A								A
699-53-55C	A	A	A	A	A	A					A	A								A
699-54-45A			3-06								A	3-06								
699-54-45B			3-06								A	3-06								
699-54-48								3-06			A	3-06								
699-54-49		A	A					A			A	A				A				A
699-55-50C	A	A	A	A				A			A	A								
699-55-57	A	A	A	A	A	A					A	A								A
699-55-60A	A	A	A	A	A	A					A	A								A
699-57-59[e]	A	A	A	A	A	A	A	A	A	A	A	A	A			A	A		A	A
699-59-58[e]	A	A	A	A	A	A	A	A	A	A	A	A	A			A	A		A	A
699-60-60[e]	A	A	A	A	A	A	A	A	A	A	A	A	A			A	A		A	A
699-61-62[e]	A	A	A	A	A	A	A	A	A	A	A	A	A			A	A		A	A
699-61-66[e]	A	A	A	A	A	A	A	A	A	A	A	A	A			A	A		A	A
699-64-62[e]	A	A	A	A	A	A	A	A	A	A	A	A	A			A	A		A	A
699-65-50	3-07										A	3-07								
699-65-72		3-07									A	3-07								
699-66-58	3-07	3-07									A	3-07								
699-66-64	3-07	3-07									A	3-07								
699-70-68	3-07	3-07									A	3-07								

Table 2.2. (contd)

Well Name	Contaminants of Concern										Supporting Constituents/Measurements									
	Tc-99	Tritium	Nitrate[c]	I-129	Cyanide	Co-60	Uranium	Sr-90	Cs-137	Pu-239/240	Water Level[a, b]	Field Parameters[a, f]	Alkalinity	Am-241	Arsenic	Gross alpha/beta	Metals (filtered)[d]	Np-237	TOC/TOX	Oxygen and Redox[a]
699-72-73	3-07	3-07	3-07								A	3-07								
699-73-61		3-07									A	3-07								

Footnotes

(a) Field measurement.
(b) Water level measurements are to be conducted annually in July for selected wells in the 200-BP-5 Operable Unit as indicated in the table. In addition, water level measurements are routinely performed whenever a well is sampled. Wells are also sampled in March as part of the site-wide annual water-table measurements activity (PNNL-13021).
(c) Other anions to be analyzed in addition to nitrate include, but are not limited to, chloride and sulfate.
(d) Metals – Analytes include but not limited to arsenic, chromium, iron, calcium, potassium, magnesium, and sodium.
(e) Guard wells – Sampled annually for constituents listed above.
(f) Field parameters include pH, temperature, specific conductance, and turbidity.

Codes

A = To be sampled annually.
3-xx = To be sampled triennially (every three years); xx indicates the first fiscal year of sampling for specified analyte in accordance with this revised sampling plan.

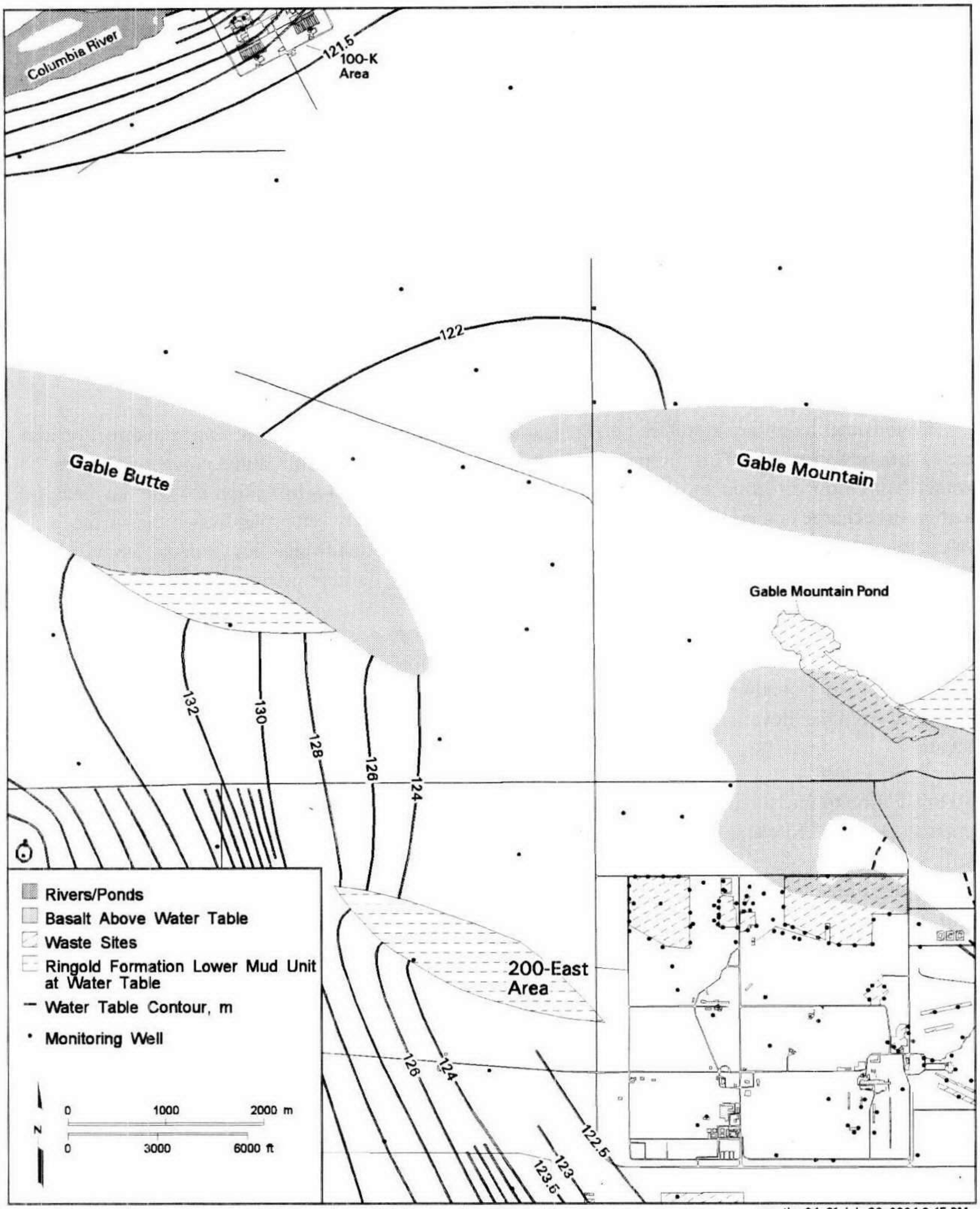

Figure 2.1. Water Table in the 200-BP-5 Operable Unit, March 2003

Relatively few changes have been made in terms of the constituents analyzed for in wells formerly associated with CERCLA monitoring. Four wells have been removed from the network for the reasons described in Section 2.2.

