DOE/RL-2009-69
Revision 1

Interim Status Groundwater Monitoring Plan for the LLBG WMA-4

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

U.S. DEPARTMENT OF ENERGY | Richland Operations Office

P.O. Box 550
Richland, Washington 99352

Approved for Public Release;
Further Dissemination Unlimited

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Executive Summary

Low-Level Waste Management Area (LLWMA) 4, which consists of the 218-W-4B and the 218-W-4C Burial Grounds, is regulated via *Revised Code of Washington* (RCW) 70.105 ("Public Health and Safety," "Hazardous Waste Management") and its implementing requirements in *Washington Administrative Code* (WAC) 173-303-400 ("Dangerous Waste Regulations," "Interim Status Facility Standards"). The Washington State Department of Ecology has been authorized by the U.S. Environmental Protection Agency (*Authorized State Hazardous Waste Programs*) to conduct its hazardous waste regulatory program in lieu of the *Resource Conservation and Recovery Act of 1976.*

This document supersedes *Interim Status Groundwater Monitoring Plan for Low-Level Waste Management Areas 1 to 4, RCRA Facilities, Hanford, Washington* (PNNL-14859), as revised in interim change notices PNNL-14859-ICN-1 and PNNL-14859-ICN-2, to incorporate changes that have occurred at LLWMA-4, as well as changes to the monitoring program resulting from transfer of the groundwater monitoring workscope from Pacific Northwest National Laboratory to the Soil and Groundwater Remediation Project.

This document describes the groundwater monitoring plan for LLWMA-4. This monitoring plan addresses the following:

- Number, locations, and depths of wells in the LLWMA-4 groundwater monitoring network
- Sampling and analytical methods for groundwater parameters and hazardous wastes or hazardous waste constituents
- Procedures for evaluating groundwater quality information
- Schedule for groundwater monitoring at the LLWMA

This indicator monitoring plan is the principal controlling document for conducting groundwater monitoring at LLWMA-4.

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Terms

CFR	*Code of Federal Regulations*
DOE	U.S. Department of Energy
DQO	data quality objective
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
LLW	low-level waste
LLWMA	low-level waste management area
OU	operable unit
PFP	Plutonium Finishing Plant
QAPjP	quality assurance project plan
RCRA	*Resource Conservation and Recovery Act of 1976*
RCW	*Revised Code of Washington*
SVOC	semivolatile organic compound
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TOC	total organic carbon
TOX	total organic halides
TPH	total petroleum hydrocarbon
TRU	transuranic
VOC	volatile organic compound
WAC	*Washington Administrative Code*

1 Introduction

Low-Level Waste Management Area (LLWMA) 4 is located in the 200 West Area of the Hanford Site (Figure 1-1). The LLWMA-4 consists of the 218-W-4B and the 218-W-4C Burial Grounds, which contain 28 unlined trenches that were used for waste disposal. The 218-W-4B Burial Ground also contains 12 below-grade caissons at the southern end of the facility. The LLWMA-4 was used for disposal of low-level radioactive and low-level mixed wastes beginning in 1967. The caissons in the 218-W-4B Burial Ground contain remote-handled, low-level waste (LLW) and retrievable transuranic (TRU) waste. The dangerous chemicals in the low-level mixed waste portions of LLWMA-4 are regulated under the *Resource Conservation and Recovery Act of 1976* (RCRA), as modified in 40 *Code of Federal Regulations* (CFR) 265 ("Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities") and *Revised Code of Washington* (RCW) 70.105 ("Public Health and Safety," "Hazardous Waste Management") and its implementing requirements in Washington State's dangerous waste regulations (*Washington Administrative Code* [WAC] 173-303-400, "Dangerous Waste Regulations," "Interim Status Facility Standards").

The objectives for indicator evaluation monitoring, as required by 40 CFR 265.92(d), "Sampling and Analysis," are to determine the following:

- Concentrations of specified groundwater quality parameters annually
- Concentrations of groundwater contamination indicator parameters semiannually
- Annual elevation of the water table

The scope of this plan is to obtain the necessary groundwater data to reach the above objectives. This document replaces the previous groundwater monitoring plan (PNNL-14859, *Interim Status Groundwater Monitoring Plan for Low-Level Waste Management Areas 1 to 4, RCRA Facilities, Hanford, Washington*, as revised in interim change notices PNNL-14859-ICN-1 and PNNL-14859-ICN-2) to include several activities that have occurred at LLWMA-4 since that plan was written. Chapter 2 summarizes background information, with reference to additional documents for more detail. Chapter 2 also describes the LLWMA and the types of waste present, provides a brief history of groundwater monitoring, and describes the geology and hydrology pertinent to LLWMA-4. This information is summarized as a site conceptual model to aid in development of the groundwater monitoring program.

Chapter 3 describes the RCRA groundwater monitoring program, including the wells in the monitoring network, constituents analyzed, sampling frequency, and sampling protocols. Chapter 4 describes data evaluation and reporting, and Chapter 5 contains references. Appendix A provides the quality assurance project plan (QAPjP).

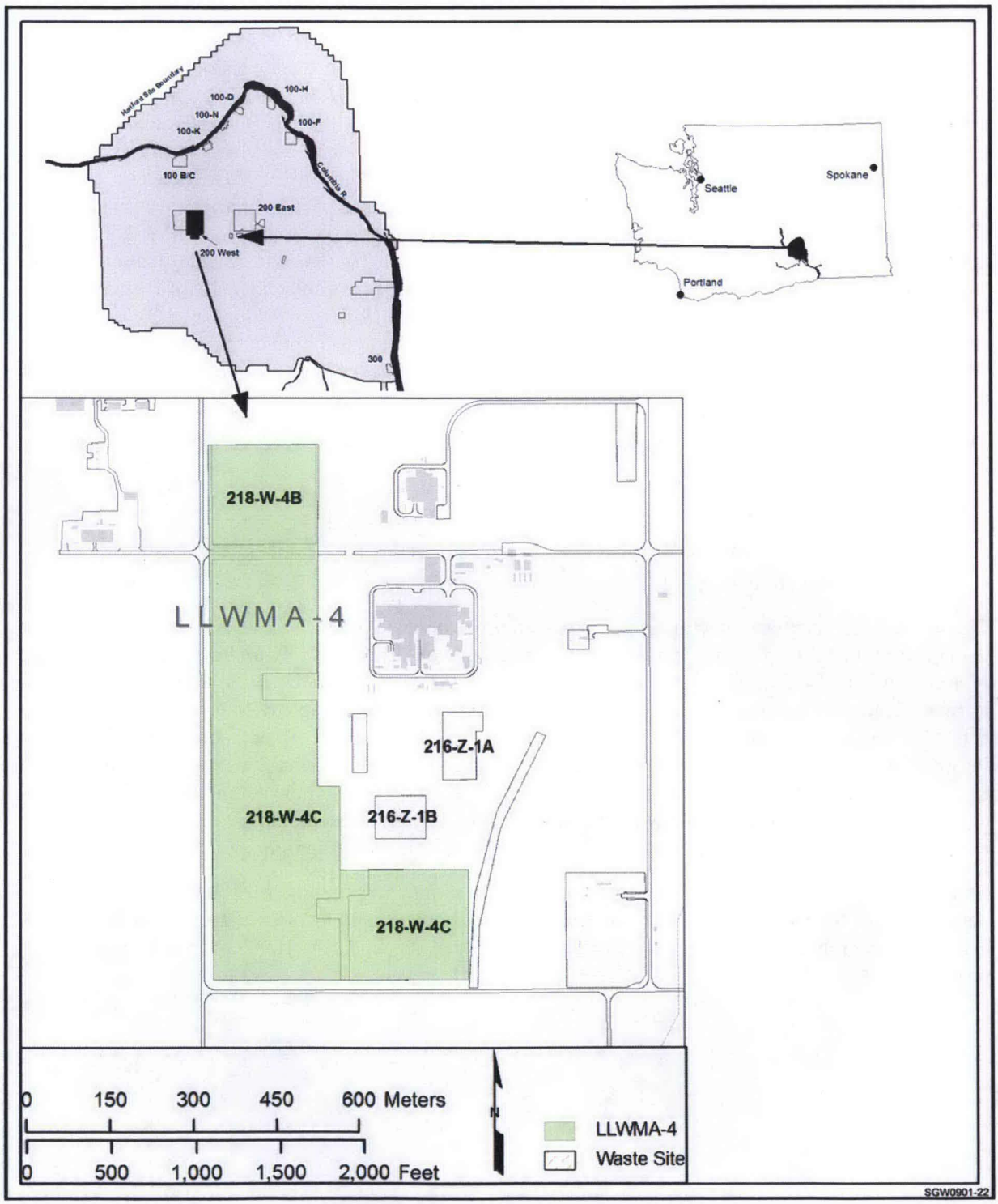

Figure 1-1. Location Map for LLWMA-4

2 Background

This chapter describes the LLWMA-4 facility and operating history, the waste and waste characteristics associated with the LLWMA, the geology and hydrology local to the LLWMA, a summary of previous monitoring, the groundwater and vadose zone contamination at the LLWMA, and a conceptual model for the LLWMA. The discussion in this chapter is summarized from previous documents.

2.1 Facility Description and Operating History

The LLWMA-4 is located in the western portion of 200 West Area, west of the Plutonium Finishing Plant (PFP) and Waste Management Area U. The LLWMA-4 consists of the 218-W-4B and 218-W-4C Burial Grounds.

2.1.1 218-W-4B Burial Ground

The 218-W-4B Burial Ground began receiving waste in 1967. After August 19, 1987, RCRA and state-only designated, mixed LLW was not disposed to the 218-W-4B Burial Ground. The burial ground covers 4 ha (10 ac) and contains TRU and TRU mixed waste, some of which is contained in caissons (DOE/RL-2004-60, *200-SW-1 Nonradioactive Landfills Group Operable Unit and 200-SW-2 Radioactive Landfills Group Operable Unit Remedial Investigation/Feasibility Study Work Plan*).

The 218-W-4B Burial Ground is located in the central portion of the 200 West Area, about 150 m (500 ft) northwest of the 234-5Z Building and directly west of the 231-Z Building. It consists of 14 trenches (one trench contains 12 caissons, of which 4 caissons contain suspect TRU waste). The trenches are approximately 490 m (1,600 ft) long and 3.7 m (12 ft) deep.[1] The burial ground received miscellaneous radioactive waste from the 100, 200, and 300 Areas, as well as offsite waste shipments from 1967 to 1990 (a total of approximately 10,461 m^3 [13,682 yd^3] of waste). Solid waste disposed at the site consisted of rags, paper, cardboard, plastic, pumps, tanks, process equipment, and other miscellaneous high-dose-rate and TRU dry waste. The last waste trench at the 218-W-4B Burial Ground was closed in 1990 (DOE/RL-2004-60).

2.1.2 218-W-4C Burial Ground

The 218-W-4C Burial Ground began receiving waste in 1978. The 218-W-4C Burial Ground contains post-August 19, 1987, RCRA- and state-regulated mixed waste. The burial ground covers approximately 20 ha (50 ac) and contains TRU (some combustible) and test reactor fuel waste. The largest portion of the 218-W-4C Burial Ground is located west and southwest of the PFP, east of Dayton Avenue. A smaller section of the burial ground is located directly south of the PFP and north of 16th Street (DOE/RL-2004-60).

