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STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

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May 24, 2017 17-NWP-055

Mr. Doug S. Shoop, Manager
Richland Operations Office
United States Department of Energy
PO Box 550, MSIN: A7-50
Richland, Washington 99352

Mr. Ty Blackford, President and CEO
CH2M HILL Plateau Remediation Company
PO Box 1600, MSIN: H7-30
Richland, Washington 99352

Re: Approval of the Proposed Class 2 Modification 8C.2017.1F to the *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste*, WA7890008967 (Site-wide Permit), Part VI, Postclosure Unit 1, 300 Area Process Trenches (300 APT) and Postclosure Unit 2, 183-H Solar Evaporation Basins (183-H SEB)

T-1-4 - D-3-1

RECEIVED
MAY 24 2017
EDMC

Reference: See page 3

Dear Mr. Shoop and Mr. Blackford:

The Department of Ecology (Ecology) approves your request for a Class 2 Modification 8C.2017.1F to the 300 APT and the 183-H SEB (Reference) in accordance with Washington Administrative Code (WAC) 173-303-830(4)(b)(vi)(A)(I).

With this Class 2 Modification, the Final Status Groundwater Monitoring Plans for the 300 APT and 183-H SEB are being added to the Site-wide Permit.

Ecology received three comments from the United States Department of Energy's public comment period. We reviewed the document comments and issued a Response to Comments document. A minor change was made to each Groundwater Monitoring Plan to address one of the public comments.

The change was made to a table, which addresses "Change Control for Monitoring Plans". The table listed the use of "Temporary addition of wells…". The use of "Temporary addition of wells…" was removed from the table. All monitoring wells must be listed in the Groundwater Monitoring Plan and any changes to the monitoring well network require a permit modification.

The enclosed DVD includes the Response to Comments Ecology Publication 17-05-004 and is available on the Ecology website at
https://fortress.wa.gov/ecy/publications/SummaryPages/1705004.html.

In accordance with WAC 173-303-830(4)(f)(ii), Ecology's decision to grant or deny a Class 2 permit modification request under this section may be appealed under the permit appeal procedures of WAC 173-303-845.

332

Your Right to Appeal:

You have a right to appeal this permit modification to the Pollution Control Hearings Board (PCHB) within 30 days of the date of receipt of this Permit. The appeal process is governed by Chapter 43.21B of the Revised Code of Washington (RCW) and Chapter 371-08 of the WAC. "Date of receipt" is defined in RCW 43.21B.001(2).

To appeal you must do all of the following within 30 days of the date of receipt of this Permit:

- File your appeal and a copy of this Permit with the PCHB (see addresses below). Filing means actual receipt by the PCHB during regular business hours.
- Serve a copy of your appeal and this Permit to Ecology in paper form – by mail or in person (see addresses below). E-mail is not accepted.

You must also comply with other applicable requirements in Chapter 43.21B of the RCW and Chapter 371-08 of the WAC.

1. **To file your appeal with the Pollution Control Hearings Board:**

Mail appeal to:

Pollution Control Hearings Board
PO Box 40903
Olympia, Washington 98504-0903

OR

Deliver your appeal in person to:

Pollution Control Hearings Board
1111 Israel Road, Southwest, Suite 301
Tumwater, Washington 98501

2. **To serve your appeal to the Department of Ecology:**

Mail appeal to:

Department of Ecology
Attn: Appeals Processing Desk
PO Box 47608
Olympia, Washington 98504-7608

OR

Deliver your appeal in person to:

Department of Ecology
Attn: Appeals Processing Desk
300 Desmond Drive, Southeast
Lacey, Washington 98503

3. **Send a copy of your appeal to:**

Debra Alexander, Revision 8C Permit Coordinator
Department of Ecology
Nuclear Waste Program
3100 Port of Benton Boulevard
Richland, Washington 99354

If there are any questions regarding this permit modification, please contact Nina Menard, Environmental Restoration Project Manager, at nina.menard@ecy.wa.gov or (509) 372-7941, Stephanie Schleif, Facility Transition Project Manager, at stephanie.schleif@ecy.wa.gov or (509) 372-7929, or Debra Alexander, Rev 8C Permit Coordinator, at debra.alexander@ecy.wa.gov or (509) 372-7896.

Sincerely,

Suzanne Dahl
Dangerous Waste Permit Manager
Nuclear Waste Program

da/mrb
Enclosure

cc: See page 4

Reference: Letter 17-AMRP-0082, dated January 17, 2017, "Class 2 Modification Request to Revise Groundwater Monitoring Plans for the 183-H Solar Evaporation Basins and 300 Area Process Trenches"

1242457

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Cindy Preston, WSDNR
BNI Correspondence Control
CHPRC Correspondence Control
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Gonzaga University Foley Center Library
Hanford Facility Operation Record
MSA Correspondence Control
PNNL Correspondence Control
Portland State University Library, Government Information
University of Washington Suzzallo Library, Government Publications
USDOE-ORP Correspondence Control
USDOE Public Reading Room, CIC
USDOE-RL Correspondence Control
USEPA Region 10 Correspondence Control
USEPA Region 10 Hanford Field Office Correspondence Control

cc w/enc, DVD, and hard copy:

Administrative Record: Hanford Site-wide Permit
NWP Central File
NWP Library

183-H SOLAR EVAPORATION BASINS
CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have a "**Last Modification Date**" which represents the last date the portion of the unit has been modified. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Last modification to 183-H Solar Evaporation Basins **05/24/2017**

Chapters	Last Modification Date	Modification Number
Unit-Specific Conditions	05/24/2017	8C.2017.1F
1.0 Part A Form	10/1/2008	
2.0 Modified Postclosure Institutional Controls and Periodic Assessments	06/30/2002	
3.0 Groundwater Monitoring	05/24/2017	8C.2017.1F
4.0 Corrective Action Plan	06/30/2002	
5.0 Personnel Training During Post-Closure	06/30/2002	
6.0 Security	02/2004	
7.0 Closure Contact	02/2004	
8.0 Certification of Postclosure	06/30/2002	

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183-H SOLAR EVAPORATION BASINS
PART VI, POST-CLOSURE UNIT 2 UNIT-SPECIFIC CONDITIONS
CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
05/24/2017	8C.2017.1F
08/13/2013	

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PART VI, POST-CLOSURE UNIT 2 UNIT-SPECIFIC CONDITIONS
183-H SOLAR EVAPORATION BASINS

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PART VI, POST-CLOSURE UNIT 2 UNIT-SPECIFIC CONDITIONS
183-H SOLAR EVAPORATION BASINS

The 183-H Solar Evaporation Basins comprise an inactive Treatment, Storage, and Disposal (TSD) unit that is undergoing postclosure activities. This TSD unit was operated as an evaporation treatment unit for dangerous wastes.

VI.2.A COMPLIANCE WITH APPROVED MODIFIED CLOSURE PLAN

The Permittees shall comply with all requirements set forth in Post-Closure Unit 2, including Permit Conditions specified in VI.2.B. All sections, figures, and tables included in these portions are enforceable:

POST-CLSOURE UNIT 2

Chapter 1.0	Part A Form, dated October 1, 2008
Chapter 2.0	Modified Post-Closure Institutional Controls and Periodic Assessments, dated June 30, 2002
Chapter 3.0	Groundwater Monitoring, dated May 24, 2017
Chapter 4.0	Corrective Action Plan, dated June 30, 2002
Chapter 5.0	Personnel Training, dated June 30, 2002
Chapter 6.0	Security, dated February 2004
Chapter 7.0	Closure Contact, dated February 2004
Chapter 8.0	Certification of Post-Closure, dated June 30, 2002

VI.2.B AMENDMENTS TO THE APPROVED POST-CLOSURE PLAN

VI.2.B.1 The Permittee will review the modified closure option in five (5) years (February 28, 2008). The purpose of the review will be to determine if this TSD unit can be clean closed.

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183-H SOLAR EVAPORATION BASINS
CHAPTER 3.0
GROUNDWATER MONITORING

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
05/24/2017	8C.2017.1F

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CHAPTER 3.0
GROUNDWATER MONITORING

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EXECUTIVE SUMMARY

This document presents a revision to the 1997 183-H Solar Evaporation Basins groundwater monitoring plan.[1] This revised monitoring plan is based on the requirements for final status facilities, as identified in the WA7890008967, *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste*[2] (hereafter referred to as the Hanford Facility RCRA Permit), Part II, Condition II.F, which specifies that final status groundwater monitoring programs are subject to the requirements in WAC 173-303-645.[3] Due to the age of the plan, the United States Department of Energy, Richland Operations Office is revising this groundwater monitoring plan to ensure that the plan contains the most current Hanford Site groundwater monitoring information for the post-closure unit group (e.g., changes in the constituents to be monitored, sampling frequency, well network, concentration limits, statistical evaluation, identification of point of compliance wells, and clarification of compliance period). This document will supersede the previous groundwater monitoring plan (PNNL-11573) upon modification of the Hanford Facility RCRA Permit. This corrective action groundwater monitoring plan is the principal controlling document for conducting groundwater monitoring at 183-H Solar Evaporation Basins.

The 183-H Solar Evaporation Basins are a final status, post-closure unit group (Post Closure Unit Group 2) in the 100-HR-1 Source Operable Unit (OU). The 183-H Solar Evaporation Basins are located north of the 105-H Reactor. The 183-H Solar Evaporation Basins are in modified closure with corrective action. The four basins were originally part of the 183-H water treatment facility but were used for evaporation of 300 Area fuel fabrication wastes from 1973 to 1985. In 1996, the basins were demolished and the soil was removed to a depth of 0.6 m (2 ft) below the basin floor, with excavation to 4.6 m (15 ft) below Basin 1. The basin floor depth ranged from 4.7 to 5.0 m (15.5 to 16.5 ft). Groundwater protection was demonstrated through modeling and a modified closure (soil column) was approved in 1997. Clean closure was not approved due to high levels of fluoride and nitrate remaining in the soil 4.6 m (15 ft) below the Basin 1 floor. Groundwater at the site is approximately 13 m (42 ft) below ground surface.

A final status groundwater compliance monitoring program in accordance with WAC 173-303-645 was implemented in 1995 (WHC-SD-EN-AP-180[4]). The plan identified chromium (collected as a filtered sample) and nitrate as dangerous waste constituents and technetium-99 and uranium as waste indicators. Fluoride was monitored as an indicator of 183-H contamination in groundwater. Additional constituents to aid data interpretation (alkalinity, anions, and selected metals) and field parameters (pH, specific conductance, temperature, and turbidity) were also included.

The first samples collected under the compliance monitoring plan exceeded concentration limits for nitrate, chromium, uranium, and technetium-99. As a result, corrective action was required. Groundwater remediation (pump and treat) was undertaken as part of the interim remedial measure (IRM)

---

[1] PNNL-11573, 1997, *Groundwater Monitoring Plan for the 183-H Solar Evaporation Basins*, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D1659822.

[2] WA7890008967, *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste,* Revision 8c, as amended, Washington State Department of Ecology, Richland, Washington. Available at: http://www.ecy.wa.gov/programs/nwp/permitting/hdwp/rev/8c/index.html.

[3] WAC 173-303-645, "Releases from Regulated Units," *Washington Administrative Code*, Olympia, Washington. Available at: http://app.leg.wa.gov/WAC/default.aspx?cite=173-303-645.

[4] WHC-SD-EN-AP-180, 1995, *Groundwater Monitoring Plan for the 183-H Solar Evaporation Basins*, Rev. 0, Westinghouse Hanford Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D196050052.

and, therefore, the corrective action for the 183-H Solar Evaporation Basins was deferred to the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA)[5] program (Soper, 1997[6]). The IRM commenced in 1997 and is ongoing at the 100-HR-3 groundwater OU. In accordance with WAC 173-303-645(11), a final status, corrective action groundwater monitoring plan (PNNL-11573) replaced the compliance monitoring plan (WHC-SD-EN-AP-180) in 1997.

This revised groundwater monitoring plan retains total chromium, collected as a filtered sample, and nitrate as dangerous waste constituents identified for corrective action monitoring. Other constituents identified for monitoring in the previous plan (PNNL-11573), uranium, technetium-99, and fluoride, are removed in this revised plan. Fluoride is no longer monitored because it is below background and has been below its background groundwater concentration in the monitoring well network throughout the corrective action monitoring period. Monitoring of uranium is conducted under the CERCLA remedial action. Technetium-99 is monitored under the *Atomic Energy Act of 1954*[7] groundwater monitoring program. Alkalinity, anions, and metals are also not included in this plan since these analytes are collected at multiple nearby wells supporting the IRM.

This revised groundwater monitoring plan presents an updated corrective action monitoring plan of the uppermost aquifer beneath the 183-H Solar Evaporation Basins. This plan addresses the following:

- Number, locations, and depths of wells in the 183-H Solar Evaporation Basins groundwater monitoring network.
- Sampling and analytical methods of dangerous waste required under corrective action monitoring.
- Methods for evaluating groundwater quality information.
- Schedule for groundwater monitoring at the 183-H Solar Evaporation Basins.

This revised plan modifies the existing groundwater monitoring well network as identified in the previous groundwater monitoring plan (PNNL-11573). Previous monitoring network changes occurred in 2005 and 2013 and were incorporated into the Hanford Facility RCRA Permit. In 2005, well 199-H4-7 was removed from the monitoring network and replaced with 199-H4-8. In 2013, well 199-H4-84 replaced 199-H-3 when it was decommissioned.

This plan removes well 199-H4-12C, which is completed in the confined aquifer, from the monitoring network. Monitoring well 199-H4-12A is replaced with 199-H4-85, which is located closer to the 183-H Solar Evaporation Basins and is completed in the unconfined aquifer. New wells 199-H4-88 and 199-H4-89 were drilled in 2016 and are added to the monitoring network. In summary, upon Hanford Facility RCRA Permit modification, the well network will include wells 199-H4-8, 199-H4-84, 199-H4-85, 199-H4-88, and 199-H4-89. The monitoring network wells represent the point of compliance.

Groundwater flows generally toward the east-northeast beneath the 183-H Solar Evaporation Basins and is influenced by the ongoing IRM as well as changes in river stage.

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

[6] Soper, W.W., 1997, "Re: Acceptance of "Closure Certification for the 183-H Solar Evaporation Basins (T-1-4), 96-EAP-246" (letter to J. Wagoner, U.S. Department of Energy, Richland Operations Office, Richland, Washington from W.W. Soper), Washington State Department of Ecology, Richland, Washington, May 13. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0080812H.

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

The concentration limit for total chromium (filtered) in this plan is changed to 48 µg/L. This concentration represents the WAC 173-340-720(3)[8], "Model Toxics Control Act-Cleanup," "Groundwater Cleanup Standards," "Method B Cleanup Levels for Potable Groundwater," groundwater cleanup level for hexavalent chromium, which is the soluble and mobile form of chromium and is equivalent to total chromium as a filtered sample. The concentration limit for nitrate is the same as the previous plan at 45 mg/L, which is the drinking water standard in 40 CFR 141.[9,10]

Under this plan, groundwater in the 183-H Solar Evaporation Basins monitoring wells will be sampled and analyzed semiannually for dangerous waste constituents (total chromium (filtered) and nitrate) and field parameters (pH, specific conductance, temperature, dissolved oxygen, and turbidity). Water level measurements will be taken each time a sample is collected to satisfy WAC 173-303-645(8)(f).

[8] WAC 173-340, "Model Toxics Control Act—Cleanup," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-340.

[9] 40 CFR 141, "National Primary Drinking Water Regulations," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title40/40cfr141_main_02.tpl.

[10] Nitrate may be expressed as nitrate-nitrogen (NO_3-N) or as nitrate (NO_3). The drinking water standard for NO_3-N is 10,000 µg/L, and the mathematical equivalent value for nitrate (NO_3) is 45,000 µg/L.

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CHAPTER 3.0
GROUNDWATER MONITORING

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TERMS

AEA	*Atomic Energy Act of 1954*
amsl	above mean sea level
bgs	below ground surface
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
CSM	conceptual site model
DOE	United States Department of Energy
DOE-RL	United States, Richland Operations Office
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
FWS	Field Work Supervisor
IRM	interim remedial measure
MCL	maximum contaminant level
MTCA	"Model Toxics Control Act—Cleanup" (WAC 173-340)
NAD83	*North American Datum of 1983*
NAVD88	*North American Vertical Datum of 1988*
OU	operable unit
QAPjP	quality assurance project plan
RCRA	*Resource Conservation and Recovery Act of 1976*
RUM	Ringold Formation upper mud
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TSD	treatment, storage, and disposal
UCL	upper confidence limit
WAC	*Washington Administrative Code*
WIDS	Waste Information Data System

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3.0 INTRODUCTION

This document presents the revised corrective action groundwater monitoring plan for the 183-H Solar Evaporation Basins and supersedes the previous plan (PNNL-11573, *Groundwater Monitoring Plan for the 183-H Solar Evaporation Basins*). The United States Department of Energy (DOE), Richland Operations Office (RL), is revising this groundwater monitoring plan due to the age of the plan and to ensure that the plan contains the most current Hanford Site groundwater monitoring information for the post-closure unit group (e.g., changes in the constituents to be monitored, sampling frequency, well network, concentration limits, statistical evaluation, identification of point of compliance wells, and clarification of compliance period). The 183-H Solar Evaporation Basins are a post-closure unit group in Part VI, Unit 2, of WA7890008967, *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste* (hereafter referred to as the Hanford Facility RCRA Permit). The basins and underlying soil were remediated in 1996, and the unit was closed in 1997 under modified closure conditions in the Hanford Facility RCRA Permit with specified remedial measures under post-closure care (Soper, 1997, "Re: Acceptance of "Closure Certification for the 183-H Solar Evaporation Basins (T-1-4)," 96-EAP-246"). The Hanford Facility RCRA Permit, Part II, Condition II.F specifies final status groundwater monitoring program requirements will comply with WAC 173-303-645, "Dangerous Waste Regulations," "Releases from Regulated Units." Groundwater is monitored in accordance with WAC 173-303-645 and Part VI, Chapter 2, of the Hanford Facility RCRA Permit.

This plan monitors dangerous waste and field parameters in groundwater samples that are used to demonstrate the effectiveness of the associated corrective action. For regulatory purposes, the boundary of the 183-H Solar Evaporation Basins unit group is identified on the current Hanford Facility RCRA Permit Part A Form.

The 183-H Solar Evaporation Basins (waste sites 116-H-6 and 100-H-33) are located within the 100-H Area, in the 100-HR-1 Source OU (Figure 3-1). The basins (Figure 3-2) were originally part of the 183-H water treatment facility. Operating records indicate that four of the basins were used from 1973 to 1985 to evaporate various liquid waste streams, including neutralized, spent acid etch solutions from the 300 Area Fuel Fabrication Facility containing technetium-99 and uranium, as well as miscellaneous used and unused chemicals (DOE/RL-97-48, *183-H Solar Evaporation Basins Postclosure Plan*). All operations ceased in 1985 and Basin 1 solids and sludge material was removed in 1985. In 1990, Basins 1 and 4 were cleaned by wet sandblasting. Waste generated during sandblasting was packaged and disposed.

In 1989 and 1991, the basin concrete and soil were sampled. Analytical results indicated the presence of contamination within 0.6 m (2 ft) below the bottom of the basin structure (DOE/RL-97-48, Section 1.2.4). Decontamination and demolition of the basins started in September 1995, and the demolition waste was removed and disposed (DOE/RL-97-48, Section 1.2.4). As a result of the 1991 borehole data showing contamination, the soil underlying the basins was removed starting in 1996 with excavation to a depth of 0.6 m (2 ft) below the structure (DOE/RL-97-48, Section 1.2.4). Deeper contamination was indicated below Basin 1 and soil removal continued to 4.6 m (15 ft) below the former structure (DOE/RL-97-48, Section 1.2.4). A test pit below Basin 1 was dug to 7.6 m (25 ft) (DOE/RL-97-48, Section 1.2.4). DOE/RL-97-48 does not specify whether the Basin 1 test pit depth is measured from ground surface or from the excavation depth, however, the test pit results represent soil at least 7.6 m (25 ft) bgs. Both nitrate and fluoride contamination were identified at this depth (DOE/RL-97-48, Section 1.2.4). No additional soil removal was performed (DOE/RL-97-48, Section 1.2.4).

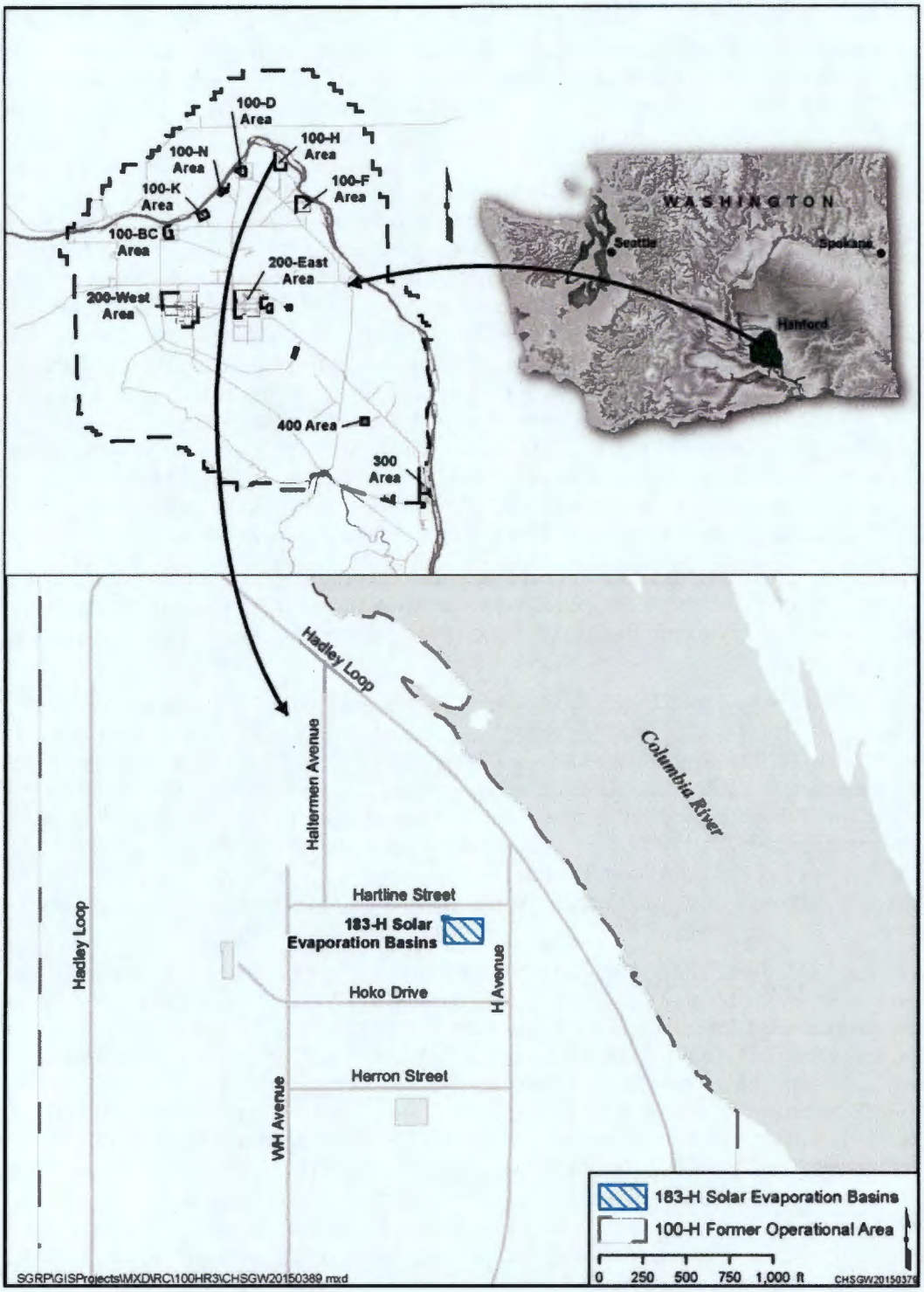
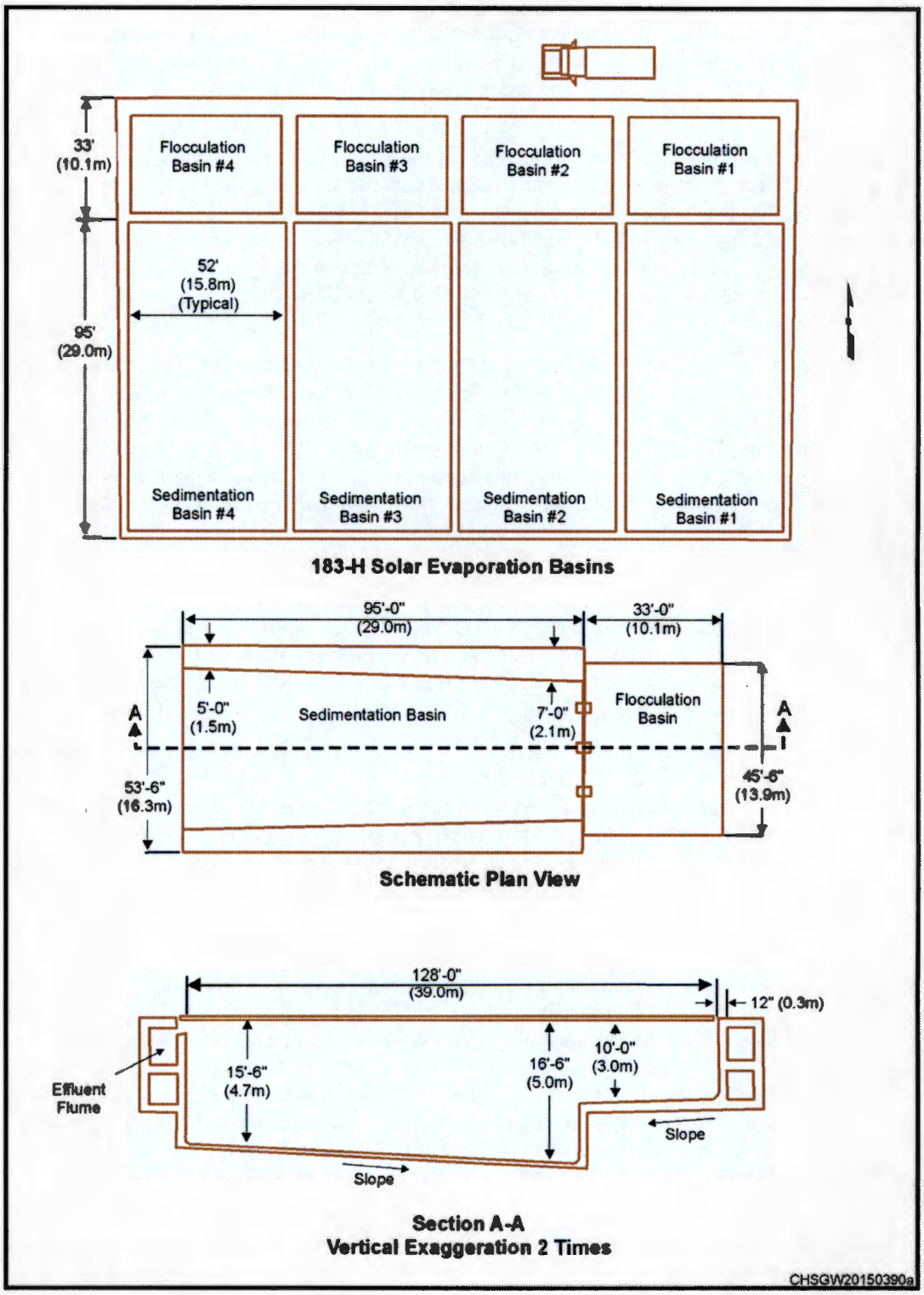


Figure 3-1 Location Map for 183-H Solar Evaporation Basins



Source: DOE/RL-97-48, *183-H Solar Evaporation Basins Postclosure Plan*

Figure 3-2 Schematic (Plan and Section Views) of the Former 183-H Solar Evaporation Basins

Because of the presence of contamination extending from 4.6 to 7.6 m (15 to 25 ft) below the Basin 1 structure, waste site 116-H-6 underwent a modified closure in accordance with the Hanford Facility RCRA Permit in 1997, which included groundwater monitoring. The radiological component of the basins was later addressed under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) as the 100-H-33 waste site and reclassified to (interim) No Action.

RCRA compliance groundwater monitoring began at the 183-H Solar Evaporation Basins in 1985, based on the groundwater monitoring requirements for interim status facilities. In 1994, the Washington State Department of Ecology (Ecology) issued the Hanford Facility RCRA Permit, which included the Part II, Condition II.F requirement that final status treatment, storage, and disposal (TSD) units comply with WAC 173-303-645. A final status compliance monitoring plan under WAC 173-303-645 (WHC-SD-EN-AP-180, *Groundwater Monitoring Plan for the 183-H Solar Evaporation Basins*) was initiated in 1995.

Results from the first final status compliance monitoring samples collected in 1995 (Furman, 1996, "Exceedance of Concentration Limits in Groundwater at 183-H Solar Evaporation Basins") showed exceedances of the concentration limits for nitrate, chromium, uranium, and technetium-99 that were established per WAC 173-303-645(5). The regulations in WAC 173-303-645(11), "Corrective Action Program," require implementation of a corrective action program to reduce contaminant concentrations in groundwater. Groundwater corrective action for the 183-H Solar Evaporation Basins was implemented through the CERCLA interim action for the 100-HR-3 Groundwater OU, which includes groundwater affected by the basins. The CERCLA interim remedial measure (IRM) at the 100-HR-3 OU consists of two pump and treat systems.

A corrective action groundwater monitoring plan (PNNL-11573) was developed in accordance with WAC 173-303-645(11) and implemented in 1997. The post-closure plan (DOE/RL-97-48) was incorporated into the Hanford Facility RCRA Permit in February 1998 and includes the corrective action groundwater monitoring described in PNNL-11573.

The purpose of this groundwater monitoring plan is to present an updated groundwater monitoring program for dangerous wastes from the 183-H Solar Evaporation Basins. Specifically, this plan is intended to satisfy monitoring requirements for a final status unit undergoing corrective action, as prescribed in Part VI of the Hanford Facility RCRA Permit and required by WAC 173-303-645(11). This monitoring plan is the principal controlling document for conducting groundwater monitoring at the 183-H Solar Evaporation Basins and is used to modify the Hanford Facility RCRA Permit. Once the permit is modified, this document will supersede PNNL-11573.

This revised plan monitors dangerous wastes (total chromium [filtered] and nitrate) and includes field parameters (pH, specific conductance, temperature, dissolved oxygen, and turbidity). Other constituents monitored in PNNL-11573 (uranium, technetium-99, and fluoride) are not included in this plan. Uranium is monitored under the 100-HR-3 OU pump and treat system, technetium-99 is monitored under the *Atomic Energy Act of 1954* (AEA) monitoring program (DOE/RL-2015-56, *Hanford Atomic Energy Act Sitewide Groundwater Monitoring Plan*), and fluoride will no longer be monitored. The corrective action monitoring program detailed in this plan requires semiannual sampling of total chromium (collected as a filtered sample), nitrate, and field parameters at five wells. Additionally, water level measurements are also required each time that a sample is collected in accordance with WAC 173-303-645(8)(f).

This groundwater monitoring plan addresses the operational history, current hydrogeology, and conceptual site model (CSM) for the unit and incorporates knowledge regarding contamination originating from 183-H Solar Evaporation Basins and includes the following chapters and appendices:

- Chapter 2 summarizes background information and references other documents that contain more detailed or additional information. It also describes 183-H Solar Evaporation Basins and the regulatory basis, types of waste present, and the pertinent geology and hydrogeology beneath 183-H Solar Evaporation Basins; and it presents a brief history of groundwater monitoring. This information is summarized as a CSM to aid in development of the groundwater monitoring program.
- Chapter 3 describes the groundwater monitoring program, including the wells in the monitoring network, constituents analyzed, sampling frequency, and sampling protocols.
- Chapter 4 describes data evaluation and reporting.
- Chapter 5 contains the references cited in this plan.
- Appendix A provides the quality assurance project plan (QAPjP).
- Appendix B contains sampling protocols.
- Appendix C provides information for the wells within the groundwater monitoring.
- Appendix D presents monitoring data of the dangerous wastes (including hexavalent chromium results) that have been collected from the network wells during corrective action monitoring.

3.1 BACKGROUND

This chapter describes 183-H Solar Evaporation Basins and their operating history, regulatory basis, waste and waste characteristics associated with 183-H Solar Evaporation Basins, local subsurface geology and hydrogeology, a summary of previous groundwater monitoring, and the CSM for 183-H Solar Evaporation Basins.

The information contained in this chapter was obtained from several sources, including previous groundwater monitoring plans listed in Section 2.5 and the following documents:

- DOE/RL-88-04, Rev. 3, *Interim Status Closure/Post-Closure Plan 183-H Solar Evaporation Basins*
- DOE/RL-97-48, *183-H Solar Evaporation Basins Postclosure Plan*
- DOE/RL-2010-95, *Remedial Investigation/Feasibility Study for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units*
- DOE/RL-2011-111, *Proposed Plan for Remediation of the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units*

3.1.1 Facility Description and Operational History

The 183-H Solar Evaporation Basins were located beside the Columbia River in the northern portion of the Hanford Site (Figure 3-3). Each basin was 16 m (52 ft) wide and 39 m (128 ft) long and contained a 5 m (16 ft) deep sedimentation basin and a smaller, 3 m (10 ft) deep flocculation basin. The basins were surrounded by earthen berms.

The concrete basins were originally part of the 183-H water treatment plant for treating cooling water and operated concurrently with the 100-H Reactor from October 1949 to April 1965. At that time, there were 16 basins. Demolition of the 183-H water treatment plant was initiated in the spring of 1974. The 183-H head house, 12 of the flocculation and sedimentation basins, filter building, and the clearwell pump room were demolished and the underground portions were backfilled to grade (BHI-00127, *100-H Area Technical Baseline Report*, Section 4.6). Four basins were retained for use as solar evaporation basins for chemical waste from the 300 Area (PNL-6470, *Revised Ground-Water Monitoring Compliance Plan for the 183-H Solar Evaporation Basins*), as well as for miscellaneous used and unused chemicals. These remaining basins were modified to seal openings and to install a pipeline before being used to evaporate various liquid waste streams, including neutralized, spent acid etch solutions containing technetium-99 and uranium from the 300 Area Fuel Fabrication Facility (DOE/RL-88-04, Rev. 3, Section 1.A-3).

Use of the 183-H Solar Evaporation Basins for liquid disposal began in June 1973, when liquid was first pumped into Basin 1, but discharges ceased after two months due to operational problems at the 300 Area. Discharge to the basins resumed in 1975 and continued until 1978, when nitrate contamination in a downgradient well (199-H4-3) was attributed to wastes from the unlined Basin 1, Basins 2 and 3, with sprayed-on liners of a polyurethane material, were used beginning in 1977 and 1978, and Basin 1 was permanently retired. Basin 4, with a sprayed-on butyl and Hypalon® liner, also was used beginning in October 1982. Basins 2, 3, and 4 were used until 1985. The total volume of routine wastes from the fuel fabrication process discharged to the 183-H Solar Evaporation Basins from 1973 to 1985 was 9.573 million L (2.529 million gal) (PNL-6470).

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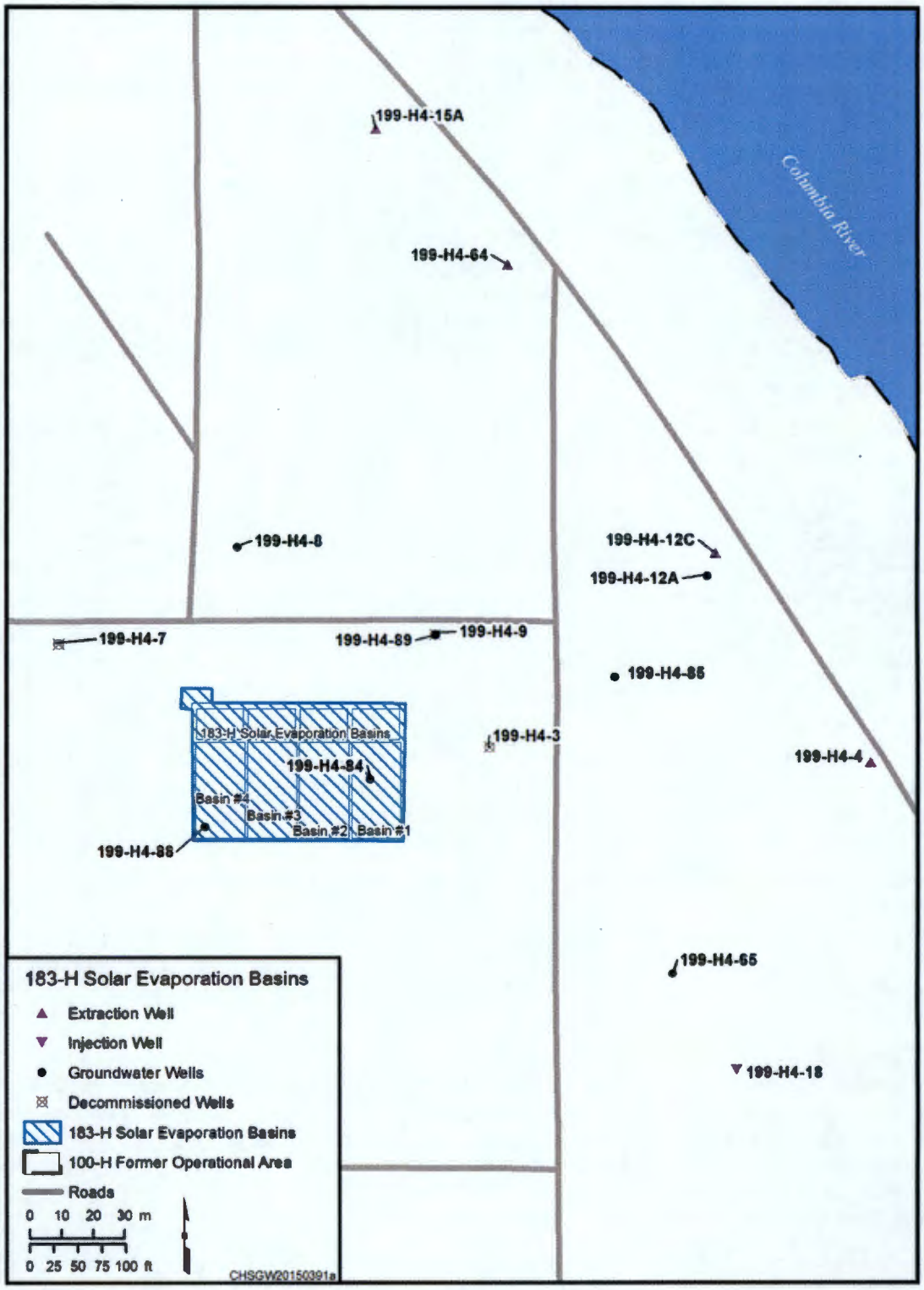


Figure 3-3 Map of 183-H Solar Evaporation Basins

Basin 1 solids and sludge were removed in 1985. Basins 2, 3, and 4 held waste consisting of three distinct layers: a basal crystalline layer, a sludge layer, and a liquid layer on top. In 1986, the liquid waste was solidified inside lined drums. The sludge and crystalline layers were removed from the basins by manually shoveling and/or scooping the material into the drums. Basins 1 and 4 were subsequently cleaned by wet sandblasting. By the end of 1990, all waste had been removed.