Six guard wells are also identified in Tables 2.1 and 2.2 and their locations provided in Figure 1.3. These wells are located in the vicinity of Gable Gap and serve to identify contamination that may be passing through the gap towards the Columbia River (PNNL-14111). They are sampled annually for technetium-99, tritium, nitrate (plus chloride and sulfate), iodine-129, cobalt-60, strontium-90, cesium-137, alkalinity, gross alpha and beta, filtered metals, total organic carbon, total organic halides, and oxygen and redox potential (Table 2.1). In addition, this revised sampling plan indicates that cyanide and uranium will be analyzed annually for the guard wells since this information will provide information regarding potential transport of groundwater contamination through Gable Gap.

2.4 Water-Level Monitoring

Groundwater levels are monitored on the Hanford Site primarily to help determine the direction and rate of groundwater flow. This information is used to interpret contaminant plume movement and to predict future flow direction and movement. Other uses of water-level information include the identification of recharge and discharge areas, assessing the interaction between groundwater and surface water, assessing the interaction between aquifers, calibration of groundwater-flow models, assessing the impact of liquid effluent disposal practices on groundwater flow, and optimizing monitoring networks.

Static water levels are measured in the monitoring well prior to sampling activities, and a minimum of two consistent measurements are taken to confirm the precision of the measurement. Technicians measure depth to groundwater according to a subcontractor's procedure. The depth to groundwater is subtracted from the elevation of a reference point (usually top of casing) to obtain the water-level elevation.

In addition to measurements taken prior to sampling, the groundwater project measures water levels across the Hanford Site annually in March to construct a site-wide water-table map (Figure 2.1). A list of wells used for water-level measurements, criteria for their selection, hydrogeologic units monitored, and descriptions of the techniques used to collect the data are provided in *Water-Level Monitoring for the Hanford Groundwater Monitoring Project* (PNNL-13021). The wells identified in PNNL-13021 will be used for annual measurements for the 200-BP-5 Operable Unit for the purpose of construction of the site-wide water-table map.

It is difficult to assess current flow direction and velocity in the 200-BP-5 Operable Unit owing to the small hydraulic gradient present in the northwestern portion of the 200 East Area and the 600 Area to the north of 200 East. However, it is important to improve our ability to measure water levels accurately in order to determine flow direction and velocity. This will help us understand contaminant movement in the operable unit and to predict future changes in contaminant distribution. Thus, additional water-level measurements are obtained for a set of the wells in the 200-BP-5 Operable Unit in July each year when barometric pressure and/or storm effects are at a minimum (Table 2.1). These measurements are obtained at nearly the same time to minimize temporal effects.

2.5 Sampling and Analysis Protocol

Groundwater monitoring for the 200-BP-5 Operable Unit is part of the groundwater project and follows the project's quality assurance plan, which is compliant with *EPA Requirements for Quality Assurance Project Plans* (EPA/240/B-01/003, QA/R-5) March 2001, as revised. Groundwater monitoring will follow the requirements of the most recent revision of the quality assurance project plan; this monitoring plan need not be revised to cite future revisions of the quality assurance plan.

Project staff schedule sampling and initiate paperwork. The project uses subcontractors for sample collection, shipping, and analysis. Quality requirements for the subcontracted work are specified in statements of work or contracts.

The statement of work for sampling specifies that activities shall be in accordance with a quality assurance project plan that meets the requirements defined in *Requirements for Quality Assurance Project Plans* (EPA/240/B-01/003, EPA QA/R-5) March 2001, as revised. Additional requirements are specified in the statement of work.

Groundwater project staff conduct laboratory audits and field surveillances to assess the quality of subcontracted work and initiate corrective actions if needed.

2.5.1 Scheduling Groundwater Sampling

The groundwater project has the responsibility for scheduling well sampling. Scheduling activities helps manage the overlap between various sampling projects, eliminating redundant sampling and meeting the needs of each sampling objective.

2.5.2 Chain of Custody

PNNL and the well sampling subcontractor use chain-of-custody forms which are consistent with *Requirements for Quality Assurance Project Plans* (EPA/240/B-01/003, EPA QA/R-5) March 2001, as revised, to document the integrity of groundwater samples from the time of collection through data reporting. The forms are generated during scheduling and managed by the samplers.

2.5.3 Sample Collection

Groundwater samples are collected as described in a subcontractor procedure. Samples generally are collected after three casing volumes of water have been purged from the well or after field parameters have stabilized (i.e., after two consecutive measurements are within 0.2 units for pH, 0.2°C for temperature, 10% for specific conductance, and <5 Nephelometric Turbidity Units (NTU) for turbidity). For routine groundwater samples, preservatives are added to the collection bottles before their use in the field. Samples to be analyzed for metals are usually filtered in the field so that results represent dissolved metals.

2.5.4 Analytical Protocols

Procedures for field measurements are specified in subcontractor's procedures. Each instrument is assigned a unique number that is tracked on field documentation and is calibrated and controlled according to procedure. Additional calibration and use instructions are specified in the instrument user's manuals.

Laboratory analytical methods are specified in contracts with the laboratories, and are standard methods from *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods* (EPA/SW-846 as amended) or *Methods for Chemical Analysis of Water and Wastes* (EPA-600/4-79-020).

3.0 Quality Assurance

The groundwater project's quality assurance plan is compliant with *EPA Requirements for Quality Assurance Project Plans* (EPA/240/B-01/003, EPA QA/R-5), March 2001, as revised. A quality control plan is included in the groundwater project quality assurance plan, and quality control sampling requirements for subcontracted work are discussed in a statement of work.

The groundwater project's quality control program is designed to assess and enhance the reliability and validity of groundwater data. This is accomplished through evaluating the results of quality control samples, conducting audits, and validating groundwater data. This section describes the quality control program for the entire groundwater project, which includes the 200-BP-5 Operable Unit. The quality control practices of the groundwater project are based on guidance from the EPA as described in the *Tri-Party Agreement Action Plan*, Section 7.8 (Ecology et al. 1989). Accuracy, precision, and detection are the primary parameters used to assess data quality. Data for these parameters are obtained from two categories of quality control samples: those that provide checks on field and laboratory activities (field quality control) and those that monitor laboratory performance (laboratory quality control). Table 3.1 summarizes the types of samples in each category and the sample frequencies and characteristics evaluated.

3.1 Quality Control Criteria

Quality control data are evaluated based on established acceptance criteria for each quality control sample type. For field and method blanks, the acceptance limit is generally two times the instrument detection limit (metals), method detection limit (other chemical parameters), or minimum detectable activity (radiochemistry parameters). However, for common laboratory contaminants such as acetone, methylene chloride, 2-butanone, and phthalate esters, the limit is five times the method detection limit. Groundwater samples that are associated (i.e., collected on the same date and analyzed by the same method) with out-of-limit field blanks are flagged with a Q in the database to indicate a potential contamination problem.