The 281-W-4C Burial Ground is designed to contain up to 65 trenches, including the following:

- Forty-eight trenches run east-west:
  - Twenty-four trenches are 184 m (602 ft) long
  - Nineteen trenches are 220 m (719 ft) long
  - Four trenches are 180 m (594 ft) long
  - One trench is 91 m (300 ft) long

[1] Based on Hanford Site drawing H-2-33055, *Dry Waste Burial Ground 218-W-4B*.

- Seventeen trenches at the 281-W-4C Burial Ground run north-south:
  - Fourteen trenches are 200 m (665 ft) long
  - Three trenches are 155 m (508 ft) long

Only 15 trenches, ranging from 91 to 219 m (300 to 719 ft) long, have been used for waste storage and/or disposal.

The 218-W-4C Burial Ground began accepting packaged waste materials from 200 West Area operations, other Hanford Site areas, and offsite sources in 1974. According to records, the 218-W-4C Burial Ground contains approximately 20,473 m^3 (26,777 yd^3) of LLW, TRU, and mixed waste. The TRU waste has been segregated from other burial ground waste since 1970 and was placed in separate burial trenches and/or areas of burial trenches where the packages are retrievably stored. In 2004, the last open trench at the 218-W-4B Burial Ground was closed (DOE/RL-2004-60).

2.2 Regulatory Basis

In May 1987, the U.S. Department of Energy (DOE) issued a final rule (10 CFR 962, "Byproduct Material"), stating that the hazardous waste components of mixed waste are subject to RCRA regulations. In November 1987, the U.S. Environmental Protection Agency (EPA) authorized the Washington State Department of Ecology (Ecology) to regulate these hazardous waste components within the state of Washington (51 FR 24504, "EPA Clarification of Regulatory Authority Over Radioactive Mixed Waste"). In 1996, the Washington State Attorney General determined that the effective date of mixed waste in Washington State was August 19, 1987.

In May 1989, DOE, EPA, and Ecology signed the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al., 1989). This agreement established the roles and responsibilities of the agencies involved in regulating and controlling remedial restoration of the Hanford Site, which includes LLWMA-4. Groundwater monitoring is conducted at LLWMA-4 in accordance with WAC 173-303-400(3) (and by reference, 40 CFR 265, Subpart F, "Ground-Water Monitoring"), which requires monitoring to determine whether dangerous waste or dangerous waste constituents from the waste site have entered the groundwater. A RCRA groundwater monitoring program for LLWMA-4 was initiated in 1987 (WHC-SD-EN-AP-015, *Revised Ground-Water Monitoring Plan for the 200 Areas Low-Level Burial Grounds*) based on the interim status monitoring requirements of 40 CFR 265, Subpart F and WAC 173-303-400 and continues today.

Groundwater monitoring is conducted at LLWMA-4 in accordance with WAC 173-303-400(3) (and by reference, 40 CFR 265, Subpart F), which requires monitoring to determine whether dangerous waste or dangerous waste constituents from the waste site have entered the groundwater. A RCRA groundwater monitoring program for LLWMA-4 was initiated in 1987 (WHC-SD-EN-AP-015) based on the interim status monitoring requirements of 40 CFR 265, Subpart F and WAC 173-303-400.

Between 1989 and January 2009, groundwater monitoring was conducted under an indicator evaluation monitoring program. In January 2009, a groundwater quality assessment program was initiated at LLWMA-4 (SGW-40211, *First Determination RCRA Groundwater Quality Assessment Plan for the Low-Level Burial Grounds Low-Level Waste Management Area–4*) due to elevated total organic carbon (TOC) in one downgradient well (299-W15-224). In March 2009, groundwater was sampled from wells 299-W15-224, 299-W15-30, and 299-W15-83 and analyzed for coliform bacteria, oil and grease, chemical oxygen demand, total petroleum hydrocarbons (TPHs) (gasoline, diesel, and kerosene), pesticides, herbicides, dioxins, and polychlorinated biphenyls, as well as the 40 CFR 264, Appendix IX ("Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities,"

"Ground-Water Monitoring List") list of volatile organic analyses and semivolatile organic analyses. In July 2009, the results of the March sampling did not find dangerous waste in the groundwater at LLWMA-4, and monitoring at the LLWMA returned to indicator evaluation monitoring.

2.3 Waste Characteristics

The waste characteristics for the 218-W-4B and 218-W-4C Burial Grounds are discussed below.

2.3.1 218-W-4B Burial Ground

The 218-W-4B Burial Ground received shipments described as miscellaneous, solid, radioactive mixed waste from several sources on the Hanford Site, including the 100-C, 100-N, 200 West, and 300 Areas. The waste disposed in the burial ground included rags, paper, rubber gloves, disposable supplies, and broken tools. The 12 caissons at the south end of the facility contain remote-handled, retrievable TRU and alpha LLW. Two trenches are also filled with retrievable TRU and TRU mixed waste. The 218-W-4B Burial Ground did not receive any post-August 19, 1987, RCRA- and state-only designated mixed LLW.

2.3.2 218-W-4C Burial Ground

The 218-W-4C Burial Ground started receiving waste in 1978. The burial ground covers approximately 23 ha (57 ac) and contains TRU (some combustible) and test reactor fuel waste (DOE REG-0271, *Low-Level Burial Grounds Fact Sheet*).

The 218-W-4C Burial Ground began accepting packaged waste materials from 200 West Area operations, other Hanford Site areas, and offsite sources in 1974 (based on information from the Waste Information Data System database). According to burial records, the 218-W-4C Burial Ground contained approximately 21,916 m^3 (28,665 yd^3) of LLW, TRU, and mixed waste. The TRU waste has been segregated from other landfill waste since 1970 and placed in separate burial trenches and/or areas of burial trenches, where the packages were retrievably stored.

Trenches 1, 4, 7, 20, and 29, and the east end of Trench 24, contained retrievably stored suspect TRU waste. Trenches NC, 14, 19, 23, 28, 33, 48, 53, and 58 and the remainder of Trench 24 received buried LLW. In addition, some of the waste in Trenches NC, 14, and 58 is currently identified as mixed LLW and was disposed after the effective date of mixed waste regulation at the Hanford Site (August 19, 1987).

The northernmost trench (Trench NC) contains a number of core barrels originating from the U.S. Department of the Navy. Trench 1 contains drums generated from mining the 216-Z-9 Crib/Trench and approximately 500 cans of ash received in the early 1980s. The ash was generated by the 232-Z Waste Incinerator Facility, which incinerated miscellaneous waste (e.g. rubber gloves, rags, paper, spent solvent, and cutting oils).

Trench 7 is at the location of a former waste site. The Z Plant Burning Pit was a disposal site for combustible nonradioactive construction, office, and nonhazardous laboratory waste, including unnamed chemicals. The burning pit is reported to have received 2,000 m^3 (2,600 yd^3) of waste for burning, including less than 1,000 m^3 (1,300 yd^3) of laboratory chemicals. The burning pit was 15 m (50 ft) long, 12 m (40 ft) wide, and 3 m (10 ft) deep, and it was used from 1950 to 1960.

The waste in the 218-W-4C Burial Ground is mainly from the 200 West Area (24 percent by volume), the 100 Area (12 percent), the 300 Area (9 percent), and offsite generators (47 percent). The remaining 8 percent is from miscellaneous Hanford Site areas and the tank farms. The eastern annex portion of this unit never received waste (DOE/RL-2004-60).

2.4 Geology and Hydrogeology

The geology and hydrology of the 200 West Area, including the area of LLWMA-4, has been described in detail in the following documents:

- PNL-6820, *Hydrogeology of the 200 Areas Low-Level Burial Grounds – An Interim Report*
- PNNL-13858, *Revised Hydrogeology for the Suprabasalt Aquifer System, 200-West Area and Vicinity, Hanford Site, Washington*
- PNNL-16887, *Geologic Descriptions for the Solid Waste Low-Level Burial Grounds*
- WHC-SD-EN-AP-015, *Revised Ground-Water Monitoring Plan for the 200 Areas Low-Level Burial Grounds*
- WHC-SD-EN-TI-290, *Geologic Setting of the Low-Level Burial Grounds*

The following discussion summarizes descriptions from these documents. The uppermost aquifer and aquifers hydraulically interconnected beneath the LLWMA are also discussed.

The LLWMA-4 is underlain from the ground surface to the top of the basalt by the Hanford formation, the Cold Creek unit, and the Ringold Formation. The vadose zone beneath LLWMA-4 is approximately 68 to 76 m (223 to 249 ft) thick and consists of the Hanford formation, the Cold Creek unit, the Taylor Flats member of the Ringold Formation, and the upper portion of Unit E of the Wooded Island member of the Ringold Formation. The water table is at approximately 136 to 137 m (446 to 449 ft) in elevation and is entirely within the Ringold Unit E. The Ringold lower mud unit is present everywhere beneath the LLWMA-4 and forms the bottom of the unconfined aquifer. The saturated thickness of the unconfined aquifer is approximately 69 m (226 ft) in the south (at well 299-W18-22) and 59 m (194 ft) in the north (at well 299-W15-17). The thickness of the aquifer, as well as the groundwater flow direction and flow rate, are influenced by the 200-ZP-1 Operable Unit (OU) pump-and-treat system injection wells to the west of the LLWMA and the extraction wells located northeast of the LLWMA.

Water levels in the unconfined aquifer increased as much as approximately 25 m (82 ft) above the pre-Hanford natural water table in the area of U Pond (about 325 m [1,066 ft] south of LLWMA-4) due to artificial recharge from liquid waste disposal operations active between the mid-1940s and 1995. The height of the water table mound beneath LLWMA-4 was at least 18 m (59 ft) above the pre-Hanford elevation, as indicated by water levels from well 699-39-79 (located just west of the LLWMA).

Discharges to U Pond and other disposal facilities from the 1940s through the 1970s changed the groundwater flow direction beneath the LLWMA from eastward (the pre-Hanford direction) to a north or northwest direction. The groundwater flow direction has more recently returned to the pre-Hanford eastward direction, which can be attributed to (1) the groundwater mound beneath U Pond dissipating as a result of cessation of discharges to U Pond, (2) the influence of the 200-ZP-1 OU pump-and-treat system extraction wells east of LLWMA-4, and (3) the injection wells west of the LLWMA reinforcing eastward movement of groundwater in the area.

The hydraulic conductivity in the unconfined aquifer beneath LLWMA-4 is on the order of 2.5 to 10 m/day (8.2 to 32.8 ft/day), and the hydraulic gradient is approximately 0.004. Using these values and assuming an average effective porosity of aquifer materials between 0.1 and 0.3, the groundwater flow rate is calculated at 0.05 to 0.2 m/day (0.16 to 0.66 ft/day). Figure 2-1 provides a current water table map for LLWMA-4.