The basins were decontaminated and demolished in 1996 and soil was removed to at least 0.6 m (2 ft) beneath each of the former basins. Below Basin 1, additional soil was removed up to a depth of 4.6 m (15 ft) below the former structure (DOE/RL-97-48). In Basin 1, a test pit was excavated to a depth of at least 7.6 m (25 ft) bgs (DOE/RL-97-48, Section 1.2.4). Soil from the test pit was sampled and both nitrate and fluoride contamination above 1996 WAC 173-340, "Model Toxics Control Act—Cleanup" (MTCA) Method B cleanup levels were detected at this depth. No further source remediation was done and the excavation was filled with clean soil to meet the surrounding grade. All decontamination and demolition waste and contaminated soil was transported from the site and appropriately disposed.

3.1.2 Regulatory Basis

In 1986, DOE entered into a regulatory order (EPA and Ecology, 1986, EPA Regulatory Order No. 1085-10-07-3008 and Ecology No. DE 86-133). The compliance order mandated interim status groundwater quality assessment monitoring according to 40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," and WAC 173-303-400, "Dangerous Waste Regulations," "Interim Status Facility Standards," at the 183-H Solar Evaporation Basins. This initiated the RCRA groundwater monitoring program at the 183-H Solar Evaporation Basins (PNL-6470).

In May 1987, DOE issued a final rule (10 CFR 962, "Byproduct Material"), stating that the hazardous waste components of mixed waste are subject to RCRA regulations. The hazardous waste components of mixed waste were determined to be subject to Ecology authority to regulate these waste since August 19, 1987.

In May 1989, DOE, the United States Environmental Protection Agency (EPA), and Ecology signed the Ecology et al., 1989, *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement). This agreement established the roles and responsibilities of the agencies involved in regulating and controlling remedial restoration of the Hanford Site, which includes 183-H Solar Evaporation Basins.

Dangerous waste is regulated under RCW 70.105, "Hazardous Waste Management," and its Washington State implementing regulations (WAC 173-303). Radionuclides in mixed waste may include source, special nuclear, and byproduct materials as defined in the AEA. AEA states that these radionuclide materials are regulated at DOE facilities, exclusively by DOE, acting pursuant to its AEA authority. Radionuclide materials are not hazardous/dangerous wastes and, therefore, are not subject to regulation by the state of Washington under RCRA or RCW 70.105.

In 1994, Ecology issued the Hanford Facility RCRA Permit. The 183-H Solar Evaporation Basins were included as a closure unit in Part V of the permit, which contains requirements specifically applicable to TSD units that are undergoing closure. Part II, Condition II.F of the permit specified that a groundwater monitoring program under final status was subject to the requirements of WAC 173-303-645. A final status compliance monitoring program was prepared in 1995 (WHC-SD-EN-AP-180) to comply with the groundwater monitoring requirements specified in Part II, Condition II.F., of the permit and in the requirements established in Chapter 3.0 of Part VI, Post-Closure Unit 2.

The first sample set collected under the final status plan (in Fall 1995 with confirmation samples collected in Spring 1996) showed that downgradient concentrations of the four identified analytes (nitrate, chromium, uranium, and technetium-99) exceeded the concentration limits established in the compliance monitoring plan (WHC-SD-EN-AP-180) (Furman, 1996). WAC 173-303-645(11) requires corrective action activities to reduce contaminant concentrations in groundwater.

Groundwater protection at the site was demonstrated through modeling and a modified closure (soil) was approved by Ecology on May 13, 1997 (Soper, 1997). The site was not clean-closed under RCRA because fluoride and nitrate concentrations were identified above the 1996 MTCA (WAC 173-340) Method B cleanup levels. Therefore, the unit was closed in place under the modified closure provisions of the Hanford Facility RCRA Permit with post-closure care. Corrective action for the contaminated groundwater attributable to the basins was coordinated with remedial action for the 100-HR-3 OU under CERCLA (Soper 1997). Remedial action under CERCLA to address chromium groundwater contamination in the 100-H Area was initiated as part of CERCLA remediation activities through a pump and treat system. The IRM to remove hexavalent chromium began operation in 1997 as specified in DOE/RL-96-84, *Remedial Design and Remedial Action Work Plan for the 100-HR-3 and 100-KR-4 Groundwater Operable Units' Interim Action*. Although nitrate was not specifically targeted by the CERCLA IRM, it was considered likely that nitrate would be retained on the ion exchange columns utilized by the pump and treat system (DOE/RL-97-48). The CERCLA IRM is ongoing and is not subject to the conditions of the Hanford Facility RCRA Permit.

Corrective action groundwater monitoring at the 183-H Solar Evaporation Basins was initiated in accordance with WAC 173-303-645(11). In 1997, the corrective action groundwater monitoring plan (PNNL-11573) replaced the compliance monitoring plan (WHC-SD-EN-AP-180) and was incorporated in the post-closure plan (DOE/RL-97-48) and the Hanford Facility RCRA Permit. Corrective action groundwater monitoring under PNNL-11573 continues to this day.

RCRA closures do not have authority to address the cleanup of radiological contamination, which is performed under CERCLA. Waste site 116-H-6 pertains to the chemical contamination beneath the site which underwent a modified closure under the Hanford Facility RCRA Permit (Soper, 1997). Accordingly, the 116-H-6 waste site was reclassified to Closed Out in 1997 in the Waste Information Data System (WIDS). A second waste site for the 183-H Solar Evaporation Basins, 100-H-33, was created to address the radiological contamination that is within the same footprint as 116-H-6. Waste site 100-H-33 (radiological component) was evaluated and reclassified in 2012 to No Action in WIDS.

3.1.3 Waste Characteristics

The waste discharged to the 183-H Solar Evaporation Basins from 1973 to 1985 was received from the 300 Area Fuel Fabrication Facility, along with miscellaneous used and unused chemicals. The four basins received routine waste consisting of spent acid etch solutions (i.e., chromic, hydrofluoric, nitric, and sulfuric acids), typically neutralized with sodium hydroxide (PNNL-11573). Metal constituents included aluminum, chromium, copper, manganese, nickel, silicon, uranium, and zirconium (primarily in the form of precipitates after neutralization). The resultant slurry of liquid and metal precipitates was discharged into the basins.

Chemical analyses were not performed routinely on the waste discharged during the operating life of the basins; however, chemical waste disposal permits indicate that some of the waste was corrosive (high and low pH). PNNL-11573 reported up to 700 µg/L of chromium were found in a monthly composite sample.

The neutralized waste contained high concentrations of nitrate and copper from the nitric acid used in the copper-stripping procedures. Chromium waste included hexavalent chromium, mostly from the chromic acid used in fuel fabrication. After 1983, hexavalent chromium was reduced to its trivalent state before disposal (PNL-6728, *Geohydrologic Characterization of the Area Surrounding the 183-H Solar Evaporation Basins*, Section 2.4). Two other minor sources of chromium were the etching of stainless steel (mostly trivalent chromium) and the disposal of various industrial solutions.

The routine waste included uranium and technetium-99, causing the material to be categorized as nontransuranic, low-level, radioactive waste. Nonroutine waste discharged to the basins periodically included unused chemicals and spent solutions from miscellaneous processes, development tests, and laboratories. These discharges included the following components: cadmium and cadmium compounds;

copper and copper compounds; oxalic acid; cyanide, mercury, and lead compounds; barium perchlorate; hydrazine; chromium and chromium compounds; vanadium pentoxide; and nickel and nickel compounds.

Operation of the 183-H Solar Evaporation Basins ceased in 1985. From 1985 to 1988, the 300 Area neutralized waste acid underwent solids separation in the 313 Building by use of a filter and a centrifuge. The solids were contained in the building for later disposal in the 200 Area. The liquid was sent to the 311 Tank Farm for storage; however, the effluent was taken to the 340-B Facility by tanker truck and eventually sent by rail car to the 200 Area Double-Shell Tank system for long-term storage (DOE/RL-2010-99, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units*, Section 1.3.1).

3.1.4 Geology and Hydrogeology

The following documents describe the geology and hydrogeology of the 100-H Area and 100-HR-3 groundwater OU, including the region of 183-H Solar Evaporation Basins, in detail:

- DOE/RL-2010-95, *Remedial Investigation/Feasibility Study for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units*
- PNL-6728, *Geohydrologic Characterization of the Area Surrounding the 183-H Solar Evaporation Basins*
- BHI-00917, *Conceptual Site Models for Groundwater Contamination at 100-BC-5, 100-KR-4, 100-HR-3, and 100-FR-3 Operable Units*
- WHC-SD-EN-TI-011, *Geology of the Northern Part of the Hanford Site: An Outline of Data Sources and the Geologic Setting of the 100 Areas*
- WHC-SD-EN-TI-132, *Geologic Setting of the 100-HR-3 Operable Unit, Hanford Site, South-Central Washington*

3.1.4.1 Stratigraphy

The 100-H Area is underlain by unconsolidated sediments and the Columbia River Basalt Group. Unconsolidated sediments in this area include the Hanford formation (informal name) and the Ringold Formation. The stratigraphy of the 100-H Area has been described in WHC-SD-EN-TI-132 and DOE/RL-2010-95. Stratigraphic units at 100-HR-3 are listed in the following text and shown on the left side of Figure 3-4.

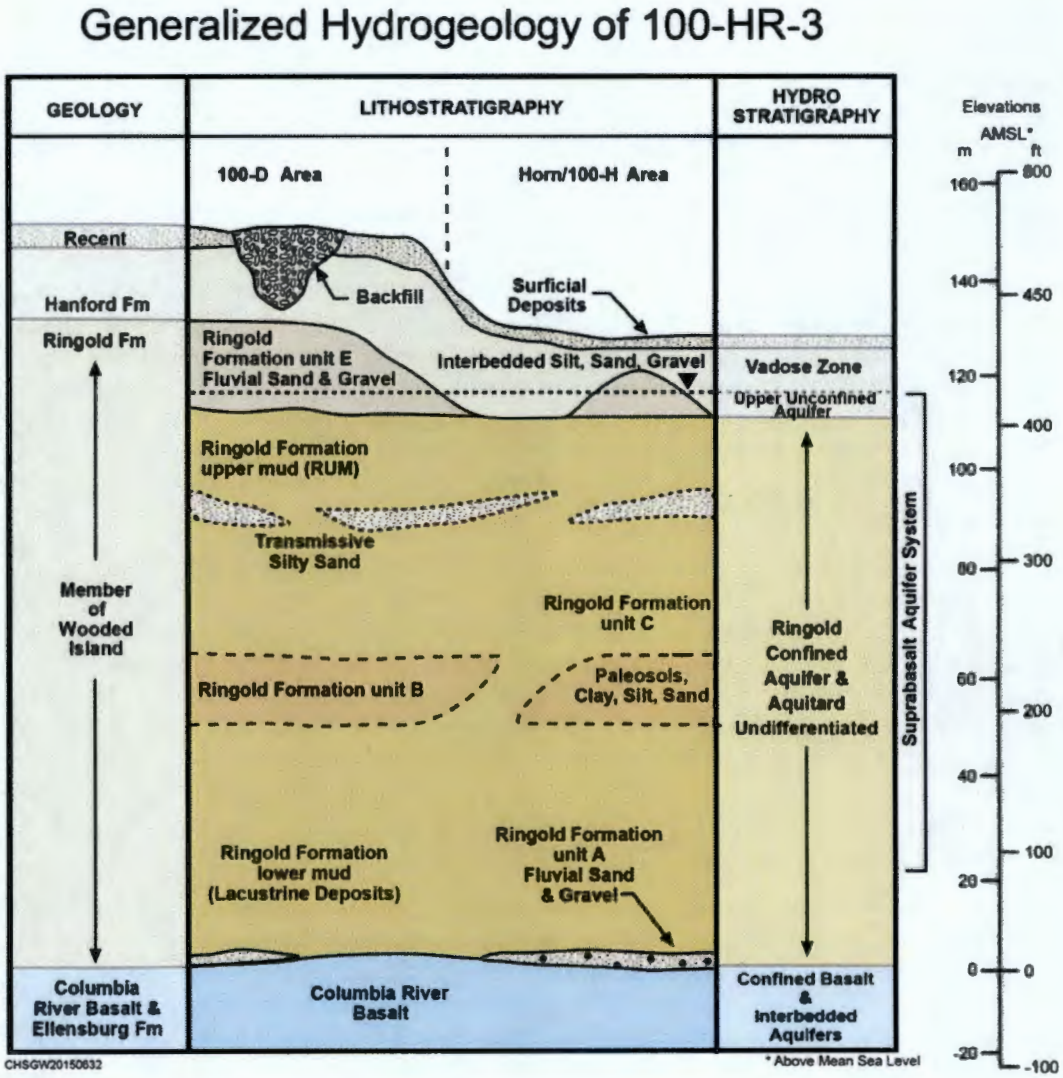


Figure 3-4 Stratigraphy and Hydrogeologic Units of 100-HR-3

Surface sediments at the 100-H Area include Holocene deposits and backfill, generally less than 0.3 m (1 ft) thick. Recent deposits include eolian sands and river alluvium, which were placed over the past 10,000 years, and backfill materials deposited by humans. Construction backfill varies in depth, depending on the excavated depth of waste sites and building foundations, and backfill material may cover larger graded areas to depths of 0.3 m (1 ft) or more. Backfill deposits may be up to 8 m (26 ft) thick near the 100-H reactor and 183-H Clearwells, but are generally less than 5 m (16 ft) thick in other areas.

The Hanford formation consists predominantly of unconsolidated sediments that cover a wide range of grain sizes, from boulder-sized gravel to sand, silty sand, and silt. The Hanford formation facies consists of moderately to very poorly sorted, large to very large, cobble- to boulder-sized clasts in open framework gravels that include discrete sand lenses, with little or no silt and clay-sized material. The Hanford formation has traditionally been classified into three separate lithofacies: gravel-dominated, sand-dominated, and interbedded sand and silt-dominated (DOE/RL-2002-39, *Standardized Stratigraphic Nomenclature for Post-Ringold-Formation Sediments Within the Central Pasco Basin*). The gravel-dominated Hanford formation is highly basaltic, ranging from approximately 50 to 80 percent

basalt (WHC-SD-EN-TI-011). The sand fractions are also high in basalt content, with the remaining portion composed of feldspar, quartz, and traces of mica. The grains typically are subround to round gravel and subangular to subround in the sand grain fraction. The gravel-dominated facies typically are well stratified and contain little to no cementation (WHC-SD-EN-TI-132). Discrete sand lenses are present in 100-D/H, which may serve as preferential flow paths or collection zones for vadose zone contaminants. Caliche (calcium carbonate crust) is occasionally observed on Hanford formation gravels. The thickness of the Hanford formation ranges from 10 to 19 m (33 to 62 ft) across the 100-H Area and makes up most of the unconfined aquifer material.

Ringold Formation underlies the Hanford formation and is a combination of alluvial and lacustrine deposits produced by the ancestral Columbia River and other regional river systems. The formation is approximately 41 m (134 ft) thick beneath the 100-H Area, and consists of nonindurated and semi-indurated clay, silt, fine- to coarse-grained sand, and variably cemented, multilithic, granule to cobble gravel. The Ringold Formation under the 100-H Area includes the following three main depositional facies: overbank/paleosol deposits, sand and interbedded overbank paleosol deposits, and the lacustrine-dominated lower mud unit. Ringold Formation unit E is the uppermost Ringold unit, but is found in small areas at 100-H.

The Ringold Formation upper mud (RUM) unit is dominated by a fine-grained overbank paleosol facies association that is up to 61 m (200 ft) thick (WHC-SD-EN-TI-132). The silt- and clay-rich RUM has low hydraulic conductivity values relative to the Hanford formation. The RUM is considered an aquitard and forms the base of the unconfined aquifer. Within the RUM, thin sand-to-gravel layers form zones with variable hydraulic conductivity (K). Horizontal K ranges from 1.2×10^{-4} to 1.9×10^{-3} cm/sec (3.4×10^{-1} to 5.4 ft/day) and vertical K ranges from 1.4×10^{-8} to 5.0×10^{-3} cm/sec (4.0×10^{-5} to $1.4 \times 10^{+1}$ ft/day). These sand and gravel layers form confined or semiconfined aquifers within the RUM. The connectivity of the first water bearing unit of the RUM across the site and the extent of connection to the unconfined aquifer has not been determined. The top surface of the RUM is found between 11 and 40 m (37 and 66 ft) below ground surface (bgs) at 100-H.

The Ringold unit B separates and differentiates the fine-grained sediment of the RUM from the underlying fine-grained sediment of the Ringold lower mud unit. Fine sand to silty sand deposits of the Ringold unit B overlie the lower mud unit and are approximately 15 to 24.5 m (50 to 80 ft) thick beneath 100-D/H. The Ringold unit B sands are inferred to be equivalent to fluvial gravel deposits of unit B (and possibly unit D) to the south in the Cold Creek Syncline. Ringold units A and C, which are present in other parts of the Cold Creek Syncline to the south of Gable Mountain, have not been found beneath 100-H. The lower mud consists of fine-grained (silt- and clay-dominated) deposits that are approximately 23.0 to 30.5 m (75 to 100 ft) thick beneath 100-H (WHC-SD-EN-TI-132).

Approximately 300 basalt flows of the Columbia River Basalt Group have been identified, with a maximum total thickness of approximately 4,600 m (15,000 ft) in the Pasco Basin. The basalt has been divided into four formations from youngest to oldest: Saddle Mountains Basalt, Wanapum Basalt, Grand Ronde Basalt, and Imnaha Basalt. The Elephant Mountains Member of the Saddle Mountains Basalt Formation is the upper basalt unit beneath 100-H. The Saddle Mountains Basalt Formation was encountered in well 199-H4-15C at a depth of 95 m (314 ft). Sedimentary units of the Ellensburg Formation are interbedded with the basalt flows. The shallowest of these beneath 100-H is the Rattlesnake Ridge interbed.

Geologic cross-sections, which include selected wells in the 183-H Solar Evaporation Basins monitoring network and surrounding area, present the approximate stratigraphy underlying and adjacent to the site (Figures 3-5 and 3-6).

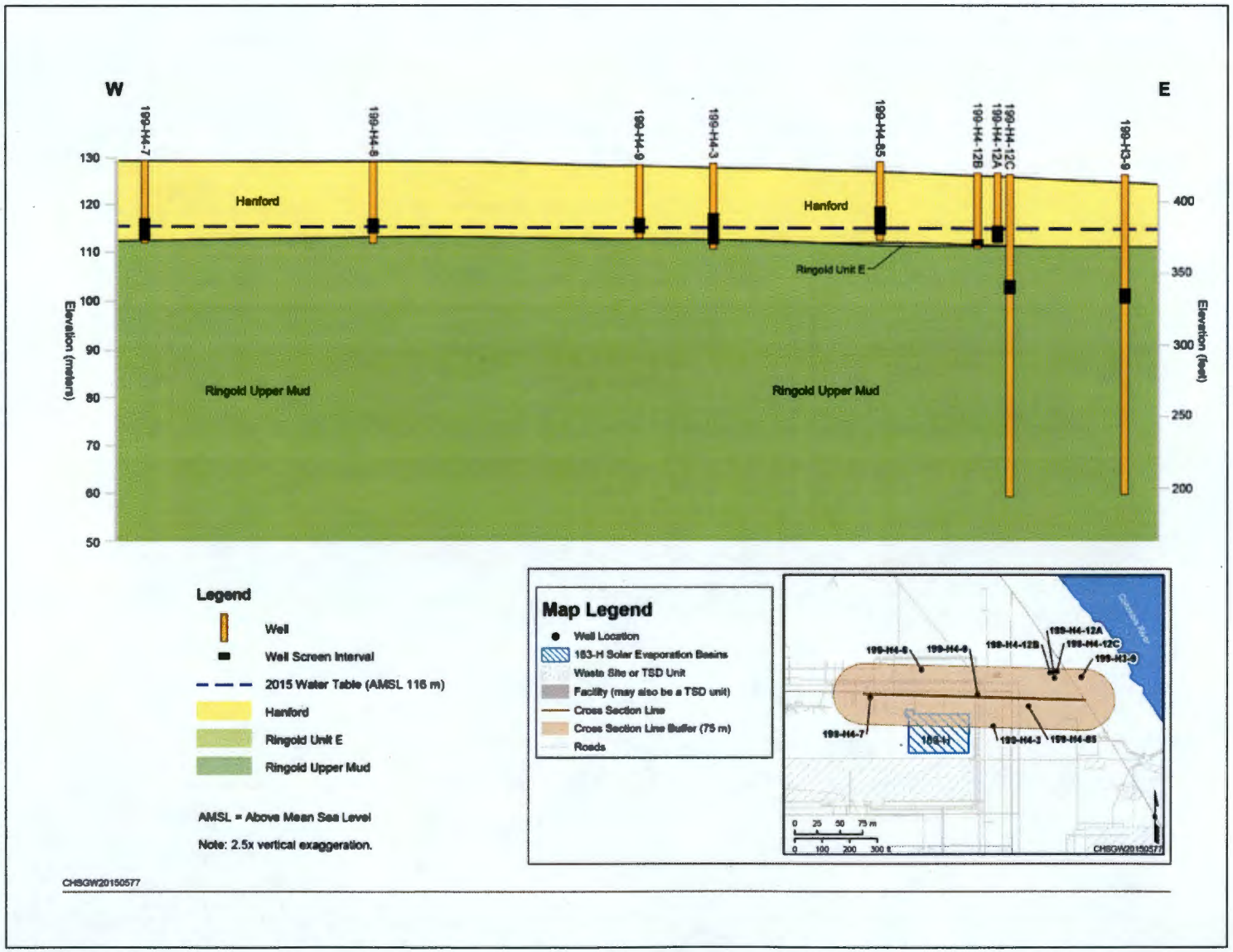


Figure 3-5 West-East Geologic Cross Section Showing the Stratigraphy Underlying the 183-H Solar Evaporation Basins

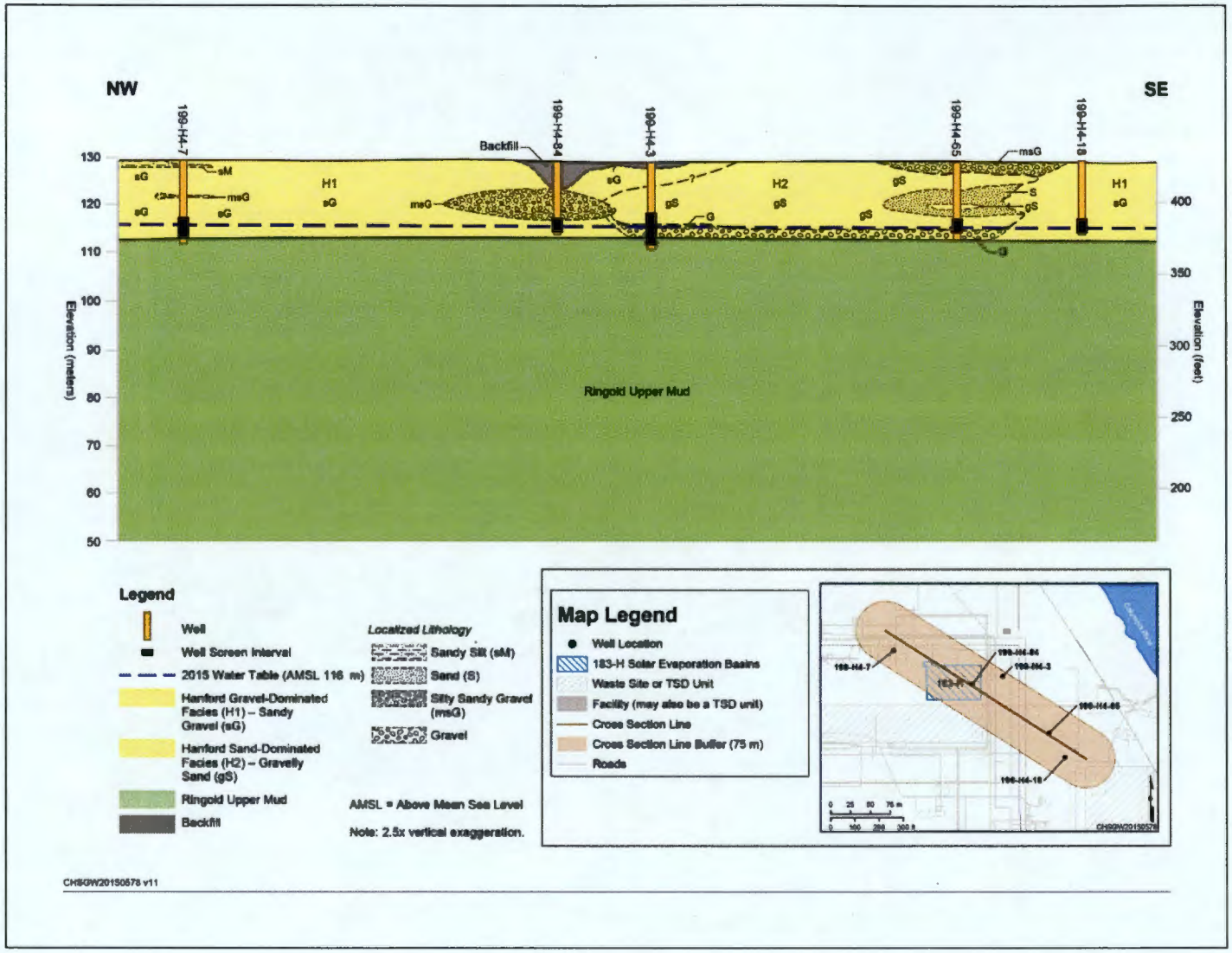


Figure 3-6 Northwest-Southeast Geologic Cross Section Showing the Stratigraphy Underlying the 183-H Solar Evaporation Basins

3.1.4.2 Hydrogeology

The principal hydrostratigraphic units encountered beneath the 100-H Area include the following, in descending order:

- The unsaturated sediments of the Hanford formation (vadose zone)
- An unconfined aquifer in the saturated sediments of the Hanford formation, and in some areas, within remnants of the Ringold Formation unit E
- A series of confined (or semiconfined) aquifers within the Ringold Formation
- A confined aquifer (within the Saddle Mountain Basalt Formation and the Rattlesnake Ridge interbed)

Figure 3-4 shows, on the right side, a generalized hydrostratigraphic column for the 100-H Area.

The vadose zone (unsaturated zone) extends from ground surface to the water table of the uppermost aquifer. Also called the zone of aeration, it includes the soil at the surface, the capillary fringe zone above the principal water bearing zone, the periodically rewetted zone, and the combined rock, soil, air, and moisture interface linking the water table to the vadose zone. As the water table fluctuates in response to river stage and changes in recharge rates, the periodically rewetted zone experiences either saturated or unsaturated conditions. The capillary fringe is the edge of that wetted surface where water seeps into the vadose zone material because of tension saturation. The thickness of the capillary fringe is typically small in sand and gravel formations (e.g., a centimeter or two), whereas the periodically rewetted zone in areas near the river may be as much as 2 m (6 ft) thick. The dominant stratigraphic unit in the vadose zone underlying 100-H is the Hanford formation.

The unconfined aquifer is the zone between the water table and the surface of the RUM. At 100-H, the unconfined aquifer is primarily present in the Hanford formation, since the Ringold Formation unit E is absent in most locations. The unconfined aquifer thickness at 100-HR-3 generally thins from west to east from 100-D toward 100-H. Thickness of the unconfined aquifer ranges from near 0 to 12 m (39 ft) across the area. At the 183-H Solar Evaporation Basins, the aquifer is approximately 1.5 m (5.0 ft) thick, with some seasonal variation. Aquifer thickness is greater beneath 100-D, where the unconfined aquifer matrix consists solely of Ringold Formation unit E sediments. The unconfined aquifer matrix in the 100-H Area consists of Hanford formation sediments where Ringold Formation unit E sediments are typically absent because of erosion. However, some remnants of unit E are present locally. The aquifer is also influenced by the river stage, which causes fluctuations in the water table. Areas closest to the river are most affected by these fluctuations, with the effect muted farther inland (DOE/RL-2010-95).

The upper confined aquifer occurs within the silty clayey sand to sandy silty clay unit of the Ringold Formation. As presented in Section 2.4.1, the stratigraphic units identified within the Ringold Formation in the 100-H Area include the RUM, the Ringold unit B, the lower mud, and Ringold unit A. Aquifers found below the upper surface of the RUM are typically confined or semiconfined, but leakage between the units may also occur. A basalt-confined aquifer occurs within the uppermost basalt flow of the Saddle Mountains Basalt Formation and the Rattlesnake Ridge interbed.

3.1.4.3 Groundwater Flow Interpretation

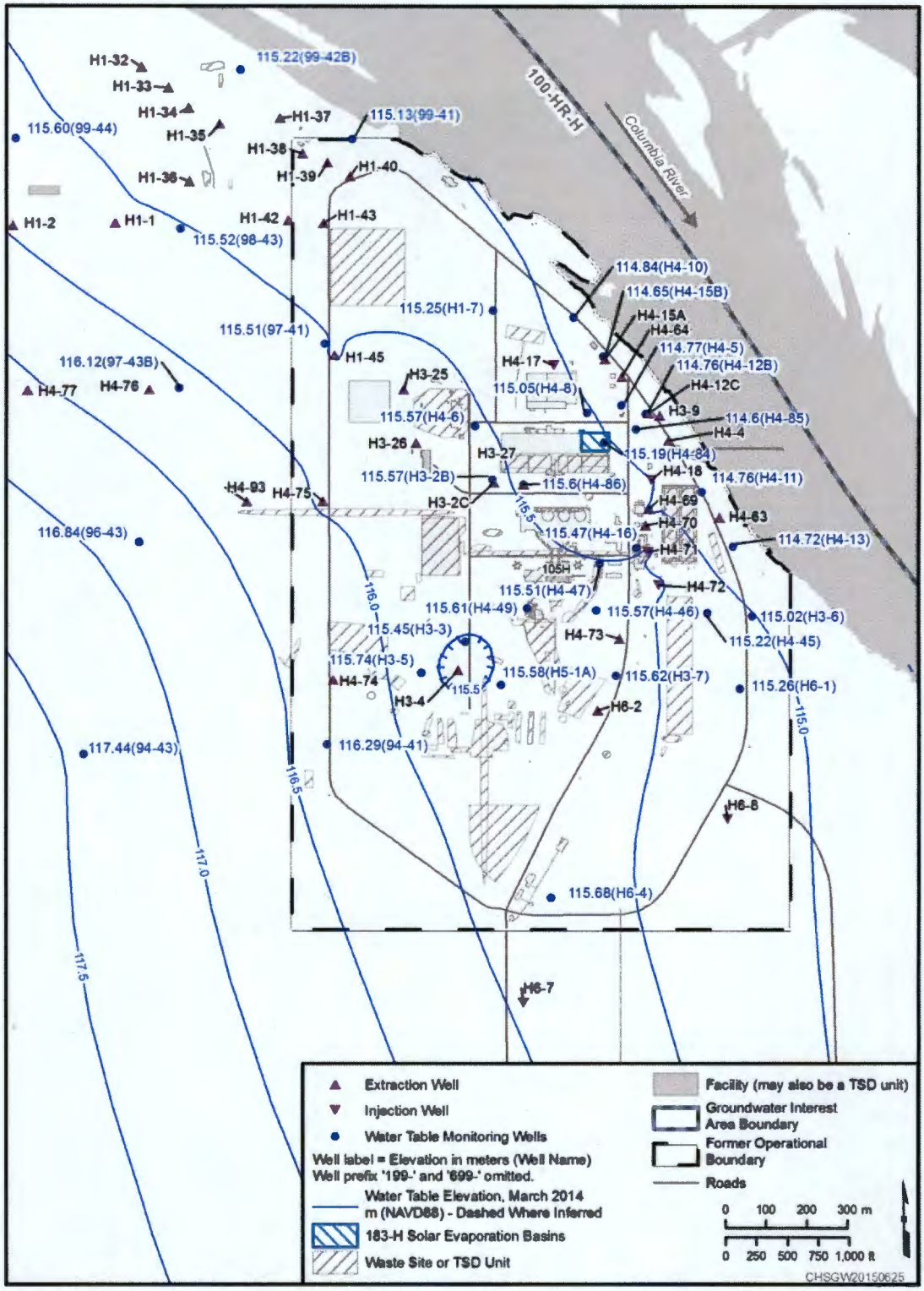
Groundwater generally flows from west to east in the uppermost aquifer beneath the 100-H Area and discharges to the Columbia River. The direction of groundwater flow is interpreted from water table elevations (Figure 3-7).

The water table is affected by daily and seasonal fluctuations in river stage, depending on upstream dam operations. Fluctuations in river stage cause hydraulic gradients in the aquifer immediately adjacent to the shoreline to be highly variable. When the river stage is high for weeks or months, the hydraulic gradient in the aquifer reverses near the river, and river water can flow into the aquifer. When the river level drops, this water flows from the bank back into the river.

Operation of the HX pump and treat system has created changes in groundwater flow direction and velocity. These changes are expressed as local depressions and mounds in the water table, affecting the local flow direction and gradient, primarily in the unconfined aquifer. However, the flow directions and gradients experienced during low and high river stage have a greater effect in wells adjacent to the river.

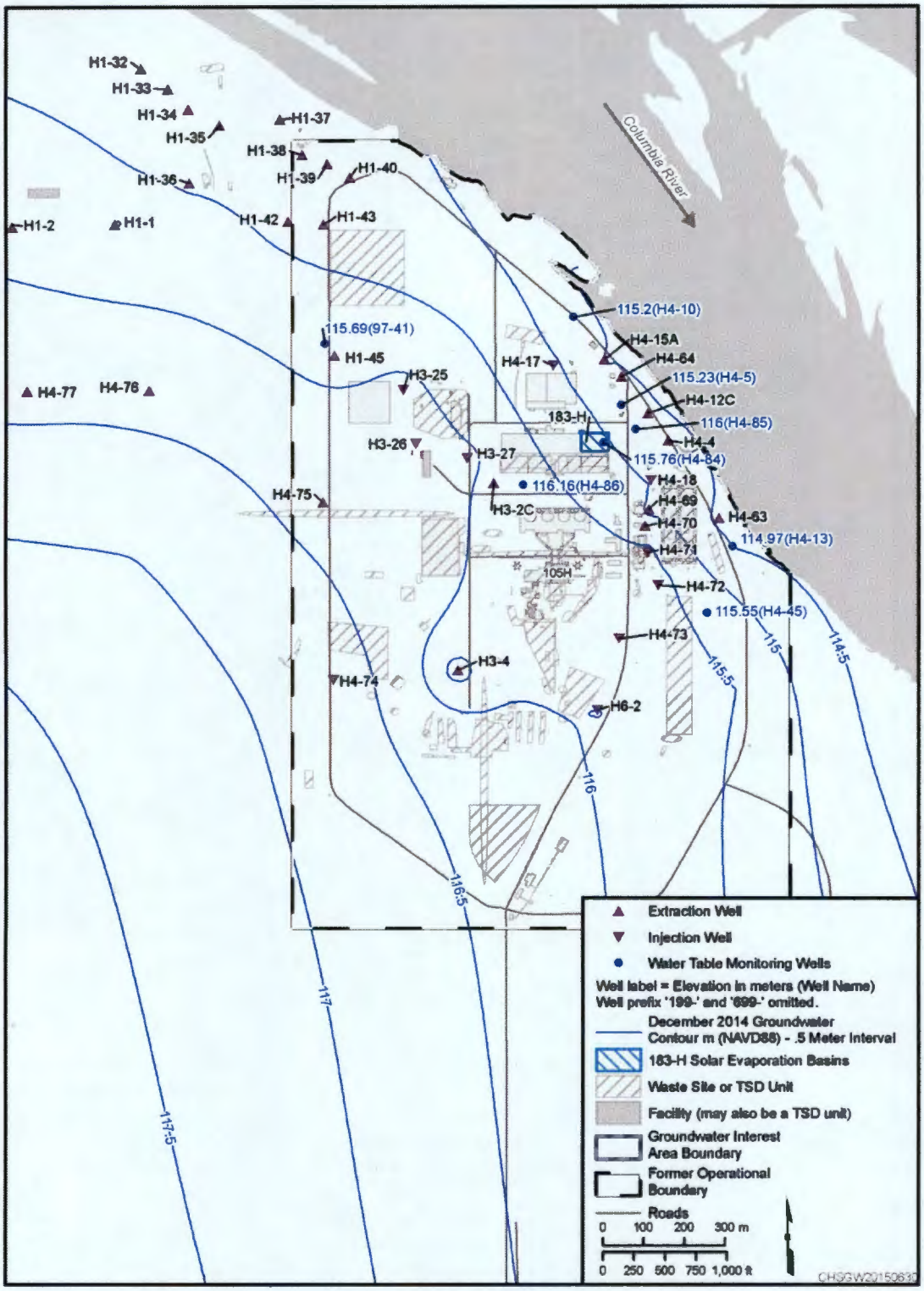
The groundwater flow at the 183-H Solar Evaporation Basins is primarily toward the river (east-northeast) during most of the year. Figures 3-8 and 3-9 present the water table maps for low and high river stage, respectively. The low river stage illustrates groundwater flow heading toward the river with isolated areas of effect from the pump and treat extraction well cones of depression or injection well mounding.

Water levels in the RUM are currently under the effects of the remediation system, which is extracting water from two locations (wells 199-H3-2C and 199-H4-12C). In areas where extraction is not taking place, the head value for the RUM well is generally slightly lower than the overlying unconfined aquifer, indicating a downward gradient. However, this is not consistent across 100-H Area, and not all RUM wells have a nearby well in the unconfined aquifer to use for comparison.



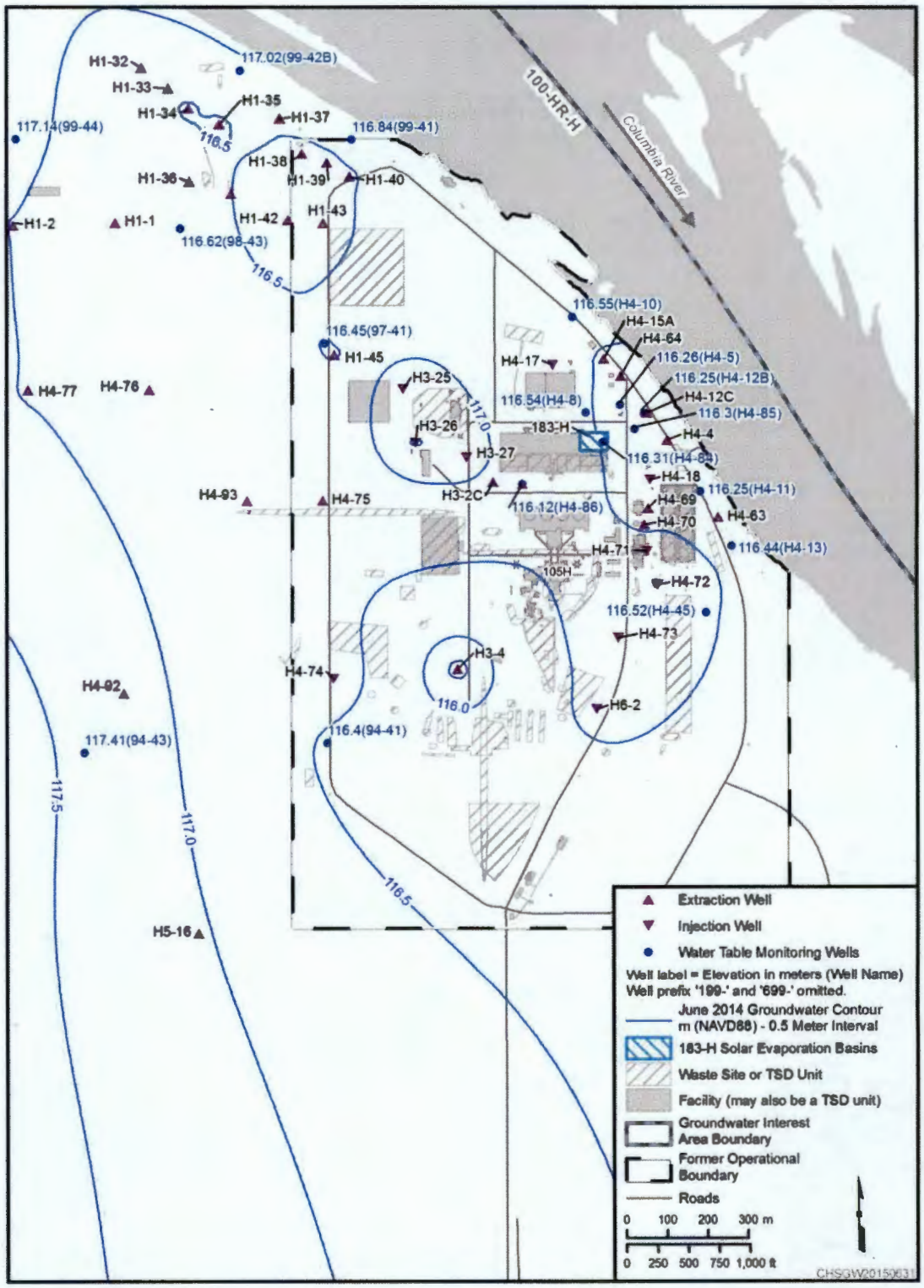
Reference: NAVD88, *North American Vertical Datum of 1988*.