Field duplicates must agree within 20%, as measured by the relative percent difference (RPD), to be acceptable. Only those field duplicates with at least one result greater than five times the appropriate detection limit are evaluated. Unacceptable field duplicate results are also flagged with a Q in the database.

For chemical analyses, the acceptance criteria for laboratory duplicates, matrix spikes, matrix spike duplicates, surrogates, and laboratory control samples are generally derived from historical data at the laboratories in accordance with *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods* (EPA/SW-846, as amended). Typical acceptance limits are within 25% of the expected values, although the limits may vary considerably with the method and analyte. For radiological analyses, the acceptance limits for laboratory quality control samples are specified in the laboratory contract. Current values for laboratory duplicates, matrix spikes, and laboratory control samples are 20% RPD, 60%-140%, and 70%-130%, respectively. These values are subject to change if the contract is modified or replaced.

Table 3.1. Quality Control Samples

Sample Type	Primary Characteristics Evaluated	Frequency
Field Quality Control		
Full Trip Blank	Contamination from containers or transportation	1 per 20 well trips
Field Transfer Blank	Airborne contamination from the sampling site	1 each day volatile organic compound samples are collected
Equipment Blank	Contamination from non-dedicated sampling equipment	1 per 10 well trips or as needed[(a)]
Duplicate Samples	Reproducibility	1 per 20 well trips
Laboratory Quality Control		
Method Blank	Laboratory contamination	1 per batch
Lab Duplicates	Laboratory reproducibility	Method/contract specific[(b)]
Matrix Spike	Matrix effects and laboratory accuracy	Method/contract specific[(b)]
Matrix Spike Duplicate	Laboratory reproducibility and accuracy	Method/contract specific[(b)]
Surrogates	Recovery/yield	Method/contract specific[(b)]
Laboratory Control Sample	Accuracy	1 per batch
Double Blind Standards	Accuracy and precision	Varies by constituent[(c)]

(a) When a new type of non-dedicated sampling equipment is used, an equipment blank should be collected every time sampling occurs until it can be shown that less frequent collection of equipment blanks is adequate to monitor the equipment's decontamination procedure.
(b) If called for by the analytical method, duplicates, matrix spikes, and matrix spike duplicates are typically analyzed at a frequency of 1 per 20 samples. Surrogates are routinely included in every sample for most gas chromatographic methods.
(c) Double blind standards containing known concentrations of selected analytes are typically submitted in triplicate or quadruplicate on a quarterly, semi-annual, or annual basis.

Table 3.2 lists the acceptable recovery limits for the double blind standards. These samples are prepared by spiking background well water (currently wells 699-19-88 and 699-49-100C) with known concentrations of constituents of interest. Spiking concentrations range from the detection limit to the upper limit of concentration determined in groundwater on the Hanford Site. Double blind standard results that are outside the acceptance limits are investigated and appropriate actions are taken if necessary.

Holding time is the elapsed time period between sample collection and analysis. Exceeding recommended holding times could result in changes in constituent concentrations due to volatilization, decomposition, or other chemical alterations. Recommended holding times depend on the analytical method, as specified in *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods* (EPA/SW-846, as amended) or *Methods for Chemical Analysis of Water and Wastes* (EPA-600/4-79-020, 1983). Holding times are specified in laboratory contracts. Data associated with exceeded holding times are flagged with an "H" in the Hanford Environmental Information System (HEIS) database.

Table 3.2. Recovery Limits for Double Blind Standards

Constituent	Frequency	Recovery Limits	Precision Limits (RSD)
Specific conductance	Quarterly	75%–125%	25%
Fluoride	Quarterly	75%–125%	25%
Nitrate	Quarterly	75%–125%	25%
Chromium	Annually	80%–120%	20%
Carbon tetrachloride	Quarterly	75%–125%	25%
Chloroform	Quarterly	75%–125%	25%
Trichloroethene	Quarterly	75%–125%	25%
Gross alpha[a]	Quarterly	70%–130%	20%
Gross beta[b]	Quarterly	70%–130%	20%
Tritium	Annually	70%–130%	20%
Strontium-90	Semiannually	70%–130%	20%

(a) Gross alpha standards will be spiked with plutonium-239.
(b) Gross beta standards will be spiked with strontium-90.
RSD = Relative Standard Deviation.

Additional quality control measures include laboratory audits and participation in nationally based performance evaluation studies. The contract laboratories participate in national studies such as the EPA-sanctioned Water Pollution and Water Supply Performance Evaluation studies. The groundwater project periodically audits the analytical laboratories to identify and solve quality problems, or to prevent such problems. Audit results are used to improve performance. Summaries of audit results and performance evaluation studies are presented in the annual groundwater monitoring report.

3.2 Groundwater Data Validation Process

The groundwater project's data validation process provides requirements and guidance for validation of groundwater data that are routinely collected as part of the groundwater project. Validation is a systematic process of reviewing data against a set of criteria to determine whether the data are acceptable for their intended use. This process applies to groundwater data that have been verified (see Section 4.1) and loaded into the Hanford Environmental Information System database (HEIS). The outcome of the activities described below is an electronic data set with suspect or erroneous data corrected or flagged. Groundwater monitoring project staff document the validation process quarterly by signing a checklist, which is stored in the project file.

Responsibilities for data validation are divided among project staff. Each groundwater interest area is assigned to a project scientist, who is familiar with the hydrogeologic conditions of that site. The data validation process includes the following elements:

- **Generation of data reports.** Twice each month, data management staff provide tables of newly loaded data to project scientists for evaluation (biweekly reports). Also, after laboratory results from a reporting quarter have been loaded into HEIS, staff produce tables of water-level data and analytical data for wells sampled within that quarter (quarterly reports). The quarterly data reports include any data flags added during the quality control evaluation or as a result of prior data review.

- **Project scientist evaluation**. As soon as practical after receiving biweekly reports, project scientists review the data to identify changes in groundwater quality or potential data errors. Evaluation techniques include comparing key constituents to historical trends or spatial patterns. Other data checks may include comparison of general parameters to their specific counterparts (e.g., conductivity to ions) and calculation of charge balances. Project scientists request data reviews if appropriate (see Section 4.2). If necessary, the laboratory may be asked to check calculations or reanalyze the sample, or the well may be resampled. After receiving quarterly reports, project scientists review sampling summary tables to determine whether network wells were sampled and analyzed as scheduled. If not, they work with other project staff to resolve the problem. Project scientists also review quarterly reports of analytical and water-level data using the same techniques as for biweekly reports. Unlike the biweekly reports, the quarterly reports usually include a full data set (i.e., all the data from the wells sampled during the previous quarter have been received and loaded into HEIS).

- **Reporting and results.** Staff report results of quality control evaluations informally to project staff, DOE, and Ecology each quarter; DOE will provide them to EPA on request. Results for each fiscal year are described in the annual groundwater monitoring report.