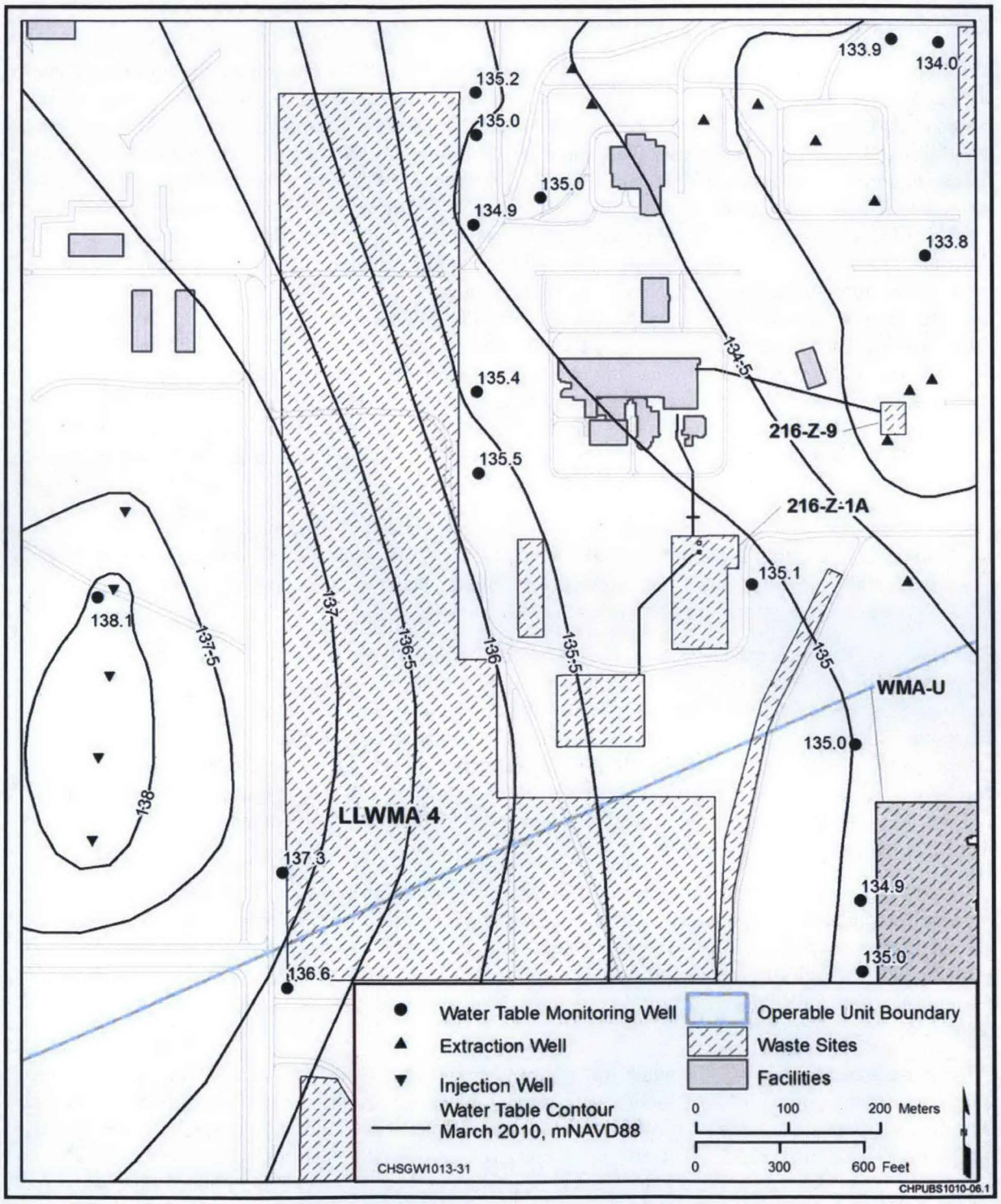

Figure 2-1. Water Table Map for LLWMA-4, March 2010

2.5 Summary of Previous Groundwater Monitoring

Monitoring wells were installed at LLWMA-4 between 1987 and 1992. The original monitoring network included 17 wells. One well, 299-W18-29, was completed in a perched aquifer but went dry soon after it was drilled. Sampling at LLWMA-4 was suspended for a period of time during fiscal years 1990 and 1991. Groundwater flow was toward the west at the beginning of RCRA monitoring, but the hydraulic gradient altered dramatically with termination of discharges to U Pond and other facilities. The initiation of the 200-ZP-1 OU pump-and-treat groundwater remediation also impacted groundwater flow and quality at LLWMA-4. The monitoring network was updated in 1998 to redefine the upgradient and downgradient wells. Four shallow wells were chosen to monitor upgradient conditions, and three shallow wells were chosen to monitor downgradient of the burial ground. In addition, one deep upgradient well and one shallow upgradient well remained in the monitoring network. Since that time, three additional upgradient wells have gone dry (299-W15-15, 299-W18-21, and 299-W18-23). After the monitoring network was updated in 1998 to reflect the changing flow directions, newly designated downgradient well 299-W15-16 exceeded the statistical comparison value for total organic halides (TOX). The exceedance was attributed to the regional carbon tetrachloride plume that moved into the area under previous flow conditions. This exceedance was first reported to Ecology in August 1999. The TOX values continue to exceed the critical mean value at LLWMA-4.

The LLWMA-4 is affected by regional volatile organic compound (VOC) contamination, and the northern portion is within the capture zone of the 200-ZP-1 OU interim action pump-and-treat system. Carbon tetrachloride is the major contaminant in the plume, but chloroform, trichloroethene, tetrachloroethene, and nitrate are also present.

The TOC concentration exceeded the critical mean of 790 μg/L in well 299-W15-224, with a concentration between 1,090 and 1,300 μg/L in August 2008. This was the first time that the well had exceeded the critical mean for TOC. The well was resampled, and the new results available in November 2008 were 2,100 and 2,200 μg/L, again exceeding the critical mean. A request was then submitted to resample the well and analyze for an extensive list of VOCs, semivolatile organic compounds (SVOCs), and TPHs to identify the cause of elevated TOC. The resampling event occurred in December 2008, and the results received in January 2009 indicted that no organic compounds were identified that would account for the elevated TOC.

In January 2009, the Soil and Groundwater Remediation Project notified DOE and other CH2M HILL Plateau Remediation Company organizations regarding the elevated TOC concentration at LLWMA-4, and DOE then notified Ecology. The project also prepared a groundwater quality assessment plan to evaluate the elevated TOC, which proposed sampling wells 299-W15-224, 299-W15-30, and 299-W15-83 for analysis of 40 CFR 264, Appendix IX organic constituents and other constituents potentially responsible for elevated TOC.

Prior to assessment sampling, the pump was removed from well 299-W15-224 and a camera survey was completed to determine if any anomalies were present in the well. Nothing out of the ordinary was noted during the camera survey, the pump was replaced, and samples were collected on March 15 and 16, 2009. The samples were analyzed for 40 CFR 264, Appendix IX list of VOC and SVOC compounds, TOX, chemical oxygen demand, oil and grease, phenols, pesticides, herbicides, polychlorinated biphenyls, dioxans, dissolved oxygen, TPH (diesel, gasoline, and kerosene), and coliform bacteria. In July 2009, the results of the first determination did not find dangerous waste in the groundwater at LLWMA-4, and monitoring at the LLWMA returned to indicator evaluation monitoring.

2.6 Conceptual Model

This section describes the LLWMA-4 conceptual model for potential contaminant transport to guide future groundwater monitoring. The conceptual model for contaminant release and transport is based on the following assumptions:

- Engineered barriers are not taken into account, so the model is applicable to unlined trenches but is highly conservative for the newest (lined) mixed waste trenches.
- Average precipitation and net infiltration (5 to 10 cm/yr [2 to 3.9 in./yr]) prevail over the timeframe of interest.
- Net infiltration is assumed to occur under gravity drainage.
- Maximum vertical hydraulic conductivity in the vadose zone is assumed to be significantly larger than the net infiltration rate.
- The effective saturated porosity in the vadose zone is equal to the moisture content.
- Leaching of mobile contaminants from buried waste in unsealed containers, or contaminated soils in direct contact with the trench, are assumed to be the major potential sources for contamination.
- There are no artificial sources of water (e.g., leaking potable or raw water lines) based on Hanford Site drawings.
- Extreme conditions or accidental releases are recognized as factors but would be addressed under emergency response/corrective actions.

2.6.1 Geochemical Considerations

The solubility and subsequent mobility of waste constituents in pore fluid depend on the container, chemical nature of the waste constituents, and natural subsurface geochemical conditions.

Pore fluid in the unsaturated and saturated zones beneath LLWMA-4 is slightly alkaline ($7 < pH < 8$), with appreciable amounts of bicarbonate and very little natural organic material. The lack of organic matter means that conditions are generally oxidizing. Calcium carbonate is also abundant in vadose zone sediment. These general conditions favor sorption or retardation of many heavy metals (e.g., uranium) and favor formation of anionic species, which enhances mobility for other metals (e.g., hexavalent chromium). Laboratory sorption studies have documented these effects and related mobility issues in Hanford Site media (e.g., WHC-EP-0645, *Performance Assessment of the Disposal of Low-Level Waste in the 200 West Area Burial Grounds*; and PNNL-11800, *Composite Analysis for Low-Level Waste Disposal in the 200 Area Plateau of the Hanford Site*).

2.6.2 Soil Moisture Factors

With the exception of waste in sealed metal or concrete containers (e.g., retrievable waste), direct precipitation is the primary driver for hypothetical leaching of waste constituents from the burial trenches and subsequent transport to groundwater. Contaminants in the soil disposed to the trench or waste in degradable containers (e.g., cardboard boxes or wooden boxes) subject to collapse are assumed to be leachable.

The amount of natural infiltration that can pass through the leachable buried waste and drain to the water table is controlled by the texture of the cover and backfill and by the amount of vegetative cover. Stratigraphic features in the soil column beneath the buried waste can also influence or retard downward

migration by spreading soil moisture laterally. Direct observational evidence to assess this effect at LLWMA-4 is lacking. Under the gravity drainage assumption, only a small horizontal gradient component is likely to be available to produce lateral spreading of infiltrating water.

Most of the burial ground trenches are backfilled with natural excavation materials (Hanford formation) consisting of coarse gravel, cobbles, and some interstitial sand. Some amount of vegetation exists on the established backfilled areas and on unused portions of the LLWMA. A coarse, nonvegetated cover material allows a major fraction of the precipitation to infiltrate and potentially drain to groundwater. In "Hanford Site Vadose Zone Studies: An Overview" (Gee et al., 2007), it is estimated that recharge rates at the Hanford Site range from near zero at highly vegetated sites to greater than 50 mm/yr at gravel-covered, nonvegetated sites.

2.6.3 Hydrogeologic Considerations

The vadose zone beneath LLWMA-4 is between 68 and 76 m (223 and 249 ft) thick and consists of (from top to bottom) the Hanford formation, the Cold Creek unit, and the Ringold Formation. The Cold Creek unit is likely to retard downward movement of moisture and contaminants due to the finer textured sediment and cementing that characterize this stratigraphic feature in the vadose zone.

If contaminants do break through to groundwater beneath LLWMA-4, contaminants would move toward the east-northeast. The flow direction has shifted from nearly north to northeast and is slowly changing eastward as the influence of the groundwater mound subsides. Also, because of the low permeability of the aquifer in this area, groundwater flow rate is estimated to be between about 18.3 to 73 m/yr (60.03 to 239.50 ft/yr).

As the 200-ZP-1 OU groundwater pump-and-treat system is expanded to add extraction and injection wells to provide greater capacity, the pump-and-treat system may impact groundwater levels and gradients beneath LLWMA-4. After the system is completed and operating, groundwater-level data will be evaluated. Any hydrologic and hydrogeologic impacts that occur based on the operation of the pump-and-treat system will be reported and incorporated into the monitoring program.

2.7 Data Quality Objectives

To define the required information for groundwater indicator evaluation monitoring, the data quality objective (DQO) process is used to ensure that data gathered are of appropriate quantity and quality to meet specific objectives. The DQO parameters, regulatory interim status requirements, and associated reports supporting the regulatory requirements are outlined in Table 2-1.