Figure 3-7 Water Table Map for 100-H Area (March 2014)



Reference: NAVD88, North American Vertical Datum of 1988.

Figure 3-8 Water Table Contours (December 2014; Low River Stage)



Reference: NAVD88, North American Vertical Datum of 1988.

Figure 3-9 Water Table Contours (June 2014; High River Stage)

3.1.5 Summary of Previous Groundwater Monitoring

Table 3-1 lists the previous groundwater monitoring plans implemented at the 183-H Solar Evaporation Basins.

Table 3-1 Previous Monitoring Plans

Document	Date Issued	Monitoring Program
PNL-6470, *Revised Ground-Water Monitoring Compliance Plan for the 183-H Solar Evaporation Basins*	1986	Interim Status Compliance[a]
DOE/RL-88-04, Rev. 1, Rev. 2, and Rev. 3, *Interim Status Closure/Post-Closure Plan 183-H Solar Evaporation Basins*	1988, 1990, 1991	Interim Status Compliance[a]
WHC-SD-EN-AP-180, *Groundwater Monitoring Plan for the 183-H Solar Evaporation Basins*	1995	Final Status Compliance[b]
PNNL-11573, *Groundwater Monitoring Plan for the 183-H Solar Evaporation Basins*[c]	1997	Final Status Corrective Action[d]

[a] The compliance monitoring programs in PNL-6470 and DOE/RL-88-04 were developed to satisfy the requirements in 40 CFR 265.90, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Applicability," and WAC 173-303-400, "Dangerous Waste Regulations," "Interim Status Facility Standards."

[b] The compliance monitoring program satisfied the requirements of WAC 173-303-645(10), "Dangerous Waste Regulations," "Releases from Regulated Units," "Compliance Monitoring Program."

[c] The requirements identified in PNNL-11573 were incorporated in WA7890008967, *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste*.

[d] The corrective action monitoring program satisfies the requirements of WAC 173-303-645(11), "Dangerous Waste Regulations," "Releases from Regulated Units," "Corrective Action Program."

Limited groundwater monitoring was conducted during the operational life of the 183-H Solar Evaporation Basins (1973 to 1985). Analytical sampling results in 1977 indicated the presence of groundwater contamination associated with Basin 1 (PNL-6470, p. 19). Due to known groundwater contamination, a facility-specific, RCRA compliance groundwater monitoring program for the 183-H Solar Evaporation Basins started in June 1985, as described in PNL-6470.

The 1985 compliance monitoring program was intended to meet 40 CFR 265.90(d), "Applicability," and WAC 173-303-400 but was determined to have an inadequate well network by Ecology. This determination resulted in a regulatory order (EPA and Ecology, 1986). In 1986 and 1987, 18 monitoring wells were installed, and a compliance plan (PNL-6470) was developed in response to the regulatory order (EPA and Ecology, 1986). Analytes monitored at all wells include temperature, pH, specific conductance, coliform bacteria, metals (aluminum, arsenic, barium, cadmium, calcium, chromium, copper, iron, lead, manganese, mercury, nickel, potassium, selenium, silver, sodium, vanadium, and zinc), anions (chloride, fluoride, nitrate, and sulfate), volatile organic compounds (1,1,1-trichloroethane, perchloroethylene, chloroform, and methylene chloride), pesticides, herbicides, total organic halogens, total organic carbon, ammonium ion, hydrazine, gamma scan, total alpha-emitters, total beta-emitters, gamma emitters, radium, uranium, and strontium-90 (PNL-6470, pp. 32-39). Two wells (199-H3-1 and 199-H4-3) were sampled for additional constituents that are identified in WAC 173-303-9905, "Dangerous Waste Constituents List" (PNL-6470, p. 33).

The 1986 monitoring plan (PNL-6470) was incorporated into the 1988 closure/post-closure plan (DOE/RL-88-04, Rev. 1) with the removal of hydrazine and the addition of phenol to the standard list of analyses. WCH-SD-EN-AP-180 (Section 4.7.1) reports that in May 1989, each of the monitoring wells in the network was analyzed for an extensive list of constituents that included those listed in WAC 173-303-9905, plus those constituents listed in 40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Appendix IX, "Ground-Water Monitoring List," that are not included in WAC 173-303-9905. The monitoring data indicated that most of the WAC 173-303-9905 constituents were below regulatory standards and continued monitoring was no longer needed. The monitoring plan was subsequently modified in 1990 to remove the WAC 173-303-9905 constituents and strontium-90 and add phosphate, total carbon, total dissolved solids, 1,1,2-trichloroethane, tetrachloroethene, xylene, hexone, radium, and technetium-99 to the standard list of analyses for groundwater samples (DOE/RL-88-04, Rev. 2). Under DOE/RL-88-04 (Rev. 2 and 3), 23 wells surrounding the basins were to be sampled on a monthly or quarterly basis until closure activities were concluded.

The 1994 Hanford Facility RCRA Permit required groundwater monitoring programs under final status to comply with requirements of WAC 173-303-645. Accordingly, a final status compliance monitoring program for the 183-H Solar Evaporation Basins (WHC-SD-EN-AP-180) began in 1995. Previous monitoring had included up to 23 wells, many of which were outside the area influenced by the basins. Information from these wells defined the contaminant plume boundaries and provided groundwater chemistry data for the larger 100-H Area. The wells identified in WHC-SD-EN-AP-180 were intended to meet the requirements of compliance monitoring of the identified constituents of concern (nitrate, chromium, uranium, and technetium-99) and represented conditions upgradient of the basins as well as in the most contaminated zone downgradient of the basins. The network consisted of eight wells: 199-H4-6 and 199-H3-2A (upgradient) and 199-H4-3, 199-H4-4, 199-H4-9, 199-H4-12A, 199-H4-18, and 199-H4-12C (downgradient). Groundwater samples were collected semiannually and analyzed for nitrate, chromium, uranium, and technetium-99.

The first sample set collected under the 1995 compliance monitoring plan showed that downgradient concentrations of nitrate, chromium, uranium, and technetium-99 exceeded concentration limits identified in the monitoring plan (WHC-SD-EN-AP-180). The exceedance was reported to Ecology through a letter in 1996 (Furman, 1996). Corrective action groundwater monitoring at the 183-H Solar Evaporation Basins, as required in WAC 173-303-645(11), was then initiated in 1997 under PNNL-11573. The corrective action groundwater monitoring plan (PNNL-11573) was incorporated into the post-closure plan (DOE/RL-97-48) in 1997 and the Hanford Facility RCRA Permit. The corrective action was implemented through the interim remedial action under CERCLA for the 100-HR-3 Groundwater OU.

Groundwater monitoring under PNNL-11573 included sampling from a network of four wells (199-H4-3, 199-H4-7, 199-H4-12A, and 199-H4-12C). These wells were identified based on their location within the chromium plume and met the monitoring objective of tracking concentration trends in the contaminant plume during the IRM. None of these wells were upgradient wells because of changes in the flow system from pump and treat activities and river stage effects. Samples were collected annually and analyzed for dangerous waste constituents (chromium and nitrate), waste indicators (technetium-99 and uranium), additional constituents to aid data interpretation (alkalinity, anions [chloride and sulfate], and selected metals [aluminum, antimony, barium, beryllium, cadmium, calcium, cobalt, copper, iron, magnesium, manganese, nickel, potassium, silver, sodium, vanadium, and zinc]), and field parameters (pH, specific conductance, temperature, and turbidity). Fluoride was also monitored as an indicator of 183-H contamination in groundwater because of previous releases from Basin 1. Water level measurements were collected each time a sample was obtained from a network well.

Hexavalent chromium samples are often collected from 183-H monitoring wells, as part of the CERCLA monitoring program. The hexavalent chromium plume for high and low river stage of 2014 are presented in Figures 3-10 and 3-11. The hexavalent chromium plume near well 199-H4-86, shown on Figure 3-10,

is likely associated with waste site 100-H-46, while the plume near the river appears to be associated with the 183-H Solar Evaporation Basins (Figure 3-10 and 3-11).

Since its issuance in 1997, two changes to the well network identified in PNNL-11573 were made to accommodate waste site remediation. In 2005, well 199-H4-7 was removed from the monitoring network and replaced with well 199-H4-8. The Hanford Facility RCRA Permit was modified to incorporate this change. In 2013, the permit was again modified to change the monitoring network because well 199-H4-3 required decommissioning due to its proximity to an active soil remediation site. Well 199-H4-84 was added to the network in May 2013 to replace 199-H4-3. Ecology approved this revision by letter (13-NWP-051, "Approval of 13-EMD-0019, Class 2 Modification to the Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste, Part VI, Post-Closure Unit 2, 183-H Solar Evaporation Unit (T-1-4) WA7890008967").

Chromium at the 183-H Solar Evaporation Basins is attributed to both the waste disposal activities at the basins and from other sources. The 1996 chromium plume clearly demonstrates the upgradient contribution (Figure 3-12). Chromium continues to be present at the basins and monitoring under the Hanford Facility RCRA Permit will continue.

As with chromium, nitrate contamination was the result of multiple sources. Historically, the highest concentrations of nitrate were found in wells 199-H4-18 and 199-H4-69, located to the south of the basins. In 2013 and 2014, nitrate concentrations in 100-H Area did not exceed the 45 mg/L DWS[11] (DOE/RL-2014-32, *Hanford Site Groundwater Monitoring Report for 2013*; DOE/RL-2015-07). In 2012, four wells at and near the 183-H Solar Evaporation Basins exceeded the nitrate DWS with a peak concentration of 135 mg/L at 199-H4-84 in August 2012 (DOE/RL-2013-22, *Hanford Site Groundwater Monitoring Report for 2012*; Appendix D).

Uranium, technetium-99, and fluoride are removed from 183-H Solar Evaporation Basins monitoring under this plan. Uranium is attributed to the basins and monitoring of uranium is performed under CERCLA. Technetium-99 concentrations have been below the maximum contaminant level (MCL) since 2005, and fluoride has not been detected above the MCL. Technetium-99 monitoring is performed under the AEA groundwater monitoring program (DOE/RL-2015-56). Monitoring of fluoride will be discontinued.

Under this monitoring plan, the network is modified to replace well 199-H4-12A with 199-H4-85, which is closer to the site, and remove 199-H4-12C. Well 199-H4-12C is an extraction well that is completed in the first water bearing unit of the RUM unit, a confined aquifer. As reported in SGW-52135, *First Semiannual Report for 2011 Post-Closure Corrective Action Groundwater Monitoring at the 183-H Solar Evaporation Basins and 300 Area Process Trenches: January-June 2011* (Section 2.3), chromium concentrations from well 199-H4-12C reflect contamination from past releases that entered the RUM.

[11] Nitrate may be expressed as nitrate-nitrogen (NO_3-N) or as nitrate (NO_3). The drinking water standard for NO_3-N is 10,000 µg/L, and the mathematical equivalent value for nitrate (NO_3) is 45,000 µg/L.

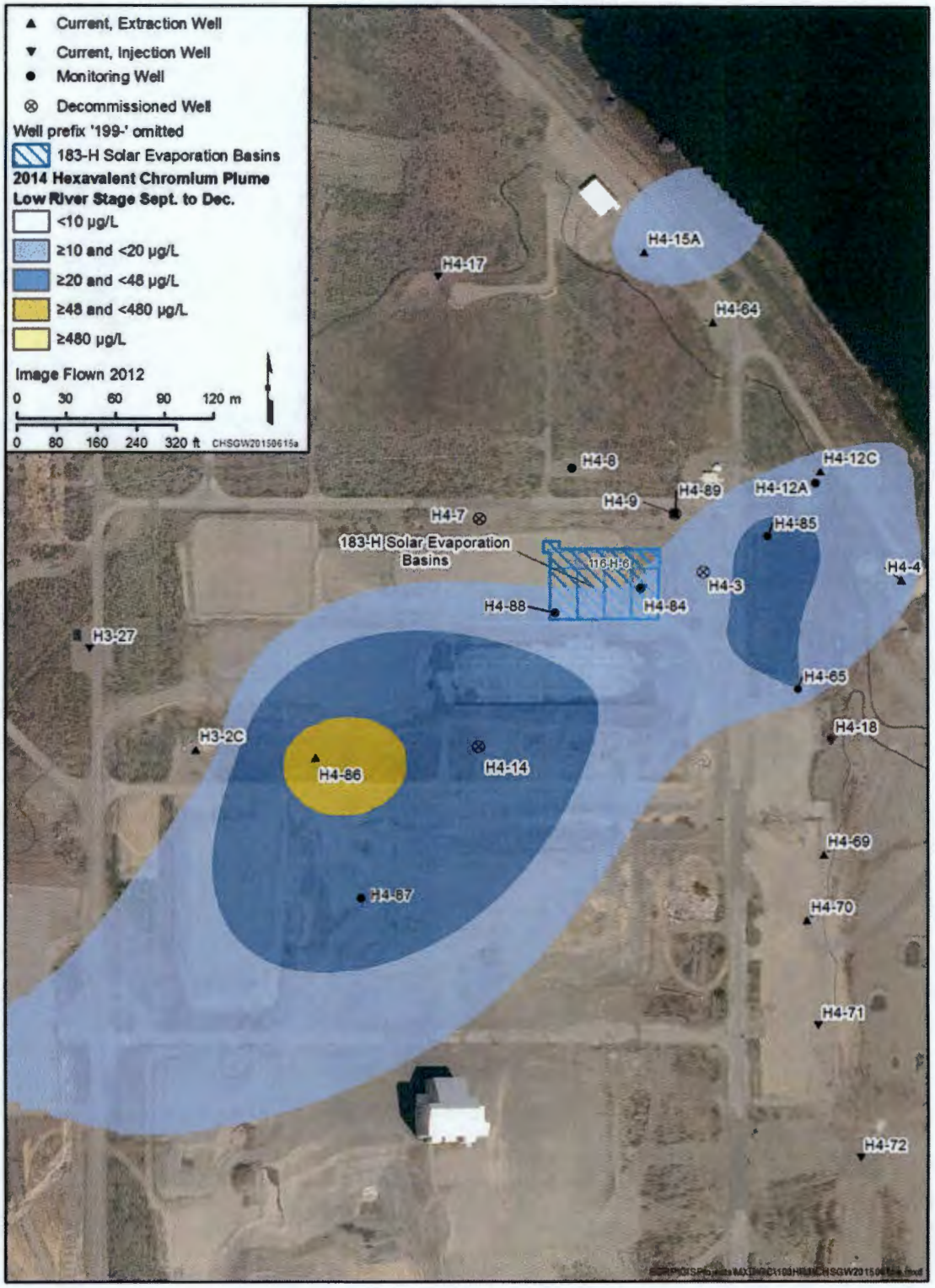
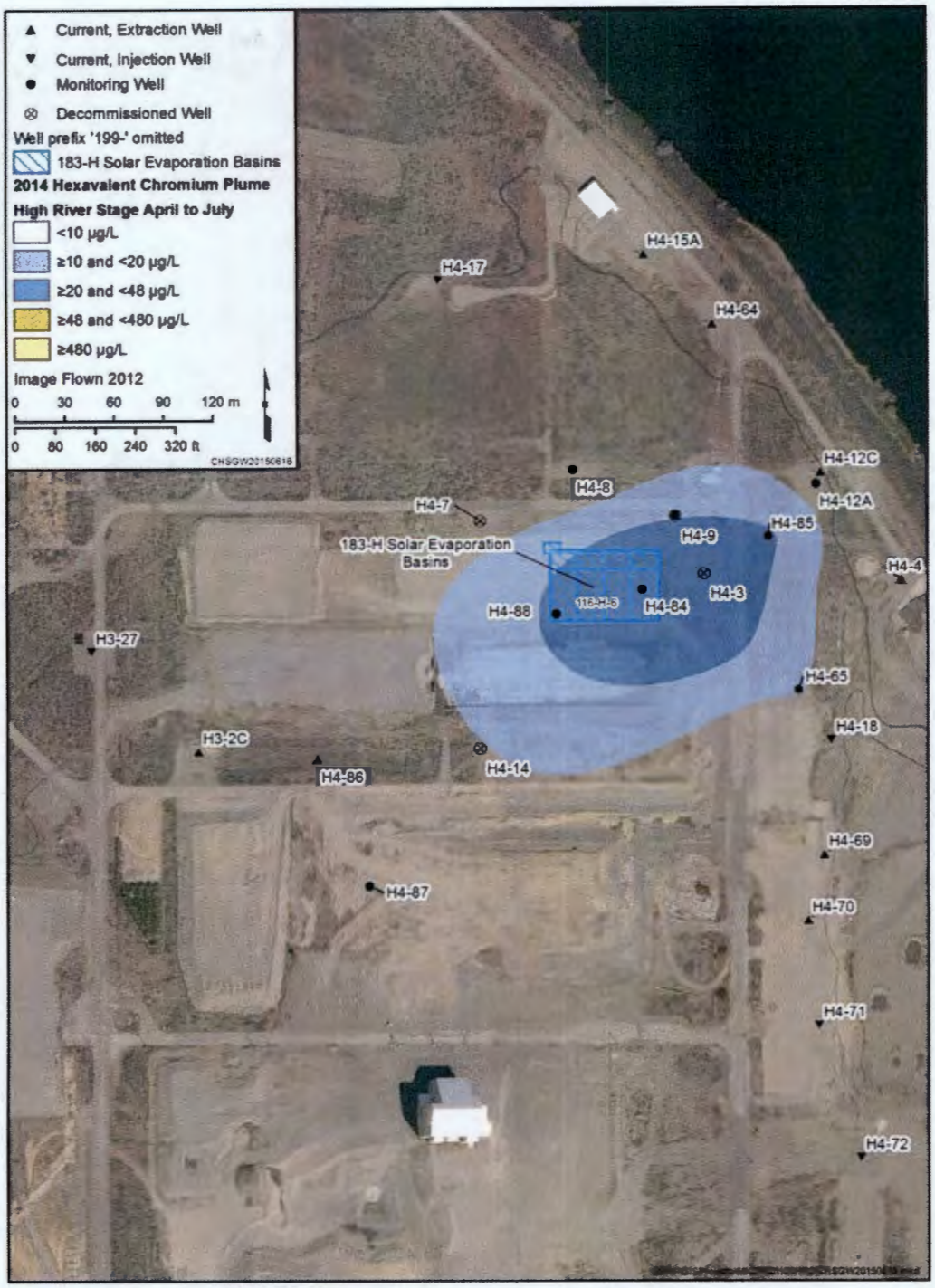


Figure 3-10 2014 Hexavalent Chromium Plume during Low River Stage (September to December)



Note: High and low river stage are evaluated each year based on actual flows. For the year presented (2014) high river stage occurred from April through the end of July (DOE/RL-2015-07, *Hanford Site Groundwater Monitoring Report for 2014* [Figure 4-6]).

Figure 3-11 2014 Hexavalent Chromium Plume during High River Stage (April through July)

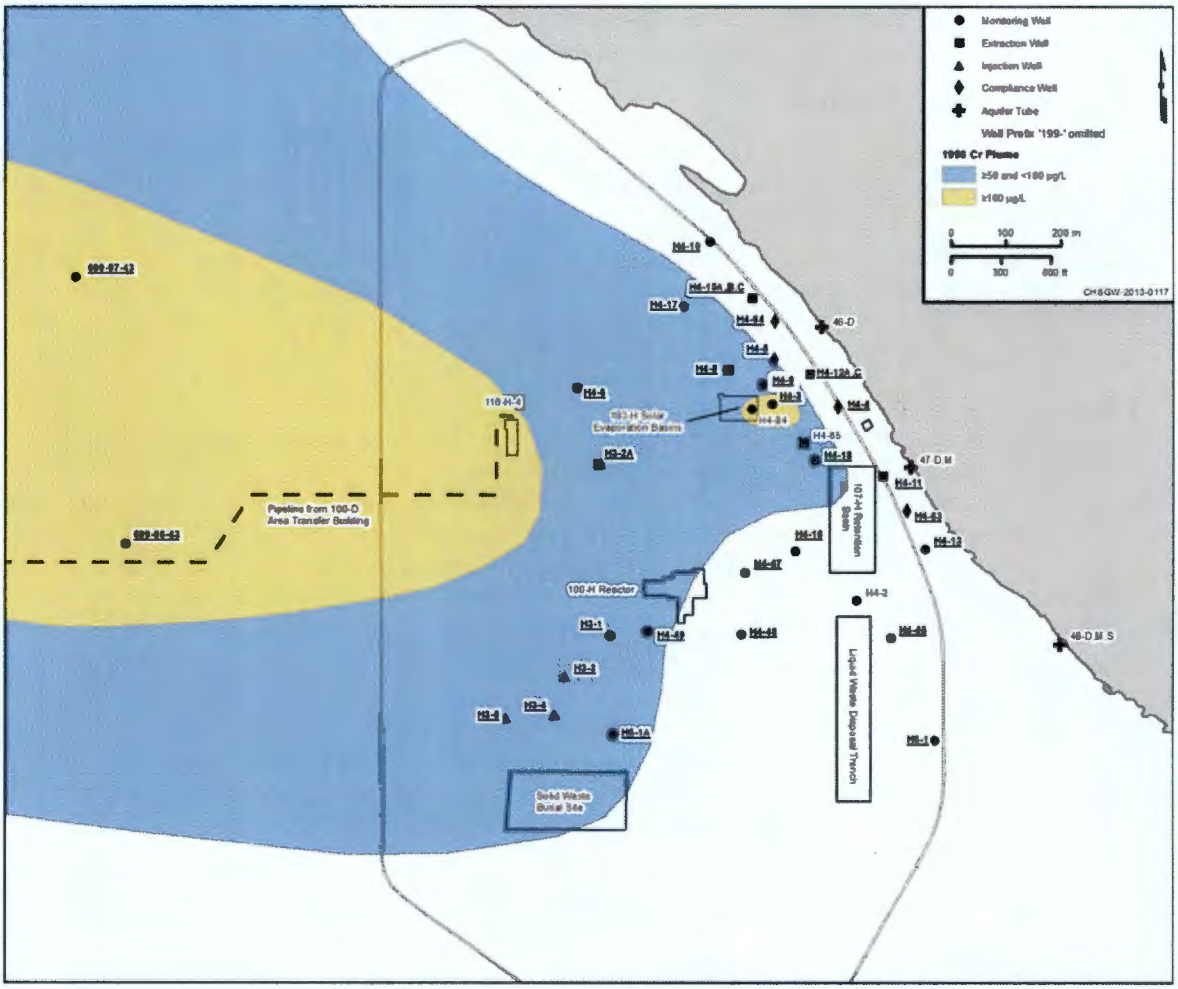


Figure 3-12 100-H Area Chromium Plume in 1996

Hexavalent chromium levels in well 199-H4-12C declined from approximately 300 µg/L in the early 1990s, and were stable until 2009, when the well was connected to the 100-HR-3 pump and treat system (see Appendix D, Figure D-5). After the connection, hexavalent chromium concentrations climbed, as contaminated groundwater was pulled towards the extraction well. This conclusion is also supported by observation that basin co-contaminants (i.e., nitrate, technetium-99, and uranium) are not elevated in well 199-H4-12C (SGW-52135, Section 2.3), and that the 100-H aquifer test and rebound study suggests that there is low communication between the unconfined aquifer and the confined aquifer at this location (SGW-47776, *Aquifer Testing and Rebound Study in Support of the 100-H Deep Chromium Investigation*, Section 4.1).

This plan includes three existing monitoring wells (199-H4-8, 199-H4-84, and 199-H4-85) and two additional new monitoring wells (199-H4-88 and 199-H4-89), which were drilled 2016. The sampling frequency is modified from annual to semiannual. The new wells will be sampled quarterly for two years to obtain sufficient data for statistical evaluation. Samples will be analyzed semiannually for total chromium (filtered), nitrate, and field parameters under this plan. Water level measurements are collected each time a sample is obtained from a network well. Most of the network wells also are included in the annual comprehensive March water level measurement campaign (SGW-38815, *Water-Level Monitoring Plan for the Hanford Site Soil and Groundwater Remediation Project*). Groundwater monitoring results for the 183-H Solar Evaporation Basins are reported on a semiannual basis per WAC 173-303-645(11)(g)

and are summarized annually in the annual Hanford Site RCRA groundwater monitoring report (e.g., DOE/RL-2016-12, *Hanford Site RCRA Groundwater Monitoring Report for 2015*).

3.1.6 Conceptual Site Model

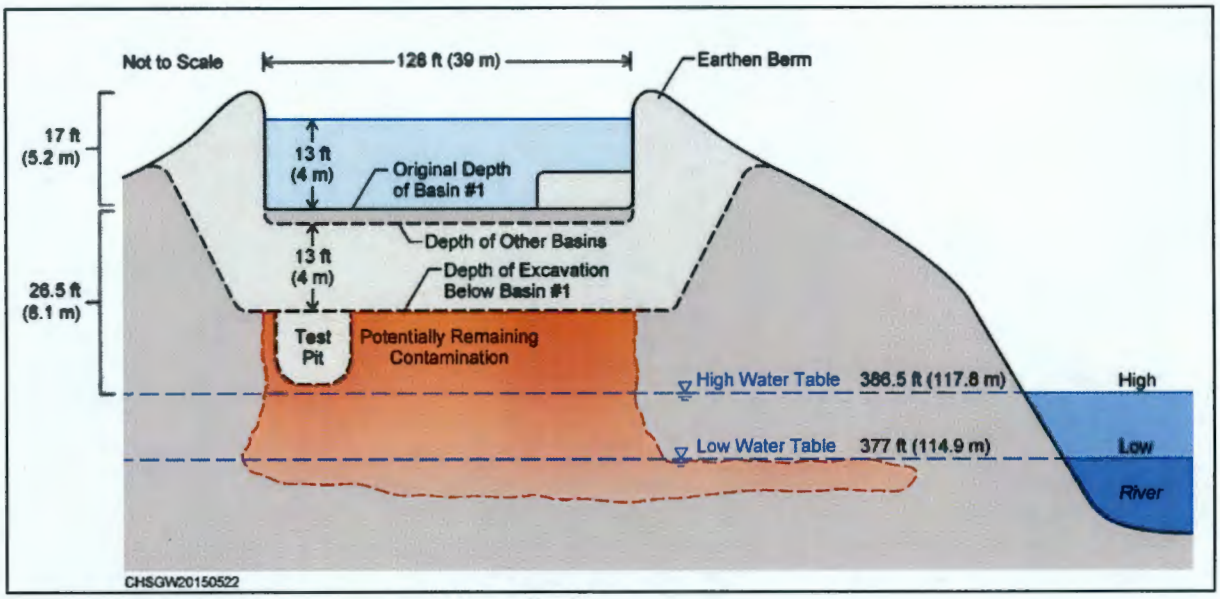
This section describes the 183-H Solar Evaporation Basins CSM for potential contaminant transport to guide future groundwater monitoring. The CSM (Figure 3-13) describes the current understanding of the contaminant release and transport.

The most likely sources of chromium contamination from the 183-H Solar Evaporation Basins included sodium dichromate dihydrate used for corrosion control in reactor cooling water when the basins were used as a water treatment facility and the liquid waste discharged into the basins when they were used as evaporation basins.

Source remediation removed the engineered structure and soil contaminants underneath the 183-H Solar Evaporation Basin as necessary to reduce or eliminate the potential for: direct exposure, migration of contaminants through the vadose zone to the groundwater, and wind-blown suspended particles. Dangerous waste constituents of concern during remediation were arsenic, hexavalent chromium, copper, fluoride, nitrate, and nickel (DOE/RL-97-48, Table 1-1). Remediation extended to 0.6 m (2 ft) beneath each basin. Below Basin 1, additional soil was removed to depths of up to 4.6 m (15 ft) below the former structure (DOE/RL-97-48). A test pit below Basin 1 was dug to 7.6 m (25 ft) (DOE/RL-97-48, Section 1.2.4). DOE/RL-97-48 does not specify whether the Basin 1 test pit depth is measured from ground surface or from the excavation depth, however, the test pit results represent soil at least 7.6 m (25 ft) bgs. Both nitrate and fluoride contamination were identified at this depth (DOE/RL-97-48, Section 1.2.4). Since removal of the source of contamination (the basin liquids) in the late 1980s, contaminant concentrations in the groundwater have declined. However, at the time of closure, the extent of remaining contamination extended from a depth of 4.6 m (15 ft) below the bottom of the basin structure to groundwater, and appeared to include fluoride and nitrate (DOE/RL-97-48, Section 1.2.4).

An evaluation of the borehole and Basin 1 test pit sample results for the 183-H Solar Evaporation Basins was performed as part of the CERCLA remedial investigation/feasibility study conducted in 2009 through 2010 (DOE/RL-2010-95, Section 4.3.17). In 1991, eight boreholes were drilled in and around the basins. Of the four boreholes within the basins (A5716/17/18/19), the depths ranged from 9.6 m (31.5 ft) to 10.2 m (33.4 ft) bgs. Of the four boreholes outside of the basins (A5720/21/22/23), the depths ranged from 11.3 m (37.0 ft) to 17.3 m (56.9 ft) bgs. In 2011, a borehole within the Basin 1 footprint was drilled to 14.8 m (48.6 ft) bgs.

Contaminant distribution in individual boreholes indicated that technetium-99, strontium-90, and tritium concentrations increased with depth, but their levels were typically <2 to 7 pCi/g (Table 3-2). Nitrate reached a maximum of 304 mg/kg at 10.2 m (33.4 ft) bgs, while hexavalent chromium concentrations were <2 mg/kg beneath the site. Only eight contaminants (cobalt-60, technetium-99, antimony, cadmium, lead, selenium, nitrite, and fluoride) either were detected in the vadose zone (those with no background concentration established) or were present above background levels from boreholes adjacent to the site (Table 3-2). Detecting fewer contaminants adjacent to the site suggests that transport was mainly vertical beneath the site with little lateral spreading in the vadose zone. Hexavalent chromium and nitrate were the only contaminants detected above the MCLs in groundwater (48 µg/L and 45 mg/L, respectively) beneath this site in 2009. From amongst the monitoring well network since 2010, hexavalent chromium continues to be detected above the MCL (48 µg/L) in well 199-H4-12C (Appendix D). Nitrate above the MCL (45 mg/L) was detected at wells 199-H4-3 (2011, 2012), 199-H4-12A (2012), and 199-H4-84 (2012) (Appendix D).



Note: Water table elevations are in NAVD88, *North American Vertical Datum of 1988*.

Figure 3-13 Conceptual Site Model for the 183-H Solar Evaporation Basins

Table 3-2 Summary of Soil Contaminants Detected above Background at the 183-H Solar Evaporation Basin Boreholes

Contaminant	Maximum Result[a,b] (pCi/g) with Corresponding Depth (m/ft) bgs	Borehole (Sampling Year)	Extent of Detection Above Background (m/ft) bgs	Result (pCi/g)[c]	Borehole (Sampling Year)
Cobalt-60	0.01 (7.8/25.6)	A5720 (1991)	7.8/25.6	0.01	A5720 (1991)
Strontium-90	0.365 (11.3/37.0)	C7860 (2011)	11.3/37.0	0.365	C7860 (2011)
Technetium-99	6.6 (10.2/33.4)	A5716 (1991)	14.3/46.9	0.5	A5720 (1991)
Tritium	6.35 (8.3/27.1)	C7860 (2011)	13.1/43.0	4.96	C7860 (2011)
Contaminant	**Maximum Result[a] (mg/kg) with Corresponding Depth (m/ft) bgs**	**Borehole (Sampling Year)**	**Extent of Detection Above Background (m/ft) bgs**	**Result (mg/kg)[c]**	**Borehole (Sampling Year)**
Antimony	19.2 (9.8/32.0)	A5718 (1991)	14.8/48.6	0.292	C7860 (2011)
Cadmium	4.5 (6.4/21.0)	A5721 (1991)	9.6/32.0	0.6	A5718 (1991)

Contaminant	Maximum Result[a] (mg/kg) with Corresponding Depth (m/ft) bgs	Borehole (Sampling Year)	Extent of Detection Above Background (m/ft) bgs	Result (mg/kg)[c]	Borehole (Sampling Year)
Fluoride	10.5 (10.2/33.4)	A5716 (1991)	11.4/37.4	4.2	A5722 (1991)
Lead	36.5 (3.8/12.6)	C7860 (2011)	11.4/37.4	11.9	A5722 (1991)
Nitrite	5.0 (9.8/32.0)	A5718 (1991)	9.8/32.0	5.0	A5718 (1991)
Selenium	3.9 (9.8/32.0)	A5718 (1991)	9.8/32.0	3.9	A5718 (1991)

Reference: DOE/RL-2010-95, *Remedial Investigation/Feasibility Study for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units*, Appendix D, Tables D-91, D-92, and D-93

[a] Eight of the boreholes included in the DOE/RL-2010-95 evaluation were sampled in 1991, before remediation of the 183-H Solar Evaporation Basins. The remediation depth for the site reported in the DOE/RL-2010-95 is 2.7 m (9 ft) bgs, with a remediation depth of 6.1 m (20 ft) bgs at Basin 1. To present results that represent depths below remediation, only results from sampling depths greater than 2.7 m (9 ft) bgs for the eight 1991 boreholes are considered in this summary table, except for borehole A5716 which was located within Basin 1. For A5716, results from sampling depths greater than 6.1 m (20 ft) bgs are considered for the summary. All results for C7860, drilled in 2011, are considered for the summary.

[b] Radionuclide activities are decayed to 2012 (DOE/RL-2010-95).

[c] Maximum result from amongst the deepest samples collected at each of the nine, 183-H Solar Evaporation Basin boreholes evaluated in DOE/RL-2010-95.

bgs = below ground surface

The hydraulic and geochemical properties of this region control the downward movement of liquids and contaminants released near ground surface. Any residual contaminants that remain in the vadose zone after the cessation of waste discharges can migrate downward by any of four mechanisms:

- Contaminants may continue to move by gravity drainage of residual wastewater within the vadose zone (this process is not believed to be continuing at this time).
- Contaminants may be mobilized in the fraction of annual precipitation that actually percolates deep into the vadose zone to recharge into the aquifer (this process may be ongoing if contaminants are present in the vadose zone).
- Contaminants may be mobilized into groundwater from the vadose zone during seasonal increases in groundwater table elevation resulting from high river stages (this process may be ongoing if contaminants are present in the vadose zone).
- Contaminants may be mobilized in water added for dust control during remedial actions (for example, excavation) and migrate deeper into the vadose zone (this process may be ongoing if contaminants are present in the vadose zone).

At 183-H, chromium continues to be detected in the groundwater at the site. This indicates the chromium is present in the vadose zone soil. During periods of high river stage, some of this chromium is released into the groundwater. Chromium concentrations appear to fluctuate seasonally in response to changing river stage at the 183-H Solar Evaporation Basins. The chromium concentrations typically rise when groundwater elevations are low in the wells located downgradient from the basins. This correlation is also seen in specific conductance, indicating that there is less river water in the aquifer during low water periods. This further suggests there is remaining contamination in the vadose zone that is mobilized to

groundwater during elevated water table periods. The chromium concentrations in the vicinity of the 183-H Solar Evaporation Basins have been below 48 µg/L in the unconfined aquifer since 2005 (as shown in Appendix D). Chromium concentrations within the first water bearing unit of the RUM continue to have chromium concentrations near 120 µg/L, however the contamination in that aquifer have been determined to not originate from the basins and monitoring of that aquifer is not included in this plan.

3.1.7 Corrective Action and Groundwater Monitoring Requirements

The groundwater monitoring program at 183-H Solar Evaporation Basins is conducted with the objectives identified in WAC 173-303-645, as required by the Hanford Facility RCRA Permit, Part II, Condition II.F. Corrective action groundwater monitoring is implemented in accordance with WAC 173-303-645(11), which requires the establishment and implementation of a groundwater monitoring program that is capable of demonstrating the effectiveness of the corrective action, currently pump and treat. This requirement states two general objectives:

The corrective action groundwater monitoring program may be based on the requirements for a compliance monitoring program under WAC 173-303-645(10) and must be as effective as that program in determining compliance with the groundwater protection standard under WAC 173-303-645(3).

Monitoring during corrective actions must be capable of determining the effectiveness of the corrective action program.

Table 3-3 identifies where each groundwater monitoring element of the pertinent applicable regulations is addressed within this plan.

WAC 173-303-645(11) includes requirements for a corrective action program. Part VI, Post Closure Unit 2, Chapter 4 of the Hanford Facility RCRA Permit contains the corrective action plan for the 183-H Solar Evaporation Basins. The plan specifies that groundwater corrective action to remove hexavalent chromium is being undertaken as an interim remedial measure under CERCLA for the entire 100-HR-3 OU. The CERCLA action is not under the purview of this groundwater monitoring plan. Table 3-4 identifies where elements of corrective action under WAC 173-303-645(11) are discussed within this groundwater monitoring plan. Some components of the corrective action requirements also apply to groundwater monitoring requirements and are incorporated within Table 3-3, as appropriate.