4.0 Data Management, Evaluation, and Reporting

This section describes how groundwater data are stored, retrieved, and interpreted.

4.1 Loading and Verifying Data

The contract laboratories report analytical results electronically and in hard copy. The electronic results are loaded into HEIS. Hard copy data reports and field records are maintained as part of the Tri-Party Agreement administrative record. Project staff perform an array of computer checks on the electronic file for formatting, allowed values, data flagging (qualifiers), and completeness. Verification of the hard copy results includes checks for (1) completeness, (2) notes on condition of samples upon receipt by the laboratory, (3) notes on problems that arose during the analysis of the samples, and (4) correct reporting of results. If data are incomplete or deficient, staff work with the laboratory to get the problems corrected. Notes on condition of samples or problems during analysis may be used to support data reviews (see Section 4.2).

Field data such as specific conductance, pH, temperature, turbidity, and depth-to-water are recorded on field records. Data management staff enter these into HEIS manually through data-entry screens, verify each value against the hard copy, and initial each value on the hard copy.

4.2 Data Review

The groundwater project conducts special reviews of groundwater analytical data or field measurements when results are in question. Groundwater project staff document the process on a review form, and results are used to flag the data appropriately in HEIS. Various staff may initiate a review form, e.g., project scientists, data management staff, and quality control staff. A project scientist assigned to examine review forms determines and records the appropriate response and action on the review form, including changes to be made to the data flags in HEIS. Actions may include updating HEIS with corrected data or result of re-analysis, flagging existing data (e.g., "R" for reject, "Y" for suspect, "G" for good), and/or adding comments. Data management staff updates the temporary "F" flag to the final flag in HEIS.

4.3 Interpretation

After data are validated and verified, the acceptable data are used to interpret groundwater conditions at the site. Interpretation includes the following techniques:

- Hydrographs – graph water levels vs. time to determine decreases, increases, seasonal, or manmade fluctuations in groundwater levels.
- Water-table maps – use water-table elevations from multiple wells to construct contour maps to estimate flow directions. Groundwater flow is assumed to be perpendicular to lines of equal potential.

- Trend plots – graph concentrations of constituents vs. time to determine increases, decreases, and fluctuations. May be used in tandem with hydrographs and/or water-table maps to determine if concentrations relate to changes in water level or in groundwater flow directions.

- Plume maps – map distributions of chemical or radiological constituents are in the aquifer to determine extent of contamination. Changes in plume distribution over time aid in determining movement of plumes and direction of flow.

- Contaminant ratios – can sometimes be used to distinguish between different sources of contamination.

4.4 Reporting

Chemistry and water-level data are reviewed after each sampling event and are available in HEIS.

Any unusual results for the 200-BP-5 Operable Unit will be summarized in letter reports or informal reports to EPA (e.g., reports via e-mail or presented at unit manager's meetings). Formal, interpretive reports are issued annually in March (e.g., PNNL-14548).

4.5 Change Control

The approach to making changes in 200-BP-5 Operable Unit monitoring activities, associated documents, and approval requirements are listed in Table 4.1.

Table 4.1. Change Control for Groundwater Monitoring in the 200-BP-5 Operable Unit

<table>
<tr><th>Type of Change</th><th>Action</th><th>Documentation</th></tr>
<tr><td>Temporarily (≤ 1 year) adding constituents, wells, or increasing sampling frequency</td><td>Project management approval; notify regulator if appropriate</td><td>Project's schedule tracking system.</td></tr>
<tr><td>Deleting constituents or wells; decreasing frequency</td><td>Obtain regulator approval.</td><td rowspan="2">Initial approval may be verbal or e-mail. Formal approval via letter or signed meeting minutes; project's schedule tracking system.</td></tr>
<tr><td>Unavoidable changes (e.g., dry wells; delayed samples, one-time missed samples due to broken pump, lost bottle, etc.)</td><td>Notify regulator.</td></tr>
<tr><td>Revision to sampling and analysis plan</td><td>Revise plan; obtain regulator approval; distribute plan.</td><td>Revised plan.</td></tr>
</table>

5.0 Health and Safety

All field operations will be performed consistent with PNNL health and safety requirements as described in PNNL's online Systems Based Management System. For work performed by other contractors, these standards are implemented via subcontracts and work orders.

Where necessary, work planning packages will include, as appropriate, a job hazard analysis, and/or a site-specific health and safety plan, and applicable radiological permits.

The sampling procedures and associated activities will implement as low as reasonably achievable practices to minimize radiation exposure to the sampling team, consistent with the requirements outlined in approved PNNL procedures.

6.0 References

40 CFR 264. U.S. Environmental Protection Agency. "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities." *U.S. Code of Federal Regulations.*

40 CFR 265. U.S. Environmental Protection Agency. "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities." *U.S. Code of Federal Regulations.*

40 CFR 300. National Oil and Hazardous Substances Pollution Contingency Plan. Subpart E. "Hazardous Substance Response." *U.S. Code of Federal Regulations.*

Atomic Energy Act of 1954, as amended, Ch. 1073, 68 Stat. 919, 42 USC 2011 et seq.

CERCLA – *Comprehensive Environmental Response, Compensation, and Liability Act.* 1980. Public Law 96-150, as amended, 94 Stat. 2767, 42 USC 9601 et seq.

DOE Order 450.1. "Environmental Protection Program." U.S. Department of Energy, Washington, D.C.

DOE/RL-92-05, Rev. 0. 1993. *B Plant Aggregate Area Management Study Report.* U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-95-59, Rev. 0. 1996. *200-BP-5 Operable Unit Treatability Test Report.* U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-95-100, Rev. 1. 1997. *RCRA Facility Investigation Report for the 200-PO-1 Operable Unit.* U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-94-95, Rev. 1. 1997. *Hanford Sitewide Groundwater Remediation Strategy.* U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2001-49, Rev. 0. 2003. *Groundwater Sampling and Analysis Plan for the 200-BP-5 Operable Unit.* U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology – Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy. 1989. Hanford Federal Facility Agreement and Consent Order. Document No. 89-10, as amended (The Tri-Party Agreement), Olympia, Washington.

EPA. 2001. *USDOE Hanford Site First Five Year Review Report.* U.S. Environmental Protection Agency, Region 10, Hanford Project Office, Seattle, Washington.

EPA/SW-846. 1998 as amended. *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods.* 3rd Ed. as revised. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C.

EPA-600/4-79-020. 1983. *Methods for Chemical Analysis of Water and Wastes.* U.S. Environmental Protection Agency, Washington, D.C.

EPA/600/R-00/007 (QA/G-4HW). 2000. *Data Quality Objectives Process for Hazardous Waste Site Investigations.* U.S. Environmental Protection Agency, Washington, D.C.