Table 2-1. DQOs at RCRA Sites Monitoring for Indicator Parameters

DQO Parameter	Related Requirements	Plan Criteria and Associated Historical Documentation
Scope	RCRA interim status ground-water monitoring at sites where no impact to ground-water has been identified. Related requirements are found in WAC 173-303-400(3) and 40 CFR 265.90 through 40 CFR 265.94, as modified by WAC 173-303-400(3)(b) and WAC 173-303-400(3)(c)(v).	
Number and location of wells Point(s) of compliance	**40 CFR 265.91, Ground-Water Monitoring System.** (a) A ground-water monitoring system must be capable of yielding ground-water samples for analysis and must consist of: (1) Monitoring wells (at least one) installed hydraulically upgradient (i.e., in the direction of increasing static head) from the limit of the waste management area. Their number, locations, and depths must be sufficient to yield ground-water samples that are: (i) Representative of background ground-water quality in the uppermost aquifer near the facility; and (ii) Not affected by the facility; and (2) Monitoring wells (at least three) installed hydraulically downgradient (i.e. in the direction of decreasing static head) at the limit of the waste management area. Their number, locations, and depths must ensure that they immediately detect any statistically significant amounts of dangerous waste or dangerous waste constituents that migrate from the waste management area to the uppermost aquifer.	This plan, Section 3.2 PNNL-14859, *Interim Status Groundwater Monitoring Plan for Low-Level Waste Management Areas 1 to 4, RCRA Facilities, Hanford, Washington* PNNL-14859-ICN-1 PNNL-14859-ICN-2
Well configuration (depth and length of screened interval; well construction)	**40 CFR 265.91, Ground-Water Monitoring System, as modified by WAC 173-303-400.** (c) All monitoring wells must be cased in a manner that maintains the integrity of the monitoring well borehole. This casing must be screened or perforated, and packed with gravel or sand where necessary; to enable sample collection at depths where appropriate aquifer flow zones exist. The annular space (i.e., the space between the borehole and well casing) above the sampling depth must be sealed with a suitable material (e.g., cement grout or bentonite slurry) to prevent contamination of samples and the ground-water. **Additional Requirements from WAC 173-303-400(3)(c)(v)(C).** Ground-water monitoring wells must be designed, constructed, and operated so as to prevent ground-water contamination. WAC 173-160 may be used as guidance in the installation of wells.	This plan, Section 3.2 PNNL-14859, *Interim Status Groundwater Monitoring Plan for Low-Level Waste Management Areas 1 to 4, RCRA Facilities, Hanford, Washington* PNNL-14859-ICN-1 PNNL-14859-ICN-2

Table 2-1. DQOs at RCRA Sites Monitoring for Indicator Parameters

DQO Parameter	Related Requirements	Plan Criteria and Associated Historical Documentation
Frequency of sampling Types of analysis or measurement Method detection limits or accuracy and precision	**40 CFR 265.92 Sampling and Analysis.** (b) The owner or operator must determine the concentration or value of the following parameters in ground-water samples in accordance with paragraphs (c) and (d) of this section: (1) Parameters characterizing the suitability of the ground-water as a drinking water supply, as specified in Appendix III. *[NOTE: Have not listed these because, in accordance with 40 CFR 265.92(c)(1), these analyses are only conducted for the first year, and this site is not in the first year of monitoring.]* (2) Parameters establishing ground-water quality: (i) Chloride (ii) Iron (iii) Manganese (iv) Phenols (v) Sodium (vi) Sulfate *[COMMENT: These parameters are to be used as a basis for comparison in the event a groundwater quality assessment is required under 40 CFR 265.93(d).]* (3) Parameters used as indicators of ground-water contamination: (i) pH (ii) Specific conductance (iii) Total organic carbon (iv) Total organic halogen (c)(1) For all monitoring wells, the owner or operator must establish initial background concentrations or values of all parameters specified in paragraph (b) of this section. The owner or operator must do this quarterly for one year. (c)(2) For each of the indicator parameters specified in paragraph (b)(3) of this section, at least four replicate measurements must be obtained for each sample and the initial background arithmetic mean and variance must be determined by pooling the replicate measurements for the respective parameter concentrations or values in samples obtained from upgradient wells during the first year.	This plan, Section 3.1 and Appendix A PNNL-14859, *Interim Status Groundwater Monitoring Plan for Low-Level Waste Management Areas 1 to 4, RCRA Facilities, Hanford, Washington* PNNL-14859-ICN-1 PNNL-14859-ICN-2

Table 2-1. DQOs at RCRA Sites Monitoring for Indicator Parameters

DQO Parameter	Related Requirements	Plan Criteria and Associated Historical Documentation
	40 CFR 265.92 Sampling and Analysis. (cont'd) (d) After the first year, all monitoring wells must be sampled and the samples analyzed with the following frequencies: (1) Samples collected to establish ground-water quality must be obtained and analyzed for the parameters specified in paragraph (b)(2) of this section at least annually. (2) Samples collected to indicate ground-water contamination must be obtained and analyzed for the parameters specified in paragraph (b)(3) of this section at least semiannually. (e) Elevation of the ground-water surface at each monitoring well must be determined each time a sample is obtained.	
Methods used to evaluate the collected data	**40 CFR 265.93 Preparation, Evaluation, and Response.** (b) For each indicator parameter specified in 40 CFR 265.92(b)(3), the owner or operator must calculate the arithmetic mean and variance, based on at least four replicate measurements on each sample, for each well monitored in accordance with 40 CFR 265.92(d)(2) and compare these results with the initial background arithmetic mean. The comparison must consider individually each of the wells in the monitoring system, and must use the Student's t-test at the 0.01 level of significance (see Appendix IV) to determine statistically significant increases (and decreases, in the case of pH) over initial background.	This plan, Section 4.2 and Appendix A PNNL-14859, *Interim Status Groundwater Monitoring Plan for Low-Level Waste Management Areas 1 to 4, RCRA Facilities, Hanford, Washington* PNNL-14859-ICN-1 PNNL-14859-ICN-2

Notes: The references cited in this table are listed in the reference list (Chapter 5) of this plan.

CFR = *Code of Federal Regulations*

DQO = data quality objective

RCRA = *Resource Conservation and Recovery Act of 1976*

WAC = *Washington Administrative Code*

3 Groundwater Monitoring Program

This chapter lists the wells monitored, constituents analyzed, and sampling frequency. Protocols for sampling and analysis are provided in the QAPjP in Appendix A.

3.1 Constituent List and Sampling Frequency

Table 3-1 lists the constituents to be analyzed for RCRA. All wells are to be sampled semiannually and constituents are monitored semiannually or annually, as indicated in Table 3-1.

Maintenance problems and sampling logistics sometimes delay scheduled sampling events. If a well is delayed more than 3 months, that event will be cancelled, as it would be nearly time for the next scheduled sampling event. Missed sampling events are reported in the annual groundwater report.

3.2 Monitoring Well Network

Figure 3-1 shows the groundwater monitoring well network for LLWMA-4. Table 3-1 lists the wells in the groundwater monitoring network, their constituents, and sampling frequencies. Some of the wells in the LLWMA-4 monitoring network are also sampled for the 200-ZP-1 OU. Sampling for LLWMA-4 and the 200-ZP-1 OU is coordinated to eliminate duplicate analyses and well trips.

Table 3-2 summarizes well construction information and provides the current water table elevation in each well. All of the wells in the LLWMA-4 monitoring network are constructed to meet the requirements of WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells." These wells have stainless-steel casing and screen, sand pack in the screened interval, and full annular seal above.

There are currently no upgradient wells at LLWMA-4, as all have either gone dry or groundwater flow direction has changed due to the influence of injections wells west of the LLWMA. Four new downgradient wells were drilled in 2005 and 2006. Several alternatives are currently being considered regarding upgradient well compliance issues:

- **Deepen existing wells upgradient of LLWMA-4:** Four dry monitoring wells that have not yet been decommissioned are located along the western (upgradient) edge of LLWMA-4 and are candidates for deepening. The March 2009 depth to water is between approximately 77 m (252 ft) below ground surface at well 299-W15-15 and 68 m (223 ft) below ground surface at well 299-W18-21 prior to the wells going dry. Thus, the dry wells located west of LLWMA-4 would need to be deepened as much as 7.6 m (25 ft) from original drilled depth to have about 6.1 m (20 ft) of water in the new screened interval.

- **Identify one existing useable well upgradient:** Only well 699-39-79 is a potential candidate for use as an upgradient well. The well is an old, perforated, carbon-steel well that is currently used for water-level measurements. There is no documentation regarding the surface casing, surface seals, or annual seals; therefore, the well is not WAC 173-160-compliant but it might be usable as a monitoring well after further evaluation and extensive well maintenance.

Table 3-1. Sampling Schedule for LLWMA-4

Well Name	Purpose	WAC Compliant	RCRA Required Constituents[a]											Supporting Constituents[b]			
				Contamination Indicator Parameters				Groundwater Quality Parameters									
								Anions[d]		Metals (Filtered and Unfiltered)[d]							
			Water Level[c]	pH[c]	Specific Conductance[c]	TOC	TOX	Chloride	Sulfate	Sodium	Iron	Manganese	Phenols[d]	Temperature[c]	Turbidity[c]	Dissolved Oxygen[c]	Alkalinity
299-W15-17	Downgradient (deep)	Y	S	S	S	S	S	A	A	A	A	A	A`	S	S	S	S
299-W15-30	Downgradient	Y	S	S4	S4	S4	S4	A	A	A	A	A	A	S	S	S	S
299-W15-83	Downgradient	Y	S	S4	S4	S4	S4	A	A	A	A	A	A	S	S	S	S
299-W15-94	Downgradient	Y	S	S4	S4	S4	S4	A	A	A	A	A	A	S	S	S	S
299-W15-152	Downgradient	Y	S	S4	S4	S4	S4	A	A	A	A	A	A	S	S	S	S
299-W15-224	Downgradient	Y	S	S4	S4	S4	S4	A	A	A	A	A	A	S	S	S	S
299-W18-22	Upgradient (deep)	Y	S	S	S	S	S	A	A	A	A	A	A	S	S	S	S

a. Constituents and parameters required by 40 CFR 265.92, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Sampling and Analysis."

b. Constituents are not required by RCRA but are needed to support interpretation.

c. Field measurement.

d. For anions, analytes include, but are not limited to, chloride, fluoride, nitrate, nitrite, and sulfate. For metals, analytes include, but are not limited to, calcium, chromium, iron, magnesium, manganese, potassium, and sodium.