Table 3-3 Pertinent WAC 173-303-645 Corrective Action Groundwater Monitoring Requirements		
Groundwater Monitoring Element	**Pertinent Requirement***	**Section Where Requirement Is Addressed in Monitoring Plan**
Groundwater Monitoring Program	WAC 173-303-645(11) "Corrective Action Program": (d) In conjunction with a corrective action program, the owner or operator must establish and implement a groundwater monitoring program to demonstrate the effectiveness of the corrective action program. Such a monitoring program may be based on the requirements for a compliance monitoring program under subsection (10) of this section, and must be as effective as that program in determining compliance with the groundwater protection standard under subsection (3) of this section, and in determining the success of a corrective action program under (e) of this subsection, where appropriate.	Section 3.2.1 Section 3.2.2 Section 3.2.3 Section 3.2.4 Section 3.2.5 Section 3.2.7 Section 3.3.1 Section 3.3.2
Groundwater Protection Standard	WAC 173-303-645(3) "Groundwater Protection Standard": Conditions specified in the facility permit are designed to ensure that dangerous constituents under WAC 173-303-645(4), detected in the groundwater from a regulated unit do not exceed the concentration limits under WAC 173-303-645(5), in the uppermost aquifer underlying the waste management area beyond the point of compliance under WAC 173-303-645(6), during the compliance period under WAC 173-303-645(7).	Section 3.2.2
Dangerous Constituents	WAC 173-303-645(4) "Dangerous Constituents": (a) The facility permit will specify the dangerous constituents to which the groundwater protection standard of WAC 173-303-645(3) applies.	Section 3.2.1
Concentration Limits	WAC 173-303-645(5) "Concentration Limits": (a) The facility permit will specify concentration limits in the groundwater for the dangerous constituents established under WAC 173-303-645(4) of this section. (ii) For constituents listed in Table 3-2, the concentration limit must not exceed the value given in that table if the background level of the constituent is below the value given in Table 3-2.	Section 3.2.2
Point of Compliance	WAC 173-303-645(6) "Point of Compliance": The facility permit will specify the point of compliance at which the groundwater protection standard WAC 173-303-645(3) applies and at which monitoring must be conducted. The point of compliance is a vertical surface located at the hydraulically downgradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated units.	Section 3.2.3

Compliance Period	WAC 173-303-645(7) "Compliance Period": (a) The facility permit will specify the compliance period during which the groundwater protection standard of WAC 173-303-645(3) applies. The compliance period is the number of years equal to the active life of the waste management area (including any waste management activity prior to permitting, and the closure period). (c) If the owner or operator is engaged in a corrective action program at the end of the compliance period specified in (a), the compliance period is extended until the owner or operator can demonstrate that the groundwater protection standard of WAC 173-303-645(3) has not been exceeded for a period of three consecutive years.	Section 3.2.4 Section 3.3.2 Appendix D
Number and Location of Wells	WAC 173-303-645(8) "General Groundwater Monitoring Requirements": (a) The groundwater monitoring system must consist of a sufficient number of wells, installed at appropriate locations and depths to yield groundwater samples from the uppermost aquifer that: (i) Represent the quality of background groundwater that has not been affected by leakage from a regulated unit; (ii) Represent the quality of groundwater passing the point of compliance. (iii) Allow for the detection of contamination when dangerous waste or dangerous constituents have migrated from the waste management area to the uppermost aquifer.	Section 3.2.5
Well Configuration	WAC 173-303-645(8) "General Groundwater Monitoring Requirements": (c) All monitoring wells must be cased in a manner that maintains the integrity of the monitoring well borehole. This casing must allow collection of representative groundwater samples. Wells must be constructed in such a manner as to prevent contamination of the samples, the sampled strata, and between aquifers and water bearing strata. Wells must meet the requirements applicable to resource protection wells, which are set forth in WAC 173-160, "Minimum standards for construction and maintenance of wells."	Section 3.2.5 Appendix C
Frequency of Sampling Water Level Measurements	WAC 173-303-645(8) "General Groundwater Monitoring Requirements": (f) The groundwater monitoring program must include a determination of the groundwater surface elevation each time groundwater is sampled. (g) The owner or operator will determine an appropriate sampling procedure and interval for each hazardous constituent listed in the facility permit.	Section 3.2.1 Appendix B, Section B2.2

Procedures and Techniques	WAC 173-303-645(8) "General Groundwater Monitoring Requirements": (d) The groundwater monitoring program must include at a minimum, procedures and techniques for: (i) Decontamination of drilling and sampling equipment; (ii) Sample collection; (iii) Sample preservation and shipment; (iv) Analytical procedures and quality assurance; and (v) Chain of custody control. (e) The groundwater monitoring program must include consistent sampling and analytical methods that ensure reliable groundwater sampling, accurately measure dangerous constituents and indicator parameters in groundwater samples, and provide a reliable indication of groundwater quality below the waste management area.	Appendix A, Appendix B, Chapter B2 and Sections B5.1, B5.2, and B5.3
Statistical Evaluation Statistical Methods	WAC 173-303-645(8) "General Groundwater Monitoring Requirements": (h) Groundwater monitoring data will be evaluated using a specified statistical method. The statistical test will be conducted separately for each dangerous constituent in each well. A statistical method not specified in the subsection may be submitted for approval. (i) The statistical method must be appropriate for the distribution of the dangerous constituent. The practical quantification limit used in the statistical method must be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.	Section 3.3.2 Appendix A, Section A3.1
Recordkeeping and Reporting	WAC 173-303-645(8) "General Groundwater Monitoring Requirements": (j) Groundwater monitoring data collected in accordance with WAC 173-303-645(8)(g) including actual levels of constituents must be maintained in the facility operating record. The permit specifies when the data must be submitted for review.	Appendix A, Sections A2.6 and A3.9

Note: Complete citations for references listed in this table are provided in Chapter 5 of this plan.

* Part II, Condition II.F of the Hanford Facility RCRA Permit specifies that a groundwater monitoring program under final status is subject to the requirements of WAC 173-303-645. Because of previous exceedances of the prescribed concentration limits identified in the previous monitoring plan (PNNL-11573), the 183-H Solar Evaporation Basins are subject to corrective action monitoring under WAC 173-303-645(11).

WAC = *Washington Administrative Code*

Table 3-4 Pertinent WAC 173-303-645(11) Corrective Action Requirements		
Corrective Action Element	**Pertinent Requirement**	**Section Where Requirement is Discussed in Monitoring Plan**
Corrective Action Program	WAC 173-303-645(11) "Corrective Action Program": (a) Corrective action to ensure that regulated units comply with the groundwater protection standard under WAC 173-303-645(3). The groundwater protection standard will be specified in the facility permit, including: (i) A list of the dangerous constituents and parameters identified under WAC 173-303-645(4); (ii) Concentration limits under WAC 173-303-645(5), for each of those dangerous constituents and parameters; (iii) The compliance point under WAC 173-303-645(6); and (iv) The compliance period under WAC 173-303-645(7).	Section 3.2.1 Section 3.2.2 Section 3.2.3 Section 3.2.4
Corrective Action	(b) The owner or operator must implement a corrective action program that prevents dangerous constituents and parameters from exceeding their respective concentration limits at the compliance point by removing the dangerous waste constituents and parameters or treating them in place. The permit will specify the specific measures that will be taken. (c) The owner or operator must begin corrective action within a reasonable time period after the groundwater protection standard is exceeded. The department will specify that time period in the facility permit. (e) In addition to the other requirements of this section, the owner or operator must conduct a corrective action program to remove or treat in place any dangerous constituents or parameters under subsection (4) of this section, that exceed concentration limits under subsection (5) of this section, in groundwater between the compliance point under subsection (6) of this section, and the downgradient facility property boundary; and beyond the facility boundary, where necessary to protect human health and the environment, unless the owner or operator demonstrates to the satisfaction of the department that, despite the owner's or operator's best efforts, the owner or operator was unable to obtain the necessary permission to undertake such action. The owner/operator is not relieved of all responsibility to clean up a release that has migrated beyond the facility boundary where off-site access is denied. On-site measures to address such releases will be determined on a case-by-case basis. For a facility seeking or required to have a permit, the corrective action measures to be taken must be specified in the permit. (f) The owner or operator must continue corrective action measures during the compliance period to the extent necessary to ensure that the groundwater protection standard is not exceeded.	Section 3.1.2 Section 3.2.4

	If the owner or operator is conducting corrective action at the end of the compliance period, he must continue that corrective action for as long as necessary to achieve compliance with the groundwater protection standard. The owner or operator may terminate corrective action measures taken beyond the period equal to the active life of the waste management area (including the closure period) if he can demonstrate, based on data from the groundwater monitoring program under (d) of this subsection, that the groundwater protection standard of subsection (3) of this section, has not been exceeded for a period of three consecutive years.	
Recordkeeping and Reporting	WAC 173-303-645(11) "Corrective Action Program": (g) The owner or operator must report in writing to the department on the effectiveness of the corrective action program. The owner or operator must submit these reports semiannually. (h) If the owner or operator determines that the corrective action program no longer satisfies the requirements of this section, he must, within forty-five days, submit an application for a permit modification to make any appropriate changes to the program.	Section 3.3.4
Note: The references cited in this table are listed in the reference section (Chapter 5) of this plan. WAC = *Washington Administrative Code*		

3.2 GROUNDWATER MONITORING PROGRAM

This chapter describes the corrective action groundwater monitoring program for 183-H Solar Evaporation Basins consisting of dangerous waste constituents, field parameters, concentration limit, point of compliance, compliance period, a monitoring well network, and sampling and analysis protocols. The monitoring program presented herein has been revised from that presented in the previous plan (PNNL-11573), and supersedes the monitoring program of the previous plan.

3.2.1 Constituents List and Sampling Frequency

Table 3-5 presents the wells in the groundwater monitoring network, constituents analyzed as required for corrective action monitoring, and sampling frequency for monitoring of the 183-H Solar Evaporation Basins. The dangerous waste constituents identified for the 183-H Solar Evaporation Basins are total chromium, collected as a filtered sample, and nitrate. The sampling frequency in this revised plan is changed from annual to semiannual to align with semiannual reporting requirements under WAC 173-303-645(11)(g). Total chromium (filtered) and nitrate will be sampled semiannually with collection scheduled during low river stage (typically September through December) and high river stage (typically April through August) (note: for 2014, high river stage extended from the first part of April through the end of July). Field parameters (pH, specific conductance, temperature, dissolved oxygen, and turbidity) will also be sampled semiannually. New wells (199-H4-88 and 199-H4-89) will be sampled quarterly for the first 2 years to collect sufficient samples to support statistical evaluation (Section 3.3.2). Water level measurements at each monitoring well will be determined each time a sample is obtained (WAC 173-303-645(8)(f)).

Maintenance problems and sampling logistics resulting from multiple factors including environmental (i.e., inclement weather) and access restrictions (i.e., heightened fire danger, area access restriction due to work by other Hanford contractors such as in the tank farms) sometimes delay scheduled sampling events. Sampling events are scheduled by month. The Field Work Supervisor (FWS) determines the specific times within a given month that a well will be sampled. If a well cannot be sampled at the times determined by the FWS, then the FWS and Sampling Management and Reporting group, along with the project scientist, will consult on how best to recover or reschedule the sampling event as close to the original sampling date as possible. If it is observed during the pre-sampling walkdown that one or more network wells cannot be sampled, then sampling of the well network will not begin and management will be notified. Depending on the situation, the network sampling will be rescheduled within a short time frame (such as 3 to 4 weeks). In some cases, it may not be obvious that sampling cannot be performed until a well is accessed (e.g., an issue with a pump).

Missed sampling events that are not rescheduled within the same month are given top priority when rescheduling sampling for the following month. In the event that a sampling delay has occurred and the representativeness of the samples is in question, DOE-RL and Ecology may agree to resampling wells. DOE-RL will provide informal notification to Ecology if sampling of the network is expected to be delayed for longer than 4 weeks. Ecology may provide input in a timely fashion to DOE-RL on how to proceed. Missed or cancelled sampling events are reported to DOE-RL, and are documented in the semiannual monitoring reports required by WAC 173-303-645(11)(g), and the annual Hanford Site RCRA groundwater monitoring report (e.g., DOE/RL-2016-12).

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Table 3-5 Monitoring Well Network for the 183-H Solar Evaporation Basins

Well Name	Purpose	WAC Compliant	Dangerous Waste Constituents and Other Parameters[a]							
				Dangerous Waste Constituent		Field Parameters				
			Water Level	Total Chromium (Filtered)	Nitrate	pH	Specific Conductance	Temperature	Dissolved Oxygen	Turbidity
199-H4-8	Corrective Action Monitoring	Y	S	S	S	S	S	S	S	S
199-H4-84	Corrective Action Monitoring	Y	S	S	S	S	S	S	S	S
199-H4-85	Corrective Action Monitoring	Y	S	S	S	S	S	S	S	S
199-H4-88[b]	Corrective Action Monitoring	Y	Q	Q	Q	Q	Q	Q	Q	Q
199-H4-88[c]	Corrective Action Monitoring	Y	S	S	S	S	S	S	S	S
199-H4-89[b]	Corrective Action Monitoring	Y	Q	Q	Q	Q	Q	Q	Q	Q
199-H4-89[c]	Corrective Action Monitoring	Y	S	S	S	S	S	S	S	S

[a] Monitoring as required under WAC 173-303-645(11), "Dangerous Waste Regulations," "Releases from Regulated Units," "Corrective Action Program."
[b] Sampling frequency for the first 2 years of monitoring.
[c] Sampling frequency following the first 2 years of monitoring.
Q = to be sampled quarterly
S = to be sampled semiannually
WAC = *Washington Administrative Code*
Y = well is, or will be, constructed as a resource protection well (WAC 173-160, "Minimum Standard for Construction and Maintenance of Wells")

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3.2.2 Concentration Limit

Dangerous waste constituents from the regulated waste unit may not exceed concentration limits established by the Hanford Facility RCRA Permit (WAC 173-303-645[5]). The concentration limit for total chromium (collected as a filtered sample) in the previous plan (PNNL-11573) was 122 µg/L. This value was determined in WHC-SD-EN-AP-180, based on background concentrations of upgradient wells 199-H3-2A and 199-H4-6. The concentration limit for nitrate was 45 mg/L in PNNL-11573. Concentration limits were applied during compliance monitoring to determine whether corrective action was necessary as required by WAC 173-303-645(10).

Concentration limits of dangerous waste constituents during corrective action are required in WAC 173-303-645(11). The concentration limit for total chromium (collected as a filtered sample) in this plan is 48 µg/L. This concentration represents the WAC 173-340-720(3), "Model Toxics Control Act-Cleanup," "Groundwater Cleanup Standards," "Method B Cleanup Levels for Potable Groundwater," groundwater cleanup level for hexavalent chromium, which is the soluble and mobile form of chromium and is equivalent to total chromium as a filtered sample. The concentration limit for nitrate is 45 mg/L (as NO_3) which is the drinking water standard in 40 CFR 141, "National Primary Drinking Water Regulations." Because of the previous exceedances of the concentration limits and the ongoing remedial action, any concentration limit exceedances at the point of compliance during the remediation period do not require additional action.

3.2.3 Point of Compliance

The point of compliance is defined in WAC 173-303-645(6) as "...a vertical surface located at the hydraulically downgradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated units." This is the location in the uppermost aquifer where groundwater monitoring occurs and the groundwater protection standard applies. Three existing wells (199-H4-8, 199-H4-84, and 199-H4-85) and two new wells (199-H4-88 and 199-H4-89) are located either at or near the 183-H Solar Evaporation Basins. Wells in the monitoring network (Section 3.2.5 and Figure 3-3) represent the point of compliance. The wells were identified based on their location in the contaminant plume, extending from the 183-H Solar Evaporation Basins to the Columbia River, and within the general groundwater flow direction toward the river (downgradient). The network wells are screened in the unconfined aquifer.

The point of compliance wells will be monitored to assess the progress of the corrective action (CERCLA remedial action). Concentrations of total chromium (filtered) and nitrate in these wells will be evaluated relative to the concentration limits, in accordance with Section 3.2.4.

3.2.4 Compliance Period

The compliance period under WAC 173-303-645(7)(a) is the number of years equal to the active life of the waste management area (including any waste management activity prior to permitting, and the closure period). The 183-H Solar Evaporation Basins began operation in 1973 and were closed in 1997, which is a total of 25 years. Therefore, the compliance period for the 183-H Solar Evaporation Basins is equal to 25 years and will end in year 2022.

Under WAC 173-303-645(7)(c), if a corrective action program is ongoing at the end of the compliance period (year 2022), then the corrective action must continue for as long as necessary to achieve compliance with the concentration limit. The compliance period is extended until it is demonstrated that the concentration limit has not been exceeded for a period of three consecutive years.

Monitoring for both of the dangerous wastes will continue through the compliance period. However, it is possible that the concentrations of one or both dangerous waste could fall below the concentration limit during the compliance period. If the concentrations are less than the concentration limit for the three year period before the end of the compliance period (years 2019 through 2022), then monitoring will be

discontinued at the end of the compliance period. If concentrations of either or both dangerous wastes are not less than the concentration limit in year 2022 (or have not been less than the concentration limit for three consecutive years), then the compliance period will be extended and monitoring for the dangerous waste(s) above the concentration limit will continue until it is demonstrated that the concentration limit has not been exceeded for a period of three consecutive years.

Evaluation methodology for the sampling results is detailed in Section 3.3.2. Dangerous waste concentrations will be determined with either a 95 percent upper confidence limit (UCL) calculation (for data sets containing detections above the concentration limit) or by visual observation (for data sets containing non-detects and/or detections below the concentration limit). When both dangerous wastes have been below the concentration limit for 3 consecutive years, corrective action monitoring will be discontinued, and the site will be removed from the Hanford Facility RCRA Permit.

3.2.5 Monitoring Well Network

The current 183-H Solar Evaporation Basins monitoring network consists of five wells. Wells are not specified as upgradient or downgradient since the area is influenced by an active pump and treat system, however the groundwater flow is generally towards the river. Figure 3-3 shows the groundwater monitoring network, and information on the wells is summarized in Table 3-6. Wells 199-H4-3 and 199-H4-9 were decommissioned in 2013 in support of waste site remediation. Monitoring well 199-H4-85 was installed to replace 199-H4-3, and well 199-H4-89 will replace 199-H4-9 as described in DOE/RL-2012-45, *Sampling and Analysis Plan for Installation of 100-HR-3 Groundwater Operable Unit Replacement Wells* and TPA-CN-659, *Tri-Party Agreement Change Notice Form: DOE/RL-2015-45, Sampling and Analysis Plan for Installation of 100-HR-3 Groundwater Operable Unit Replacement Wells*.

As of the last network well change in 2013, the 183-H Solar Evaporation Basins monitoring network included four wells (199-H4-8, 199-H4-12A, 199-H4-12C, and 199-H4-84). This plan updates the monitoring network to remove well 199-H4-12C, an extraction well that is completed in the first water bearing unit of the RUM unit, a confined aquifer. Chromium concentrations from well 199-H4-12C are from historical releases at other sources and not attributable to the 183-H Solar Evaporation Basins (Section 3.1.5). Also, well 199-H4-12A is replaced with 199-H4-85, which is located closer to the 183-H Solar Evaporation Basins, is completed in the unconfined aquifer.

New wells 199-H4-89 (located downgradient) and 199-H4-88 (located in the southwest corner of the former 183-H Solar Evaporation Basins location) are added to the groundwater monitoring network. In summary, upon Hanford Facility RCRA Permit modification, the monitoring well network will include 199-H4-8, 199-H4-84, 199-H4-85, 199-H4-88, and 199-H4-89.

If a well is within approximately 2 years of going dry, a replacement well will be proposed; such wells are negotiated annually by Ecology, DOE, and EPA under Tri-Party Agreement Milestone (Ecology et al., 1989) M-24-00. At 100-H Area, the water table is not declining and is directly affected by the Columbia River, so that replacement for dry well conditions is highly unlikely.

Construction details and pertinent information for the wells are provided in Appendix C and include wells in the current network and those proposed.

Table 3-6. Attributes for Wells in the 183-H Solar Evaporation Basins Groundwater Monitoring Network

Well Name	Completion Date	Easting[a] (m)	Northing[a] (m)	Top of Casing Elevation (m [ft]) NAVD88	Total Well Depth[b] (m [ft] bgs)	Water Table Elevation (m [ft]) (amsl)	Water Depth (m [ft] bgs)	Bottom of Screen Depth (m [ft] bgs)	Water Remaining (m [ft])	Water Table Measurement Date
199-H4-8	1986	577860.70	152921.70	129.2 (423.9)[c]	14.6 (47.9)	115.8 (379.7)	12.8 (42.0)	14.6 (47.9)	1.8 (5.9)	5/20/2016
199-H4-84	2011	577902.58	152848.73	128.7 (422.2)[d]	14.6 (47.9)	115.8 (379.7)	12.9 (42.3)	14.5 (47.6)	1.6 (5.2)	5/10/2016
199-H4-85	2013	577980.02	152880.81	128.8 (422.6)[e]	16.0 (52.5)	115.6 (379.0)	12.4 (40.7)	14.4 (47.2)	2.0 (6.6)	5/22/2016
199-H4-88	2016	577850.51	152833.59	131.7 (431.8)	17.7 (58.1)	115.4 (378.4)	15.5 (50.8)	17.7 (58.0)	2.2 (7.2)	6/13/2016
199-H4-89	2016	577923.32	152893.98	129.0 (422.9)	15.1 (49.35)	115.6 (379.0)	12.6 (41.3)	14.1 (46.4)	1.5 (4.9)	6/13/2016

Reference: NAVD88, *North American Vertical Datum of 1988*.

[a] Coordinates are in NAD83, *North American Datum of 1983*.

[b] Total depth of cased well, not drilled depth.

[c] Elevation at top of casing.

[d] Elevation at top of outer casing.

[e] Elevation at top of pump plate.

amsl = above mean sea level
bgs = below ground surface

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3.2.6 Differences between This Plan and Previous Plan

Table 3-7 identifies the main differences between this plan and the previous groundwater monitoring plan.

Table 3-7. Main Differences between This Plan and Previous Plan

Type of Change	Previous Plan[a]	Current Plan	Justification Summary
Constituents	Dangerous Wastes: Chromium (collected as a filtered sample), Nitrate	Dangerous Wastes: Total chromium (collected as a filtered sample), Nitrate	Fluoride is no longer monitored because it has been below its background groundwater concentration in the monitoring wells throughout the corrective action monitoring period. Monitoring of uranium is conducted under the CERCLA remedial action. Monitoring of technetium-99 is conducted under the AEA monitoring program.
	Waste Indicators: Uranium, Technetium-99, Fluoride	None	
	Additional constituents to aid data interpretation: alkalinity, anions, and metals	None	Alkalinity, anions[b], and metals[b] will be collected under CERCLA monitoring if needed.
	Field parameters: pH, specific conductance, temperature, turbidity	Field parameters: pH, specific conductance, temperature, turbidity, dissolved oxygen	Dissolved oxygen added as a field parameter to supplement dissolved chromium results.
Concentration Limit	Total chromium at 122 µg/L: based on background determination from two upgradient wells Nitrate at 45 mg/L	Total chromium (filtered) at 48 µg/L, which is the WAC 173-340-720 Method B cleanup level for hexavalent chromium in groundwater Nitrate – no change	Total chromium concentration limit is updated to the groundwater cleanup level for hexavalent chromium, which is the soluble and mobile form of chromium and is equivalent to total chromium as a filtered sample.
Point of Compliance	Not identified at the onset of corrective action (pump and treat)	Wells in the groundwater monitoring network	Allows for comparison to the concentration limit and the compliance period standard during the CERCLA remedial action.
Sampling Frequency	Annual	Semiannual Quarterly sampling for 2 years at new wells 199-H4-88 and 199-H4-89	Alignment with semiannual reporting. Quarterly sampling at new wells will be performed for 2 years to collect sufficient samples for statistical evaluation.
Well Network	3 wells in unconfined aquifer	5 wells in unconfined aquifer:	Well 199-H4-12C is removed from the network because it is below the

	and 1 well in confined aquifer: 199-H4-3 (replaced by 199-H4-84) 199-H4-7 (replaced by 199-H4-8) 199-H4-12A 199-H4-12C	199-H4-8 199-H4-84 199-H4-85 199-H4-88 199-H4-89	unconfined aquifer and monitors contamination from other sources. Well 199-H4-12A is replaced with 199-H4-85, which is closer to the site. Wells 199-H4-3 and 199-H4-7 were previously replaced with 199-H4-8 and 199-H4-84, respectively. New wells 199-H4-88 and 199-H4-89 added to define the point of compliance.
Groundwater Flow Direction	Generally toward the river (east-northeast), and affected by the pump and treat system	Same	No change
Type of Groundwater Monitoring Program	Corrective Action	Same	No change
Compliance Period	As defined in WAC 173-303-645(7): Number of years equal to the active life of the waste management area (including any waste management activity prior to permitting and the closure period). If corrective action is engaged at the end of the compliance period, then the compliance period is extended until it can be demonstrated that the concentration limit has not been exceeded for a period of three consecutive years.	Based on computation per WAC 173-303-645(7), the compliance period for the 183-H Solar Evaporation Basins is 25 years and will end in 2022 (Section 3.4). Monitoring for both dangerous wastes will be performed through the compliance period. At the end of the compliance period, if concentrations of dangerous waste in the point of compliance wells are less than the concentration limit for the final three consecutive years (2019 to 2022), then monitoring will be discontinued. If corrective action is ongoing at the end of the compliance period (year 2022), then the	Identifies the end of the compliance period and requirement to demonstrate that further monitoring is not required.

		compliance period will be extended until it is demonstrated that the concentration limit has not been exceeded for a period of three consecutive years. When the compliance period is complete, 183-H Solar Evaporation Basins will be removed from the Hanford Facility RCRA Permit.	
Statistical Evaluation	Not identified at the onset of corrective action (pump and treat)	95 percent UCL on the mean, targeting 8 to 10 samples. Calculation of the 95 percent UCL is not performed for data sets that are less than the concentration limit. Also, the practical quantitation limit must be less than the concentration limit.	Evaluation methods will be used to determine if the corrective action (CERCLA remedial action) is progressing as expected and demonstrate that the concentration limit has been achieved. See Section 3.3.2 for details.

[a] Previous plan is PNNL-11573, *Groundwater Monitoring Plan for the 183-H Solar Evaporation Basins.*

[b] Anions and metals collected under CERCLA include:

199-H4-8: hexavalent chromium, nitrate

199-H4-84: hexavalent chromium, nitrate, uranium, antimony, cadmium, cobalt, copper, lead, silver

For new wells 199-H4-88 and 199-H4-89, the list of anions and metals collected under CERCLA will be evaluated after analytical results have been received.

AEA = *Atomic Energy Act of 1954*
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR = *Code of Federal Regulations*
MCL = maximum contaminant level
RCRA = *Resource Conservation and Recovery Act of 1976*
UCL = upper confidence interval
WAC = *Washington Administrative Code*

The previous monitoring plan (PNNL-11573) included chromium and nitrate as dangerous waste constituents and technetium-99 and uranium as waste indicators. Fluoride was monitored as an indicator of 183-H Solar Evaporation Basins contamination in groundwater. Additional constituents to aid data interpretation, alkalinity, anions, and metals were analyzed. Field parameters pH, specific conductance, temperature, and turbidity were also included.

This revised plan monitors only total chromium (collected as a filtered sample) and nitrate. Uranium is monitored as part of the CERCLA IRM and technetium-99 is monitored under the AEA groundwater monitoring program (DOE/RL-2015-56). Fluoride will no longer be monitored. Field parameters routinely collected at the wellhead are retained and measurement of dissolved oxygen is added to monitor

the potential for reduction. Collection of alkalinity, anions, and metals is not included; however, these analyses are routinely performed for multiple nearby wells as part of the IRM monitoring.

The sampling frequency in this revised plan is changed from annual to semiannual to align with semiannual reporting requirements under WAC 173-303-645(11)(g).

The concentration limit in the previous plan for chromium (122 µg/L) was determined in 1995 using two upgradient wells to represent the background concentration. The concentration limit for total chromium (filtered) in this plan is 48 µg/L, the WAC 173-340-720 groundwater cleanup level for hexavalent chromium, which is the soluble and mobile form of chromium and is equivalent to total chromium as a filtered sample.

The previous plan from 1997 included wells 199-H4-3, 199-H4-7, 199-H4-12A, and 199-H4-12C. In 2005, 199-H4-7 was removed from the monitoring network and replaced with 199-H4-8. Well 199-H4-3 required decommissioning in 2013 and was replaced with 199-H4-84. Well 199-H4-12C is removed from the monitoring network because it is completed in the confined aquifer and contaminants detected in this well are not associated the 183-H Solar Evaporation Basins. Monitoring well 199-H4-12A is replaced with 199-H4-85, which is located closer to the 183-H Solar Evaporation Basins and is completed in the unconfined aquifer. New wells 199-H4-89 and 199-H4-88 are added to the monitoring network.

The previous plan was issued in 1997 at the onset of the corrective action (pump and treat remedial action under CERCLA) and did not identify point of compliance wells. The current plan identifies the monitoring network wells as representing the point of compliance. Because of the previous exceedances of the concentration limit for chromium and nitrate and the ongoing remedial action, any concentration limit exceedances at the point of compliance during the remedial action period do not require additional action.

The previous plan did not define the compliance period. In the current plan, the end of the compliance period is identified as 2022. If corrective action is ongoing at the end of the compliance period, then the compliance period will be extended until it is demonstrated that the concentration limit has not been exceeded for a period of three consecutive years. When the compliance period has ended, then corrective action monitoring will be discontinued, and the site will be removed from the Hanford Facility RCRA Permit.

The previous plan did not include a method for statistical evaluation of the monitoring data. The current plan is updated with a statistical method that will be used to determine if the corrective action (CERCLA remedial action) is progressing as expected and demonstrate that the concentration limit has been achieved. Nonstatistical evaluation of the results will be used for data sets that are below the concentration limit and have a practical quantitation limit less than the concentration limit.

3.2.7 Sampling and Analysis Protocol

In accordance with the Hanford Facility RCRA Permit, the groundwater protection regulations of WAC 173-303-645 dictate the groundwater sampling and analysis requirements applicable to final status TSD units. The QAPjP outlining the project management structure, data generation and acquisition, analytical procedures, and quality control is provided in Appendix A. Appendix B provides the sampling protocols (e.g., sampling methods, sample handling and custody, management of waste, and health and safety considerations).

3.3 DATA EVALUATION AND REPORTING

This chapter discusses the evaluation and interpretation of data.

3.3.1 Data Review

The data review and verification tasks are discussed in the QAPjP (Appendix A).

3.3.2 Statistical Evaluation

The objective of the corrective action monitoring program is to monitor the concentration trends to demonstrate the effectiveness of the corrective action. Accordingly, the objective of the statistical evaluation during the corrective action is to monitor the concentration trends of the dangerous wastes (total chromium, collected as a filtered sample, and nitrate) to confirm that the corrective action is progressing as expected.

In corrective action monitoring, a UCL of the mean can be compared to a fixed regulatory limit to determine with prescribed confidence whether the mean concentration of the target population (population of interest) significantly exceeds the fixed limit (EPA, 1989, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Interim Final Guidance*; EPA 530/R-09-007, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance*). Calculation of UCLs of the mean are routinely calculated using EPA, 2013, ProUCL (Version 5.0.00), a software package developed for EPA that has undergone expansions and upgrades, including the most recent in 2013.

The 95 percent UCL of the mean, hereafter referred to as a 95 percent UCL, calculated with ProUCL (EPA, 2013), is the statistic used to evaluate groundwater data collected under this monitoring plan. Revised versions of ProUCL will be used as they become available. ProUCL calculates an appropriate 95 percent UCL considering data distribution, data set size, skewness of the data, and percentage of nondetects. The ProUCL technical guide recommends data sets include a minimum of eight to ten independent results, with at least four detections within the data set. Replicate samples are not considered independent.

The most recent eight to ten independent monitoring results of each dangerous waste constituent from 183-H Solar Evaporation Basins monitoring wells are the data set used to compute a 95 percent UCL on an intra-well basis. When available, results from the last nine or ten independent sampling events (whichever is the maximum number of results) from a given well are used for the calculation.

Statistical evaluation of results from wells will begin when eight independent samples are available for the 95 percent UCL calculation. Wells 199-H4-84 and 199-H4-85 have been sampled for total chromium (filtered) and nitrate under CERCLA (and the Hanford Facility RCRA Permit for well 199-H4-84) since 2013 (Appendix D) and therefore have additional results available. Results collected for CERCLA monitoring may be included in the data sets used for 95 percent UCL calculation until a sufficient number of samples (eight) is collected under this plan. Wells 199-H4-88 and 199-H4-89 were drilled in 2016 and will be sampled quarterly for the first 2 years. Until eight sample results are available to calculate the 95 percent UCL, non-statistical evaluation of monitoring results to the concentration limit will be performed.

Not all data sets require computation of a 95 percent UCL. When the sample results in the data set comprising eight to ten samples are less than the concentration limit, a nonstatistical or visual analysis of the data (such as presented in Appendix D) is appropriate. In these cases, each result in the data set (eight to ten samples) must be less than the concentration limit. In addition, the practical quantitation limit for each sample in the data set must not exceed the concentration limit.

The 95 percent UCL calculations are performed as necessary for 183-H Solar Evaporation Basins point of compliance well results to support preparation of the semiannual reports required by WAC 173-303-645(11)(g). Any calculated 95 percent UCL values will be compared to the concentration limit in the reports.

As discussed in Section 3.2.4, if a corrective action program is ongoing at the end of the compliance period (year 2022), then the corrective action must continue and the compliance period is extended until it is demonstrated that the concentration limit has not been exceeded for a period of three consecutive years. However, it is possible that concentrations will be less than the concentration limit for the three

consecutive year period before the end of the compliance period (years 2019 through 2022). In this case, monitoring will be discontinued at the end of the compliance period.

The sample frequency may be adjusted during the final three consecutive year time period to obtain additional sample results (eight to ten) for calculation of a 95 percent UCL. After three years of samples are collected, the data will be evaluated as described above. Calculation of a 95 percent UCL, if required, will be performed using the last eight to ten independent samples collected at a given well. The resulting 95 percent UCL is compared to the concentration limit to determine whether the dangerous waste constituent is below the concentration limit. If the 95 percent UCL is below the concentration limit, then monitoring will be discontinued.

3.3.3 Interpretation

Data are used to interpret groundwater conditions at 183-H Solar Evaporation Basins. Interpretive techniques may include the following:

- **Hydrographs:** Graph water levels versus time to determine decreases and increases and seasonal or manmade fluctuations in groundwater levels.
- **Water table maps:** Use water table elevations from multiple wells to construct contour maps and estimate flow directions. Groundwater flow is assumed to be perpendicular to the equal potential lines 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 relate to changes in water level or groundwater flow directions.
- **Plume maps:** Map distributions of chemical constituent concentrations in the aquifer to determine the extent of contamination. Changes in plume distribution over time assist in determining plume movement and direction of groundwater flow.

3.3.4 Reporting

The effectiveness of the corrective action program is reported twice each year as required by WAC 173-303-645(11)(g). Results from this monitoring plan are reported in both the semiannual corrective action groundwater report and the annual Hanford Site RCRA groundwater monitoring report (e.g., DOE/RL-2016-12).

In accordance with WAC 173-303-645(11)(h), if it is determined by DOE that the corrective action program no longer satisfies the requirements of the corrective action program under WAC 173-303-645(11), an application for a permit modification to make any appropriate changes to the program will be submitted within 45 days.

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APPENDIX A
QUALITY ASSURANCE PROJECT PLAN

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APPENDIX A
QUALITY ASSURANCE PROJECT PLAN

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TERMS

DOE	United States Department of Energy
DOE-RL	United States Department of Energy, Richland Operations Office
DQA	data quality assessment
DQI	data quality indicator
DUP	duplicate (laboratory)
EB	equipment blank
ECO	Environmental Compliance Officer
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
FSO	Field Sample Operations
FTB	full trip blank
FWS	Field Work Supervisor
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document* (DOE/RL-96-68)
HEIS	Hanford Environmental Information System
LCS	laboratory control sample
MB	method blank
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
N/A	not applicable
PQL	practical quantitation limit
QA	quality assurance
QAPjP	quality assurance project plan
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
S&GRP	Soil and Groundwater Remediation Project
SAF	Sampling Authorization Form
SMR	Sample Management and Reporting
SPLIT	field split
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989a)
Tri-Party Agreement Action Plan	*Hanford Federal Facility Agreement and Consent Order Action Plan* (Ecology et al., 1989b)
TSD	treatment, storage, and disposal

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A1 INTRODUCTION

A quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection. It includes planning, implementation, and assessment of sampling tasks, field measurements, laboratory analysis, and data review. This chapter describes the applicable environmental data collection requirements and controls based on the quality assurance (QA) elements found in EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5), and DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD). Sections 6.5 and 7.8 of the Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan* (Tri-Party Agreement Action Plan) require the QA/quality control (QC) and sampling and analysis activities to specify QA requirements for treatment, storage, and disposal (TSD) units, as well as for past-practice processes. This QAPjP also describes the applicable requirements and controls based on guidance provided in Ecology Publication No. 04-03-030, *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, and EPA/240/R-02/009, *Guidance for Quality Assurance Project Plans* (EPA QA/G-5). This QAPjP is intended to supplement the contractor's environmental QA program plan.

This QAPjP is divided into the following five chapters, which describe the quality requirements and controls applicable to the 183-H Solar Evaporation Basins groundwater monitoring activities:

- Chapter A2, Project Management
- Chapter A3, Data Generation and Acquisition
- Chapter A4, Assessment and Oversight
- Chapter A5, Data Review and Usability
- Chapter A6, References

A2 PROJECT MANAGEMENT

This chapter addresses the management approaches planned, project goals, and planned output documentation.

A2.1 Project/Task Organization

Project organization (regarding routine groundwater monitoring) is described in the following subsections and illustrated in Figure A-1.

A2.1.1 DOE-RL Manager

Hanford Site cleanup is the responsibility of United States Department of Energy (DOE). The DOE-RL Manager is responsible for authorizing the contractor to perform activities at the Hanford Site under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*, *Resource Conservation and Recovery Act of 1976* (RCRA); *Atomic Energy Act of 1954*; and Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement).

A2.1.2 DOE-RL Project Lead

The DOE-RL Project Lead is responsible for providing day-to-day oversight of the contractor's performance of the work scope, working with the contractor to identify and work through issues, and providing technical input to the DOE-RL management.