EPA/600/R-96/055 (QA/G-4). 2000. *Guidance for the Data Quality Objectives Process.* U.S. Environmental Protection Agency, Washington, D.C.

EPA/240/B-01/003/R-5 (QA-R5). 2001. *EPA Requirements for Quality Assurance Project Plans.* U.S. Environmental Protection Agency, Washington, D.C.

HASQARD. 1998. *Hanford Analytical Services Quality Assurance Requirements Document.* DOE/RL-96-98. U.S. Department of Energy, Richland, Washington.

PNNL-11826. 1998. *Results of Phase I Groundwater Quality Assessment for Single-Shell Tank Waste Management Areas B-BX-BY at the Hanford Site.* SM Narbutovskih, Pacific Northwest National Laboratory, Richland, Washington.

PNNL-13021. 1999. *Water-Level Monitoring Plan for the Hanford Groundwater Monitoring Project.* JP McDonald, MA Chamness, and DR Newcomer, Pacific Northwest National Laboratory, Richland, Washington.

PNNL-13080. 2000. *Hanford Site Groundwater: Settings, Sources, and Methods.* MJ Hartman (ed.), Pacific Northwest National Laboratory, Richland, Washington.

PNNL-13788. 2002. *Hanford Site Groundwater Monitoring for Fiscal Year 2001.* MJ Hartman, LF Morasch, and WD Webber (eds.), Pacific Northwest National Laboratory, Richland, Washington.

PNNL-14049. 2002. *Data Quality Objectives Summary Report – Designing a Groundwater Monitoring Network for the 200-BP-5 and 200-PO-1 Operable Units.* EC Thornton and JW Lindberg, Pacific Northwest National Laboratory, Richland, Washington.

PNNL-14111. 2002. *Fiscal Year 2003 Integrated Monitoring Plan for the Hanford Groundwater Monitoring Project.* MJ Hartman, PE Dresel, JW Lindberg, JP McDonald, DR Newcomer, and EC Thornton, Pacific Northwest National Laboratory, Richland, Washington.

PNNL-14548. 2004. *Hanford Site Groundwater Monitoring for Fiscal Year 2003.* MJ Hartman, LF Morasch, and WD Webber (eds.), Pacific Northwest National Laboratory, Richland, Washington.

RCRA – *Resource Conservation and Recovery Act.* 1976. Public Law 94-580, as amended, 90 Stat. 2795, 42 USC 6901 et seq.

WAC 173-303. *Dangerous Waste Regulations.* Washington Administrative Code, Olympia, Washington.

Appendix A

Sampling Interval Information for Wells Located in the 200-BP-5 Operable Unit

Appendix A

Sampling Interval Information for Wells Located in the 200-BP-5 Operable Unit

This appendix includes a comprehensive list of all wells in the 200-BP-5 Operable Unit boundaries. Only a portion of the wells listed in this appendix are scheduled for sampling under this Sampling and Analysis Plan (see Table 2.1 in the main text). Some wells have incomplete information regarding construction.

This appendix provides the following information for wells located in the 200-BP-5 Operable Unit.

- Well name
- Zone – the aquifer or portion of the aquifer screened or open by perforated casing
  V = Vadose, completed above the water table
  U = Unconfined aquifer
  TU = Top of the unconfined aquifer
  UU = Upper unconfined
  MU = Midlevel in the unconfined aquifer
  LU = Lower unconfined aquifer
  C = Confined aquifer
  CR = Locally confined Ringold Formation
  UC = Upper confined, but above the Pomona Member of the Saddle Mountains Basalt
  LC = Lower confined, but below the Pomona Member of the Saddle Mountains Basalt
- Elevation at top of the screen or perforated interval
- Elevation at the bottom of the screen or perforated interval
- Water-Level Elevation = most recent water level elevation in the well
- Water-Level Date = date of most recent water level elevation measured in the well
- Water Column = thickness of water column in well (water-level minus bottom of open interval)
- -- = Information not available.

Well Name	Zone	Elevation Top of Interval (m)	Elevation Bottom of Interval (m)	Water-Level Elevation (m)	Water-Level Date	Water Column (m)
299-E24-8	TU	124.56	96.52	121.60	5/24/2004	25.08
299-E26-1	UU	122.42	119.37	123.46	6/14/1996	4.09
299-E26-10	TU	125.60	120.73	124.30	3/12/2004	3.57
299-E26-11	UU	122.02	120.19	123.28	3/12/2004	3.09
299-E26-6	U	122.90	110.71	197.90	10/20/1993	87.20
299-E26-8	UC	90.46	63.13	122.14	3/22/2004	59.01
299-E26-9	TU	126.03	122.68	122.47	3/19/2002	-0.21
299-E27-10	TU	126.19	117.66	122.28	4/28/2004	4.62
299-E27-11	TU	126.16	119.76	122.22	3/16/2004	2.46
299-E27-12	TU	126.26	119.86	122.29	3/22/2004	2.43
299-E27-13	TU	126.67	120.27	122.23	3/22/2004	1.96
299-E27-14	TU	125.86	119.46	122.29	3/22/2004	2.83
299-E27-15	TU	126.62	120.22	122.28	3/22/2004	2.06
299-E27-16	TU	126.12	119.72	122.24	4/13/2004	2.52
299-E27-17	TU	125.60	119.20	122.25	4/12/2004	3.05
299-E27-18	TU	123.58	117.49	122.19	4/13/2004	4.70
299-E27-19	TU	123.79	117.70	122.17	4/13/2004	4.47
299-E27-21	UU	122.29	111.60	122.28	3/23/2004	10.68
299-E27-22	UU	123.09	110.91	122.31	3/23/2004	11.40
299-E27-23	UU	122.30	111.62	122.27	3/23/2004	10.65
299-E27-3	U	127.87	102.57	123.19	12/1/1982	20.62
299-E27-3P	U	--	--	123.63	3/6/1995	--
299-E27-4	UU	122.30	111.63	122.30	3/23/2004	10.67
299-E27-5	U	129.23	107.59	122.91	1/9/1991	15.32
299-E27-7	UU	120.67	108.48	122.31	3/22/2004	13.83
299-E27-8	TU	125.62	116.17	121.26	4/12/2004	5.09
299-E27-9	TU	125.24	117.93	122.27	4/12/2004	4.34
299-E28-1	UU	124.60	110.27	123.07	12/21/1995	12.80
299-E28-10	U	128.59	112.74	124.64	3/31/88	11.90
299-E28-11	U	--	--	--	--	--
299-E28-12	LU	112.69	112.69	123.35	11/21/1996	10.67
299-E28-13	LU	103.27	103.27	122.31	4/12/2004	19.05
299-E28-14	LU	105.15	104.54	122.20	3/19/2004	17.66
299-E28-15	UU	127.21	113.19	--	--	--
299-E28-16	TU	132.29	116.13	123.56	4/16/1993	7.43
299-E28-17	TU	128.00	113.98	122.14	3/19/2004	8.16
299-E28-18	UU	132.04	112.23	122.26	5/6/2004	10.04
299-E28-19	U	133.43	113.61	123.60	4/27/1993	9.98
299-E28-2	UU	119.82	110.68	122.20	6/17/2003	11.52
299-E28-20	U	--	--	--	--	--
299-E28-21	UU	131.87	111.14	122.24	7/14/2003	11.10
299-E28-23	UU	124.74	109.50	122.27	7/11/2003	12.77
299-E28-24	UU	125.06	109.82	122.24	6/24/2003	12.42
299-E28-25	UU	124.41	109.17	122.23	6/17/2003	13.06
299-E28-26	TU	124.79	118.70	122.26	3/12/2004	3.56