Table 3-1. Sampling Schedule for LLWMA-4

Well Name	Purpose	WAC Compliant	RCRA Required Constituents[a]											Supporting Constituents[b]			
				Contamination Indicator Parameters				Groundwater Quality Parameters									
								Anions[d]		Metals (Filtered and Unfiltered)[d]							
			Water Level[c]	pH[c]	Specific Conductance[c]	TOC	TOX	Chloride	Sulfate	Sodium	Iron	Manganese	Phenols[d]	Temperature[c]	Turbidity[c]	Dissolved Oxygen[c]	Alkalinity

A = sampled annually
CFR = *Code of Federal Regulations*
LLWMA = low-level waste management area
RCRA = *Resource Conservation and Recovery Act of 1976*
S = sampled semiannually
S4 = sampled semiannually, with quadruplicate samples taken
TOC = total organic carbon
TOX = total organic halides
WAC = *Washington Administrative Code*
Y = well is constructed to the resource protection well standards of WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"

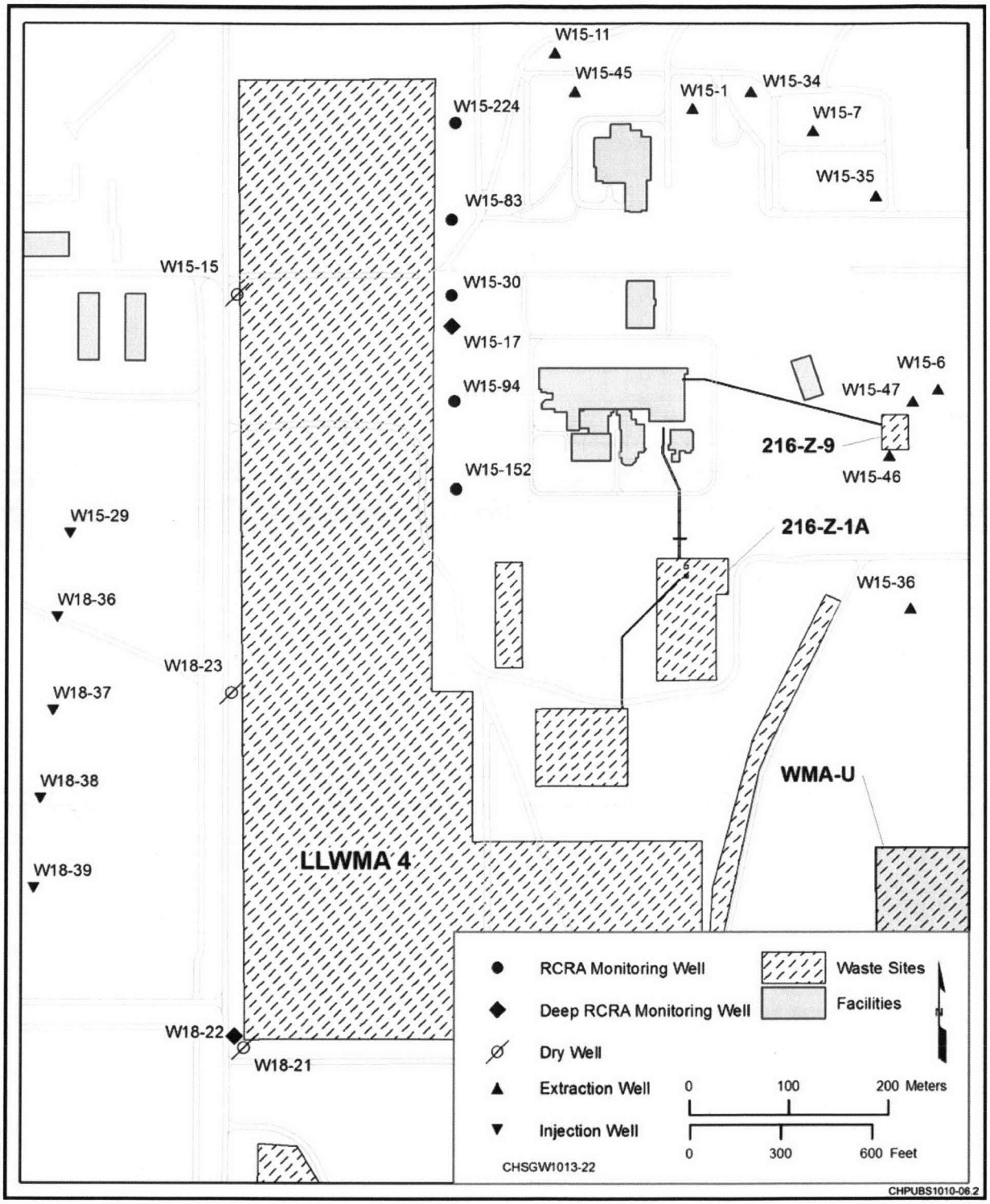

Figure 3-1. Groundwater Monitoring Network for LLWMA-4

Table 3-2. Attributes for Wells in LLWMA-4 Groundwater Monitoring Network

Well Name	Completion Date	Easting (m)	Northing (m)	Top of Casing Elevation (m NAVD88)	Water Table Elevation (m amsl)*	Open Interval Top (m amsl)	Open Interval Bottom (m amsl)	Water Remaining (m)
299-W15-17	October 1987	566306.891	135718.958	209.78	135.57	80.98	77.98	57.59
299-W15-30	May 1995	588304.617	135748.936	210.13	135.57	143.668	131.49	4.08
299-W15-83	September 2005	566304.52	135826.24	209.32	135.32	137.69	127.02	8.30
299-W15-94	September 2005	566307.58	135640.34	209.86	135.62	137.90	126.23	8.39
299-W15-152	September 2005	566309.40	135550.00	209.87	135.72	137.93	126.26	8.46
299-W15-224	April 2006	566307.89	135926.08	209.19	135.29	137.41	126.74	8.55
299-W18-22	September 1987	566088.632	134990.157	204.86	136.56	77.91	68.46	68.10

* March 2009 water levels.

amsl = above mean sea level

NAVD88 = North American Vertical Datum of 1988

- **Alternative statistics that do not require upgradient wells:** The RCRA allows application of intrawell statistical methods for analysis of groundwater monitoring data at permitted facilities. These methods, allowable in accordance with WAC 173-303-645(8) ("Releases from Regulated Units"), include the use of a tolerance or prediction interval procedure (in WAC 173-303-645[8][h][ii])) and a control-chart approach (in WAC 173-303-645[8][h][iv]). These approaches may be applied without use of upgradient wells because each new analytical result from a downgradient well is compared to previously obtained results from the same well. For groundwater applications, procedures for both methods are discussed in EPA guidance (EPA/530-R-93-003, *Statistical Training Course for Ground-Water Monitoring Data Analysis*; EPA 530/R-09-007, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance*) and in *Guide for Developing Appropriate Statistical Approaches for Ground-Water Detection Monitoring Programs* (ASTM D6312-98).

- **Temporary use of a new expanded 200 West Area pump-and-treat injection well:** New injection well IW-6 is currently planned to be located on the west (downgradient) side of LLWMA-4. It may be feasible that when the well is drilled, it could be used as an upgradient monitoring wells until such time that it is needed for an injection well. The well is not scheduled to be drilled until 2012, but it may be possible to move installation for well IW-6 to an earlier date. New injection well IW-7 is currently planned to be located on the east side (downgradient) of LLWMA-4, and this well is also scheduled for installation in 2012. Results of future modeling for the pump-and-treat system may result in moving well IW-7 further west, along the upgradient side of LLWMA-4.

3.3 Sampling and Analysis Protocol

Groundwater monitoring activities at LLWMA-4 follow the conventions of the project and are described in Chapter 4 and Appendix A.

3.4 Differences Between This Plan and Previous Plan

There are several differences between the wells and analytes monitored by this plan and the wells and analytes measured by the previous plan (PNNL-14859-ICN-2), including the following:

- Three wells that recently went dry (299-W15-15, 299-W18-21, and 299-W18-23) have been dropped from the network described in the previous plan.

- Two analytes, mercury and lead, have been dropped from the LLWMA-4 analyte list. Twenty years of monitoring for these constituents has shown that neither is a problem at the LLWMA.

- The sampling frequency for supporting parameters has been changed from semiannual to annual, which is still in compliance with 40 CFR 265.92(d)(1).

4 Data Evaluation and Reporting

This chapter discusses data evaluation and reporting for LLWMA-4.

4.1 Data Review

Data review, validation, and verification activities are discussed in the QAPjP (Appendix A).

4.2 Statistical Evaluation

Statistical upgradient and downgradient comparisons are required to test for potential impact to the groundwater at RCRA interim status facilities in accordance with 40 CFR 265.93, "Preparation, Evaluation, and Response." For each of the four indicator parameters, the owner or operator must calculate the arithmetic mean and variance based on at least four replicate measurements on each sample for each well monitored, and compare these results with the initial background arithmetic mean. The comparison must consider each of the individual wells in the monitoring system and must use the Student's t-test at the 0.01 level of significance to determine statistically significant increases (and decreases, in the case of pH) over initial background. Implementation of the statistical test method at the Hanford Site, including at LLWMA-4, is described in further detail in *Hanford Site Groundwater Monitoring: Setting, Sources and Methods* (PNNL-13080); *Statistical Approach on RCRA Groundwater Monitoring Projects at the Hanford Site* (WHC-SA-1124-FP); and EPA 530/R-09-007.

If comparisons for an upgradient well show a significant increase (or pH decrease), the information must be submitted in the Hanford Site annual groundwater report. If the comparisons for a downgradient well show a significant increase (or pH decrease), then the well is resampled and split samples are sent to different laboratories to determine if the exceedance of the comparison value was the result of laboratory error. In addition, the original samples may be re-analyzed if laboratory error is suspected.

If the exceedance of the statistical comparison value is confirmed by resampling, written notice is then provided to the regional administrator within 7 days that the facility may be affecting groundwater quality. Within 15 days after the notification, a groundwater quality assessment program must be developed and submitted. In some instances, it is possible to immediately determine that the statistical finding is not the result of contamination from the facility. In that case, the regional administrator is notified and an assessment program is not instituted.

4.3 Interpretation

After data are validated and verified, acceptable data are used to interpret groundwater conditions at LLWMA-4. Interpretive techniques include the following:

- **Hydrographs:** Graph water levels versus 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 and to estimate flow directions. Groundwater flow is assumed to be perpendicular to lines of equal potential on the maps.
- **Trend plots:** Graph concentrations of constituents versus time to determine increases, decreases, and fluctuations. May be used in tandem with hydrographs and/or water table maps to determine if concentrations are related to changes in water level or in groundwater flow directions.

- **Plume maps:** Map distributions of chemical or radiological constituent concentrations in the aquifer to determine extent of contamination. Changes in plume distribution over time assist in determining plume movement and the direction of groundwater flow.
- **Contaminant ratios:** Can sometimes be used to distinguish among different sources of contamination.

4.4 Annual Determination of Monitoring Network

The RCRA groundwater monitoring requirements include an annual evaluation of the groundwater monitoring network to determine if it remains adequate to monitor the LLWMA. The network must include upgradient and downgradient wells in the uppermost aquifer.

The groundwater flow direction beneath LLWMA-4 may change in the future due to increases or decreases in groundwater extraction and injection associated with the 200-ZP-1 OU groundwater pump-and-treat system. The 200-ZP-1 groundwater pump-and-treat system is currently being expanded and is expected to begin operations in late 2011. The expansion has delayed proposing new monitoring well construction until after the anticipated large effects of the expanded pump-and-treat system are measured. Any new RCRA wells needed at LLWMA-4 will be negotiated and prioritized by Ecology, DOE, and EPA and approved in accordance with Tri-Party Agreement Milestone M-24-00.

Water-level measurements will continue to be collected before each sampling event. A more comprehensive set of water-level measurements is made in the 200 West Area in March of each year. The resulting data presented in the annual Hanford Site groundwater monitoring report (e.g., DOE/RL-2010-11, *Hanford Site Groundwater Monitoring and Performance Report for 2009: Volumes 1 & 2*).

4.5 Reporting and Notification

The results of indicator evaluation monitoring are reported annually in accordance with the requirements of 40 CFR 265.94, "Recordkeeping and Reporting." Reporting will be made in the annual Hanford Site groundwater monitoring report (e.g., DOE/RL-2010-11).