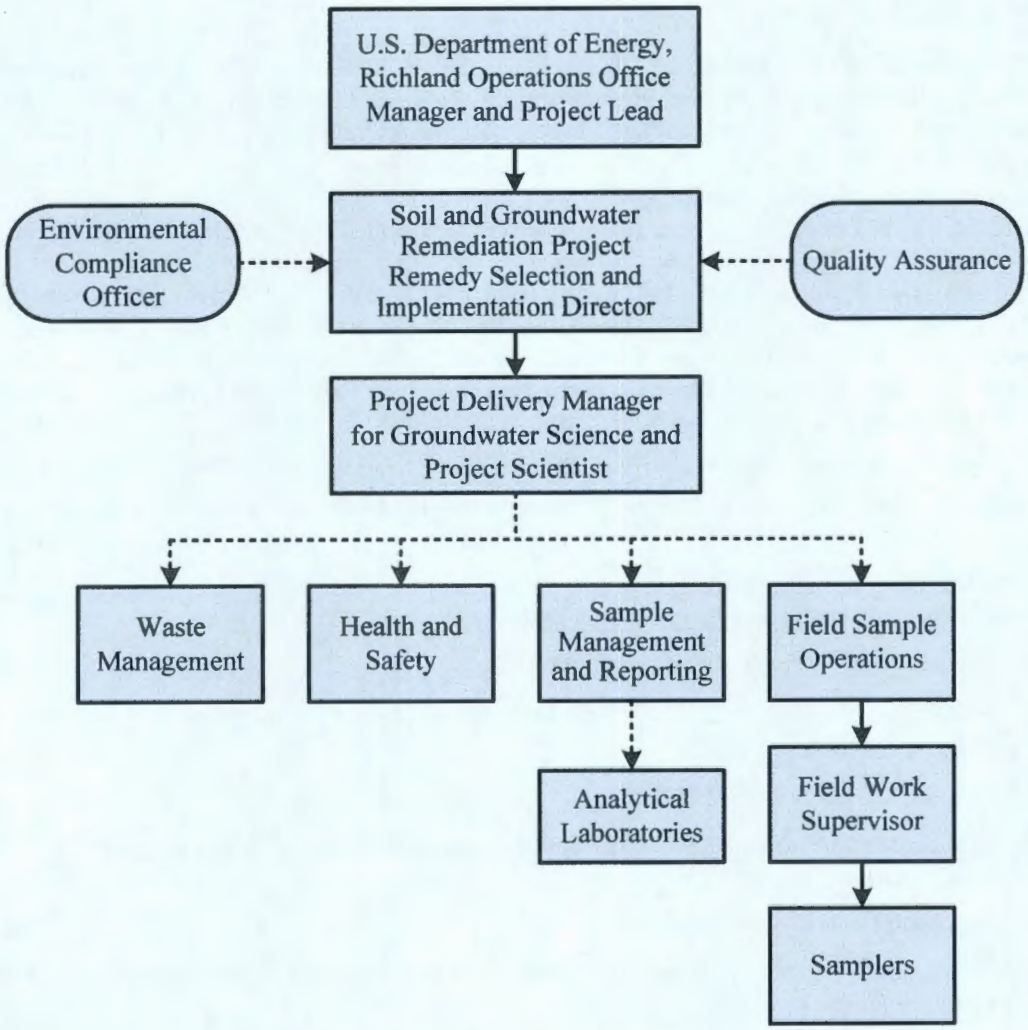

Figure A-1 Project Organization

A2.1.3 Soil and Groundwater Remediation Project Remedy Selection and Implementation Director

The Soil and Groundwater Remediation Project (S&GRP) Remedy Selection and Implementation Director provides oversight and coordinates with DOE-RL and primary contractor management in support of sampling and reporting activities. The Remedy Selection and Implementation Director also provides support to the Project Delivery Manager for Groundwater Science to ensure that work is performed safely and cost effectively.

A2.1.4 Project Delivery Manager for Groundwater Science

The Project Delivery Manager for Groundwater Science is responsible for direct management of activities performed to meet TSD unit groundwater monitoring requirements. The Project Delivery Manager for Groundwater Science coordinates with and reports to DOE-RL and primary contractor management regarding TSD unit groundwater monitoring requirements. The Project Delivery Manager for Groundwater Science (or designee) works closely with the Environmental Compliance Officer (ECO), QA, Health and Safety, and Sample Management and Reporting (SMR) group to integrate these and other technical disciplines in planning and implementing the work scope. The Project Delivery Manager for Groundwater Science assigns scientists to provide technical expertise.

A2.1.5 Sample Management and Reporting Group

The SMR group oversees offsite analytical laboratories, coordinates laboratory analytical work to ensure that laboratories conform to the requirements of this plan, and verifies that laboratories are qualified for performing Hanford Site analytical work. The SMR group generates field sampling documents, labels, and instructions for field sampling personnel and develops the Sampling Authorization Form (SAF), which provides information and instruction to the analytical laboratories. The SMR group ensures that field sampling documents are revised to reflect approved changes. The SMR group receives analytical data from the laboratories, ensures it is appropriately reviewed, performs data entry into the Hanford Environmental Information System (HEIS) database, and arranges for data validation and recordkeeping. The SMR group is responsible for resolving sample documentation deficiencies or issues associated with Field Sample Operations (FSO), laboratories, or other entities. The SMR group is responsible for informing the Project Delivery Manager for Groundwater Science of any issues reported by the analytical laboratories.

A2.1.6 Field Sample Operations

FSO is responsible for planning and coordinating field sampling resources and provides the Field Work Supervisor (FWS) for routine groundwater sampling operations. The FWS directs the nuclear chemical operators (samplers), who collect groundwater samples in accordance with this groundwater monitoring plan and corresponding standard procedures and work packages. The FWS ensures that deviations from field sampling documents or issues encountered in the field are documented appropriately (e.g., in the field logbook). The FWS ensures that samplers are appropriately trained and available. Samplers collect samples in accordance with sampling documentation. Samplers also complete field logbooks, data forms, and chain-of-custody forms, including any shipping paperwork, and enable delivery of the samples to the analytical laboratory.

Pre-job briefings are conducted by FSO, in accordance with work management and work release requirements, to evaluate activities and associated hazards by considering the following factors:

- Objective of the activities.
- Individual tasks to be performed.
- Hazards associated with the planned tasks.
- Controls applied to mitigate the hazardous environment in which the job will be performed.
- Facility where the job will be performed.
- Equipment and material required.

A2.1.7 Quality Assurance

The QA point of contact provides independent oversight and is responsible for addressing QA issues on the project and overseeing implementation of the project QA requirements. Responsibilities include reviewing project documents, including the QAPjP, and participating in QA assessments on sample collection and analysis activities, as appropriate.

A2.1.8 Environmental Compliance Officer

The ECO 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.

A2.1.9 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 internal primary contractor work requirements.

A2.1.10 Waste Management

Waste Management is responsible for identifying waste management sampling/characterization requirements, to ensure regulatory compliance and for interpreting data to determine waste designations and profiles. Waste Management communicates policies and procedures and ensures project compliance for storage, transportation, disposal, and waste tracking in a safe and cost-effective manner.

A2.1.11 Analytical Laboratories

The analytical laboratories analyze samples in accordance with established procedures and the requirements of this plan, and provide necessary data packages containing analytical and QC results. Laboratories provide explanations of results to support data review and in response to resolution of analytical issues. Statements of work flow down quality requirements consistent with the HASQARD (DOE/RL-98-68). The laboratories are evaluated under the DOE Consolidated Audit Program and must be accredited by the Washington State Department of Ecology (Ecology) for the analyses performed for S&GRP.

A2.2 Problem Definition/Background

The purpose of this groundwater monitoring plan is to satisfy WA7890008967, *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste,* Part II, Condition II.F, which specifies groundwater monitoring under WAC 173-303-645, "Dangerous Waste Regulations," "Releases from Regulated Units," for final status facilities. More specific information on the activities to satisfy the requirements is provided in the main text of this monitoring plan in Chapter 1 and Sections 3.1.7, 3.2.1, 3.2.2, 3.2.3, 3.2.4, 3.2.5, and 3.3.2. Background information on monitoring is also provided in the main text (Sections 3.1.2, 3.1.5, and 3.2.6).

A2.3 Project/Task Description

The focus of this plan is to monitor for dangerous waste in accordance with WAC 173-303-645(11), evaluate the well network, and interpret analytical results. The dangerous waste and field parameters to be monitored, along with the monitoring wells and frequency of sampling, are provided in the main text (Chapter 3). Information on the collection and analyses of groundwater from the monitoring network is provided in this appendix and in Appendix B.

A2.4 Quality Assurance Objectives and Criteria

The QA objective of this plan is to ensure that the generation of analytical data of known and appropriate quality is acceptable and useful in order to meet the evaluation requirements stated in the monitoring plan. In support of this objective, data descriptors known as data quality indicators (DQIs) are used to help determine the acceptability and usefulness of the data to the user. Principal DQIs are precision, accuracy, representativeness, comparability, completeness, bias, and sensitivity. These DQIs are defined for the purposes of this document in Table A-1.

1

Table A-1 Data Quality Indicators			
Data Quality Indicator (QC Element)[a]	**Definition**	**Determination Methodologies**	**Corrective Actions**
Precision (field duplicates, laboratory sample duplicates, and matrix spike duplicates)	Precision measures the agreement among a set of replicate measurements. Field precision is assessed through the collection and analysis of field duplicates. Analytical precision is estimated by duplicate/replicate analyses, usually on laboratory control samples, spiked samples, and/or field samples. The most commonly used estimates of precision are the relative standard deviation and, when only two samples are available, the relative percent difference.	Use the same analytical instrument to make repeated analyses on the same sample. Use the same method to make repeated measurements of the same sample within a single laboratory. Acquire replicate field samples for information on sample acquisition, handling, shipping, storage, preparation, and analytical processes and measurements.	If duplicate data do not meet objective: • Evaluate apparent cause (e.g., sample heterogeneity). • Request reanalysis or re-measurement. • Qualify the data before use.
Accuracy (laboratory control samples, and matrix spikes)	Accuracy is the closeness of a measured result to an accepted reference value. Accuracy is usually measured as a percent recovery. QC analyses used to measure accuracy include standard recoveries, laboratory control samples, and spiked samples.	Analyze a reference material or reanalyze a sample to which a material of known concentration or amount of pollutant has been added (a spiked sample).	If recovery does not meet objective: • Qualify the data before use. • Request reanalysis or re-measurement.
Representativeness (field duplicates)	Sample representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. It is dependent on the proper design of the sampling program and will be satisfied by ensuring that the approved plans were followed during sampling and analysis.	Evaluate whether measurements are made and physical samples collected in such a manner that the resulting data appropriately reflect the environment or condition being measured or studied.	If results are not representative of the system sampled: • Identify the reason for results not being representative. • Flag for further review. • Review data for usability. • If data are usable, qualify the data for limited use and define the portion of the system that the data represent. • If data are not usable, flag as appropriate.

Table A-1 Data Quality Indicators			
Data Quality Indicator (QC Element)[a]	**Definition**	**Determination Methodologies**	**Corrective Actions**
			• Redefine sampling and measurement requirements and protocols. • Resample and reanalyze, as appropriate.
Comparability (field duplicate, field splits, laboratory control samples, matrix spikes, and matrix spike duplicates)	Comparability expresses the degree of confidence with which one data set can be compared to another. It is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the approved plans are followed and that proper sampling and analysis techniques are applied.	Use identical or similar sample collection and handling methods, sample preparation and analytical methods, holding times, and quality assurance protocols.	If data are not comparable to other data sets: • Identify appropriate changes to data collection and/or analysis methods. • Identify quantifiable bias, if applicable. • Qualify the data as appropriate. • Resample and/or reanalyze if needed. • Revise sampling/analysis protocols to ensure future comparability.
Completeness (no QC element; addressed in data quality assessment)	Completeness is a measure of the amount of valid data collected compared to the amount of data planned. Measurements are considered to be valid if they are unqualified or qualified as estimated data during validation. Field completeness is a measure of the number of samples collected versus the number of samples planned. Laboratory completeness is a measure of the number of valid measurements compared to the total number of measurements planned.	Compare the number of valid measurements completed (samples collected or samples analyzed) with those established by the project's quality criteria (data quality objectives or performance/ acceptance criteria).	If data set does not meet the completeness objective: • Identify appropriate changes to data collection and/or analysis methods. • Identify quantifiable bias, if applicable. • Resample and/or reanalyze if needed. • Revise sampling/analysis protocols to ensure future completeness.
Bias (equipment blanks, field transfer blanks, full trip blanks, laboratory control samples, matrix spikes, and method blanks)	Bias is the systematic or persistent distortion of a measurement process that causes error in one direction (e.g., the sample measurement is consistently lower than the sample's true value). Bias can be introduced during sampling, analysis, and data evaluation.	Sampling bias may be revealed by analysis of replicate samples. Analytical bias may be assessed by comparing a measured value in a sample of known concentration to an accepted reference value or by determining	For sampling bias: • Properly select and use sampling tools. • Institute correct sampling and subsampling procedures to limit preferential selection or loss of sample media. • Use sample handling procedures, including proper sample preservation, that limit the

Table A-1 Data Quality Indicators

Data Quality Indicator (QC Element)[a]	Definition	Determination Methodologies	Corrective Actions
	Analytical bias refers to deviation in one direction (i.e., high, low, or unknown) of the measured value from a known spiked amount.	the recovery of a known amount of contaminant spiked into a sample (matrix spike).	loss or gain of constituents to the sample media. • Analytical data that are known to be affected by either sampling or analytical bias are flagged to indicate possible bias. • Laboratories that are known to generate biased data for a specific analyte are asked to correct their methods to remove the bias as best as practicable. Otherwise, samples are sent to other laboratories for analysis.
Sensitivity (method detection limit, practical quantitation limit, and relative percent difference)	Sensitivity is an instrument's or method's minimum concentration that can be reliably measured (i.e., instrument detection limit or limit of quantitation).	Determine the minimum concentration or attribute to be measured by an instrument (instrument detection limit) or by a laboratory (limit of quantitation). The lower limit of quantitation[b] is the lowest level that can be routinely quantified and reported by a laboratory.	If detection limits do not meet objective: • Request reanalysis or re-measurement using methods or analytical conditions that will meet required detection or limit of quantitation. • Qualify/reject the data before use.

Source: SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V, as amended.*

[a] Acceptance criteria for QC elements are provided in Table A-5.

[b] For purposes of this groundwater monitoring plan, the lower limit of quantitation is interchangeable with the practical quantitation limit.

QC = quality control

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Data quality is defined by the degree of rigor in the acceptance criteria assigned to the DQIs. The applicable QC guidelines, DQI acceptance criteria, and levels of effort for assessing data quality are dictated by the intended use of the data and the requirements of the analytical method. DQIs are evaluated during the data quality assessment (DQA) process (Section A5.3).

A2.5 Special Training/Certification

Workers receive a level of training that is commensurate with their responsibility for collecting and transporting groundwater samples according to the dangerous waste training plan maintained for the TSD unit to meet the requirements of WAC 173-303-330, "Personnel Training." The FWS, in coordination with line management, will ensure that special training requirements for field personnel are met.

Training has been instituted by the contractor management team to meet training and qualification programs that satisfy multiple training drivers imposed by applicable *Code of Federal Regulations* and *Washington Administrative Code* requirements. Training records are maintained for each employee in an electronic training record database. The contractor's training organization maintains the training records system. Line management confirms that an employee's training is appropriate and up-to-date prior to performing any fieldwork.

A2.6 Documents and Records

The Project Delivery Manager for Groundwater Science (or designee) is responsible for ensuring that the current version of the groundwater monitoring plan is used and providing any updates to field personnel. Version control is maintained by the administrative document control process. Table A-2 defines the types of changes that may affect the groundwater monitoring plan and the associated approvals, notifications, and documentation requirements. Elements of the monitoring plan that are required by WAC 173-303-645 (e.g., water-level measurements will be collected each time a sample is obtained) cannot be changed.

Table A-2 Change Control for Monitoring Plans

Type of Change	Action	Documentation
Site-specific constituents or increased sampling frequency that does not affect the requirements of WAC 173-303-645.	Project Delivery Manager for Groundwater Science approves temporary change; provides informal notification to DOE-RL.	SMR group's integrated groundwater monitoring schedule
Unintentional impact to groundwater monitoring plan that impacts the corrective action monitoring requirements of WAC 173-303-645, including one-time missed well sampling due to operational constraints, delayed sample collection, broken pump, lost bottle set, missed sampling of indicator parameters, and loss of samples in transit.	Project Delivery Manager for Groundwater Science provides informal notification to DOE-RL. DOE-RL provides informal notification to Ecology as appropriate.	Annual Hanford Site RCRA groundwater monitoring report
Planned change to groundwater monitoring activities, that impacts the corrective action monitoring requirements of WAC 173-303-645, including addition or deletion of site-specific constituents, change of sampling frequency for	Project Delivery Manager for Groundwater Science obtains DOE-RL approval; revise monitoring plan as appropriate.	Revised groundwater monitoring plan and modification to Hanford Facility RCRA Permit

Table A-2 Change Control for Monitoring Plans		
Type of Change	**Action**	**Documentation**
site-specific constituents, or changes to well network.		
Anticipated unavoidable changes.	Project Delivery Manager for Groundwater Science provides informal notification to DOE-RL; revise monitoring plan as appropriate.	Annual Hanford Site RCRA groundwater monitoring report Permanent changes require revised RCRA groundwater monitoring plan and modification to Hanford Facility RCRA Permit
References: Hanford Facility RCRA Permit (WA7890008967, *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste*). WAC 173-303-645, "Dangerous Waste Regulations," "Releases from Regulated Units." DOE-RL = U.S. Department of Energy, Richland Operations Office Ecology = Washington State Department of Ecology RCRA = *Resource Conservation and Recovery Act of 1976* SMR = Sample Management and Reporting		

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 FWS, SMR, and any field crew supervisors are responsible for ensuring that field instructions are maintained and aligned with any revisions or approved changes to the groundwater monitoring plan. The SMR group will ensure that any deviations from the plan are reflected in revised field sampling documents for the samplers and analytical laboratory. The FWS or appropriate field crew supervisors will ensure that deviations from the plan or problems encountered in the field are documented appropriately (e.g., in the field logbook).

The Project Delivery Manager for Groundwater Science, FWS, or designee is responsible for communicating field corrective action requirements and ensuring that immediate corrective actions are applied to field activities. The Project Delivery Manager for Groundwater Science is also responsible for ensuring that project files are setup, as appropriate, and/or maintained. The project files will contain project records or references to their storage locations. Project files generally include, as appropriate, the following information:

- Operational records and logbooks
- Data forms
- Global positioning system data (a copy will be provided to the SMR group)
- Inspection or assessment reports and corrective action reports
- Field summary reports
- Interim progress reports
- Final reports

- Forms required by WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," and the master drilling contract

The following records are managed and maintained by SMR personnel:

- Completed field sampling logbooks
- Groundwater sample reports and field sample reports
- Completed chain-of-custody forms
- Sample receipt records
- Laboratory data packages
- Analytical data verification and validation reports
- Analytical data "case file purges" (i.e., raw data purged from laboratory files) provided by offsite analytical laboratories

The laboratory is responsible for maintaining, and having available upon request, the following items:

- Analytical logbooks
- Raw data and QC sample records
- Standard reference material and/or proficiency test sample data
- Instrument calibration information
- Training records for employees, as they relate to analytical methods.
- Laboratory state accreditation records
- Laboratory audit records

Convenience copies of laboratory analytical results are maintained in the HEIS database. Records may be stored in either electronic (e.g., in the managed records area of the Integrated Document Management System) or hard copy format (e.g., DOE Records Holding Area). 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 (Ecology et al., 1989a) will be managed in accordance with the requirements therein. Records of analyses required by WAC 173-303-645(11), as well as associated groundwater surface elevations required by WAC 173-303-645(8) are to be maintained throughout the active life of a facility and post-closure care period.

The results of corrective action groundwater monitoring are reported twice each year as required by WAC 173-303-645(11). Groundwater monitoring results are also presented in the annual Hanford Site RCRA groundwater monitoring reports (e.g. DOE/RL-2016-12, *Hanford Site RCRA Groundwater Monitoring Report for 2015*).

A3 DATA GENERATION AND ACQUISITION

This chapter 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. Requirements for instrument calibration and maintenance, supply inspections, and data management are also addressed.

A3.1 Analytical Method Requirements

Analytical method requirements for samples collected are presented in Table A-3. Updated U.S. Environmental Protection Agency (EPA) methods may be substituted for the analytical methods identified in Table A-3.

Table A-3 Analytical Requirements for Groundwater Analysis		
Constituent	**Analytical Method[a]**	**Highest Allowable Practical Quantitation Limit[b] (µg/L)**
Dangerous Waste Constituents (µg/L)		
Metals		
Total Chromium (filtered)	EPA 200.8 or SW-846 6020 – ICP/MS	10
Anions		
Nitrate[c]	EPA/600 Method 300.0	250
Site-Specific Measurements		
Field Parameters		
Dissolved Oxygen	Field measurement Instrument/meter	N/A
pH		N/A
Specific Conductance		N/A
Temperature		N/A
Turbidity		N/A

Note: Analytical methods and highest allowable PQLs provided in this table do not represent EPA requirements but are intended solely as guidance.

[a] For EPA Method 300.0, see EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples*. For four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*. Equivalent methods may be substituted.

[b] For purposes of this groundwater monitoring plan, the highest allowable PQL is interchangeable with the lower limit of quantitation, which is the lowest level that can be routinely quantified and reported by a laboratory. The highest allowable PQLs are not to be exceeded and are specified in contracts with analytical laboratories. Actual quantitation limits vary by laboratory and may be lower than required contractually. Method detection limits are three to five times lower than quantitation limits.

[c] For general chemistry analyses, dilutions for certain ion chromatography constituents may be necessary, potentially raising the PQL above the limits established in this table. In circumstances where the PQL is critical to a project, the SMR group will negotiate with the project scientist regarding project-specific requirements.

EPA = U.S. Environmental Protection Agency N/A = not applicable
ICP-MS = inductively coupled plasma-mass spectrometry PQL = practical quantitation limit

A3.2 Field Analytical Methods

Field screening and survey data used will be measured in accordance with HASQARD (DOE/RL-96-68) requirements (as applicable). Field analytical methods may also be performed in accordance with manufacturer manuals. Table A-3 provides the parameters (if any) identified for field measurements. Appendix B provides further discussion on field measurements.

A3.3 Quality Control

QC requirements specified in the plan must be followed in the field and analytical 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 sampling variability. Laboratory QC samples estimate the precision, bias, and matrix effects of the analytical data. Field and laboratory QC sample are

summarized in Table A-4. Acceptance criteria for field and laboratory QC are shown in Table A-5. Data will be qualified and flagged in HEIS, as appropriate.

Table A-4 QC Samples

Sample Type	Frequency	Characteristics Evaluated
Field QC		
Field Duplicates	One in 20 well trips	Precision, including sampling and analytical variability
Field Splits	As needed When needed, the minimum is one for every analytical method, for analyses performed.	Precision, including sampling, analytical, and interlaboratory
Full Trip Blanks	One in 20 well trips	Cross-contamination from containers or transportation
Equipment Blanks	As needed If only disposable equipment is used or equipment is dedicated to a particular well, then an equipment blank is not required; otherwise, one for every 20 samples.[a]	Adequacy of sampling equipment decontamination and contamination from nondedicated equipment
Analytical QC[b]		
Laboratory Sample Duplicates	One per analytical batch[c]	Laboratory reproducibility and precision
Matrix Spikes	One per analytical batch[c]	Matrix effect/laboratory accuracy
Matrix Spike Duplicates	One per analytical batch[c]	Laboratory accuracy and precision
Laboratory Control Samples	One per analytical batch[c]	Laboratory accuracy
Method Blanks	One per analytical batch[c]	Laboratory contamination

Note: The information in this table does not represent EPA requirements but is intended solely as guidance.

[a] For portable pumps, equipment blanks are collected one for every 10 well trips. Whenever a new type of nondedicated equipment is used, an equipment blank will be collected every time sampling occurs until it can be shown that less frequent collection of equipment blanks is adequate to monitor the decontamination methods for the nondedicated equipment.

[b] Batching across projects is allowed for similar matrices (e.g., all Hanford groundwater).

[c] Unless not required by, or different frequency is called out in, laboratory analysis methods.

EPA = U.S. Environmental Protection Agency

QC = quality control

Table A-5 Field and Laboratory QC Elements and Acceptance Criteria

Analysis	QC Element	Acceptance Criteria	Corrective Action
Metals			
Inductively coupled plasma-mass spectrometry metals (total chromium [filtered])	MB	<MDL <5% Sample concentration	Flag with "C"
	LCS	80 to 120% Recovery	Review Data[a]
	DUP[b]/MSD[c]	≤20% RPD	Review Data[a]
	MS/MSD[c]	75 to 125% Recovery	Flag with "N"
	EB, FTB	<2 times MDL	Flag with "Q"
	Field Duplicate/SPLIT	≤20% RPD[b]	Review Data[a]
Anions			
Anions by ion chromatography (nitrate)	MB	<MDL <5% Sample Concentration	Flag with "C"
	LCS	80 to 120% Recovery	Review Data[a]
	DUP[b]/MSD[c]	≤20% RPD	Review Data[a]
	MS/MSD[c]	75 to 125% Recovery	Flag with "N"
	EB, FTB	<2 times MDL	Flag with "Q"
	Field Duplicate/SPLIT	≤20% RPD[b]	Review Data[a]

Notes:

The information in this table does not represent EPA requirements but is intended solely as guidance. The table is consistent with SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*; and DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document*.

This table only applies to laboratory analyses. Specific conductance, pH, dissolved oxygen, temperature, and turbidity are not listed as they are measured in the field.

[a] 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), failed field QC (Q flag), or rejected (R flag).

[b] Applies when at least one result is greater than the laboratory PQL (chemical analyses).

[c] Either a DUP or a MSD is to be analyzed to determine measurement precision.

DUP = laboratory sample duplicate
EB = equipment blank
EPA = U.S. Environmental Protection Agency
FTB = full trip blank
LCS = laboratory control sample
MB = method blank
MDL = method detection limit
MS = matrix spike
MSD = matrix spike duplicate
PQL = practical quantitation limit
QC = quality control
RPD = relative percent difference

Table A-5 Field and Laboratory QC Elements and Acceptance Criteria			
Analysis	**QC Element**	**Acceptance Criteria**	**Corrective Action**
Data Flags:			
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 blank: results were out of limits			

A3.3.1 Field Quality Control Samples

Field QC samples are collected to evaluate the potential for cross-contamination and provide information pertinent to field sampling variability and laboratory performance to help ensure that reliable data are obtained. Field QC samples include field duplicates, field split (SPLIT) samples, and two types of field blanks (full trip blanks [FTBs] and equipment blanks [EBs]). Field blanks are typically prepared using high-purity reagent water. QC sample definitions and their required frequency for collection are described below:

Field duplicates: independent samples collected as close as possible to the same time and same location as the scheduled sample, and intended to be identical. Field duplicates are placed in separate sample containers and analyzed independently. Field duplicates are used to determine precision for both sampling and laboratory measurements.

Field splits (SPLITs): two samples collected as close as possible to the same time and same location and are intended to be identical. SPLITs will be stored in separate containers and analyzed by different laboratories for the same analytes. SPLITs are interlaboratory comparison samples used to evaluate comparability between laboratories.

Full trip blanks (FTBs): bottles prepared by the sampling team before travel to the sampling site. The preserved bottle set is either for volatile organic analysis only or identical to the set that will be collected in the field. It is filled with high-purity reagent water[12], and the bottles are sealed and transported (unopened) to the field in the same storage containers used for samples collected that day. Collected FTBs are typically analyzed for the same constituents as the samples from the associated sampling event. FTBs are used to evaluate potential contamination of the samples attributable to the sample bottles, preservative, handling, storage, and transportation.

Equipment blanks (EBs): Reagent water passed through or poured over the decontaminated sampling equipment identical to the sample set collected and placed in sample containers, as identified on the SAF. EB sample bottles are placed in the same storage containers with samples from the associated sampling event. EB samples will be analyzed for the same constituents as samples from the associated sampling event. EBs are used to evaluate the effectiveness of the decontamination process and these samples are not required for disposable sampling equipment.

A3.3.2 Laboratory Quality Control Samples

Internal QA/QC programs are maintained by laboratories used by the project. Laboratory QA includes a comprehensive QC program that includes the use of laboratory sample duplicates (DUPs), matrix spikes (MSs), matrix spike duplicates (MSDs), laboratory control samples (LCSs), and method blanks (MBs). These QC analyses are required by EPA methods (e.g., those in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*), and will be run at the frequency specified in the respective references unless superseded by agreement. QC checks outside of

[12] High-purity water that is generally defined as water that has been distilled, deionized, or any combination of distillation, deionization, reverse osmosis, activated carbon filtration, ion exchange, particulate filtration, or other polishing techniques (DOE/RL-96-68).

control limits are documented in analytical laboratory reports during DQAs, if performed. Laboratory QC check and their typical frequencies are listed in Table A-4. Acceptance criteria are shown in Table A-5. Descriptions of the various types of laboratory QC samples are as follows:

Laboratory sample duplicate (DUP): an intralaboratory replicate sample that is used to evaluate the precision of a method in a given sample matrix.

Matrix spike (MS): an aliquot of a sample spiked with a known concentration of target analyte(s). MS is used to assess the bias of a method in a given sample matrix. Spiking occurs prior to sample preparation and analysis.

Matrix spike duplicate (MSD): a replicate spiked aliquot of a sample that is subjected to the entire sample preparation and analytical process. MSD results are used to determine the bias and precision of a method in a given sample matrix.

Laboratory control sample (LCS): a control matrix (e.g., reagent water) spiked with analytes representative of the target analytes or a certified reference material that is used to evaluate laboratory accuracy.

Method blank (MB): an analyte-free matrix to which the same reagents are added in the same volumes or proportions as used in the sample processing. The MB is carried through the complete sample preparations and analytical procedure and is used to quantify contamination resulting from the analytical process.

Laboratories are required to analyze samples within the holding times specified in Table A-6. In some instances, constituents in the samples not analyzed within the holding times may be compromised by volatilization, decomposition, or other chemical changes. Data from samples analyzed outside of the holding times are flagged in the HEIS database with an "H."

Table A-6 Holding Time Guidelines for Laboratory Analyses	
Constituent/Parameter	**Holding Time**
Total chromium (filtered) by inductively coupled plasma-mass spectrometry	6 months
Anions by ion chromatography (nitrate)	48 hours
Notes: Information in this table does not represent EPA requirements but is intended solely as guidance. This table only applies to laboratory analyses. Field parameters, pH, specific conductance, temperature, dissolved oxygen, and turbidity, are not listed as they are measured in the field.	

A3.4 Measurement Equipment

Each user of the measuring equipment is responsible to ensure that equipment is functioning as expected, properly handled, and properly calibrated at required frequencies in accordance with methods governing control of the measuring equipment. Onsite environmental instrument testing, inspection, calibration, and maintenance will be recorded in accordance with approved methods. Field screening instruments will be used, maintained, and calibrated in accordance with manufacturer specifications and other approved methods.

A3.5 Instrument and Equipment Testing, Inspection, and Maintenance

Collection, measurement, and testing equipment should meet applicable standards (e.g., ASTM International, formerly the American Society for Testing and Materials) or should have been evaluated as acceptable and valid in accordance with instrument-specific methods, requirements, and specifications. Software applications will be acceptance tested prior to use in the field.

Measurement and testing equipment used in the field or in the laboratory will be subject to preventive maintenance measures to ensure minimization of downtime. Laboratories must maintain and calibrate their equipment. Maintenance requirements (e.g., documentation of routine maintenance) will be included in the individual laboratory and onsite organization's QA plan or operating protocols, as appropriate. Maintenance of laboratory instruments will be performed in a manner consistent with applicable Hanford Site requirements.

A3.6 Instrument/Equipment Calibration and Frequency

Field equipment calibration is discussed in Appendix B. Analytical laboratory instruments are calibrated in accordance with the laboratory's QA plan and applicable Hanford Site requirements.

A3.7 Inspection/Acceptance of Supplies and Consumables

Consumables, supplies, and reagents will be reviewed in accordance with test methods in SW-846 and will be appropriate for their use. Supplies and consumables used in support of sampling and analysis activities are procured in accordance with internal work requirements and processes. Responsibilities and interfaces necessary to ensure that items procured/acquired for the contractor meet the specific technical and quality requirements must be in place. The procurement system ensures that purchased items comply with applicable procurement specifications. Supplies and consumables are checked and accepted by users prior to use.

A3.8 Nondirect Measurements

Data obtained from sources, such as computer databases, programs, literature files, and historical databases, will be technically reviewed to the same extent as data generated as part of any sampling and analysis QA/QC effort. Data used in evaluations will be identified by source.

A3.9 Data Management

The SMR group, in coordination with the Project Delivery Manager for Groundwater Science, is responsible for ensuring that analytical data are appropriately reviewed, managed, and stored in accordance with applicable programmatic requirements governing data management methods. Records of data analyses and groundwater surface elevations are maintained as required by WAC 173-303-645(8)(j).

Electronic data access, when appropriate, will be through a Hanford Site database (e.g., HEIS). Where electronic data are not available, hard copies will be provided in accordance with Section 9.6 of the Tri-Party Agreement Action Plan (Ecology et al., 1989b).

Laboratory errors are reported to the SMR group through an established process. For reported laboratory errors, a sample issue resolution form will be initiated in accordance with applicable methods. This process is used to document analytical errors and establish their resolution with the Project Delivery Manager for Groundwater Science. The sample issue resolution forms become a permanent part of the analytical data package for future reference and records management.

A4 ASSESSMENT AND OVERSIGHT

Assessment and oversight activities address the effectiveness of project implementation and associated QA/QC activities. The purpose of assessment is to ensure that the QAPjP is implemented as prescribed.

A4.1 Assessments and Response Actions

Random surveillances and assessments verify compliance with the requirements outlined in this plan, project field instructions, the QAPjP, methods, and regulatory requirements. Deficiencies identified by these assessments will be reported in accordance with existing programmatic requirements. The project's line management chain coordinates the corrective actions/deficiency resolutions in accordance with the QA program, corrective action management program, and associated methods implementing these programs. When appropriate, corrective actions will be taken by the Project Delivery Manager for Groundwater Science.

Oversight activities in the analytical laboratories, including corrective action management, are conducted in accordance with laboratory QA plans. The SMR group oversees offsite analytical laboratories and verifies that laboratories are qualified to perform Hanford Site analytical work.

A4.2 Reports to Management

Program and project management (as appropriate) will be made aware of deficiencies identified by self-assessments, corrective actions from ECOs, and findings from QA assessments and surveillances. Issues reported by the laboratories are communicated to the SMR group, which then initiates a sample issue resolution form. This process is used to document analytical or sample issues and establish resolution with the Project Delivery Manager for Groundwater Science.

A5 DATA REVIEW AND USABILITY

This chapter addresses QA activities that occur after data collection. Implementation of these activities determines whether the data conform to the specified criteria, thus satisfying the project objectives.

A5.1 Data Review and Verification

Data review and verification are performed to confirm that sampling and chain-of-custody documentation are complete. This review includes linking sample numbers to specific sampling locations, and reviewing sample collection dates and sample preparation and analysis dates to assess whether holding times, if any, have been met. Furthermore, a review of QC data is used to determine whether analyses have met the data quality requirements specified in this plan.

The criteria for verification include, but are not limited to, review for contractual compliance (samples were analyzed as requested), use of the correct analytical method, transcription errors, correct application

of dilution factors, appropriate reporting of dry weight versus wet weight, and correct application of conversion factors. Field QA/QC results also will be reviewed to ensure that they are usable.

The project scientist, assigned by the Project Delivery Manager for Groundwater Science, will perform a data review to help determine if observed changes reflect improved/degraded groundwater quality or potential data errors, which may result in submittal of a request for data review on questionable data. The laboratory may be asked to check calculations or re-analyze the sample, or the well may be resampled. Results of the request for data review process are used to flag the data appropriately in the HEIS database and/or to add comments.

A5.2 Data Validation

Data validation is performed at the discretion of the Project Delivery Manager for Groundwater Science and under the direction of the SMR group. It is based on the results of the QC samples for an individual network, discussions with the project scientist, and discussions with the laboratory services manager. If defined as appropriate, data validation (third party) will be performed at a minimum frequency of 5 percent and be based on EPA functional guidelines.

A5.3 Reconciliation with User Requirements

The DQA process compares completed field sampling activities to those proposed in corresponding sampling documents and provides an evaluation of the resulting data. The purpose of the DQA is to determine whether quantitative data are of the correct type and are of adequate quality and quantity to meet the project data quality needs. For routine groundwater monitoring performed through this groundwater monitoring plan, the DQA is captured in the DQA appendix associated with the annual Hanford Site RCRA groundwater report (e.g. DOE/RL-2016-12), which evaluates field and laboratory QC and the usability of data. Further DQAs will be performed at the discretion of the Project Delivery Manager for Groundwater Science and documented in a report overseen by the SMR group.

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APPENDIX B
SAMPLING PROTOCOL

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APPENDIX B
SAMPLING PROTOCOL

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TERMS

DOE	United States Department of Energy
DOT	United States Department of Transportation
FWS	Field Work Supervisor
gpm	gallons per minute
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document* (DOE/RL-96-68)
IATA	International Air Transport Association
NTU	nephelometric turbidity unit
QA	quality assurance
QC	quality control
SMR	Sample Management and Reporting

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B1 INTRODUCTION

Groundwater monitoring at the Hanford Site, as defined by the *Resource Conservation and Recovery Act of 1976* and implemented in WAC 173-303, "Dangerous Waste Regulations," has been conducted since the mid-1980's. Hanford Site groundwater sampling methods contain extensive requirements for sampling precautions to be taken; equipment and its use; cleaning and decontamination; records and documentation; and sample collection, management, and control activities. Together, Appendices A and B provide the sampling and analysis essentials necessary for the groundwater monitoring plan: sample collection, sample holding times, chain–of-custody control, analytical procedures, and field and laboratory quality assurance (QA)/quality control (QC).

This appendix provides more specific elements of the sampling protocols and techniques used for the groundwater monitoring plan. Chapter 3 of the groundwater monitoring plan identifies the monitoring wells that will be sampled, constituents to be analyzed, and sampling frequency for the groundwater monitoring at the 183-H Solar Evaporation Basins.

B2 SAMPLING METHODS

Sampling may include, but is not limited to, the following methods:

- Field screening measurements
- Groundwater sampling
- Water level measurements

Groundwater samples will be collected in accordance with to the current revision of applicable operating methods. Groundwater samples are collected after field measurements of purged groundwater have stabilized:

- **pH** – two consecutive measurements agree within 0.2 pH units
- **Temperature** – two consecutive measurements agree within 0.2°C (32.3°F)
- **Conductivity** – two consecutive measurements agree within 10 percent of each other
- **Turbidity** – less than 5 nephelometric turbidity units (NTUs) prior to sampling (or project scientist's recommendation)

Dissolved oxygen will also be measured in the field in this groundwater monitoring plan. Dissolved oxygen is not required to be stable prior to sample collection.

Unless special requirements are requested from project scientists, wells are typically purged using the equivalent volume as that of three borehole diameters multiplied by the length of the saturated portion of the well screen. Stable field readings are also required as specified above. The default pumping rate is 7.6 to 45.4 L/min (2 to 12 gallons per minute [gpm]), depending on the pump, although this is not practical at every well. On occasions when the purge volume is extraordinarily large, wells are purged for a minimum of 1 hour and are then sampled once stable field readings are obtained.

Field measurements (except for turbidity) are obtained using a flow-through cell. Groundwater is pumped directly from the well to the flow-through cell. At the beginning of the sample event, field crews attach a clean, stainless-steel sampling manifold to the riser discharge. The manifold has two valves and two ports: one port is used only for purgewater, and the other port is used to supply water to the flow-through cell. Probes are inserted into the flow-through cell to measure pH, temperature, conductivity, and dissolved oxygen. Turbidity is measured by inserting a sample vial into a turbidimeter. The purgewater is then discharged to the purgewater truck.

Once field measurements have stabilized, the hose supplying water to the flow-through cell is disconnected and a clean, stainless-steel drop leg is attached for sampling. The flow rate is reduced during sampling to minimize loss of volatiles (if any) and prevent over filling the bottles. Sample bottles

are filled in a sequence designed to minimize loss of volatiles (if any). Filtered samples are collected after collection of the unfiltered samples. For some constituents (e.g., metals) both filtered and unfiltered samples are collected. If additional samples require filtration (e.g., at turbidity greater than 5 NTUs), an inline, disposable 0.45 µm filter is used.

Typically, three traditional types (i.e., Grundfos[13], Hydrostar[14], and submersible electrical pumps) of environmental grade sampling pumps are used for groundwater sampling at Hanford Site monitoring wells. In addition, low-purge-volume, adjustable-rate bladder pumps may be used. Individual pumps are selected based on the unique characteristics of the well and the sampling requirements.

A small number of wells will not support pumping of samples because of low yield or the physical characteristics of the well. In these cases, a grab sample may be obtained. In cases where there is not sufficient yield, purgewater activities are not performed.