Well Name	Zone	Elevation Top of Interval (m)	Elevation Bottom of Interval (m)	Water-Level Elevation (m)	Water-Level Date	Water Column (m)
299-E28-27	TU	125.53	116.08	122.23	3/12/2004	6.15
299-E28-28	TU	125.65	119.56	122.22	3/12/2004	2.66
299-E28-3	UU	--	--	122.21	7/27/04	--
299-E28-4	UU	121.25	113.32	122.19	3/19/2004	8.87
299-E28-5	UU	126.74	113.02	122.20	6/17/2003	9.18
299-E28-52	--	--	--	--	--	--
299-E28-6	UU	119.21	110.37	122.33	6/17/2003	11.96
299-E28-7	UU	127.40	107.59	122.28	4/12/2004	14.68
299-E28-8	UU	127.63	114.22	122.05	5/24/2004	7.83
299-E28-9	U	125.24	110.00	122.18	3/19/2004	12.18
299-E32-1	TU	127.12	117.98	123.36	6/14/1996	5.38
299-E32-10	TU	125.95	119.85	122.23	3/12/2004	2.38
299-E32-2	TU	126.03	116.59	122.21	3/12/2004	5.62
299-E32-3	TU	125.85	119.76	122.25	3/12/2004	2.49
299-E32-4	TU	125.05	115.90	122.22	3/12/2004	6.32
299-E32-5	TU	125.49	119.09	122.24	3/12/2004	3.15
299-E32-6	TU	125.65	119.25	122.24	3/12/2004	2.99
299-E32-7	TU	125.65	119.25	122.24	3/12/2004	2.99
299-E32-8	TU	125.11	119.01	122.21	3/12/2004	3.20
299-E32-9	TU	125.62	119.52	122.23	3/12/2004	2.71
299-E33-10	TU	129.16	116.96	122.17	7/14/2003	5.21
299-E33-11	U	--	--	121.35	3/29/1956	--
299-E33-12	UC	97.34	72.96	122.72	6/12/2001	49.76
299-E33-13	TU	127.79	120.17	122.50	9/19/2001	2.33
299-E33-14	TU	125.25	120.67	122.28	3/12/2004	1.61
299-E33-15	TU	123.79	119.22	122.03	5/3/2004	2.81
299-E33-16	UU	124.54	118.70	122.21	5/26/2004	3.51
299-E33-17	TU	125.97	118.65	122.27	5/3/2004	3.62
299-E33-18	TU	125.79	119.69	122.28	5/3/2004	2.59
299-E33-19	TU	132.58	123.13	123.98	7/14/1974	0.85
299-E33-1A	TU	124.21	118.11	123.26	7/10/1996	5.15
299-E33-2	TU	124.16	120.20	123.40	6/13/1996	3.20
299-E33-20	TU	127.10	117.69	122.28	5/3/2004	4.59
299-E33-21	TU	132.11	119.92	122.35	5/3/2004	2.43
299-E33-23	TU	124.28	120.62	--	--	--
299-E33-25	TU	131.71	121.35	121.89	7/14/2003	0.54
299-E33-26	TU	132.49	119.99	121.92	5/5/2004	1.93
299-E33-27	U	--	--	131.27	11/26/1990	--
299-E33-28	TU	125.03	118.32	122.23	3/12/2004	3.91
299-E33-29	TU	125.59	117.36	122.22	3/12/2004	4.86
299-E33-3	TU	123.22	119.56	123.38	6/13/1996	3.82
299-E33-30	TU	125.13	118.42	122.25	3/12/2004	3.83
299-E33-31	TU	125.80	119.40	122.26	5/4/2004	2.86
299-E33-32	TU	126.26	119.86	122.22	5/5/2004	2.36
299-E33-33	TU	126.11	119.71	122.24	5/5/2004	2.53
299-E33-334	TU	124.96	117.33	122.27	5/4/2004	4.94

Well Name	Zone	Elevation Top of Interval (m)	Elevation Bottom of Interval (m)	Water-Level Elevation (m)	Water-Level Date	Water Column (m)
299-E33-335	--	124.31	118.21	122.25	5/4/2004	4.05
299-E33-337	--	124.18	116.55	122.28	5/4/2004	5.72
299-E33-338	--	123.93	117.84	122.29	5/4/2004	4.45
299-E33-339	--	123.26	117.20	122.28	5/4/2004	5.08
299-E33-34	TU	126.49	120.39	122.35	3/12/2004	1.96
299-E33-35	TU	126.68	120.28	122.23	3/12/2004	1.95
299-E33-36	TU	125.65	119.56	121.82	5/5/2004	2.26
299-E33-37	TU	126.03	119.63	122.26	4/15/2004	2.63
299-E33-38	TU	126.28	119.88	122.28	5/5/2004	2.40
299-E33-39	TU	126.72	120.32	122.28	5/4/2004	1.96
299-E33-4	TU	125.20	120.32	123.37	6/14/1996	3.05
299-E33-40	UC	100.80	97.54	117.08	8/6/2001	19.54
299-E33-41	TU	124.91	120.04	122.25	5/4/2004	2.21
299-E33-42	TU	126.54	120.14	122.24	5/4/2004	2.10
299-E33-43	TU	125.72	119.32	122.19	5/5/2004	2.87
299-E33-44	TU	123.53	118.96	122.26	5/5/2004	3.31
299-E33-5	TU	127.25	122.07	122.42	7/14/2003	0.35
299-E33-6	TU	--	--	124.32	2/4/1986	--
299-E33-7	TU	126.07	121.50	122.25	5/5/2004	0.75
299-E33-8	TU	128.33	120.10	122.33	7/14/2003	2.23
299-E33-9	TU	122.40	119.35	122.27	3/3/2004	2.92
299-E34-1	TU	126.60	122.03	123.39	6/14/1996	1.36
299-E34-10	TU	126.59	120.19	122.27	4/28/2004	2.08
299-E34-11	TU	125.01	121.96	122.34	7/15/2003	0.38
299-E34-12	TU	126.55	120.15	122.17	4/14/2004	2.02
299-E34-2	TU	125.75	119.66	122.34	4/14/2004	2.68
299-E34-3	TU	128.04	121.63	122.35	7/21/2003	0.72
299-E34-4	V	--	--	--	--	--
299-E34-5	TU	128.50	122.40	122.79	4/12/2004	0.39
299-E34-6	TU	129.58	123.49	123.52	12/10/1993	0.03
299-E34-7	TU	125.18	121.83	121.51	4/12/2004	-0.32
299-E34-8	TU	125.92	119.83	122.15	4/14/2004	2.32
299-E34-9	TU	126.89	120.49	122.25	4/12/2004	1.76
299-E35-1	V	127.23	123.97	123.91	6/8/1998	-0.06
299-E35-2	TU	125.50	122.45	122.37	3/12/2004	-0.08
699-42-40A	UU	124.07	114.62	124.69	3/16/2004	10.07
699-42-40B	UU	127.24	121.15	124.62	3/16/2004	3.47
699-42-40C	UC	73.20	47.90	123.91	3/16/2004	76.01
699-43-40	TU	130.49	124.09	124.60	9/19/2003	0.51
699-43-41E	MU	126.83	123.48	124.55	5/14/2004	1.07
699-43-41F	LU	117.94	114.68	126.41	10/29/1998	11.73
699-43-41G	CR	110.74	107.39	124.03	3/16/2004	16.64
699-44-39B	UU	126.18	120.09	124.89	1/23/2004	4.80
699-44-42	TU	130.51	123.81	124.34	3/16/2004	0.53
699-44-43B	TU	129.37	123.27	124.00	3/16/2004	0.73
699-45-42	TU	127.90	121.19	123.96	3/16/2004	2.77