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Appendix A

Quality Assurance Project Plan

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Terms

CFR	*Code of Federal Regulations*
DOE	U.S. Department of Energy
DQO	data quality objective
EB	equipment blank
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FTB	full trip blank
FXR	field transfer blank
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Documents*
HEIS	Hanford Environmental Information System
QA	quality assurance
QAPjP	quality assurance project plan
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
RL	U.S. Department of Energy, Richland Operations Office
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TSD	treatment, storage, and disposal
WAC	*Washington Administrative Code*

Quality Assurance Project Plan

The contractor's quality assurance (QA) program describes the contractor's QA structure, requirements, implementation methods, and responsibilities. The contractor's environmental QA program plan provides the requirements for collecting and assessing environmental data in accordance with the following:

- 10 *Code of Federal Regulations* (CFR) 830, Subpart A, "Nuclear Safety Management," "Quality Assurance Requirements"
- DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Documents* (HASQARD)
- EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans*
- U.S. Department of Energy (DOE) O 414.1C, *Quality Assurance*

This quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection including the planning, implementation, and assessment of sampling, field measurements, and laboratory analyses. Sections 6.5 and 7.8 of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al., 1989a), Attachment 2, "Action Plan," require that QA/quality control (QC) and sampling and analysis activities specify the QA requirements for treatment, storage, and disposal (TSD) units. The HASQARD requirements (DOE/RL-96-68) also apply to this work.

The content of this QAPjP is patterned after the QA elements of EPA/240/B-01/003. The QAPjP demonstrates conformance to the Part B requirements of ANSI/ASQ E4, *Quality Systems for Environmental Data and Technology Programs: Requirements with Guidance for Use*. This QAPjP is divided into four sections (designated in EPA/240/B-01/003) that describe the quality requirements and controls applicable to this investigation. This QAPjP is intended to supplement the contractor's environmental QA program plan.

A1 Project Management

This section addresses the basic aspects of project management and will ensure that the project has defined goals, that the participants understand the goals and the approaches used, and that the planned outputs are appropriately documented.

A1.1 Project/Task Organization

The project organization in regard to planning, sampling, analysis, and data assessment is described in the following subsections and is shown in Figure A-1. For each functional primary contractor role, there is a corresponding oversight role within the DOE.

A1.1.1 Regulatory Project Manager

The Washington State Department of Ecology (Ecology) project manager is responsible for oversight of the work being performed under this groundwater monitoring plan. Ecology will work with the DOE Richland Operations Office (RL) to resolve concerns regarding the work as described in this QAPjP. Ecology can request this plan during a regulatory compliance inspection for review.

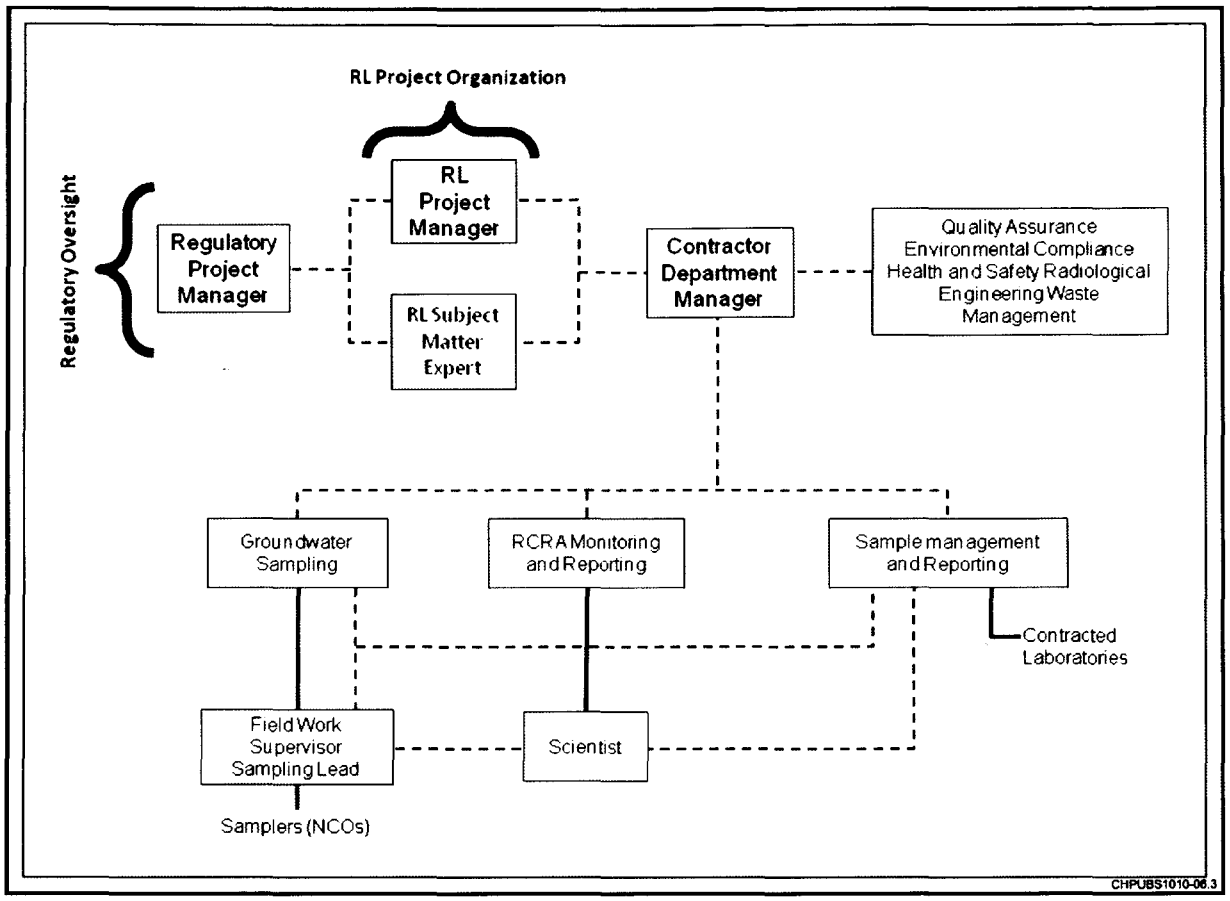

Figure A-1. Project Organization

A1.1.2 U.S. Department of Energy, Richland Operations Office Project Manager

Hanford Site cleanup is the responsibility of RL. The RL project manager is responsible for authorizing the contractor to perform activities under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*; the *Resource Conservation and Recovery Act of 1976* (RCRA); the *Atomic Energy Act of 1954*; and the Tri-Party Agreement for the Hanford Site.

A1.1.3 U.S. Department of Energy, Richland Operations Office Subject Matter Expert

The RL subject matter expert is responsible for day-to-day oversight of the contractor's performance of workscope, for working with the contractor and the regulatory agencies to identify and work through issues, and for providing technical input to the RL project manager.

A1.1.4 Contractor Groundwater Remediation Department Manager

The contractor groundwater remediation department manager provides oversight for all activities and coordinates with DOE, the regulators, and primary contractor management in support of sampling and reporting activities. The remediation department manager also provides support to the RCRA Monitoring and Reporting manager to ensure that work is performed safely and cost effectively.

A1.1.5 Groundwater Sampling Operations

Groundwater sampling operations is responsible for planning and coordinating field sampling resources and provides the field work supervisor for routine groundwater sampling operations. The field work supervisor directs the samplers, who collect groundwater samples in accordance with the sampling and analysis plan, and corresponding standard procedures and work packages. The samplers also complete the field logbook and chain-of-custody forms, including any shipping paperwork, and ensure delivery of the samples to the analytical laboratory.

A1.1.6 RCRA Monitoring and Reporting

The RCRA Monitoring and Reporting manager is responsible for direct management of activities performed to meet RCRA TSD monitoring requirements. The RCRA Monitoring and Reporting manager coordinates with and reports to DOE and primary contractor management regarding RCRA TSD monitoring requirements. The RCRA Monitoring and Reporting manager assigns scientists to provide technical expertise.

A1.1.7 Sample Management and Reporting Organization

The Sample Management and Reporting organization coordinates laboratory analytical work to ensure that laboratories conform to HASQARD requirements (or their equivalent), as approved by DOE, the U.S. Environmental Protection Agency (EPA), and Ecology. Sample Management and Reporting receives analytical data from the laboratories, performs data entry into the Hanford Environmental Information System (HEIS) database, and arranges for data validation. Sample Management and Reporting is responsible for informing the RCRA Monitoring and Reporting manager of any issues reported by the analytical laboratories.

A1.1.8 Contract Laboratories

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

A1.1.9 Quality Assurance

The QA point of contact is matrixed to the subject matter expert and is responsible for QA issues on the project. Responsibilities include overseeing implementation of the project QA requirements; reviewing project documents, including data quality objective (DQO) summary reports, sampling and analysis plans, and the QAPjP; and participating in QA assessments on sample collection and analysis activities, as appropriate. The QA point of contact must be independent of the unit generating the data.

A1.1.10 Environmental Compliance Officer

The environmental compliance officer provides technical oversight, direction, and acceptance of project and subcontracted environmental work, and also develops appropriate mitigation measures with the goal of minimizing adverse environmental impacts.

A1.1.11 Health and Safety

The Health and Safety organization is responsible for coordinating industrial safety and health support within the project as carried out through health and safety plans, job hazard analyses, and other pertinent safety documents required by federal regulations or by internal primary contractor work requirements.

A1.1.12 Waste Management

Waste Management communicates policies and procedures and ensures project compliance for storage, transportation, disposal, and waste tracking in a safe and cost-effective manner.

A1.2 Problem Definition/Background

The problem definition, as required by *Washington Administrative Code* (WAC) 173-303-400 ("Dangerous Waste Regulations," "Interim Status Facility Standards") and 40 CFR 265, Subpart F ("Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Ground-Water Monitoring"), is outlined in the main text discussion of this monitoring plan. The background is also provided in the monitoring plan.

A1.3 Project/Task Description

The project description is provided in Chapters 3 and 4 of this monitoring plan and includes the selection of appropriate dangerous waste or dangerous waste constituents, collection and analyses of groundwater from the monitoring network, interpretation of analytical results, evaluation of the monitoring network, and reporting.

The target analytes, along with the monitoring wells and frequency of sampling, are provided in Chapter 3.

A1.4 Quality Objectives and Criteria

The quality objectives and criteria for groundwater monitoring are defined in this QAPjP in order to meet the evaluation requirements stated in the monitoring plan.

A1.5 Special Training/Certification

Workers receive a level of training that is commensurate with their responsibility of collecting and transporting groundwater samples according to the requirements of WAC 173-303-330, "Personnel Training." The field work supervisor, in coordination with line management, will ensure that all field personnel meet training requirements.

A1.6 Documents and Records

The project scientist is responsible for ensuring that the current version of the groundwater monitoring plan is used and for providing any updates to field personnel. Version control is maintained by the administrative document control process. Significant changes to the plan that affect DQOs will be reviewed and approved by DOE and the regulatory agency prior to implementation. Table A-1 defines the types of changes that may be made to the sampling design and the documentation requirements.

Logbooks and data forms are required for field activities. The logbook must be identified with a unique project name and number. Individuals responsible for the logbooks shall be identified in the front of the logbook, and only authorized individuals may make entries into the logbooks. Logbooks will be controlled in accordance with internal work requirements and processes.

The HEIS database will be identified as a data repository for the Hanford Facility Operating Record unit file. Records may be stored in either electronic or hardcopy format. Documentation and records, regardless of medium or format, are controlled in accordance with internal work requirements and processes that ensure accuracy and retrievability of stored records. Records required by the Tri-Party Agreement will be managed in accordance with the requirements therein.