Low-purge-volume sampling methodology for the collection of groundwater samples is also being implemented at the Hanford Site. Low-flow purging and sampling uses a low-purge-volume, adjustable-rate bladder pump with flow rates typically on the order of 0.1 to 0.5 L/min (0.26 to 0.13 gpm). This methodology is intended to minimize excessive movement of water from the soil formation into the well. The objective is to pump in a manner that minimizes stress (drawdown) to the system. Purge volumes for wells using low-purge bladder pumps are determined on a well-specific basis based on drawdown, pumping rate, pump and sample line volume, and volume required to obtain stable field conditions prior to collecting samples.

For certain types of samples, preservatives are required. Preservatives, based on the analytical methods used, are added to the collection bottles before their use in the field. Samples may require filtering in the field, as noted on the chain-of-custody form.

To ensure sample and data usability, sampling associated with this groundwater monitoring plan will be performed in accordance with the requirements of DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD), pertaining to sample collection, collection equipment, and sample handling.

Sample holding-time requirements are specified for groundwater samples in Appendix A, Table A-6. These requirements are in accordance with the analytical method specified in Appendix A, Table A-3. The container types, preservatives, and volumes will be identified on the chain-of-custody form. This groundwater monitoring plan defines a sample as a filled sample bottle for purposes of starting the clock for holding-time restrictions.

Holding time is the maximum allowable period between sample collection and analysis. Exceeding required holding times could result in changes in constituent concentrations due to volatilization, decomposition, or other chemical alterations. Required holding times depend on the constituent and are listed in analytical method compilations such as APHA/AWWA/WEF, 2012, *Standard Methods for the Examination of Water and Wastewater;* and SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition; Final Update V*. Recommended holding times are also provided in HASQARD (DOE/RL-96-68) and in applicable laboratory contracts.

B2.1 Decontamination of Sampling Equipment

Sampling equipment will be decontaminated in accordance with sampling equipment decontamination methods. To prevent potential contamination of the samples, care should be taken to use decontaminated equipment for each specific sampling activity.

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[13] Grundfos® is a registered trademark of Grundfos Holding A/S Corporation, Bjerringbro, Denmark.

[14] Hydrostar® is a registered trademark of KYB Corporation, Tokyo, Japan.

Special care should be taken to avoid the following common ways in which cross-contamination or background contamination may compromise the samples:

- Improperly storing or transporting sampling equipment and sample containers.
- Contaminating the equipment or sample bottles by setting the equipment/sample bottle on or near potential contamination sources (e.g., uncovered ground).
- Handling bottles or equipment with dirty hands or gloves.
- Improperly decontaminating equipment before sampling or between sampling events.

Decontamination of sampling equipment and pumps is performed using high-purity water[15] in each step. In general, three rinse cycles are performed to decontaminate sampling equipment: a detergent rinse, an acid rinse, and a water rinse. During the detergent rinse, the equipment is washed in a phosphate-free detergent solution, followed by rinsing with water in three sequential containers. After the third water rinse, equipment that is stainless-steel or glass is rinsed in a 1M nitric acid solution (pH less than 2). Equipment is then rinsed with water in three sequential containers (the water rinses following the acid rinse are conducted in separate water containers that are not used for detergent rinse). Following the final water rinse, equipment is rinsed in hexane and then placed on a rack to dry. Dry equipment is loaded into a drying oven. The oven is set at 50 degrees C (122 degrees F) for items that are not metal or glass or at 100 degrees C (212 degrees F) for metal or glass. Once reaching temperature, equipment is baked for 20 minutes and then cooled. The equipment is then removed from the oven, and the equipment is enclosed in clean, unused aluminum foil using surgeon's gloves. The wrapped equipment is stored in a custody-locked, controlled-access area.

To decontaminate sampling pumps that are not permanently installed, the pump cowling is first removed, washed (if needed) in phosphate-free detergent solution, and then reinstalled on the pump. The pump is then submerged in phosphate-free detergent solution, and 11.4 L (3 gal) of solution is pumped through the unit and disposed. Detergent solution is then circulated through the submerged pump for 5 minutes. The pump is removed from solution and rinsed with water. The pump is submerged in water and 30.3 L (8 gal) of water is pumped through the unit and disposed. The pump is removed from the water and the intake and housing are covered with plastic sleeving. The cleaning is documented on a tag that is affixed to the pump, and the tag will include the following information:

- Date pump cleaned
- Pump identification
- Comments
- Signature of person performing decontamination

B2.2 Water Levels

Each time a sample is obtained, measurement of the groundwater surface elevation at each monitoring well is required by WAC 173-303-645(8)(f), "Releases from Regulated Units." Using a calibrated depth measurement tape, the depth to water is recorded in each well prior to sampling. When two consecutive measurements are taken that agree within 6 mm (0.24 in.), the final determined measurement is recorded along with the date and time for the specific event (e.g., sampling or annual water level measurements). The depth to groundwater is subtracted from the elevation of a reference point (usually the top of the casing) to obtain the water-level elevation. The top of the casing is a known elevation reference point because it has been surveyed to local reference data.

[15] High-purity water that is generally defined as water that has been distilled, deionized, or any combination of distillation, deionization, reverse osmosis, activated carbon filtration, ion exchange, particulate filtration, or other polishing techniques (DOE/RL-96-68).

B3 DOCUMENTATION OF FIELD ACTIVITIES

Logbooks or data forms are required for field activities and will be used in accordance with HASQARD (DOE/RL-96-68) requirements. A logbook must be identified with a unique project name and number. The individual(s) responsible for logbooks will be identified in the front of the logbook, and only authorized persons may make entries in logbooks. Logbook entries will be reviewed by the sampling Field Work Supervisor (FWS), cognizant scientist/engineer, or other responsible manager; the review will be documented with a signature and date. Logbooks will be permanently bound, waterproof, and ruled with sequentially numbered pages. Pages will not be removed from logbooks for any reason. Entries will be made in indelible ink. Corrections will be made by marking through the erroneous data with a single line, entering the correct data, and initialing and dating the changes.

Data forms may be used to collect field information; however, information recorded on data forms must follow the same requirements as those for logbooks. The data forms must be referenced in the logbooks.

A summary of information to be recorded in logbooks or on data forms is as follows:

- Day and date; time task started; weather conditions; and names, titles, and organizations of personnel performing the task.
- Purpose of visit to the task area.
- Site activities in specific detail (e.g., maps and drawings) or the forms used to record such information (e.g., soil boring log or well completion log). Also, details of any field tests that were conducted reference to any forms that were used, other data records, and methods followed in conducting the activity.
- Details of any field calibrations and surveys that were conducted. Reference any forms that were used, other data records, and the methods followed in conducting the calibrations and surveys.
- Details of any samples collected and the preparation, if any, of splits, duplicates, matrix spikes, or blanks. Reference the methods followed in sample collection or preparation; list location of sample collected, sample type, each label or tag number, sample identification, sample containers and volume, preservation method, packaging, chain-of-custody form number, and analytical request form number pertinent to each sample or sample set; and note the time and the name of the individual to whom custody of samples was transferred.
- Time, equipment type, serial or identification number, and methods followed for decontaminations and equipment maintenance performed. Reference the page number(s) of any logbook where detailed information is recorded.
- Any equipment failures or breakdowns that occurred, with a brief description of repairs or replacements.

B3.1 Corrective Actions and Deviations for Sampling Activities

The Project Delivery Manager for Groundwater Science, FWS, appropriate field crew supervisors, and Sample Management and Reporting (SMR) personnel must document deviations from protocols, issues pertaining to sample collection, chain-of-custody forms, target analytes, contaminants, sample transport, or noncompliant monitoring. Examples of deviations include samples not collected due to field conditions.

As appropriate, such deviations or issues will be documented (e.g., in the field logbook) in accordance with internal corrective action methods. The Project Delivery Manager for Groundwater Science, FWS, field crew supervisors, or SMR personnel will be responsible for communicating field corrective action requirements and ensuring that immediate corrective actions are applied to field activities.

Changes in sample activities that require notification, approval, and documentation will be performed as specified in Appendix A, Table A-2.

B4 CALIBRATION OF FIELD EQUIPMENT

Onsite environmental instruments are calibrated in accordance with the manufacturer's operating instructions, internal work requirements and processes, and/or field instructions that provide direction for equipment calibration or verification of accuracy by analytical methods. Calibration records shall include the raw calibration data, identification of the standards used, associated reports, date of analysis, and analyst's name or initials. The results from all instrument calibration activities are recorded in accordance with the HASQARD requirements (DOE/RL-96-68).

Field instrumentation calibration and QA checks will be performed as follows:

- Prior to initial use of a field analytical measurement system.
- At the frequency recommended by the manufacturer or methods, or as required by regulations.
- Upon failure to meet specified QC criteria.
- Daily calibration checks will be performed and documented for each instrument used. These checks will be made on standard materials sufficiently like the matrix under consideration for direct comparison of data. Analysis times will be sufficient to establish detection efficiency and resolution.
- Using standards used for calibration that are traceable to a nationally recognized standard agency source or measurement system. Manufacturer's recommendations for storage and handling of standards (if any) will be followed.

B5 SAMPLE HANDLING

Sample handling and transfer will be in accordance with established methods to preclude loss of identity, damage, deterioration, and loss of sample. Custody seals or custody tape will be used to verify that sample integrity has been maintained during sample transport. The custody seal will be inscribed with the sampler's initials and date.

A sampling and analytical database is used to track samples from the point of collection through the laboratory analysis process.

B5.1 Containers

Samples shall be collected, where and when appropriate, in break-resistant containers. The field sample collection record shall indicate the laboratory lot number of the bottles used in sample collection. When commercially pre-cleaned containers are used in the field, the name of the manufacturer, lot identification, and certification shall be retained for documentation.

Containers shall be capped and stored in an environment that minimizes the possibility of sample container contamination. If contamination of the stored sample containers occurs, corrective actions shall be implemented to prevent reoccurrences. Contaminated sample containers cannot be used for a sampling event. Container sizes may vary depending on laboratory-specific volumes/requirements for meeting analytical detection limits. Container types and sample amounts/volumes are identified on the chain-of-custody form.

B5.2 Container Labeling

Each sample is identified by affixing a standardized label or tag to the container. This label or tag shall contain the sample identification number. The label shall identify or provide reference to associate the sample with the date and time of collection, preservative used (if applicable), analysis required, and collector's name or initials. Sample labels may be either preprinted or handwritten in indelible or waterproof ink.

B5.3 Sample Custody

Sample custody will be maintained in accordance with existing protocols to ensure that sample integrity is maintained throughout the analytical process. Chain-of-custody protocols will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained. A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples shipped to any laboratory.

Shipping requirements will determine how sample shipping containers are prepared for shipment. The analyses requested for each sample will be indicated on the accompanying chain-of-custody form. Each time the responsibility for custody of the sample changes, new and previous custodians will sign the record and note the date and time. The field sampling team will make a copy of the signed record before sample shipment and transmit the copy to the SMR group.

The following minimum information is required on a completed chain-of-custody form:

- Project name
- Collectors' names
- Unique sample number
- Date and time of collection
- Matrix
- Preservatives
- Chain of possession information (i.e., signatures and printed names of each individual involved in the transfer of sample custody and storage locations, and dates/times of receipt and relinquishment)
- Requested analyses (or reference thereto)
- Shipped-to information (i.e., analytical laboratory performing the analysis)

Samplers should note any anomalies with the samples. If anomalies are found, samplers should inform the SMR group; so special direction for analysis can be provided to the laboratory if deemed necessary.

B5.4 Sample Transportation

Packaging and transportation instructions shall comply with applicable transportation regulations and United States Department of Energy (DOE) requirements. Regulations for classifying, describing, packaging, marking, labeling, and transporting hazardous materials, hazardous substances, and hazardous wastes are enforced by the U.S. Department of Transportation (DOT) as described in 49 CFR 171, "Transportation," "General Information, Regulations, and Definitions," through 49 CFR 177, "Carriage by Public Highway."[16] Carrier-specific requirements defined in the current edition of International Air Transport Association (IATA) *Dangerous Goods Regulations*, shall also be used when preparing sample shipments conveyed by air freight providers.

Samples containing hazardous constituents shall be considered hazardous material in transportation and transported according to DOT/IATA requirements. If the sample material is known or can be identified, then it will be classified, described, packaged, marked, labeled, and shipped according to the specific instructions for that material. Appropriate laboratory notifications will be made, if necessary, through the SMR project coordinator.

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[16] Transportation regulations 49 CFR 174, "Carriage by Rail," and 49 CFR 176, "Carriage by Vessel," are not applicable, as these two transportation methods are not used.

B6 MANAGEMENT OF WASTE

Waste materials are generated during sample collection, processing, and subsampling activities. Waste will be managed in accordance with DOE/RL-97-01, *Interim Action Waste Management Plan for the 100-HR-3 and 100-KR-4 Operable Units*. For waste designation purposes, wells listed in Table 3-6 in the main text of the monitoring plan may be surveyed in the Hanford Environmental Information System and the maximum concentration for each analyte within the most recent 5 years will be evaluated for use in creating a waste profile, if required.

Miscellaneous solid waste that has contacted suspect dangerous waste will be managed as dangerous waste. Purgewater and decontamination fluids will be collected and managed in accordance with DOE/RL-2011-41, *Hanford Site Strategy for Management of Investigation Derived Waste*; and DOE/RL-2009-80, *Investigation Derived Waste Purgewater Management Work Plan*. Waste materials requiring collection will be placed in containers appropriate for the material and the receiving facility in accordance with the applicable waste management or waste control plan and applicable substantive federal and/or state requirements.

Packaging and labeling during waste storage and transportation will meet WAC 173-303 and DOT requirements, as appropriate. Packaging exceptions to DOT requirements may be used for onsite waste shipments if documented as such and if the packaging provides an equivalent degree of safety during transportation.

Offsite analytical laboratories are responsible for the disposal of unused sample quantities.

B7 HEALTH AND SAFETY

DOE established the hazardous waste operations safety and health program pursuant to the *Price-Anderson Amendments Act of 1988* to ensure the safety and health of workers involved in mixed-waste site activities. The program was developed to comply with the requirements of 10 CFR 851, "Worker Safety and Health Program," which incorporates the standards of 29 CFR 1910.120, "Occupational Safety and Health Standards," "Hazardous Waste Operations and Emergency Response"; 10 CFR 830, "Nuclear Safety Management"; and 10 CFR 835, "Occupational Radiation Protection." The health and safety program defines the chemical, radiological, and physical hazards and specifies the controls and requirements for daily work activities on the overall Hanford Site. Personnel training; control of industrial safety and radiological hazards; personal protective equipment; site control; and general emergency response to spills, fire, accidents, injury, site visitors, and incident reporting are governed by the health and safety program.

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APPENDIX C
WELL CONSTRUCTION

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APPENDIX C
WELL CONSTRUCTION

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C1 INTRODUCTION

This appendix provides the following information for the 183-H Solar Evaporation Basins groundwater monitoring wells:

- Well name
- Hydrogeologic unit to be monitored (the portion of the aquifer that is located at the well screen or perforated casing) (Table C-1)

The following sampling interval information, as shown in Table C-2:

- Elevation at top of the screen or perforated interval
- Elevation at the bottom of the screen or perforated interval
- Open interval length (i.e., difference between elevations of top and bottom of the screen or perforated interval)

Figures C-1 through C-5 provide the well construction and completion summary for wells 199-H4-8, 199-H4-84, 199-H4-85, 199-H4-88, and 199-H4-89.

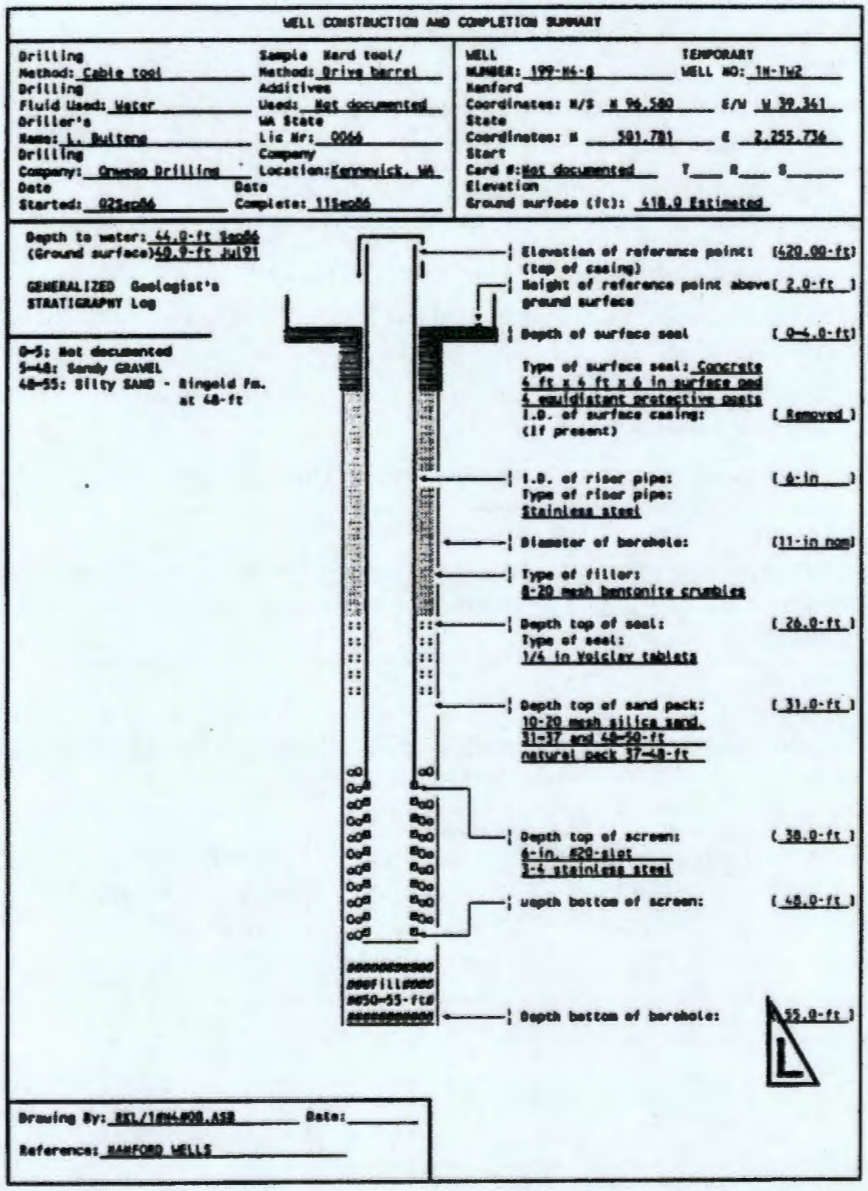
Table C-1 Hydrogeologic Monitoring Unit Classification Scheme

Unit	Description
TU	**Top of Unconfined.** Screened across the water table or the top of the open interval is within 1.5 m (5 ft) of the water table, and the bottom of the open interval is no more than 10.7 m (35 ft) below the water table.

Table C-2 Sampling Interval Information for Wells within the 183-H Solar Evaporation Basins Network

Well Name	Hydrogeologic Unit Monitored	Elevation Top of Open Interval (m [ft]) NAVD88	Elevation Bottom of Open Interval (m [ft]) NAVD88	Open Interval Length (m [ft])
199-H4-8	TU	117.0 (383.9)	114.0 (374.0)	3.0 (9.9)
199-H4-84	TU	117.2 (384.5)	114.1 (374.3)	3.1 (10.2)
199-H4-85	TU	119.7 (392.7)	113.6 (372.7)	6.1 (20.0)
199-H4-88	TU	119.3 (391.1)	113.2 (371.1)	6.1 (20.0)
199-H4-89	TU	118.6 (388.9)	114.1 (374.1)	4.6 (15.0)

Reference: NAVD88, *North American Vertical Datum of 1988*.
Note: See Table 3-2 in main text for depth of remaining water column.
TU = Top of Unconfined, as described in Table C-1



80

Figure C-1 Well 199-H4-8 Construction and Completion Summary

WELL SUMMARY SHEET		Start Date: 2-4-11	Page 1 of 1
		Finish Date: 2-16-11	
Well ID: C7860		Well Name 199-H4-84	
Location: N of D Reactor		Project: WCH Characterization Borehole	
Prepared by: C. Burnette	Date: 2-22-11	Reviewed by: L. D. Walker	Date: 3-2-11
Signature: [signature]		Signature: [signature]	

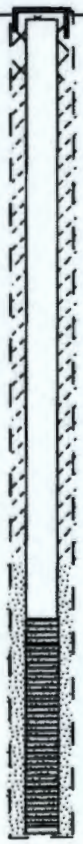
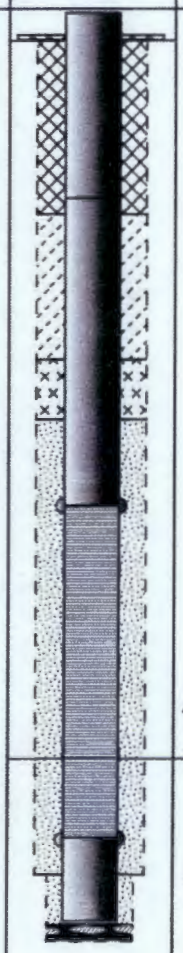
CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
Ground surface circular concrete seal with brase well marker: 0-2.5 ft bgs Well monument 0.0-1.0 ft bgs		0		0-19' Sandy Gravel (sG) 0-19 ft bgs was backfill from previous remediation.
4-in dia SCH 40 PVC blank 0.42-37.65 ft bgs		10		
#8 bentonite crumbles: 2.5-33.5 ft bgs				
		20		19-41 ft. bgs Silty Sandy Gravel (msG)
Temporary Casing: 10 5/8-in Carbon Steel: 0-46.2 ft bgs				
4-in dia. 20 slot PVC Screen 37.65-47.65 ft bgs		30		
mesh 10-20 slot silica sand 33.5-48.6 ft bgs bgs				
		40		41-48.6 ft bgs Sandy Gravel (sG) Static water at 41.5 ft bgs. Tagged on 2-9-11
PVC cap 47.65-48.0 ft bgs				T.D 48.6 ft bgs Tagged on 2-9-11
Note: All temporay casing was removed during well construction. Centralizers were place just above and below the screen.		50		

Figure C-2 Well 199-H4-84 Construction and Completion Summary

WELL SUMMARY SHEET		Start Date: 3/05/2013 Finish Date: 3/14/2013	Page 1 of 1
Well ID: C8723		Well Name: 199-H4-85	
Location: 100-H, North of Reactor on H Ave.		Project: WCH Replacement Wells at 100-D/H	
Prepared by: Tessa Clark	Date: 3/18/2013	Reviewed by: L. Craig Swanson	Date: 5/29/13
Signature:		Signature:	

CONSTRUCTION DATA

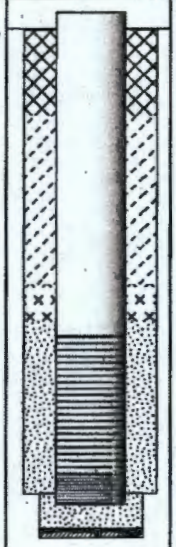
Description	Diagram
Surface Completion: 4'x4'x6" Concrete Pad w/brass survey marker and 8 5/8" protective monument (3 ft ags). Concrete Surface Seal: Type I/II Portland Cement 0.0' bgs - 10.2' bgs. Permanent Well: 6 5/8" OD Stainless Steel Blank 2.0' ags - 27.39' bgs 6 5/8" OD Stainless Steel 0.040 slot Screen 27.39' bgs - 47.29 ' bgs 6 5/8" Stainless Steel Sump w/end cap 47.29' bgs - 52.40' bgs #8 Granular Bentonite Crumbles: 10.2' bgs - 18.9' bgs 1/4" Uncoated Bentonite Pellets: 18.9' bgs - 22.5' bgs 10-20 Colorado Silica Sand Pack: 22.5' bgs - 52.5' bgs Natural Backfill: 52.5' bgs - 53.5' bgs All temporary 10 3/4" OD casing completely removed from ground (3/13/2013). bgs = below ground surface ags = above ground surface	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
0		0 - 2: Silty Sandy Gravel, msG
		2 - 5: Sandy Gravel, sG
		5 - 35: Silty Sandy Gravel, msG
10		
20		
30		
		35 - 47.5: Silty Sandy Gravel, msG
40		
		DTW = 42.6'bgs (3/11/2013)
		47.5 - 53.5: Silt, M
50		
		TD = 53.5' bgs (3/7/2013)

Figure C-3 Well 199-H4-85 Construction and Completion Summary

WELL SUMMARY SHEET		Start Date: 3/14/16 Finish Date: 3/23/16	Page 1 of 1
Well ID: C8734		Well Name: 199-H4-88	
Location: 0.2 miles NNE of H reactor		Project: HR-3 Replacement Wells	
Prepared by: Julie Johanson	Date: 4/6/16	Reviewed by: J.D. MEHRER Environmental Scientist	Date: 4-13-16
Signature: Julie Johanson		Signature:	

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
Surface Completion: 4'x4'x6" Concrete Pad with brass survey marker and 6 9/16" protective monument (3.00' ags)		0		0-16: Sandy Gravel (sG)
Well Completion material: High Strength Concrete 0.0' bgs - 0.65' bgs				
Type I/II Portland Cement 0.65' bgs - 10.08' bgs		20		
Granular Bentonite 3/8" 10.08' bgs - 30.08' bgs				
3/8" Bentonite Pellets 30.08 bgs - 34.29' bgs		40		
10-20 Colorado Silica Sand 34.29' bgs - 52.91' bgs				
20-40 Colorado Silica Sand 52.91' bgs - 59.17' bgs				53-59.90: Silt (M) [RUM]
Natural Fill 59.17' bgs - 59.90' bgs		60		
Permanent Well: 6" ID Stainless Steel Blank 2.01' ags - 38.00' bgs				
6" ID Stainless Steel 0.040 Slot Screen 38.00' bgs - 53.00' bgs		80		
6" ID Stainless Steel 0.006 Slot Screen w/Cap 53.00' bgs - 58.09' bgs				
		100		
All temporary casing completely removed from ground on 3/21/2016 ags = above ground surface bgs = below ground surface				

A-6003-643 (03/03)

Figure C-4 Well 199-H4-88 Construction and Completion Summary

WELL SUMMARY SHEET		Start Date: 1/27/16 Finish Date: 3/30/16	Page 1 of 1
Well ID: C8735		Well Name: ~~199-H4-87~~ 199-H4-89	
Location: S. of 100 H Pump & Treat		Project: HR-3 Replacement Wells	
Prepared by: Julie Johanson	Date: 4/6/16	Reviewed by: J.D. MEHRER Environmental Scientist	Date: 4-13-16
Signature: Julie Johanson		Signature:	

CONSTRUCTION DATA

Surface Completion:

4'x4'x6" Concrete Pad with brass survey marker and 6 9/16" protective monument (3.00' ags)

Well Completion material:

Type I/II Portland Cement
0.00' bgs - 10.10' bgs

Granular Bentonite 3/8"
10.10' bgs - 24.02' bgs

3/8" Bentonite Pellets
24.02 bgs - 27.10' bgs

10-20 Colorado Silica Sand
27.10' bgs - 50.25' bgs

3/8" Bentonite Pellets
50.25' bgs - 53.40' bgs

Natural Fill
53.40' bgs - 56.60' bgs

Permanent Well:

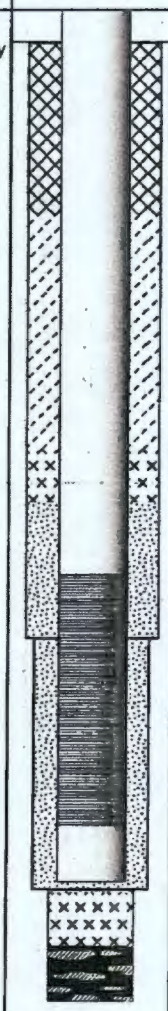
6" ID Stainless Steel Blank
2.00' ags - 31.42' bgs

6" ID Stainless Steel 0.040 Slot Screen
31.42' bgs - 46.37' bgs

6" ID Stainless Steel Sump
46.37' bgs - 49.35' bgs

All temporary casing completely removed from ground on 3/17/2016

ags = above ground surface
bgs = below ground surface



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet: 0, 10, 20, 30, 40, 50

Graphic Log

Lithologic Description:

- 0-15: Silty Sandy Gravel (msG)
- 15-29: Sandy Gravel (sG)
- 29-35: Silty Gravel (mG)
- 35-45: Sandy Gravel (sG)
- 45-46: Silty Sand (mS)
- 46-56.60: Silt (M) [RUM]

A-6003-643 (03/03)

Figure C-5 Well 199-H4-89 Construction and Completion Summary

C2 REFERENCE

NAVD88, 1988, *North American Vertical Datum of 1988*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Spring, Maryland. Available at: http://www.ngs.noaa.gov/.

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APPENDIX D
DANGEROUS WASTE CORRECTIVE ACTION MONITORING RESULTS

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APPENDIX D
DANGEROUS WASTE CORRECTIVE ACTION MONITORING RESULTS

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D1 INTRODUCTION

This appendix presents the corrective action monitoring results of the 183-H Solar Evaporation Basins dangerous waste total chromium (collected as a filtered sample) in the groundwater monitoring well network. Results for hexavalent chromium (filtered) are also presented.

Corrective action monitoring of 183-H Solar Evaporation Basins commenced in 1997. The 183-H Solar Evaporation Basins concentration limits identified in Part VI, Post Closure Unit 2, of the WA7890008967, *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste* are 48 µg/L for total chromium (filtered) and 45 mg/L for nitrate.

The 183-H Solar Evaporation Basins monitoring network has included a total of four wells since the corrective action monitoring period began in 1997. However, wells within the network have changed since 1997. Wells have been within the 183-H Solar Evaporation Basins network for the following durations:

- 199-H4-3 – 1997 to 2013
- 199-H4-7 – 1997 to 2005
- 199-H4-8 – 2005 to present
- 199-H4-12A – 1997 to present
- 199-H4-12C – 1997 to present
- 199-H4-84 – 2013 to present

Figures D-1 through D-6 present the results of total chromium (filtered) monitoring at 183-H Solar Evaporation Basin monitoring network wells during corrective action monitoring. The available hexavalent chromium (filtered) results during these periods are also included. Well 199-H4-85 was drilled in 2013 and is added to the monitoring network in this updated plan. Available sampling results for total chromium (filtered) and hexavalent chromium (filtered) at well 199-H4-85 are presented in Figure D-7. Figures D-8 through D-14 present results of nitrate monitoring for these wells during corrective action monitoring.

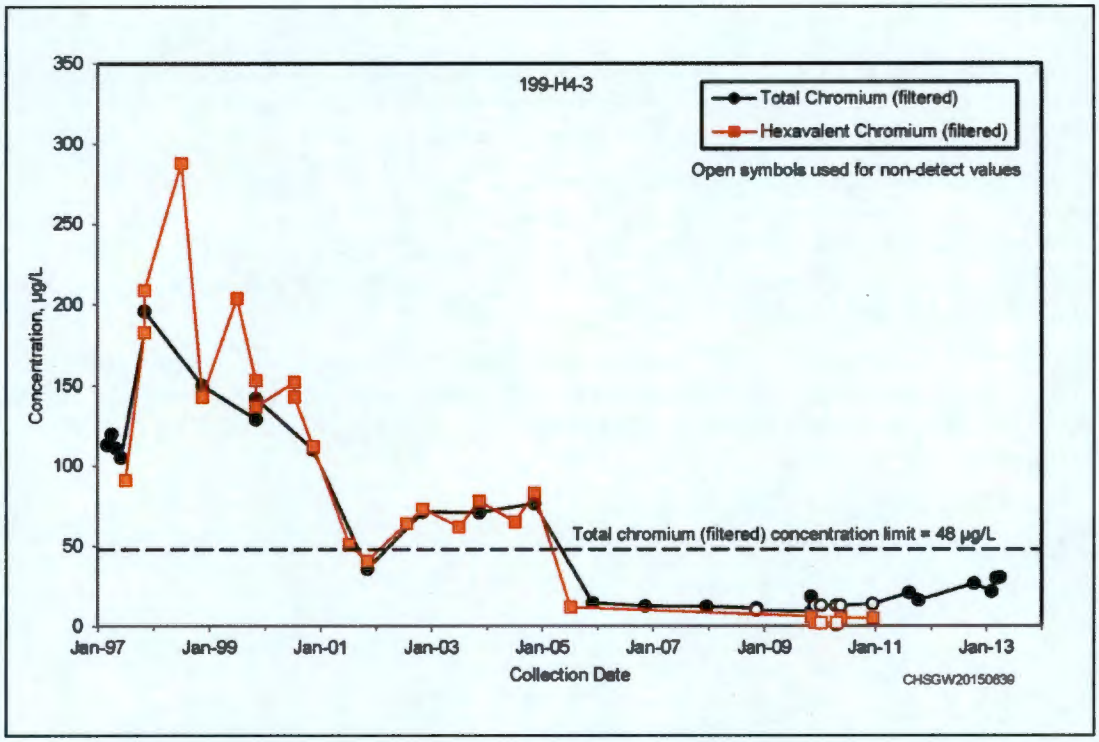

Figure D-1 Corrective Action Monitoring Results of Total Chromium (Filtered) and Hexavalent Chromium (Filtered) at Well 199-H4-3

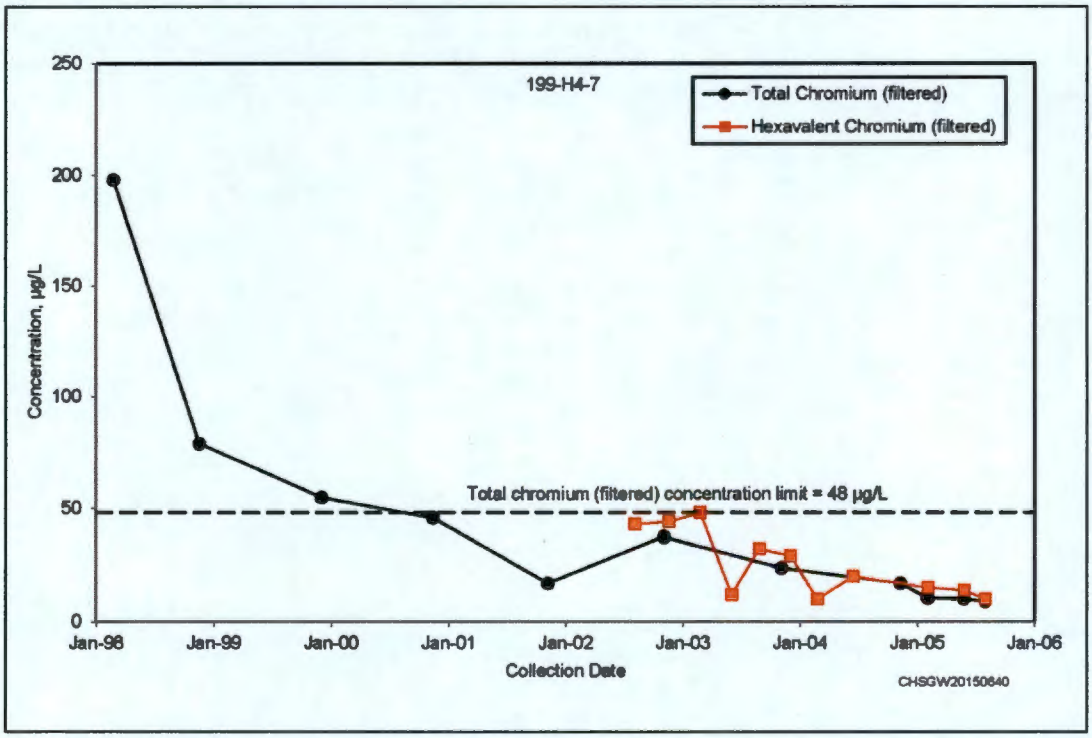

Figure D-2 Corrective Action Monitoring Results of Total Chromium (Filtered) and Hexavalent Chromium (Filtered) at Well 199-H4-7

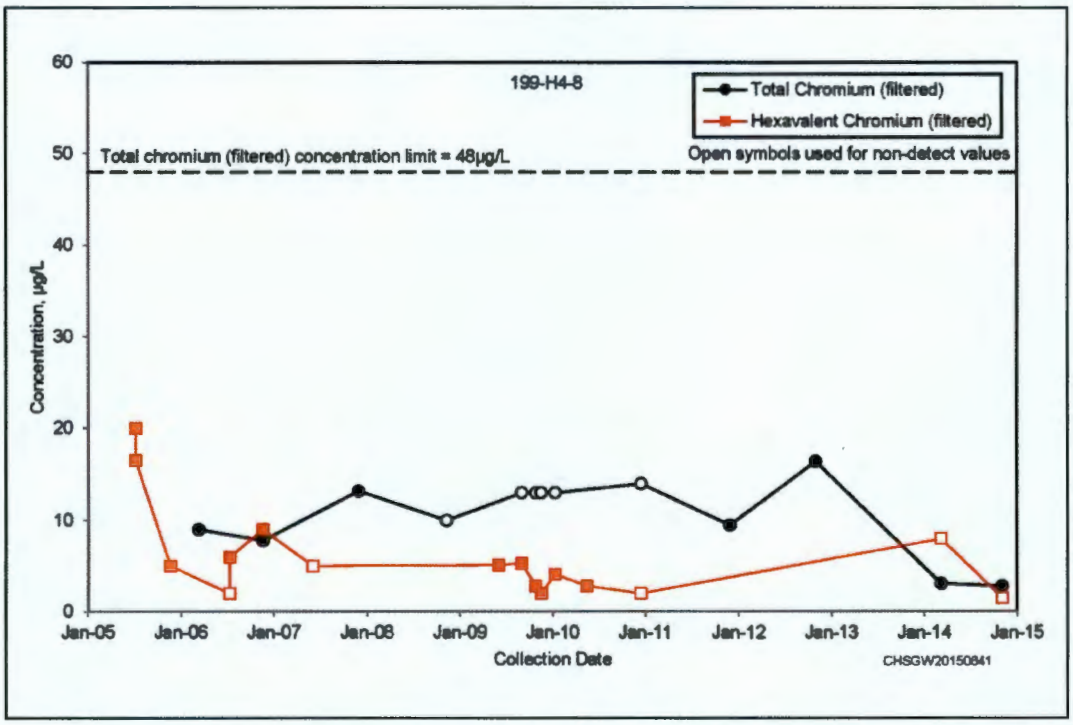

Figure D-3 Corrective Action Monitoring Results of Total Chromium (Filtered) and Hexavalent Chromium (Filtered) at Well 199-H4-8