Well Name	Zone	Elevation Top of Interval (m)	Elevation Bottom of Interval (m)	Water-Level Elevation (m)	Water-Level Date	Water Column (m)
699-46-31	C	--	--	124.53	3/29/2004	--
699-46-32	UC	--	--	124.59	3/29/2004	--
699-46-33	U	--	--	126.11	6/19/1996	--
699-47-35A	UU	126.38	115.10	125.04	3/29/2004	9.93
699-47-35B	UU	121.83	115.74	125.04	3/29/2004	9.30
699-47-35C	U	--	--	126.89	6/19/1996	--
699-47-46A	LU	126.62	122.66	123.59	6/18/1996	0.93
699-47-50	UC	99.09	88.42	122.80	3/29/2004	34.38
699-47-60	TU	122.61	114.38	122.31	3/23/2004	7.93
699-48-18	TU	111.10	106.53	110.85	3/9/2004	4.32
699-48-35	U	--	--	126.26	6/19/1996	--
699-48-48A	LC	--	--	123.15	12/28/1993	--
699-48-48AP	LC	-1294.10	-1297.15	125.78	3/31/2004	1422.93
699-48-48AQ	LC	-1033.51	-1036.56	126.20	3/31/2004	1162.76
699-48-48AR	LC	-808.58	-811.62	125.97	3/31/2004	937.59
699-48-48AS	LC	-724.15	-727.20	125.49	3/31/2004	852.69
699-48-48AT	LC	-196.26	-466.30	123.17	3/31/2004	589.47
699-48-49	U	--	--	124.86	5/11/1970	--
699-48-50	TU	126.69	120.29	122.82	3/29/2004	2.53
699-49-28	TU	121.52	119.99	120.51	3/23/1999	0.52
699-49-31	U	--	--	124.34	6/19/1997	--
699-49-32B	UC	--	--	124.85	3/29/2004	--
699-49-33	U	--	--	126.29	6/19/1996	--
699-49-55A	TU	124.29	119.72	122.25	3/29/2004	2.53
699-49-55B	UC	108.76	93.22	122.41	3/29/2004	29.19
699-49-57A	TU	125.05	119.87	122.34	3/29/2004	2.47
699-49-57B	UC	102.79	99.62	122.27	3/29/2004	22.65
699-50-28A	--	--	--	--	--	--
699-50-28B	UU	119.40	116.35	119.78	5/25/2004	3.43
699-50-30	TU	121.59	93.86	119.43	3/26/2004	25.57
699-50-42	TU	126.19	122.84	124.33	3/29/2004	1.49
699-50-42P	UC	--	--	124.34	3/26/2004	--
699-50-45	UC	97.39	83.68	123.89	3/26/2004	40.21
699-50-48A	U	--	--	125.52	4/6/1989	--
699-50-48B	UC	103.33	92.05	123.19	3/26/2004	31.14
699-50-53A	TU	126.88	122.46	122.35	3/26/2004	-0.11
699-50-53B	UC	104.76	101.71	122.52	3/26/2004	20.81
699-51-36A	LC	-98.43	-113.67	124.74	3/26/2004	238.41
699-51-36B	UC	--	--	125.63	3/26/2003	--
699-51-36C	UC	--	--	124.87	3/26/2004	--
699-51-36D	C	--	--	124.96	3/26/2004	--
699-51-46	UC	101.49	86.25	123.47	3/26/2004	37.22
699-52-19	TU	110.07	97.88	110.88	3/9/2004	13.00
699-52-46A	UC	86.02	70.78	124.04	3/26/2004	53.26
699-52-46B		--	--	--	--	--
699-52-48	UC	96.18	83.38	123.11	3/26/2004	39.73