Table A-1. Actions and Documentation for Regulatory Notification

Type of Change	Action	Documentation
Temporary addition of wells or constituents, or increased sampling frequency	RCRA Monitoring and Reporting manager approval; notify regulatory agency, if appropriate	Project's schedule tracking system
Unintentional impact to groundwater monitoring plan including one-time missed well sampling due to operational constraints, delayed sample collection, broken pump, lost bottle set, missed sampling of indicator parameters, loss of samples in transit, etc.	Electronic notification	RCRA annual report
Planned change to groundwater monitoring activities, including addition or deletion of constituents or wells, change of sampling frequency, etc.	Revise monitoring plan	Revised RCRA groundwater monitoring plan
Anticipated unavoidable changes (e.g., dry wells)	Electronic notification; revise monitoring plan	RCRA annual report and revised groundwater monitoring plan

RCRA = *Resource Conservation and Recovery Act of 1976*

The results of groundwater monitoring are reported annually in accordance with the requirements of 40 CFR 265.94, "Recordkeeping and Reporting." Reporting will be made in annual Hanford Site groundwater monitoring reports (e.g., DOE/RL-2010-11, *Hanford Site Groundwater Monitoring and Performance Report for 2009: Volumes 1 & 2*).

A2 Data Generation and Acquisition

This section addresses data generation and acquisition to ensure that the project's methods for sampling, measurement and analysis, data collection or generation, data handling, and QC activities are appropriate and documented.

A2.1 Sampling Process Design (Experimental Design)

The sampling design is based on regulatory requirements and judgmental sampling.

A2.1.1 Regulatory Requirements

The groundwater protection regulations of WAC 173-303-400 dictate the groundwater sampling and analysis requirements applicable to interim status TSD units.

A2.1.2 Judgmental Sampling

The selection of sampling and analysis requirements is based on knowledge of the feature or condition under investigation and is also based on professional judgment. The TSD monitoring is based on professional judgment. Conclusions depend on the validity and accuracy of professional judgment.

A2.2 Sampling Methods

Sampling is described in the contractor's environmental QA program plan, including the following:

- Field sampling methods
- Sample preservation, containers, and holding times
- Corrective actions for sampling activities
- Decontamination of sampling equipment

The groundwater sampling operations supervisor must ensure that situations that may impair the usability of samples and/or data are documented in the field logbook or on nonconformance report forms in accordance with internal corrective action procedures, as appropriate. The groundwater sampling operations supervisor will note any deviations that occur from the standard procedures for sample collection, contaminants of potential concern, sample transport, or monitoring. The groundwater sampling operations supervisor is also responsible for coordinating all activities related to the use of field monitoring equipment (e.g., dosimeters and industrial hygiene equipment). Field personnel will document in the logbook all noncompliant measurements taken during field sampling. Ultimately, the groundwater sampling operations supervisor is responsible for developing, implementing, and communicating corrective action procedures; for documenting all deviations from procedure; and for ensuring that immediate corrective actions are applied to field activities. Problems with sample collection, custody, or data acquisition that adversely impact data quality or impair the ability to acquire data or failure to follow procedure will be documented in accordance with internal corrective action procedures, as appropriate.

A2.3 Sample Handling and Custody

A sampling and data tracking database is used to track samples from the point of collection through the laboratory analysis process. Laboratory analytical results are entered and maintained in the HEIS database. Each sample is identified and labeled with a unique HEIS sample number. The contractor's environmental QA program plan specifies sample handling information, including the following:

- Container requirements
- Container labeling and tracking process
- Sample custody requirements
- Shipping and transportation

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

A2.4 Analytical Methods

Information on analytical methods is provided in Tables A-2 and A-3. These analytical methods are controlled in accordance with the laboratory's QA plan and the requirements of this QAPjP. The primary contractor participates in oversight of offsite analytical laboratories to qualify the laboratories for performing Hanford Site analytical work.

Table A-2. Preservation Techniques, Analytical Methods Used, and Current Method Quantitation Limits for Continuing Constituents

Constituent	Collection and Preservation[a]	Analysis Methods[b]	Method Quantitation Limit (µg/L)[c]
Contamination Indicator Parameters			
Total organic carbon	G, HCl to pH <2	SW-846 Method 9060	1,000
Total organic halides	G, H_2SO_4 to pH <2, no headspace	SW-846 Method 9020	20
Metals Analyzed by Inductively Coupled Plasma Method – Unfiltered/Filtered			
Calcium	P, HNO_3 to pH <2	SW-846[d] Method 6010B/C, SW-846 Method 6020, or EPA/600 Method 200.8	1,000
Chromium			10
Sodium			500
Manganese			5
Potassium			4,000
Iron			50
Magnesium			750
Anions by Ion Chromatography			
Fluoride	P, none	EPA/600 Method 300.0[e]	500
Nitrate			250
Sulfate			500
Chloride			200
Nitrite			250
Other			
Temperature	Field measurement	Instrument/meter	--
Conductivity, field	N/A	Instrument/meter	1 µohm
pH, field measurement	N/A	Instrument/meter	0.1

a. Samples will be collected in plastic (P) or glass (G) containers and will be cooled to 4°C upon collection.

b. Constituents grouped together are analyzed by the same method, unless otherwise indicated.

c. Detection limit units, except where indicated.

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

e. SW-846 Method 6010 is the preferred method; however, Method 6020 or EPA/600 Method 200.8 may be used, as long as the method quantitation limit listed is met.

EPA = U.S. Environmental Protection Agency

N/A = not applicable

Table A-3. Preservation Techniques, Analytical Methods Used, and Current Method Quantitation Limits for Supporting Constituents

Constituent	Collection and Preservation[a]	Analysis Methods[b]	Method Quantitation Limit (µg/L)[c]
Volatiles by Gas Chromatography/Mass Spectrometry			
1,1-Dichloroethane	G, no headspace	SW-846 Method 8260B	10
1,1-Dichloroethylene			10
1,1,1-Trichloroethane			5
1,1,2,2-Tetrachloroethane			5
1,1,2-Trichloroethane			5
1,2-Dibromoethane			5
1,2-Dichloroethane			5
1,2-Dichloropropane			5
1,2,4-Trichlorobenzene			10
1,4-Dichlorobenzene			5
1,4-Dioxane			500
2-Butanone			10
2-Hexanone			20
2-Propanone			20
3-Chloropropene			10
4-Methyl-2-petanone			10
Acetonitrile			100
Acrolein			100
Acrylonitrile			100
Benzene			5
Bromomethane			10
Carbon disulfide			5
Carbon tetrachloride			5
Chlorobenzene			5
Chloroethene			10
Chloroform			5
Chloromethane			10
cis-1,3-Dichloropropene			5

Table A-3. Preservation Techniques, Analytical Methods Used, and Current Method Quantitation Limits for Supporting Constituents

Constituent	Collection and Preservation[a]	Analysis Methods[b]	Method Quantitation Limit (µg/L)[c]
Dichlorodifluoromethane			10
Dichloromethane			5
Ethylbenzene			5
Ethyl cyanide			10
Methacrylonitrile			10
Styrene			5
Tetrachloroethene			5
Toluene			5
Trans-1,3-dichloropropene			5
Trichloroethylene			5
Trichlorofluoromethane			10
Xylene			10
Other Supporting Constituents			
Alkalinity	G/P, none	Standard Method[d] 2320, EPA/600 Method 310.1, EPA/600 Method 310.2	5,000

a. All samples will be collected in plastic (P) or glass (G) containers, and all samples will be cooled to 4°C upon collection.

b. Constituents grouped together are analyzed by the same method, unless otherwise indicated.

c. Detection limit units.

d. Analytical method adapted from Method 300.0, *Test Methods for Determination of Inorganic Anions in Water by Ion Chromatography* (EPA-600/4-84-017).

EPA = U.S. Environmental Protection Agency

Laboratories providing analytical services in support of this QAPjP will report errors to the Sample Management and Reporting project coordinator, who will then initiate a sample disposition record. The error-reporting process is intended to document analytical errors and the resolution of those errors with the project scientist. The corrective action program addresses the following:

- Evaluation of impacts of laboratory QC failures on data quality
- Root-cause analysis of QC failures
- Evaluation of recurring conditions that are adverse to quality
- Trend analysis of quality-affecting problems
- Implementation of a quality improvement process
- Control of nonconforming materials that may affect quality

A2.5 Quality Control

The QC procedures must be followed in the field and laboratory to ensure that reliable data are obtained. Field QC samples will be collected to evaluate the potential for cross-contamination and to provide information pertinent to field variability. Field QC for sampling will require the collection of field replicates (duplicates), trip or field blanks, and equipment blanks. Laboratory QC samples estimate the precision and bias of the analytical data. Field and laboratory QC samples are summarized in Table A-4.

Table A-4. Quality Control Samples

Sample Type	Primary Characteristics Evaluated	Frequency
Field QC		
Full trip blank	Contamination from containers or transportation	1 per 20 well trips
Field transfer blank	Contamination from sampling site	1 each day; volatile organic compounds sampled
Equipment blank	Contamination from non-dedicated equipment	As needed[a]
Replicate/duplicate samples	Reproducibility	1 per 20 well trips
Laboratory QC		
Method blanks	Laboratory contamination	1 per batch
Laboratory duplicates	Laboratory reproducibility	See footnote b
Matrix spikes	Matrix effect and laboratory accuracy	See footnote b
Matrix spike duplicates	Laboratory reproducibility/accuracy	See footnote b
Surrogates	Recovery/yield	See footnote b
Laboratory control samples	Method accuracy	1 per batch

a. For portable Grundfos® (registered trademark of Grundfos Pumps Corporation, Colorado Springs, Colorado) pumps, equipment blanks are collected 1 per 10 well trips. Whenever a new type of non-dedicated equipment is used, an equipment blank shall be collected every time sampling occurs until it can be shown that less frequent collection of equipment blanks is adequate to monitor the decontamination procedure for the non-dedicated equipment.

b. As defined in the laboratory contract or quality assurance plan, and/or analysis procedures.

QC = quality control

A2.5.1 Field Quality Control Samples

Field QC samples will be collected to evaluate the potential for cross-contamination and laboratory performance. The QC samples and the required frequency for collection are described in this section.

Full trip blanks (FTBs) are prepared by the sampling team prior to traveling to the sampling site. The FTB is filled with high-purity reagent water. The bottles are sealed and transported, unopened, to the field in the same storage containers used for samples collected that day. Collected FTBs are analyzed for the same constituents as the samples. The FTBs are used to evaluate potential contamination of the samples due to the sample bottles, preservative, handling, storage, or transportation.

Field transfer blanks (FXRs) are preserved volatile organic analysis sample bottles that are filled at the sample collection site with high-purity reagent water that has been transported to the field. After collection, FXR bottles are sealed and placed in the same storage containers with the samples from the associated sampling event. The FXR samples are analyzed for volatile organic compounds only. The FXRs are used to evaluate potential contamination caused by conditions in the field.

Equipment blanks (EBs) are samples in which high-purity reagent water is passed through the pump or placed in contact with the sampling surfaces of the equipment to collect blank samples identical to the sample set that will be collected. The EB bottles are placed in the same storage containers with the samples from the associated sampling event. The EB samples are analyzed for the same constituents as the samples from the associated sampling event. The EBs are used to evaluate the effectiveness of the cleaning process to ensure that samples are not cross-contaminated from previous sampling events.