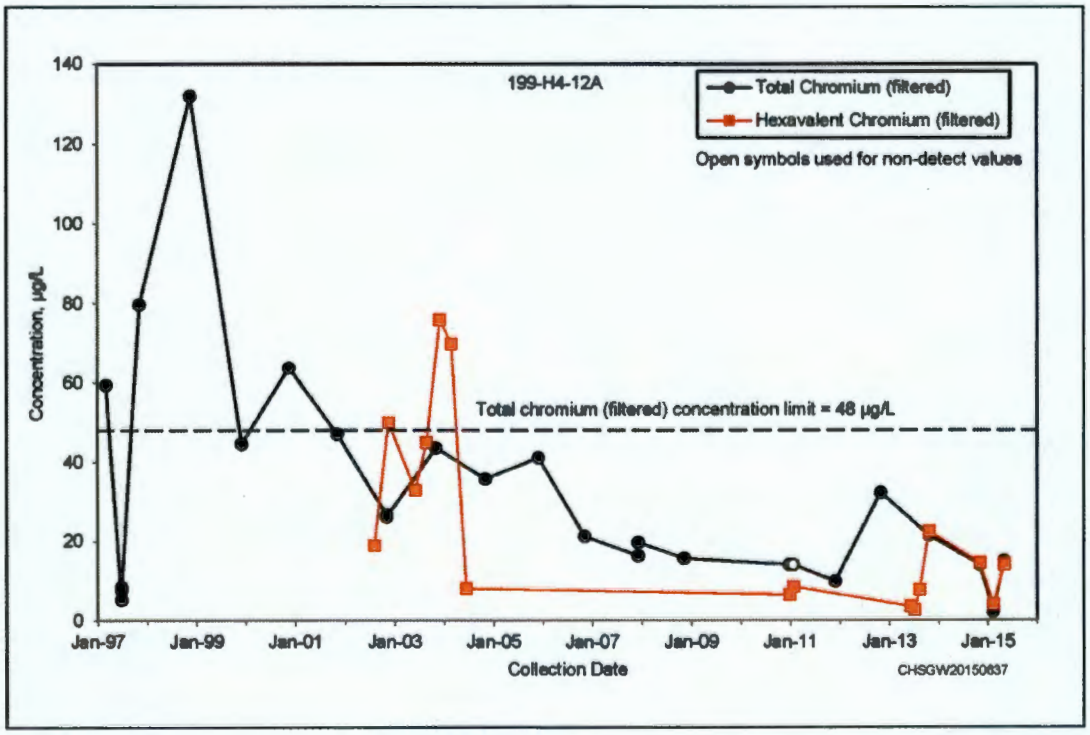

Figure D-4 Corrective Action Monitoring Results of Total Chromium (Filtered) and Hexavalent Chromium (Filtered) at Well 199-H4-12A

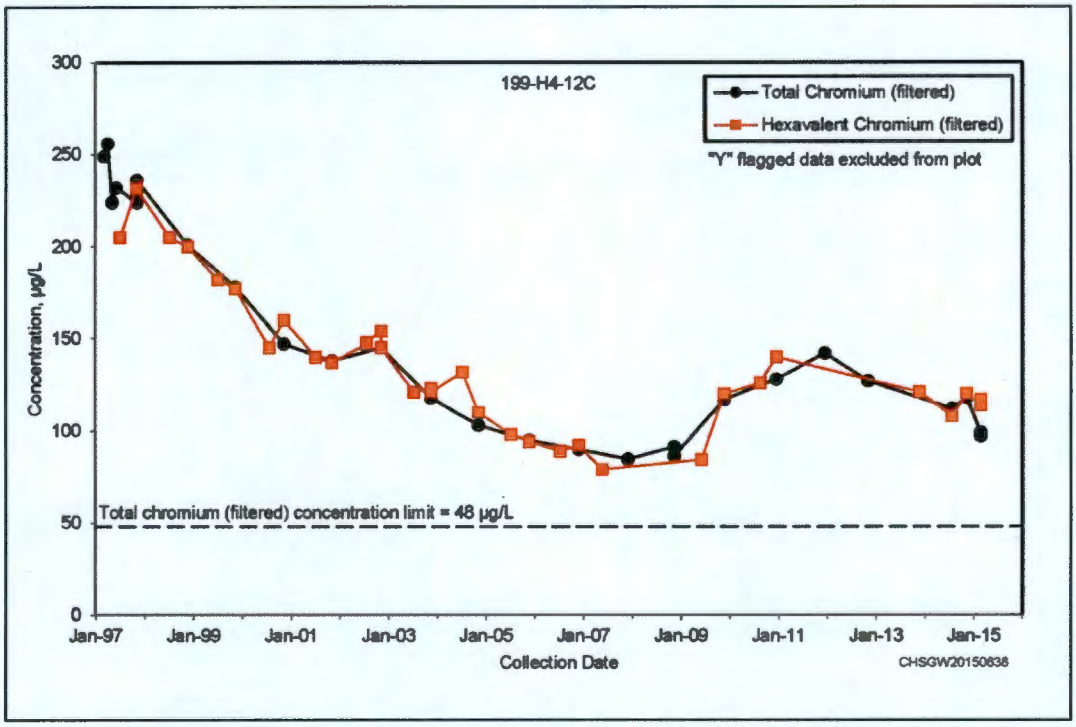

Figure D-5 Corrective Action Monitoring Results of Total Chromium (Filtered) and Hexavalent Chromium (Filtered) at Well 199-H4-12C

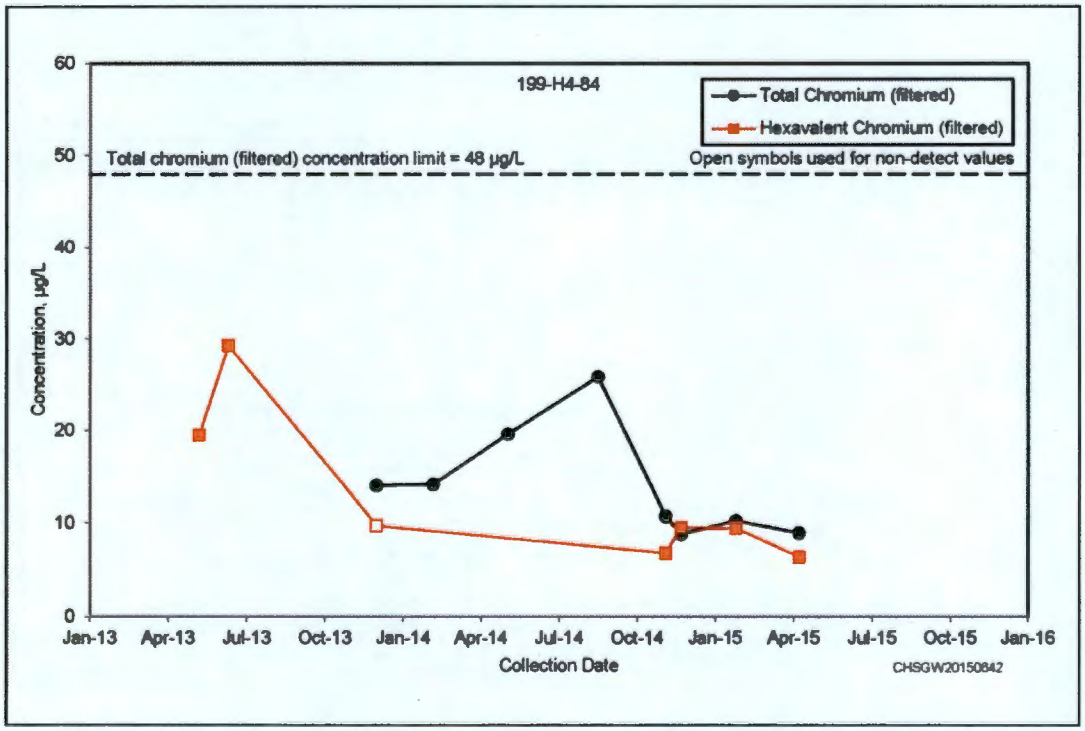

Figure D-6 Corrective Action Monitoring Results of Total Chromium (Filtered) and Hexavalent Chromium (Filtered) at Well 199-H4-84

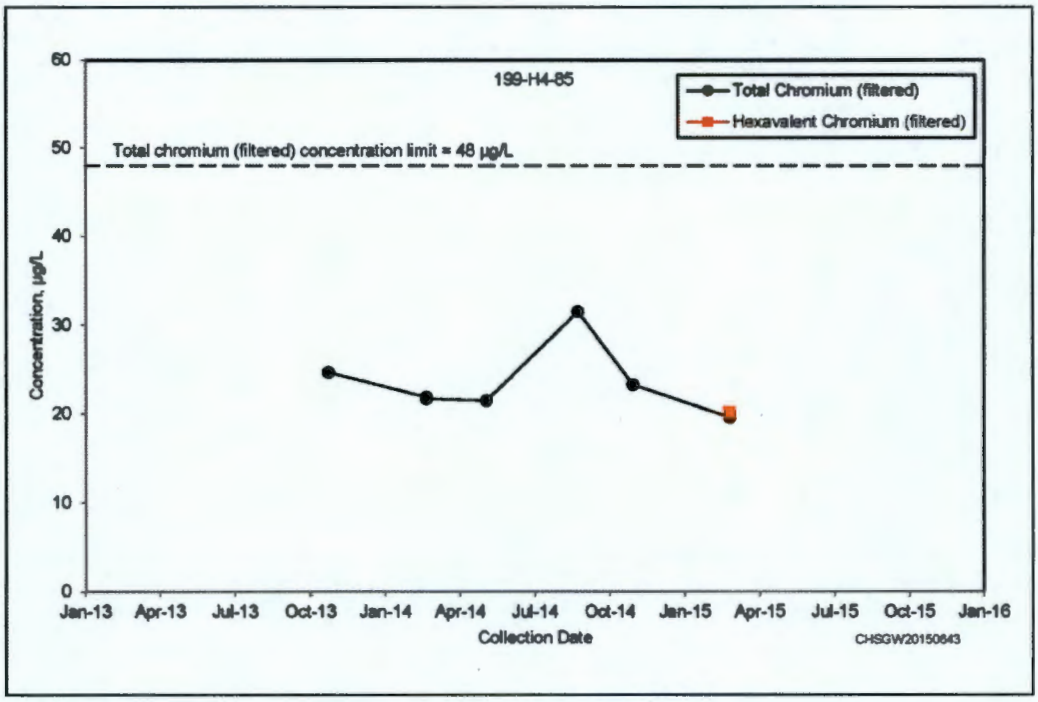

Figure D-7 Corrective Action Monitoring Results of Total Chromium (Filtered) and Hexavalent Chromium (Filtered) at Well 199-H4-85

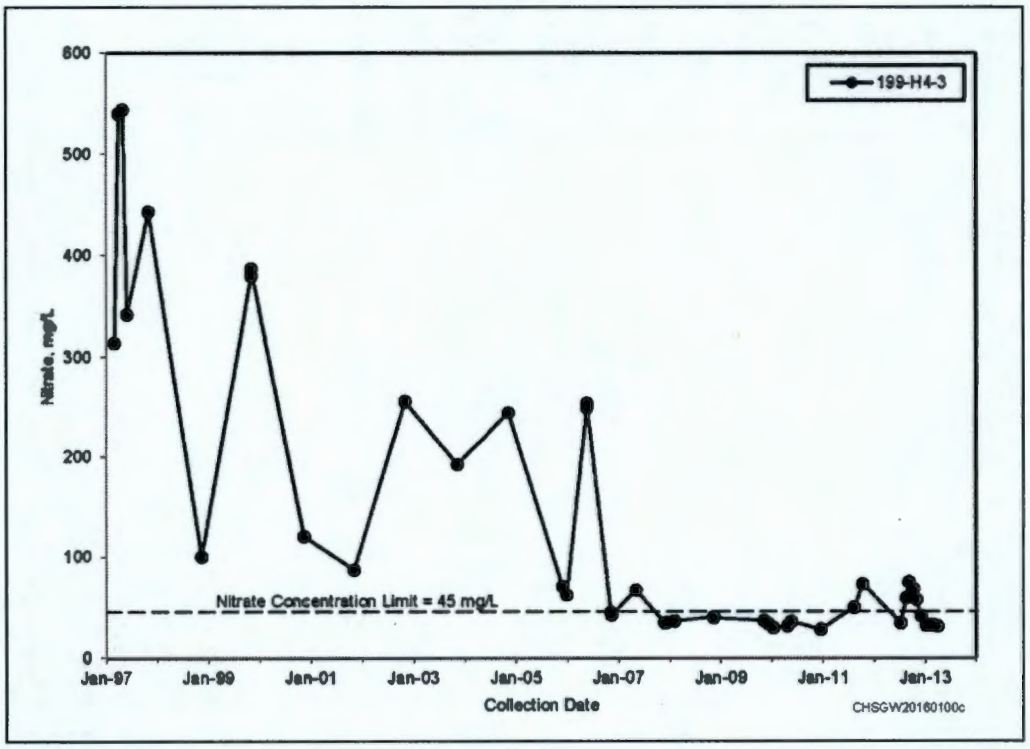

Figure D-8 Corrective Action Monitoring Results of Nitrate at Well 199-H4-3

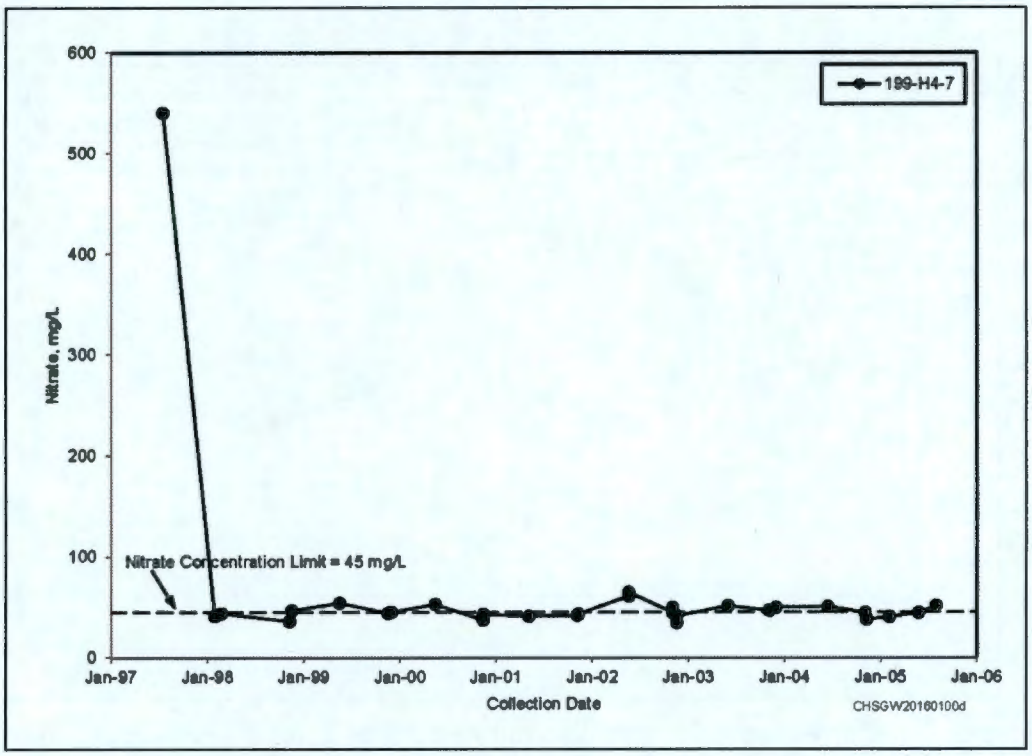

Figure D-9 Corrective Action Monitoring Results of Nitrate at Well 199-H4-7

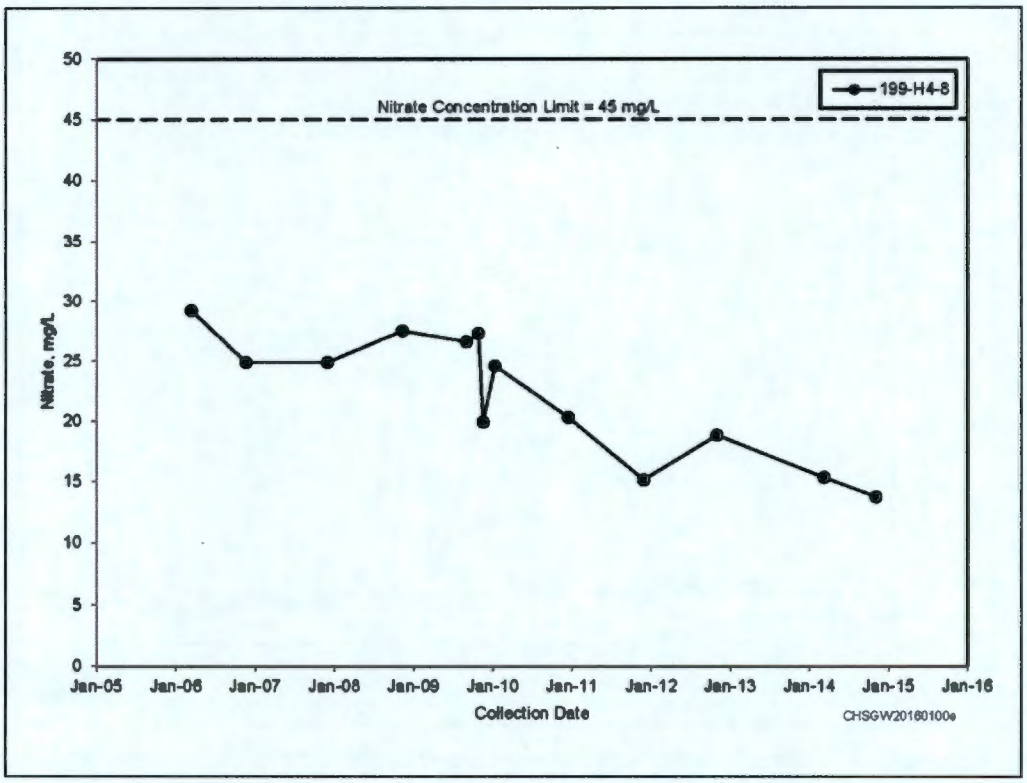

Figure D-10 Corrective Action Monitoring Results of Nitrate at Well 199-H4-8

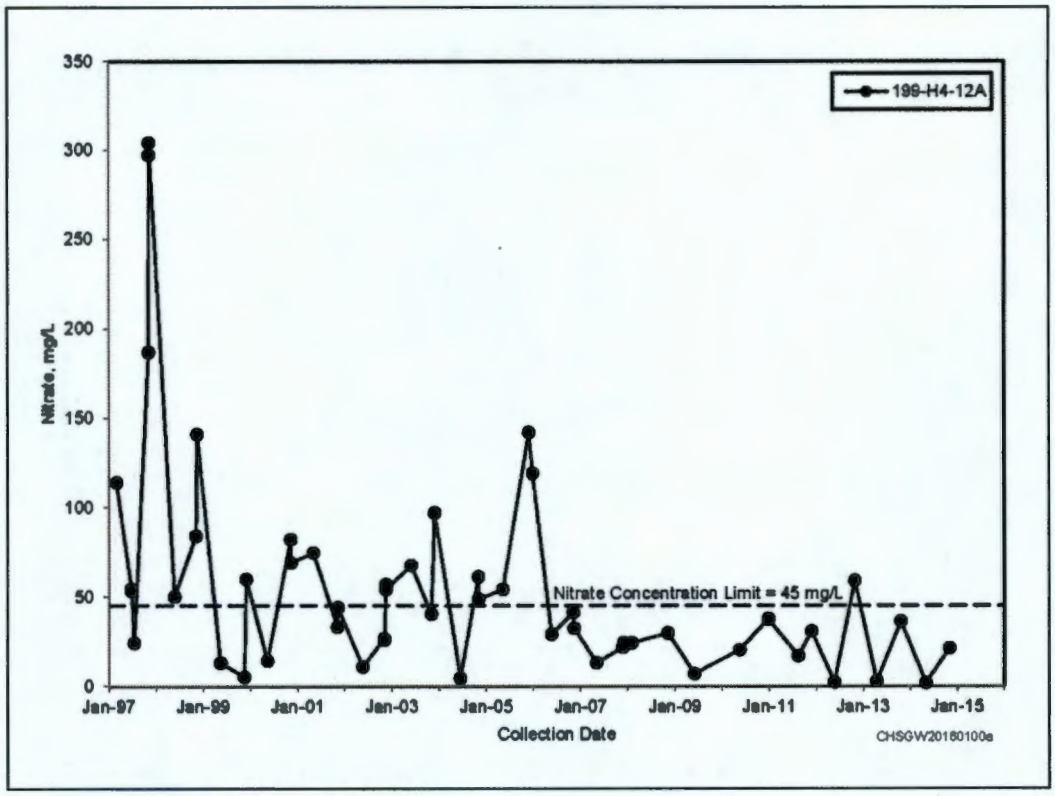

Figure D-11 Corrective Action Monitoring Results of Nitrate at Well 199-H4-12A

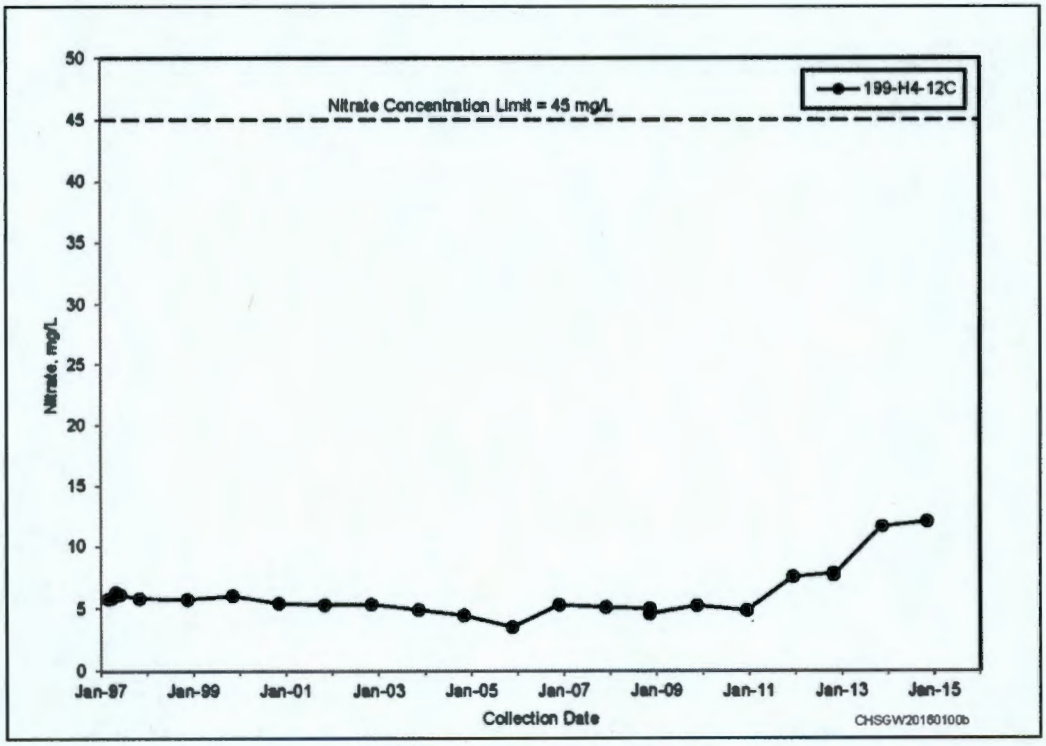

Figure D-12 Corrective Action Monitoring Results of Nitrate at Well 199-H4-12C

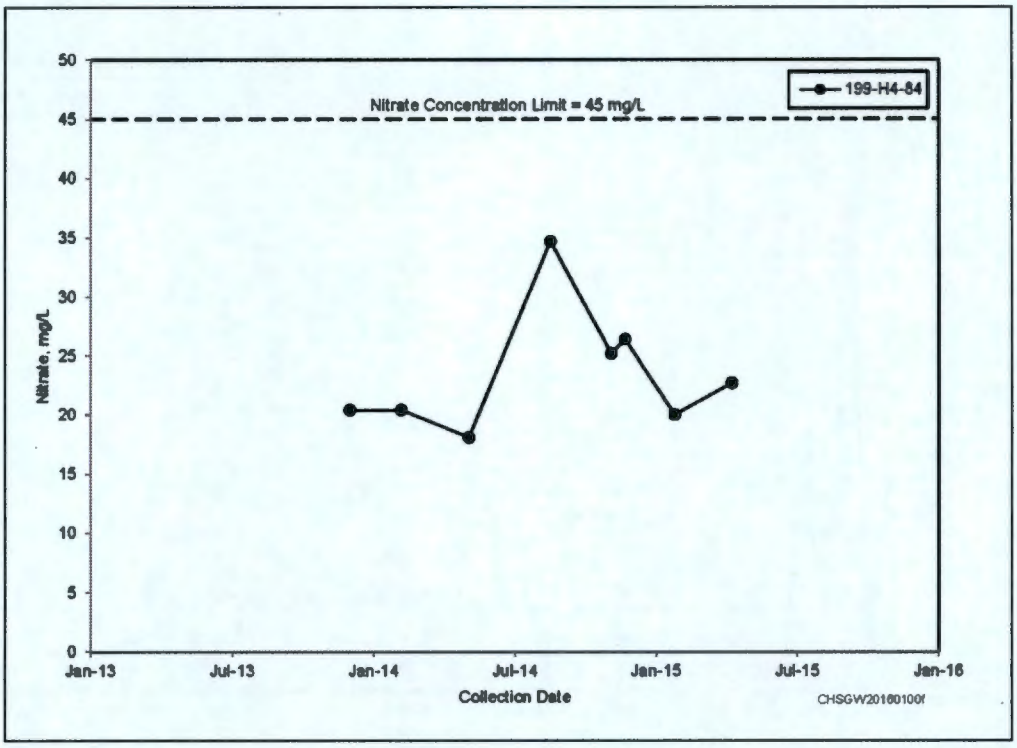

Figure D-13 Corrective Action Monitoring Results of Nitrate at Well 199-H4-84

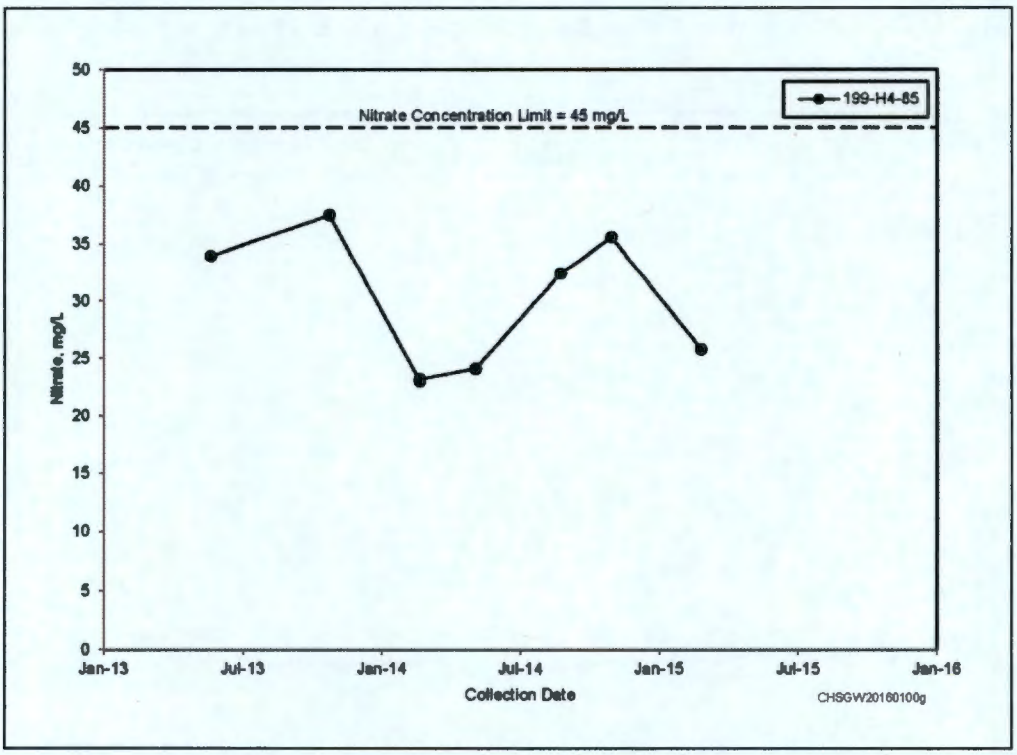

Figure D-14 Corrective Action Monitoring Results of Nitrate at Well 199-H4-85

D2 REFERENCES

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq. Available at: http://www.epw.senate.gov/rcra.pdf.

WA7890008967, *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste*, Revision 8c, as amended, Washington State Department of Ecology. Available at: http://www.ecy.wa.gov/programs/nwp/permitting/hdwp/rev/8c/index.html.

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300 AREA PROCESS TRENCHES
CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have a "**Last Modification Date**" which represents the last date the portion of the unit has been modified. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Last modification to 300 Area Process Trenches **May 24, 2017**

Chapters	Last Modification Date	Modification Number
Unit-Specific Conditions	05/24/2017	8C.2017.1F
1.0 Part A Form	10/1/2008	
2.0 Introduction	06/30/2002	
3.0 Groundwater Monitoring Plan	05/24/2017	8C.2017.1F
4.0 Closure Contact	02/2004	
5.0 Certification of Postclosure	02/2004	
6.0 Reserved		
7.0 Reserved		
8.0 Postclosure Plan	06/30/2002	

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300 AREA PROCESS TRENCHES
PART VI, POST-CLOSURE UNIT 1 UNIT-SPECIFIC CONDITIONS
CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
05/24/2017	8C.2017.1F
10/1/2008	

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PART VI, POST-CLOSURE UNIT 1 UNIT-SPECIFIC CONDITIONS
300 AREA PROCESS TRENCHES

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PART VI, POST-CLOSURE UNIT 1 UNIT-SPECIFIC CONDITIONS
300 AREA PROCESS TRENCHES

The 300 Area Process Trenches were operated to receive effluent discharges of dangerous mixed waste from fuel fabrication laboratories in the 300 Area. This chapter sets forth the modified closure requirements.

VI.1.A COMPLIANCE WITH APPROVED MODIFIED CLOSURE PLAN

The Permittees shall comply with all requirements set forth in Post-Closure Unit 1, including Permit Conditions specified in VI.1.B. The Permittees shall also comply with all the requirements in the 300-FF-1 and 300-FF-5 Record of Decision. All sections, figures, and tables included in these portions are enforceable:

POST-CLOSURE UNIT 1

Chapter 1.0	Part A Form, dated October 1, 2008
Chapter 2.0	Introduction, dated June 30, 2002
Chapter 3.0	Groundwater Monitoring, dated May 24, 2017
Chapter 4.0	Closure Contact, dated February 2004
Chapter 5.0	Certification of Post-Closure, dated February 2004
Chapter 8.0	Post-Closure, dated June 30, 2002

VI.1.B AMENDMENTS TO THE APPROVED MODIFIED CLOSURE PLAN

VI.1.B.1 Pursuant to Permit Condition II.K.7, the 300 Area Process Trenches (APT) closure shall be a Modified Closure in coordination with the Record of Decision (ROD) for 300-FF-1 and 300-FF-5. Sections of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) documents (examples may include, but are not limited to, Remedial Design/Remedial Action CERCLA work plan, the Operation and Monitoring Work Plan, etc.), which satisfy requirements and Conditions of this Modified Closure Plan, will be reviewed and approved by the Washington State Department of Ecology.

VI.1.B.2 Sampling, required by WAC 173-303-645(10)(g), shall not be required unless post-closure monitoring results indicate a need to do so.

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300 AREA PROCESS TRENCHES
CHAPTER 3.0
GROUNDWATER MONITORING

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
05/24/2017	8C.2017.1F

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GROUNDWATER MONITORING

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EXECUTIVE SUMMARY

This document presents a revision to the 1995 (1996 revised) 300 Area Process Trenches groundwater monitoring plan (WHC-SD-EN-AP-185, Rev. 0 and Rev. 0A).[1,2] This revised monitoring plan is based on the requirements for final status facilities, as identified in the WA7890008967, *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste*[3] (hereafter referred to as the Hanford Facility RCRA Permit), Part II, Condition II.F, which specifies that final status groundwater monitoring programs are subject to the requirements in WAC 173-303-645.[4] Due to the age of the plan, the U.S. Department of Energy (DOE), Richland Operations Office is revising this groundwater monitoring plan to ensure that the plan contains the most current Hanford Site groundwater monitoring information for the post-closure unit group (changes in the constituents to be monitored, sampling frequency, concentration limits, statistical evaluation, and clarification of compliance period). This document will supersede the previous plan (WHC-SD-EN-AP-185, Rev. 0 and Rev. 0A) upon modification of the Hanford Facility RCRA Permit. This corrective action groundwater monitoring plan is the principal controlling document for conducting groundwater monitoring at the 300 Area Process Trenches.

The 300 Area Process Trenches are a final status, post-closure unit group (Post Closure Unit Group 1), located in the 300-FF-1 Source Operable Unit (OU), that are undergoing corrective action groundwater monitoring. The 300 Area Process Trenches are located in the northern section of the 300 Area Industrial Complex approximately 300 m (980 ft) west of the Columbia River. The facility consisted of two 460 m (1,500 ft) long trenches used for effluent discharge from the 300 Area process sewer system . The site was closed under a modified closure; that is, the site was remediated and the soil column was clean closed in 1998 with post-closure requirements for groundwater monitoring (Ecology, 1998).[5]

The 300 Area Process Trenches received wastewater contaminated with dangerous waste or dangerous waste constituents. Per the Hanford Facility RCRA Permit, a final status groundwater compliance monitoring program in accordance with WAC 173-303-645 was implemented in 1995 (WCH-SD-EN-AP-185, Rev. 0). The constituents identified for monitoring in the plan were *cis*-1,2-dichloroethene (*cis*-1,2-DCE), trichloroethene (TCE), and uranium. Gross alpha, gross beta, iron, manganese, and field parameters (pH, conductivity, turbidity, and temperature) were also monitored.

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[1] WHC-SD-EN-AP-185, 1995, *Groundwater Monitoring Plan for the 300 Area Process Trenches*, Rev. 0, Westinghouse Hanford Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/vewDoc?accession=D196020117.

[2] WHC-SD-EN-AP-185, 1996, *Groundwater Monitoring Plan for the 300 Area Process Trenches*, Rev. 0A, Westinghouse Hanford Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D196135178.

[3] WA7890008967, *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste,* Revision 8c, as amended, Washington State Department of Ecology, Richland, Washington. Available at: http://www.ecy.wa.gov/programs/nwp/permitting/hdwp/rev/8c/.

[4] WAC 173-303-645, "Releases from Regulated Units," *Washington Administrative Code*, Olympia, Washington. Available at: http://app.leg.wa.gov/WAC/default.aspx?cite=173-303-645.

[5] Ecology, 1998, "Acceptance of Certification of the 300 Area Process Trenches Clean Closure of the Soil Column and Ground Water Corrective Action Requirements" (letter to J.E. Rasmussen, U.S. Department of Energy, from T.A. Wooley, Nuclear Waste Program), Washington State Department of Ecology, Kennewick, Washington, August 10. Available at: http://pdw hanford.gov/arpir/index.cfm/viewDoc?accession=D198148423.

The first samples collected under the compliance monitoring plan exceeded concentration limits for *cis*-1,2-DCE, TCE, and uranium. As a result, corrective action was required. The *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*[6] (CERCLA) action for the 300-FF-5 OU (institutional controls [ICs] and groundwater monitoring) was implemented in EPA/ROD/R10-96/143.[7] Corrective action for the 300 Area Process Trenches was deferred to the CERCLA program for the 300-FF-5 Groundwater OU.

The constituents for monitoring were revised in 1996 (WCH-SD-EN-AP-185, Rev. 0A) and included *cis*-1,2-DCE, TCE, and uranium as constituents of concern, with iron and manganese included for a follow-up geochemical evaluation. Additionally, thallium, polychlorinated biphenyls (PCBs), chrysene, and benzo(a)pyrene were monitored for two years. Field parameters (pH, conductivity, turbidity, and temperature) were also included. Although written as a compliance monitoring plan, WHC-SD-EN-AP-185 (Rev. 0 and Rev. 0A) was accepted as the corrective action monitoring plan for the 300 Area Process Trenches by the Washington State Department of Ecology in 1998.

The U.S. Environmental Protection Agency (EPA) and DOE issued the 300 Area Record of Decision [ROD]/ROD Amendment[8] in 2013. Groundwater contaminants of concern identified for remedial action in the 300 Area Industrial Complex include uranium, *cis*-1,2-DCE, and TCE, which are the 300 Area Process Trenches constituents of concern that were identified in the previous corrective action monitoring plan. The soil and groundwater remedies affecting the 300 Area Process Trenches area include enhanced attenuation of uranium; groundwater monitoring of uranium; monitored natural attenuation of *cis*-1,2-DCE and TCE; and ICs.

This revised groundwater monitoring plan updates the dangerous waste constituents for corrective action monitoring and removes constituents that no longer require monitoring. The dangerous waste constituents identified for monitoring at the 300 Area Process Trenches are *cis*-1,2-DCE and TCE. Other constituents identified for monitoring in the previous plan (WHC-SD-EN-AP-185, Rev. 0 and Rev. 0A) are not included in this revision. Monitoring of uranium is conducted under the CERCLA remedial action and is not included in this monitoring plan. PCBs, benzo(a)pyrene, and chrysene were not detected the 300 Area Process Trenches groundwater monitoring network during the required two years of monitoring and therefore do not require further monitoring. Thallium was detected during the required two years of monitoring but was determined to be naturally occurring.[9] A geochemical evaluation of elevated iron and

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

[7] EPA/ROD/R10-96/143, 1996, *Record of Decision for the 300-FF-1 and 300-FF-5 Operable Units, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Washington State Department of Ecology, and U.S. Department of Energy, Olympia, Washington. Available at: http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=1000544M.TXT.

[8] EPA and DOE, 2013, *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1*, U.S. Environmental Protection Agency and U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0087180.

[9] DOE/RL-2010-99, 2013, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units*, Rev. 0, Sections 4.4.2.3 and 4.4.4.1, and Table 4-24, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at:
http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0088359.
http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0088307.
http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0088306.
http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0088305.

manganese concentrations at the bottom of the unconfined aquifer determined that these concentration levels are attributable to naturally occurring reducing conditions.[10]

This revised groundwater monitoring plan presents a corrective action monitoring plan for the uppermost aquifer beneath the 300 Area Process Trenches. This plan addresses the following:

- Number, locations, and depths of wells in the 300 Area Process Trenches groundwater monitoring network.
- Sampling and analytical methods of dangerous waste required under corrective action monitoring.
- Methods for evaluating groundwater quality information.
- Schedule for groundwater monitoring at the 300 Area Process Trenches.

This revised plan uses the existing groundwater monitoring well network as identified in the previous groundwater monitoring plan (WHC-SD-EN-AP-185, Rev. 0 and Rev. 0A) with the downgradient wells representing the point of compliance. The concentration limits for *cis*-1,2-DCE and TCE are revised in this plan to 16 µg/L and 4 µg/L, respectively, which are the cleanup levels in the 300 Area ROD/ROD Amendment. The concentration limits are based on WAC 173-340-720(4)[11] cleanup levels. Groundwater flow direction determinations indicate that the groundwater flow direction beneath the 300 Area Process Trenches is east or southeast during low river stage and south or southwest during high river stage. Groundwater in the 300 Area Process Trenches monitoring wells will be sampled and analyzed semiannually for *cis*-1,2-DCE and TCE. Field parameters (pH, specific conductance, temperature, and turbidity) will also be collected. Water level measurements will be taken each time a sample is collected to satisfy the requirements of WAC 173-303-645(8)(f).

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[10] ECF-300FF5-14-0044, 2014, *300 Area Process Trenches Geochemical Evaluation of Elevated Dissolved Iron and Manganese Concentrations in the Lower Unconfined Aquifer*, Rev. 0, Sections 4.4.2.3 and 4.4.4.1, and Table 4-24, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0082020H.

[11] WAC 173-340-720, "Model Toxics Control Act—Cleanup," "Groundwater Cleanup Standards," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-340-720.