Well Name	Zone	Elevation Top of Interval (m)	Elevation Bottom of Interval (m)	Water-Level Elevation (m)	Water-Level Date	Water Column (m)
699-52-52	LC	-77.16	-105.80	112.95	3/29/2004	218.75
699-52-54	TU	125.85	122.50	122.60	3/23/2001	0.10
699-52-57	TU	128.83	122.73	122.63	4/11/2000	-0.10
699-53-35	UU	--	--	123.64	3/26/2004	--
699-53-47A	TU	126.92	123.57	123.64	5/12/2004	0.07
699-53-47B	TU	126.75	120.66	123.73	7/15/2003	3.08
699-53-48A	TU	122.60	121.11	123.19	7/16/2003	2.09
699-53-48B	TU	130.60	124.66	122.29	7/16/2003	-2.37
699-53-50	UC	92.00	76.76	122.83	3/26/2004	46.07
699-53-55A	U	126.44	91.39	122.24	9/30/2003	30.85
699-53-55AP	LU_UC	--	--	124.37	8/9/1985	--
699-53-55B	LU	106.11	100.01	122.12	12/2/2003	22.11
699-53-55C	UU	119.52	109.40	122.19	3/9/2004	12.80
699-54-18A	MU	--	--	117.33	3/11/2004	--
699-54-18D	LC	--	--	135.79	6/24/1995	--
699-54-19	UU	106.66	100.57	111.05	6/2/1994	10.48
699-54-34	UC	121.16	118.12	125.03	3/26/2004	6.91
699-54-37A	TB	125.19	122.14	125.86	3/29/2004	3.72
699-54-42	TU	125.99	95.51	121.94	3/29/2004	26.43
699-54-45A	TU	121.84	118.79	122.29	7/16/2003	3.50
699-54-45B	UC	59.79	55.22	71.17	7/23/2003	15.97
699-54-48	TU	127.35	121.10	122.19	7/15/2003	1.09
699-54-49	TU	124.71	118.62	122.18	3/26/2004	3.56
699-54-57	UC	--	--	121.04	3/29/2004	--
699-55-21	U	--	--	110.97	6/2/1994	--
699-55-40	TU	125.40	123.87	125.55	10/4/1994	1.67
699-55-44	UU	116.72	113.68	122.10	3/29/2004	8.42
699-55-50A	TU	123.78	105.49	123.09	6/19/1996	17.61
699-55-50AP	--	--	--	123.17	3/2/1995	--
699-55-50AQ	--	--	--	123.18	3/2/1995	--
699-55-50C	TU	124.84	117.53	121.91	5/26/2004	4.38
699-55-50D	TU	125.19	107.81	123.20	6/19/1996	15.38
699-55-55	TU	126.73	119.72	122.16	3/26/2004	2.44
699-55-57	TU	131.83	122.68	122.15	3/9/2004	-0.53
699-55-60A	UU	116.77	104.57	122.24	3/26/2004	17.67
699-55-60B	MU	105.75	88.99	124.21	8/9/1985	35.22
699-56-42A	--	--	--	125.66	3/2/1992	--
699-56-42C	--	--	--	125.42	3/2/1995	--
699-56-42D	--	--	--	125.91	2/26/1992	--
699-56-42E	--	--	--	125.59	3/2/1992	--
699-56-42F	--	--	--	150.94	2/26/1992	--
699-56-43	UC	120.57	117.52	124.12	3/29/2004	6.60
699-56-51	LU	117.50	102.26	123.41	6/19/1996	21.15
699-56-53	UC	74.96	50.58	122.33	3/26/2004	71.75
699-57-25A	TU	111.51	102.98	111.07	6/2/1994	8.10
699-57-29A	TU	111.42	106.85	110.91	3/11/2004	4.06

Well Name	Zone	Elevation Top of Interval (m)	Elevation Bottom of Interval (m)	Water-Level Elevation (m)	Water-Level Date	Water Column (m)
699-57-41B	--	--	--	125.61	3/5/1992	--
699-57-42	--	--	--	125.94	3/10/1992	--
699-57-59	TU	125.16	119.06	122.16	3/26/2004	3.10
699-58-41E	--	--	--	134.48	2/24/1993	--
699-58-41F	--	--	--	199.91	3/5/1992	--
699-58-48	--	--	--	--	--	--
699-59-55	U	87.62	87.62	122.26	3/26/2004	34.64
699-59-58	TU	124.59	120.02	122.60	1/30/2004	2.58
699-60-57	U	126.68	100.16	122.17	3/26/2004	22.01
699-60-59	LC	-301.68	-320.49	122.98	12/15/1994	443.47
699-60-60	TU	125.88	117.65	122.14	3/26/2004	4.49
699-60-60P	UU	--	--	124.12	8/9/1985	--
699-61-55B	LC	123.04	42.28	124.40	3/26/2004	82.12
699-61-57	LC	-14.02	-40.02	121.75	3/10/2004	161.95
699-61-62	TU	125.55	121.28	122.15	3/10/2004	0.87
699-61-66	TU	127.19	110.43	122.07	3/10/2004	11.64
699-62-43F	UU	122.41	107.78	119.19	12/30/2003	11.41
699-63-58	TU	125.23	113.04	121.97	3/10/2004	8.93
699-64-62	TU	124.74	118.64	121.97	3/10/2004	3.33
699-65-50	TU	125.60	104.27	121.76	3/10/2004	17.49
699-65-59A	TU	124.06	116.44	121.96	3/10/2004	5.52
699-65-72	TU	123.85	117.76	121.88	3/10/2004	4.11
699-66-58	TU	125.06	118.96	121.92	3/10/2004	2.96
699-66-64	TU	124.93	118.84	121.90	3/10/2004	3.06
699-70-68	TU	121.98	115.57	121.77	3/9/2004	6.20
699-72-73	TU	128.84	93.48	121.21	3/9/2004	27.73
699-73-61	TU	128.79	116.60	121.74	3/9/2004	5.14

Appendix B

List of Supplemental Wells Potentially Used to Support CERCLA Groundwater Monitoring for the 200-BP-5 Operable Unit

Appendix B
List of Supplemental Wells Potentially Used to Support CERCLA Groundwater Monitoring for the 200-BP-5 Operable Unit

Well Numbers	Sampling Project
299-E26-6	Existing well to be sampled for SST A-AX
299-E26-8	Surveillance Basalt
299-E27-11	B-63, LLBG 2, LLBG 2-PA
299-E27-12	SST C
299-E27-13	SST C
299-E27-16	B-63 Trench
299-E27-19	B-63 Trench
299-E27-21	SST C
299-E27-22	SST C
299-E27-23	SST C
299-E27-4	SST C
299-E27-8	B-63, LLBG 2, LLBG 2-PA
299-E27-9	B-63, LLBG 2, LLBG 2-PA
299-E28-7	Historical/Surveillance (to be decommissioned)
299-E32-3	LLBG 1, LLBG 1-PA
299-E33-1A	Existing well to be sampled for SST B-BX-BY
299-E33-10	SST B
299-E33-17	SST B
299-E33-2	Existing well to be sampled for SST B-BX-BY
299-E33-20	SST B
299-E33-21	SST B
299-E33-3	Existing well to be sampled for SST B-BX-BY
299-E33-31	SST B
299-E33-337	SST B
299-E33-339	SST B
299-E33-36	B-63 Trench
299-E33-4	Existing well to be sampled for SST B-BX-BY
C4259/299-E33-47	Proposed new well east of SST B
C4260/299-E33-48	Proposed new well south of SST B
C4261/299-E33-49	Proposed new well south of SST BX
299-E33-9	SST B
299-E34-10	B-63, LLBG 2, LLBG 2-PA
299-E34-12	LLBG 2, LLBG 2-PA

Well Numbers	Sampling Project
299-E34-3	LLBG 2, LLBG 2-PA
299-E34-8	B-63 Trench
699-50-53B	Surveillance Basalt
699-52-19	200-PO-1 Operable Unit
699-52-46A	Surveillance Basalt
699-54-34	Surveillance Basalt
699-56-43	Surveillance Basalt
699-56-53	Surveillance Basalt
699-62-43F	100-FR-3 Operable Unit
699-63-55	100-FR-3 Operable Unit
699-67-51	100-FR-3 Operable Unit

LLBG = Low-level burial ground.
SST = Single-shell tank.
WMA = Waste Management Area.