For the field blanks (i.e., FTBs, FXRs, and EBs), results above two times the method detection limit are identified as suspected contamination. However, for common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the limit is five times the method detection limit.

Field duplicates, also known as replicates, are two samples that are collected as close as possible to the same time and same location, and they are intended to be identical. Field duplicates are stored and transported together and are analyzed for the same constituents. The field duplicates are used to determine precision for both sampling and laboratory measurements. The results of the field duplicates must have precision within 20 percent, as measured by the relative percent difference. Only field duplicates with at least one result greater than five times the method detection limit or minimum detectable activity are evaluated.

Double-blind samples contain a concentration of analyte known to the supplier but unknown to the analyzing laboratory. The laboratory is not informed that the samples are QC samples. The project submits double-blind samples to assess analytical precision and accuracy.

A2.5.2 Laboratory Quality Control Samples

The laboratory QC samples (e.g., method blanks, laboratory control sample/blank spikes, and matrix spikes) are defined in Chapter 1 of SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*, and will be run at the frequency specified in that reference, unless superseded by agreement.

A2.5.3 Quality Control Requirements

Table A-5 lists the acceptance criteria for QC samples, and Table A-6 lists the acceptable recovery limits for the double-blind standards. These samples are prepared by spiking Hanford Site background well water 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. Investigations shall be conducted for double-blind standards that are outside of acceptance limits. The results from these standards are used to determine the acceptability of the associated parameter data.

Table A-5. Field and Laboratory Quality Control Elements and Acceptance Criteria

Method[a]	QC Element	Acceptance Criteria	Corrective Action
General Chemical Parameters			
Alkalinity Conductivity pH Total organic carbon Total organic halides	MB[b]	<MDL	Flagged with "C"
	LCS	80-120% recovery[c]	Data reviewed[d]
	DUP	≤20% RPD[c]	Data reviewed[d]
	MS[e]	75-125% recovery[c]	Flagged with "N"
	EB, FTB	<2 times MDL	Flagged with "Q"
	Field duplicate	≤20% RPD[f]	Flagged with "Q"
Anions			
Anions by IC	MB	<MDL	Flagged with "C"
	LCS	80-120% recovery[c]	Data reviewed[d]
	DUP	≤20% RPD[c]	Data reviewed[d]
	MS	75-125% recovery[c]	Flagged with "N"
	EB, FTB	<2 times MDL	Flagged with "Q"
	Field duplicate	≤20% RPD[f]	Flagged with "Q"
Metals			
ICP metals ICP/MS metals	MB	<CRDL	Flagged with "C"
	LCS	80-120% recovery[c]	Data reviewed[d]
	MS	75-125% recovery[c]	Flagged with "N"
	MSD	<20% RPD[c]	Data reviewed[d]
	EB, FTB	<2 times MDL	Flagged with "Q"
	Field duplicate	≤20% RPD[f]	Flagged with "Q"
Volatile Organic Compounds			
Volatiles by GC/MS	MB	<MDL	Flagged with "B"
	LCS	Statistically derived[g]	Data reviewed
	MS	Statistically derived[g]	Flagged with "N"
	MSD	Statistically derived[g]	Data reviewed[d]
	SUR	Statistically derived[g]	Data reviewed[d]
	EB, FTB, FXR	<2 times MDL[h]	Flagged with "Q"
	Field duplicate	≤20% RPD[f]	Flagged with "Q"

Table A-5. Field and Laboratory Quality Control Elements and Acceptance Criteria

Method[a]	QC Element	Acceptance Criteria	Corrective Action
Semivolatile Organic Compounds			
Phenols by GC	MB	<2 times MDL	Flagged with "B"
	LCS	Statistically derived[g]	Data reviewed[d]
	MS	Statistically derived[g]	Flagged with "N"
	MSD	Statistically derived[g]	Data reviewed[d]
	SUR	Statistically derived[g]	Data reviewed[d]
	EB, FTB	<2 times MDL[h]	Flagged with "Q"
	Field duplicate	≤20% RPD[f]	Flagged with "Q"

a. Refer to Tables A-2 and A-3 for specific analytical methods.

b. Does not apply to pH.

c. Laboratory-determined, statistically derived control limits may also be used. Such limits are reported with the data.

d. After review, corrective actions are determined on a case-by-case basis. Corrective actions may include a laboratory recheck or flagging the data as suspect ("Y" flag) or rejected ("R" flag).

e. Applies to total organic carbon and total organic halides only.

f. Applies only in cases where one or both results are greater than five times the detection limit.

g. Determined by the laboratory based on historical data. Control limits are reported with the data.

h. For common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the acceptance criteria is less than five times the MDL.

Data flags:

B, C = possible laboratory contamination (analyte was detected in the associated method blank)

N = result may be biased (associated matrix spike result was outside the acceptance limits)

Q = problem with associated field QC sample (blank and/or duplicate results were out of limits)

Abbreviations:

CRDL = contract-required detection limit
DUP = laboratory matrix duplicate
EB = equipment blank
FTB = full trip blank
FXR = field transfer blank
GC = gas chromatography
IC = ion chromatography
ICP = inductively coupled plasma
ICP/MS = inductively coupled plasma/mass spectrometry
LCS = laboratory control sample
MB = method blank
MDA = minimum detectable activity
MDL = method detection limit
MS = matrix spike
MSD = matrix spike duplicate

Table A-5. Field and Laboratory Quality Control Elements and Acceptance Criteria

Method[a]	QC Element	Acceptance Criteria	Corrective Action

QC = quality control
RPD = relative percent difference
SUR = surrogate

Table A-6. Blind-Standard Constituents and Schedule

Constituents	Frequency	Accuracy (%)	Precision (% RSD)*
Carbon tetrachloride	Quarterly	±25%	≤25%
Chloroform	Quarterly	±25%	≤25%
Trichloroethene	Quarterly	±25%	≤25%
Fluoride	Quarterly	±25%	≤25%
Nitrate	Quarterly	±25%	≤25%
Cyanide	Quarterly	±25%	≤25%
Chromium	Annually	±20%	≤20%

* If the results are less than five times the required detection limit, then the criterion is that the difference of the results of the replicates is less than the required detection limit.

RSD = relative standard deviation

Holding time is the elapsed time period between sample collection and analysis. The contractor's environmental QA program plan provides a table with holding times. Exceeding the required 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 SW-846 or *Methods of Chemical Analysis of Water and Wastes* (EPA-600/4-79-020). Data associated with exceeded holding times are flagged with an "H" in the HEIS database. Data that exceed the holding time shall be maintained but potentially may not be used in statistical analyses.

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

Failure of QC will be determined and evaluated during data validation and the data quality assessment process. Data will be qualified, as appropriate.

A2.6 Instrument/Equipment Testing, Inspection, and Maintenance

Measurement and testing equipment used in the field or in the laboratory that directly affects the quality of analytical data will be subject to preventive maintenance measures to minimize measurement system downtime. Laboratories and onsite measurement organizations must maintain and calibrate their equipment. Maintenance requirements (e.g., documentation of routine maintenance) will be included in the individual laboratory and the onsite organization's QA plan or operating procedures, as appropriate. Maintenance of laboratory instruments will be performed in a manner consistent with SW-846, or with auditable HASQARD and contractual requirements. Consumables, supplies, and reagents will be reviewed in accordance with SW-846 requirements and will be appropriate for their use.

A2.7 Instrument/Equipment Calibration and Frequency

Specific field equipment calibration information is provided in the environmental QA program plan. Standards used for calibration will be certified and traceable to nationally recognized performance standards. Analytical laboratory instruments and measuring equipment are calibrated in accordance with the laboratory's QA plan.

A2.8 Inspection/Acceptance of Supplies and Consumables

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

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

A2.9 Non-Direct Measurements

Non-direct measurements include data obtained from sources such as computer databases, programs, literature files, and historical databases. If evaluation includes data from historical sources, whenever possible such data will be validated to the same extent as the data generated as part of this effort. All data used in evaluations will be identified by source.

A2.10 Data Management

The Sample Management and Reporting organization, in coordination with the RCRA Monitoring and Reporting manager, is responsible for ensuring that analytical data are appropriately reviewed, managed, and stored in accordance with applicable programmatic requirements that govern data management procedures. Electronic data access, when appropriate, will be via a database (e.g., HEIS or project-specific database). Where electronic data are not available, hardcopies will be provided in accordance with Section 9.6 of the Tri Party Agreement Action Plan (Ecology et al., 1989b). The HEIS database will be identified as a data repository for the Hanford Facility Operating Record unit file.

All field activities will be recorded in the field logbook.

Laboratory errors are reported to the Sample Management and Reporting organization on a routine basis. For reported laboratory errors, a sample disposition record will be initiated in accordance with contractor procedures. This process is used to document analytical errors and to establish resolution of the errors

with the RCRA Monitoring and Reporting manager. Sample disposition records become a permanent part of the analytical data package for future reference and for records management.

A3 Assessment and Oversight

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

A3.1 Assessments and Response Actions

The contractor management, Regulatory Compliance, Quality, and/or Health and Safety organizations may conduct random surveillances and assessments to verify compliance with the requirements outlined in this QAPjP.

Oversight activities in the analytical laboratories, including corrective action management, are conducted in accordance with the laboratory's QA plan. The primary contractor conducts oversight of offsite analytical laboratories to qualify them for performing Hanford Site analytical work.

A3.2 Reports to Management

Reports to management on data quality issues will be made if and when these issues are identified. Issues reported by the laboratories are communicated to the Sample Management and Reporting organization, which initiates a sample disposition record in accordance with contractor procedures. This process is used to document analytical or sample issues and to establish resolution with the RCRA Monitoring and Reporting manager.

A4 Data Validation and Usability

The elements in this section address the QA activities that occur after the data collection phase of the project is completed. Implementation of these elements determines whether the data conform to the specified criteria, thus satisfying project objectives. These elements are further discussed in the contractor's environmental QA program plan.

A4.1 Data Review, Verification, and Validation

The criteria for verification may include review for completeness (e.g., all samples were analyzed as requested), use of the correct analytical method/procedure, transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight, and correct application of conversion factors. Laboratory personnel may perform data verification.

A4.2 Verification and Validation Methods

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

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

The data validation process provides the requirements and guidance for validating groundwater data that are routinely collected. Validation is a systematic process of reviewing verified data against a set of criteria (provided in Section A2.5) to determine whether the data are acceptable for their intended use.

Results of laboratory and field QC evaluations, double-blind sample results, laboratory performance evaluation samples, and holding-time criteria are considered when determining data usability. Staff review the data to identify whether observed changes reflect changes in groundwater quality or potential data errors, and they may request data reviews of laboratory, field, or water-level data for usability purposes. The laboratory may be asked to check calculations or re-analyze the sample, or the well may be resampled. Results of the data reviews are used to flag the data appropriately in the HEIS database (e.g., "R" for reject, "Y" for suspect, or "G" for good) and/or to add comments.

A4.3 Reconciliation with User Requirements

The data quality assessment process compares completed field sampling activities to those proposed in corresponding sampling documents and provides an evaluation of the resulting data. The purpose of the data evaluation is to determine if quantitative data are of the correct type and are of adequate quality and quantity to meet project DQOs. The RCRA Monitoring and Reporting manager is responsible for determining if data quality assessment is necessary and for ensuring that, if required, one is performed. The results of the data quality assessment will be used in interpreting the data and determining if the objectives of this activity have been met.

A5 References

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