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TERMS

AEA	*Atomic Energy Act of 1954*
amsl	above mean sea level
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
cis-1,2-DCE	*cis*-1,2-dichloroethene
COC	contaminant of concern
CSM	conceptual site model
DNAPL	dense nonaqueous phase liquid
DOE	United States Department of Energy
DOE-RL	United States Department of Energy, Richland Operations Office
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
ERA	expedited response action
FWS	Field Work Supervisor
HSU	hydrostratigraphic unit
IC	institutional control
MNA	monitored natural attenuation
NAD83	*North American Datum of 1983*
NAVD88	*North American Vertical Datum of 1988*
OU	operable unit
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
QAPjP	quality assurance project plan
RCRA	*Resource Conservation and Recovery Act of 1976*
ROD	record of decision
TCE	trichloroethene
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989)
TSD	treatment, storage, and disposal
UCL	upper confidence limit
VOC	volatile organic compound
WAC	*Washington Administrative Code*

3.0 INTRODUCTION

This document presents the revised groundwater monitoring plan for the 300 Area Process Trenches and supersedes the previous plan (WHC-SD-EN-AP-185, Rev. 0 and Rev. 0A, *Groundwater Monitoring Plan for the 300 Area Process Trenches)*. The United States Department of Energy (DOE), Richland Operations Office (DOE-RL) is revising this groundwater monitoring plan due to the age of the plan and to ensure that the plan contains the most current Hanford Site groundwater monitoring information for the post-closure unit group (changes in the constituents to be monitored, sampling frequency, concentration limits, statistical evaluation, and clarification of compliance period). The 300 Area Process Trenches are a post-closure unit group in Part VI, Unit 1, of the WA7890008967, *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste* (hereafter referred to as the Hanford Facility RCRA Permit). Soil remediation of the trenches was completed in 1998, and the unit was closed in 1998 under modified closure conditions in the Hanford Facility RCRA Permit with requirements for continued groundwater monitoring in post-closure care (Ecology, 1998, "Acceptance of Certification of the 300 Area Process Trenches Clean Closure of the Soil Column and Ground Water Corrective Action Requirements"). The Hanford Facility RCRA Permit, Part II, Condition II.F, specifies that final status groundwater monitoring program requirements will comply with WAC 173-303-645, "Dangerous Waste Regulations," "Releases from Regulated Units." Groundwater is monitored in accordance with WAC 173-303-645 and Part VI, Unit 1, of the Hanford Facility RCRA Permit. For regulatory purposes, the boundary of the 300 Area Process Trenches unit group is identified on the current Hanford Facility RCRA Permit Part A Form.

The 300 Area Process Trenches (waste site 316-5) are located within the 300 Area Industrial Complex in the 300-FF-1 Operable Unit (OU) (Figure 3-1). The 300 Area Process Trenches comprised two, unlined 460 m (1,500 ft) long trenches that were excavated 3.7 m (12 ft) below ground surface. The trenches were one of the primary disposal facilities for 300 Area liquid process waste. Operating records indicate that the 300 Area Process Trenches began receiving wastewater from the 300 Area process sewer in 1975. An expedited response action (ERA) was performed in 1991 to relocate contaminated sediments to the north portions of the trenches (DOE/RL-91-11, *Expedited Response Action Proposal for the 316-5 Process Trenches*). Discharges to the 300 Area Process Trenches ceased in 1994, and remediation of the site was performed in 1997 and 1998.

RCRA compliance groundwater monitoring was initiated at the 300 Area Process Trenches in 1985 (as described in PNL-6671, *Revised Ground-Water Monitoring Compliance Plan for the 300 Area Process Trenches*) based on the groundwater monitoring requirements for interim status facilities. In 1994, the Washington State Department of Ecology (Ecology) issued the Hanford Facility RCRA Permit for the Hanford Site, which included the Part II, Condition II.F requirement that final status treatment, storage, and disposal (TSD) units comply with WAC 173-303-645. As a final status compliance monitoring plan under WAC 173-303-645, WHC-SD-EN-AP-185 (Rev. 0) was incorporated into the Hanford Facility RCRA Permit and initiated in 1996.

Results for the initial compliance monitoring samples collected in late 1996 and early 1997 (Furman, 1997, "Exceedance of Concentration Limits in Groundwater at the 316-5 Process Trenches") showed exceedances of the concentration limits established per WAC 173-303-645(5) for *cis*-1,2-dichloroethene (*cis*-1,2-DCE), trichloroethene (TCE), and uranium. Based on the concentration limit exceedances, the regulations in WAC 173-303-645(11), "Corrective Action Program," require implementation of a corrective action program to reduce contaminant concentrations in groundwater.

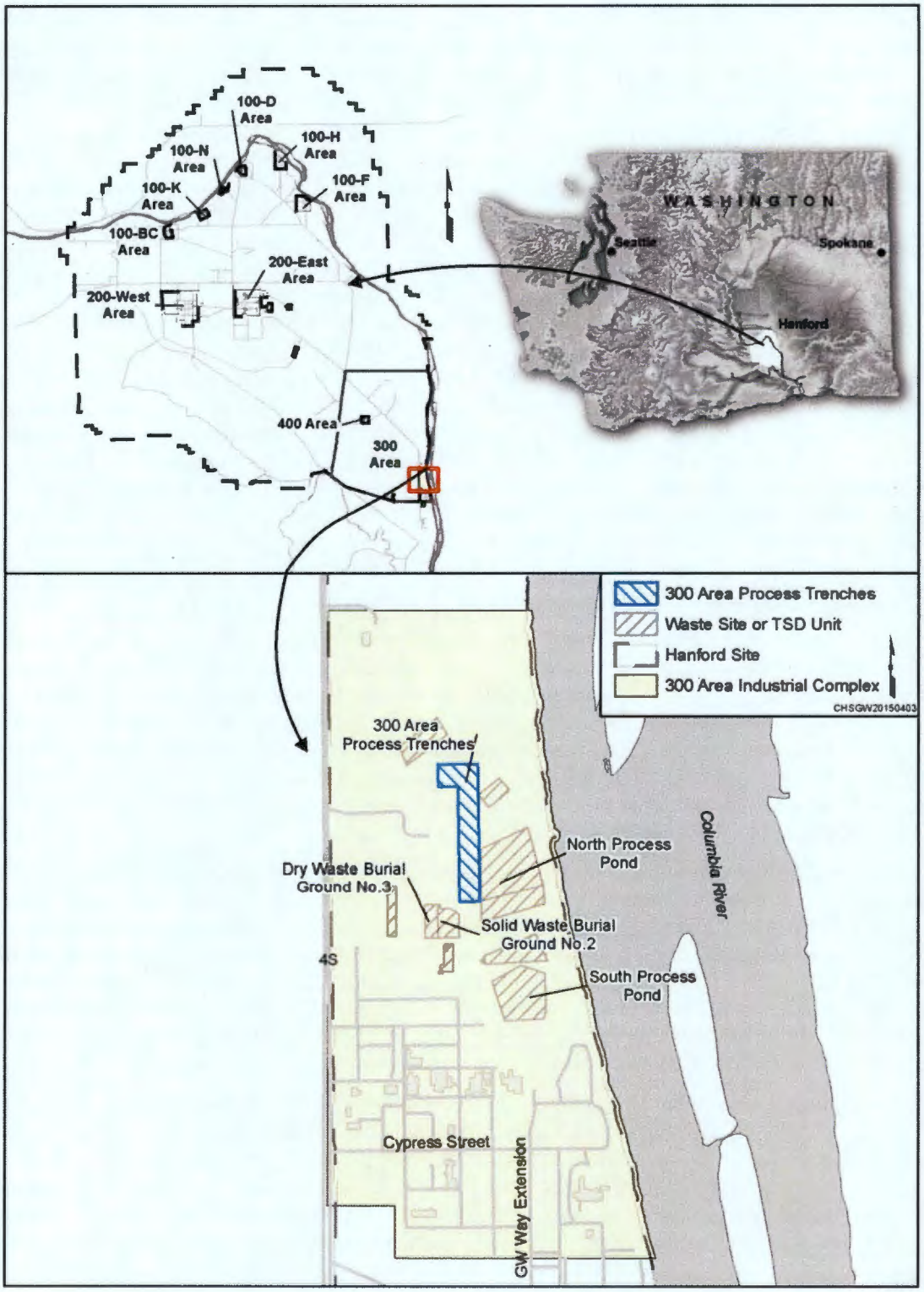


Figure 3-1 Location Map for the 300 Area Process Trenches

The monitoring plan (WHC-SD-EN-AP-185, Rev. 0, Chapter 6), which was incorporated into Chapter VI, Unit 1 of the Hanford Facility RCRA Permit, deferred further groundwater corrective action to the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) action for the 300-FF-1 Source and 300-FF-5 Groundwater OUs. The 300-FF-5 OU alternative selected in EPA/ROD/R10-96/143, *Record of Decision for the 300-FF-1 and 300-FF-5 Operable Units, Hanford Site, Benton County, Washington*, was groundwater monitoring and institutional controls (ICs) (groundwater use restrictions). This alternative required continued monitoring of contaminant trends under the corrective action plan and constituted the corrective action measures under WAC 173-303-645(11).

The monitoring plan (WHC-SD-EN-AP-185, Rev. 0) was revised in 1996 (Rev. 0A) to specify constituents for sampling but remained a compliance monitoring plan. Remediation of the 300 Area Process Trenches was conducted in 1997 and 1998 under an integrated CERCLA/RCRA process described in DOE/RL-93-73, *300 Area Process Trenches Modified Closure/Postclosure Plan*. While the soil portion of the 300 Area Process Trenches met clean closure performance standards under WAC 173-303-610, "Closure and Post-Closure," post-closure groundwater monitoring requirements under the Hanford Facility RCRA Permit and the 300-FF-5 OU record of decision (ROD) (EPA/ROD/R10-96/143) remained (Ecology, 1998). Remediation of the 300 Area Process Trenches under CERCLA (waste site 316-5) was completed and the site was reclassified to "closed out" in 1998. The existing groundwater compliance monitoring plan (WHC-SD-EN-AP-185, Rev. 0 and Rev. 0A) was accepted without modification by Ecology in 1998 as the corrective action monitoring plan and was incorporated into DOE/RL-98-31, *300 Area Process Trenches Postclosure Plan*. WHC-SD-EN-AP-185 (Rev. 0 and Rev. 0A) has remained the controlling document for the 300 Area Process Trenches groundwater monitoring.

The 300 Area ROD/ROD Amendment (EPA and DOE, 2013, *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1* [hereafter referred to as the 300 Area ROD/ROD Amendment]) was issued in 2013. The remedies affecting the 300 Area Process Trenches area include enhanced attenuation of uranium for soil and monitored natural attenuation (MNA), groundwater monitoring, and ICs for groundwater. The 300 Area ROD/ROD Amendment identifies groundwater contaminants of concern (COCs) in the 300 Area Industrial Complex. These include the constituents of concern identified in WHC-SD-EN-AP-185 (Rev. 0A): uranium and the dangerous waste constituents *cis*-1,2-DCE and TCE.

Remedies required under the 300 Area ROD/ROD Amendment (EPA and DOE, 2013) include MNA for *cis*-1,2-DCE and TCE in the 300 Area Industrial Complex. A portion of the 300 Area Process Trenches is within the area identified for enhanced attenuation of uranium. Uranium in groundwater will be monitored until the cleanup level is achieved. ICs restricting groundwater access and use will be implemented until groundwater cleanup levels are achieved.

Cleanup levels for *cis*-1,2-DCE and TCE are identified in the 300 Area ROD/ROD Amendment (EPA and DOE, 2013). Within the 300 Area Process Trenches monitoring network wells, TCE last exceeded the cleanup level of 4 µg/L established in the 300 Area ROD/ROD Amendment (EPA and DOE, 2013) in 1999. A 2015 CERCLA evaluation of TCE in 300 Area groundwater wells found that only one well (which does not monitor the 300 Area Process Trenches) had not attained the established cleanup level for TCE. Based on these results, monitoring for TCE under the CERCLA remedial action is not performed at any wells monitoring the 300 Area Process Trenches under DOE/RL-2014-42, *300-FF-5 Operable Unit Remedy Implementation Sampling and Analysis Plan*, which was approved by the United States Environmental Protection Agency (EPA) in September 2015.

The purpose of this groundwater monitoring plan is to present an updated groundwater monitoring program for dangerous wastes from the 300 Area Process Trenches. This plan is intended specifically to satisfy monitoring requirements for a final status unit undergoing corrective action, as prescribed in Part VI of the Hanford Facility RCRA Permit and required by WAC 173-303-645(11). This monitoring plan is the principal controlling document for conducting groundwater monitoring at the 300 Area Process Trenches and is used to modify the permit. Once the permit is modified, this document will supersede WHC-SD-EN-AP-185 (Rev. 0 and Rev. 0A).

This revised plan monitors *cis*-1,2-DCE, TCE, and field parameters (pH, specific conductance, temperature, and turbidity). Monitoring of uranium is conducted under the CERCLA remedial action and is not included for monitoring in this plan. Polychlorinated biphenyls (PCBs), benzo(a)pyrene, and chrysene were not detected in the 300 Area Process Trenches groundwater monitoring network during the required two years of monitoring and do not require further monitoring. Thallium was detected during the required two years of monitoring and was determined to be naturally occurring based on evaluation in DOE/RL-2010-99, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units* and does not require further monitoring. A geochemical evaluation of elevated iron and manganese concentrations in the deep unconfined aquifer was performed in 2014 and found that the elevated concentrations are attributed to naturally occurring reducing conditions (ECF-300FF5-14-0044, *300 Area Process Trenches Geochemical Evaluation of Elevated Dissolved Iron and Manganese Concentrations in the Lower Unconfined Aquifer*, Section 8) and does not require further monitoring. The corrective action monitoring program detailed in this plan requires semiannual sampling and analysis of *cis*-1,2-DCE, TCE, and field parameters at two upgradient and six downgradient wells. Water level measurements are required each time a sample is collected to satisfy WAC 173-303-645(8)(f).

This groundwater monitoring plan addresses the operational history, current hydrogeology, and conceptual site model (CSM) for the unit and incorporates knowledge regarding contamination originating from the 300 Area Process Trenches and includes the following chapters and appendices:

- Chapter 2 summarizes background information and references other documents that contain more detailed or additional information. It also describes the 300 Area Process Trenches and the regulatory basis, the types of waste present, and the pertinent geology and hydrogeology beneath the 300 Area Process Trenches; and it presents a brief history of groundwater monitoring. This information is summarized as the CSM to aid in development of the groundwater monitoring program.
- Chapter 3 describes the groundwater monitoring program, including the wells in the monitoring network, constituents analyzed, sampling frequency, and sampling protocols.
- Chapter 4 describes data evaluation and reporting.
- Chapter 5 contains the references cited in this plan.
- Appendix A provides the quality assurance project plan (QAPjP).
- Appendix B contains sampling protocols.
- Appendix C provides information for the wells within the groundwater monitoring network.
- Appendix D presents monitoring data of the dangerous wastes (*cis*-1,2-DCE and TCE) that have been collected from the network wells during corrective action monitoring.

3.1 BACKGROUND

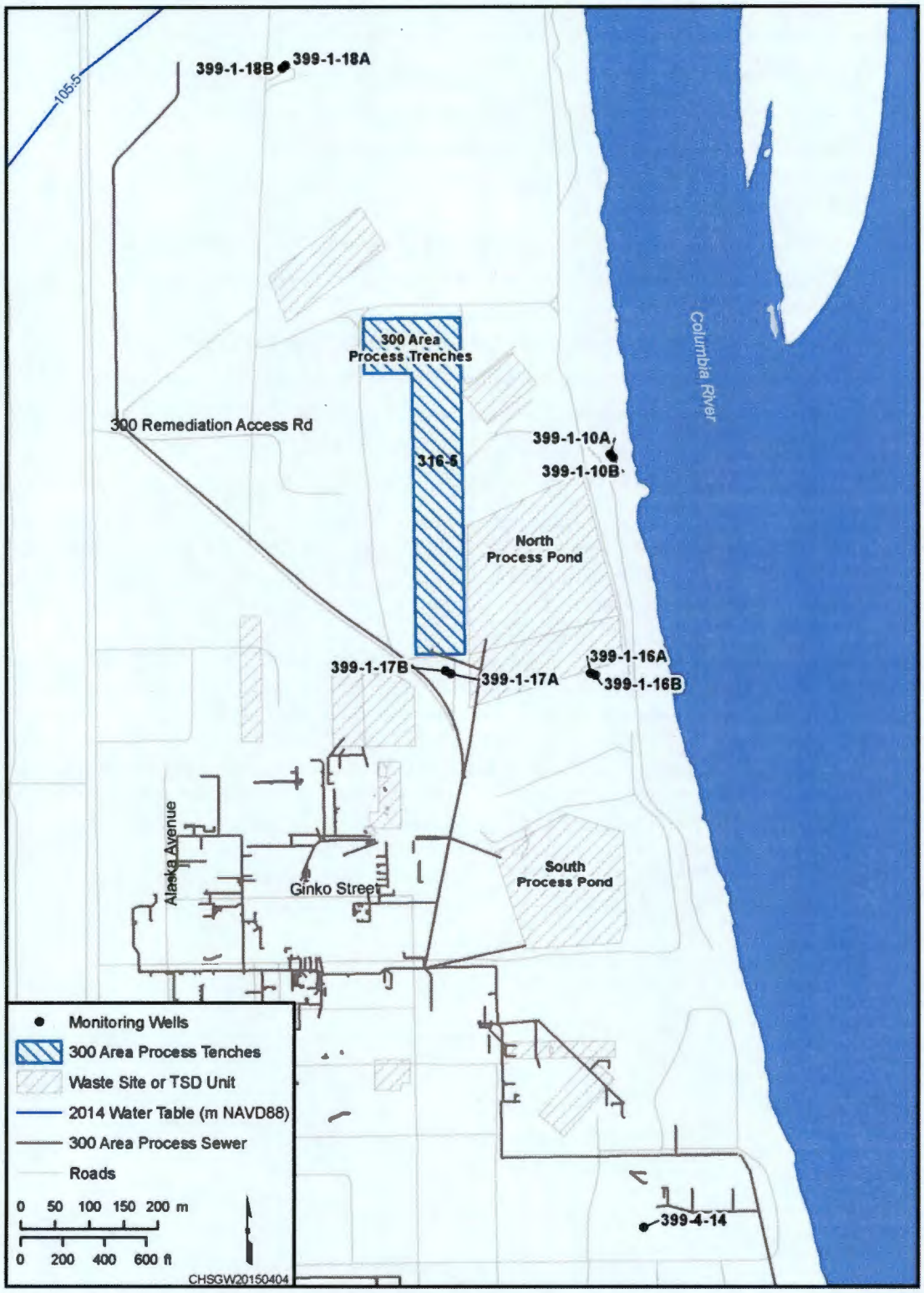
This chapter describes the 300 Area Process Trenches and their operating history, regulatory basis, wastes, and waste characteristics associated with the 300 Area Process Trenches, local subsurface geology and hydrogeology, a summary of previous groundwater monitoring, and the CSM for the 300 Area Process Trenches.

The information contained in this chapter was obtained from several sources, including previous groundwater monitoring plans listed in Section 3.1.5 and the following documents:

- DOE/RL-91-11, *Expedited Response Action Proposal for the 316-5 Process Trenches*
- DOE/RL-92-32, *Expedited Response Action Assessment for 316-5 Process Trenches*
- DOE/RL-98-31, *300 Area Process Trenches Postclosure Plan*
- DOE/RL-2010-99, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units*
- DOE/RL-2015-07, *Hanford Site Groundwater Monitoring Report for 2014*
- EPA and DOE, 2013, *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1*
- PNL-6716, *Interim Characterization Report for the 300 Area Process Trenches*
- PNNL-13645, *300 Area Process Trenches Groundwater Monitoring Plan*
- PNNL-17666, *Volatile Organic Compound Investigation Results, 300 Area, Hanford Site, Washington*

3.1.1 Facility Description and Operational History

The 300 Area Process Trenches are located in the northern portion of the 300 Area Industrial Complex about 300 m (985 ft) west of the Columbia River (Figure 3-2). The site began operating March 16, 1975, and was the main facility for disposal of most liquid process waste generated in the 300 Area from 1975 until the trenches were removed from service in December 1994. The liquid waste discharged to the 300 Area Process Trenches came only from the 300 Area process sewer and consisted mostly of wastewater with relatively low concentrations of chemical contaminants. More concentrated waste was generally not discharged to the process sewer and trenches. The discharge rate varied over the years, but it reached a maximum average of about 8,641 L/min (2,283 gallons per minute [gpm]) during 1979. Total discharge for that year was 4.5 billion L (1.2 billion gal). Between 1987 (when fuels fabrication ceased in the 300 Area) and 1994 (when waste discharges ceased), the wastewater consisted of cooling water with small quantities of nonhazardous maintenance and process waste. When the 300 Area Process Trenches were in use, the east and west trenches were used alternately for periods of up to approximately 8 months. The west trench was removed from service in November 1992; the east trench remained in service with an average discharge of 814 L/min (215 gpm). The trenches were administratively isolated from receiving further discharges in December 1994 and were physically isolated in January 1995.



Elevation in NAVD88, *North American Vertical Datum of 1988*.

Figure 3-2 Map of the 300 Area Process Trenches

The 300 Area Process Trenches consisted of two 457 m (1,500 ft) long trenches excavated 3.7 m (12 ft) into the subsurface and separated by an earthen berm. The unlined trenches were excavated into the sandy gravels of the Hanford formation, an open framework, clast supported pebble/cobble/boulder gravel with intercalated, variably thick, sand and silty sand lenses (additional description provided Section 3.1.4.1, Stratigraphy). The trench bottoms were about 6 m (20 ft) above the average water table elevation (however, the water table elevation varies with river stage, which fluctuates several meters depending on the season and operation of the several dams on the Columbia River). In 1990, the west trench was divided by a berm between the natural depression in the northern end of the trench and the remainder of the trench to the south. The berm was needed to support a bird screen placed over the trench. From 1991 until the site was remediated from 1997 to 1998, the northern 91 m (300 ft) of the original trenches, including the natural depression, were used as an impoundment for low-level radioactive and low-level, mixed waste soil dredged from the southern portions of the trenches.

Administrative controls to prevent disposal of dangerous wastes to the 300 Area Process Trenches were instituted on February 1, 1985. Prior to that time, a variety of chemical waste was included with the wastewater. However, no large quantity of any one waste was included in the process waste. From the beginning of operations in 1975 until October 1993, a continuous, composite sampler was located at the headwall to analyze the wastewater at the point of discharge to the trenches. Subsequently, a sampler located outside the unit analyzed the effluent. In addition, chemical spills are known to have entered the process sewer through 300 Area building floor drains.

In 1991, at the request of the regulatory agency (Ecology), an expedited response action (ERA) was undertaken at the 300 Area Process Trenches (waste site 316-5) to reduce the potential migration of contaminants to groundwater (DOE/RL-91-11). The specific goal was to reduce the measurable level of radiation in the trenches to less than three times the upper tolerance limit of background. The ERA included removing contaminated sediment, using it to fill in the north ends of the trenches, and immobilizing the sediment by covering it with a plastic barrier followed by a layer of clean soil (DOE/RL-92-32). The removal of sediment contaminated with radionuclides also reduced the levels of inorganic constituents remaining in the trenches. Approximately 5,400 m^3 (190,700 ft^3) of sediment was removed and relocated in each trench. About 0.3 m (1 ft) of contaminated soil was removed from the sides and 1.3 m (4 ft) from the bottom of each trench. The less radioactively contaminated sediment (less than 2,000 counts/second) was relocated to the north end of each trench. The more radioactively contaminated sediment (greater than 2,000 counts/sec) was consolidated in the depression located at the northwestern corner of the west trench. The contaminated sediments were isolated from the effluent and then covered with a plastic barrier and a layer of clean aggregate. Results of pre- and post-ERA sampling and analysis of the sediments indicate that the ERA successfully reduced trench contamination at all areas of the trenches except the locations where contaminated sediment was stockpiled. Results of groundwater sampling and analysis after the ERA also showed a drop in concentrations of groundwater contamination.

Remediation of the 300 Area Process Trenches was performed from July 1997 to February 1998 under an integrated RCRA/CERCLA process and included removal and disposal of the site structures (bird screens, head-works, and blockhouse structures) and contaminated sediment that had been previously stockpiled during the 1991 ERA (DOE/RL-98-31). After removal of contaminated soil, clean backfill was added, and site grading and revegetation were performed.

3.1.2 Regulatory Basis

In 1986, DOE entered into a regulatory order (EPA and Ecology, 1986, EPA Regulatory Order No. 1085-10-07-3008 and Ecology No. DE 86-133). The order mandated interim status groundwater quality assessment monitoring according to 40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," and WAC 173-303-400, "Interim Status Facility Standards," at the 300 Area Process Trenches.

In May 1987, DOE issued a final rule (10 CFR 962, "Byproduct Material"), stating that the hazardous waste components of mixed waste are subject to RCRA regulations. The hazardous waste components of mixed waste were determined to be subject to Ecology authority to regulate these waste since August 19, 1987.

In May 1989, DOE, EPA, and Ecology signed the Ecology et al., 1989, *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement). This agreement established the roles and responsibilities of the agencies involved in regulating and controlling remedial restoration of the Hanford Site, which includes the 300 Area Process Trenches.

Dangerous waste is regulated under RCW 70.105 ("Hazardous Waste Management") and its Washington State implementing regulations (WAC 173-303). Radionuclides in mixed waste may include "source, special nuclear, and byproduct materials" as defined in the *Atomic Energy Act of 1954* (AEA). AEA states that these radionuclide materials are regulated at DOE facilities, exclusively by DOE, acting pursuant to its AEA authority. Radionuclide materials are not hazardous/dangerous wastes and, therefore, are not subject to regulation by the state of Washington under RCRA or RCW 70.105.

In 1994, Ecology issued the Hanford Facility RCRA Permit for the Hanford Site. The 300 Area Process Trenches were included in Part V of the permit, which contains requirements specifically applicable to TSD units that are undergoing closure. Part II, Condition II.F, of the Hanford Facility RCRA Permit specified that a groundwater monitoring program under final status would be subject to the requirements of WAC 173-303-645. A final status compliance monitoring plan was issued in 1995 (WHC-SD-EN-AP-185, Rev. 0).

The first sample set collected under the final status plan showed that downgradient concentrations of *cis*-1,2-DCE, TCE, and uranium exceeded the concentration limits established in the compliance monitoring plan (WHC-SD-EN-AP-185, Rev. 0). WAC 173-303-645(11) requires corrective action activities to reduce contaminant concentrations in groundwater. Remediation of the groundwater was deferred to the CERCLA program, with the corrective action to be integrated with the prescribed 300-FF-5 OU action (groundwater monitoring and ICs) in the 300-FF-5 OU ROD (EPA/ROD/R10-96/143). The monitoring plan was revised in 1996 (WHC-SD-EN-AP-185, Rev. 0A) but continued as a compliance monitoring plan.

The 300 Area Process Trenches (316-5 waste site) were remediated in 1997 and 1998 under an integrated CERCLA/RCRA process. The waste site was reclassified under CERCLA to Closed Out in the Waste Information Database System in May 1998. The 300 Area Process Trenches were closed under a modified closure; that is the soil column was clean closed in 1998 under the Hanford Facility RCRA Permit with requirements for continued corrective action groundwater monitoring (Ecology, 1998). The corrective action plan was included in the 300 Area Process Trenches post-closure plan (DOE/RL-98-31), which states that the CERCLA actions under the 300-FF-5 ROD (EPA/ROD/R10-96/143) constitute the corrective action measures to be taken in accordance with WAC 173-303-645(11). The existing compliance monitoring plan (WHC-SD-EN-AP-185, Rev. 0 and Rev. 0A) was accepted by Ecology as the corrective action monitoring plan for the 300 Area Process Trenches (Ecology, 1998). The corrective action groundwater monitoring plan was incorporated into the post-closure plan (DOE/RL-98-31) and the Hanford Facility RCRA Permit. Corrective action groundwater monitoring under WHC-SD-EN-AP-185 (Rev. 0 and Rev. 0A) continues to this day.

The 300 Area ROD/ROD Amendment (EPA and DOE, 2013) was issued in 2013. Remedies selected for the groundwater COCs (*cis*-1,2-DCE and TCE) in the 300 Area Process Trenches area (300 Area Industrial Complex) include MNA and ICs. MNA will be performed until the concentrations of *cis*-1,2-DCE and TCE meet the cleanup levels. ICs restricting groundwater access and use will be implemented until groundwater cleanup levels are achieved.

In 2015, an evaluation of groundwater COCs was performed for wells identified for monitoring the CERCLA MNA remedy. The evaluation was incorporated into the 300 Area sampling plan that implements the MNA remedy under CERCLA (DOE/RL-2014-42) and was approved by EPA. The evaluation found that TCE had attained the cleanup level identified in the 300 Area ROD/ROD Amendment (EPA and DOE, 2013) at each well in the 300 Area network, except for well 399-4-14 (ECF-300FF5-15-0017, *Calculation of Concentration Trends, Means, and Confidence Limits for cis-1,2-Dichloroethene, Gross Alpha, Nitrate, Trichloroethene, Tritium, and Uranium in the 300-FF-5 Operable Unit*, Table 7.4). Based on these results, monitoring for TCE under CERCLA is required at well 399-4-14 only (DOE/RL-2014-42, Table 3.3). Well 399-4-14 does not monitor 300 Area Process Trenches.

3.1.3 Waste Characteristics

The waste generating processes in the 300 Area that produced liquid waste that, in turn, was sent to the 300 Area Process Trenches via the process sewer, included fuel fabrication process waste, laboratory process waste, unplanned waste releases, and some miscellaneous waste. Highly radioactive liquid waste was generally diverted away from the process sewer and was sent to the 300 Area Radioactive Liquid Waste Sewer. Estimated quantities for the chemicals discharged to the process sewer from 1975 until the implementation of administrative controls in 1985 are listed in Table 3-1. Table 3-2 provides the flow history for the process sewer.

From 1975 (when the trenches entered service) until 1987 (when fuel fabrication essentially ceased), the fabrication of fuel elements was primarily for N Reactor. The primary discharge from fuel fabrication was cooling and rinse water. However, fuel fabrication activities routinely used a broad range of organic and inorganic lubricants, organic solvents, and other chemicals that were discharged to the process sewer (Table 3-3). Fuel fabrication was also a source of approximately 1 percent enriched uranium discharged to the trenches, but was not the source of the types of fission products found in the 300 Area Process Trenches. These radionuclides (other than uranium) originated from the re-anodizing of aluminum spacers used in the reactors before 1975. Most of this waste was intended for the Radioactive Liquid Waste Sewer but occasionally may have entered the process sewer. Additionally, some of these radionuclides were likely deposited in process sewer sludge and could have been released to the 300 Area Process Trenches after 1975 during high sewer flows or deviations from normal pH trends.

The chemical makeup and quantity of 300 Area laboratory waste has not been documented. Although a wide variety of laboratory activities occurred in the 300 Area, laboratory waste is considered similar to fuel fabrication process waste because most of the buildings supported fuel fabrication. Typical laboratory waste could have consisted of standard laboratory cleaners, reagents, organic solvents, neutralizers, and drying agents. These chemical wastes could have been discharged directly to the process sewer through laboratory drains or from the retention process sewer in quantities insignificant to the waste stream.

Table 3-1 Estimated Nonradiological Chemical Waste Inventory for the 300 Area Process Trenches

Total of Intermittent Discharges of Dangerous Chemicals Ending February 1, 1985[a,b]		Larger Discharges[c] Continuing until September 1986[d]		Total of Larger Discharges[e] (1975 to 1986)
Less than 1 g	Less than 1 kg			
Ammonium Biofluoride	Benzene	Copper	= 30 kg/mo[f]	3,960 kg
Antimony	Carbon Tetrachloride	Detergents	≤30 kg/mo[f]	3,460 kg

Table 3-1 Estimated Nonradiological Chemical Waste Inventory for the 300 Area Process Trenches

Total of Intermittent Discharges of Dangerous Chemicals Ending February 1, 1985[a,b]		Larger Discharges[c] Continuing until September 1986[d]		Total of Larger Discharges[e] (1975 to 1986)
Less than 1 g	**Less than 1 kg**			
Arsenic	Chromium	Ethylene Glycol	≤200 L/mo[f]	26,400 L
Barium	Chlorinated Benzenes	Heating Oil	= 300 L[g]	300 L
Cadmium	Formaldehyde	Hydrofluoric Acid	= 100 kg/mo[f]	13,200 kg
Dioxine	Formic Acid	Nitrates	≤2,000kg/mo[f]	264,000 kg
Dioxin	Hexachlorophene	Nitric Acid	≤300 L/mo[f]	39,600 L
Hydrocyanic Acid	Kerosene	Paint Solvents	≤100 L/mo[f]	13,200 L
Pyridine	Lead	Tetrachloroethene	= 450 L[g]	450 L
Selenium Compounds	Methyl Ethyl Ketone	Photo Chemicals	≤700 L/mo[f]	92,400 L
Thiourea	Mercury	Sodium Chloride	= 75 tons/yr[f]	825 Tons
Miscellaneous Laboratory Chemicals	Sulfuric Acid	Sodium Hydroxide	≤300 L/mo[f]	39,600 L
	Tetrachloroethene	Uranium	= 20 kg/mo[f]	2,640 kg
	Toluene			
	Tri-butyl-phosphate			
	1,1,1-trichlorothane			
	Trichloroethene			
	Xylenes			

Reference: Adapted from DOE/RL-91-11, *Expedited Response Action Proposal for the 316-5 Process Trenches.*

[a] February 1, 1985 is the date of administrative controls disallowing discharge of dangerous waste to the process sewer.

[b] Includes organics that were not analyzed for by process sewer effluent sampling.

[c] These discharges, except for the spills, were relatively continuous.

[d] September 1986 was the approximate end of fuel fabrication activities.

[e] Total is monthly average discharge times 12 (months per year) times 11 (operating year from March 1975 to September 1986).

[f] Monthly or annual quantity is an average over a 17-month period (February 1985 to September 1986).

[g] Known spills.

Table 3-2 Flow History for the 300 Area Process Trenches

Year	Amount Discharged (Millions of Liters)	Liters/Minute
1975	682	1,298
1976	3,447	6,554
1977	1,894	3,601
1978	1,894	3,601
1979	4,545	8,642
1980	3,180	6,050
1981	3,218	6,122
1982	3,218	6,122
1983	3,445	6,554
1984	3,520	6,698
1985	3,558	6,770
1986	3,407	6,482
1987	3,255	6,194
1988	1,628	3,097
1989	1,893	3,601
1990	1,968	3,745
1991	1,287	2,449
1992	568	1,080
1993	416	792
1994	379	720
Reference: PNNL-13645, *300 Area Process Trenches Groundwater Monitoring Plan.*		

Table 3-3 Fuel Fabrication Chemicals and Radionuclides

Chemicals Routinely Used in Fuel Fabrication	Radionuclides Generated by Fuel Fabrication
Chromic Acid	Scandium-46
Chromium Trioxide	Chromium-51
Copper Sulfate	Cobalt-58
Hydrofluoric Acid	Iron-59
Nitric Acid	Cobalt-60
Oxalic Acid	Zinc-65
Phosphoric Acid	Zirconium/Niobium Isotopes
Potassium Nitrite	Cesium-137
Sodium Aluminate	Promethium-147
Sodium Bisulfate	Thorium-234
Sodium Carbonate	Uranium Isotopes
Sodium Dichromate	Plutonium Isotopes
Sodium Fluorosilicate	
Sodium Gluconate	
Sodium Hydroxide	
Sodium Nitrate	
Sodium Nitrite	
Sodium Pyrophosphate	
Sodium Silicate	
Sulfuric Acid	
Trichloroethene	

Reference: DOE/RL-88-31, *Remedial Investigation/Feasibility Study Work Plan for the 300-FF-1 Operable Unit, Hanford Site, Richland, Washington.*

Chemical spills are known to have entered the process sewer through 300 Area building floor drains. The majority of these releases were spent uranium contaminated acid etch solutions. Other unplanned releases to the process sewer system include two spills of tetrachloroethene (PCE) in 1982 (455 L [120 gal]) and 1984 (76 L [20 gal]), and two releases of ethylene glycol in April 1993 (1,364 L [360 gal]) and October 1993 (7.6 L [2 gal]).

While the 300 Area Process Trenches were in operation, some of the facilities in the 300 Area connected to the process sewer performed activities related to reactor operations, irradiated fuel examinations, chemical separations processes, photographic processing, and waste management. Other facilities also supported such activities as peaceful uses of plutonium, reactor fuels development, liquid metal technology, environmental remediation technology development, and life science programs. Although such facilities may have contributed small quantities of radioactive or dangerous waste to the process sewer, trench soil analytical results indicate that their contribution to the waste stream and to subsequent trench soil and potential groundwater contamination is insignificant compared to that of fuel fabrication.

3.1.4 Geology and Hydrogeology

The geology and hydrogeology of the 300 Area Industrial Complex and 300-FF-5 OU, including the region of the 300 Area Process Trenches, are described in detail in the following documents:

- DOE/RL-2010-99, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units*
- PNNL-16435, *Limited Field Investigation Report for Uranium Contamination in the 300-FF-5 Operable Unit at the 300 Area, Hanford Site, Washington*
- PNNL-17666, *Volatile Organic Compound Investigation Results, 300 Area, Hanford Site, Washington*
- PNNL-22048, *Updated Conceptual Model for the 300 Area Uranium Groundwater Plume*

3.1.4.1 Stratigraphy

Figure 3-3 summarizes the general stratigraphy at the Hanford Site. The stratigraphic units that underlie the 300 Area Industrial Complex, from youngest to oldest, are the eolian surficial deposits and the Hanford formation and Ringold Formation sediments overlying the Columbia River Basalt Group.

- Eolian deposits (Holocene Age) - the most recently deposited sediment is a discontinuous veneer containing eolian sand and/or anthropogenic backfill of previously excavated sediment. These deposits generally overlie the 300 Area Industrial Complex, with a typical thickness of 1 to 6 m (3.3 to 19.7 ft).
- Hanford formation (Pleistocene Age) – equivalent to hydrostratigraphic unit (HSU) 1. The Hanford formation cataclysmic flood deposits are three facies subunits (silt dominated, sand dominated, and gravel dominated), which grade into one another vertically and laterally. In the 300 Area Industrial Complex the Hanford formation is persistently the gravel dominated lithostratigraphic sequence (subunit H1) that typically ranges in thickness from 12 to 24 m (40 to 80 ft). Subunit H1 is coarse-grained, basalt-rich, clast supported, open framework, sandy gravel with variable silt/clay content. As a result, the Hanford formation permeability is generally several orders of magnitude greater than the underlying Ringold Formation. Therefore, the contact between these two highly contrasting stratigraphic units may act as a distinct hydrologic boundary.
- Ringold Formation Unit E and Lower Mud (Miocene Age) – equivalent to hydrostratigraphic unit (HSU) 5 and HSU8, respectively. The gravel dominated Ringold Formation upper coarse unit (Unit E) overlies the Ringold Formation lower mud unit. Unit E is up to 24 m (80 ft) thick and consists of pebbles and cobbles compacted within a matrix of fine- to medium-grained sand with silt. Up to 24 m (80 ft) of Ringold Formation lower mud unit fine-grained sediments overlie the basalt. These low-permeability sediments vary in grain size among clay, silt, and fine sand. This unit forms an aquitard beneath the unconfined aquifer system. The Ringold Formation upper fine member of Taylor Flat, which may be equivalent to the Ringold upper mud unit defined in the 100 Areas, is not present beneath the 300 Area and was most likely removed from the area by paleo-flood and historical River erosional forces.

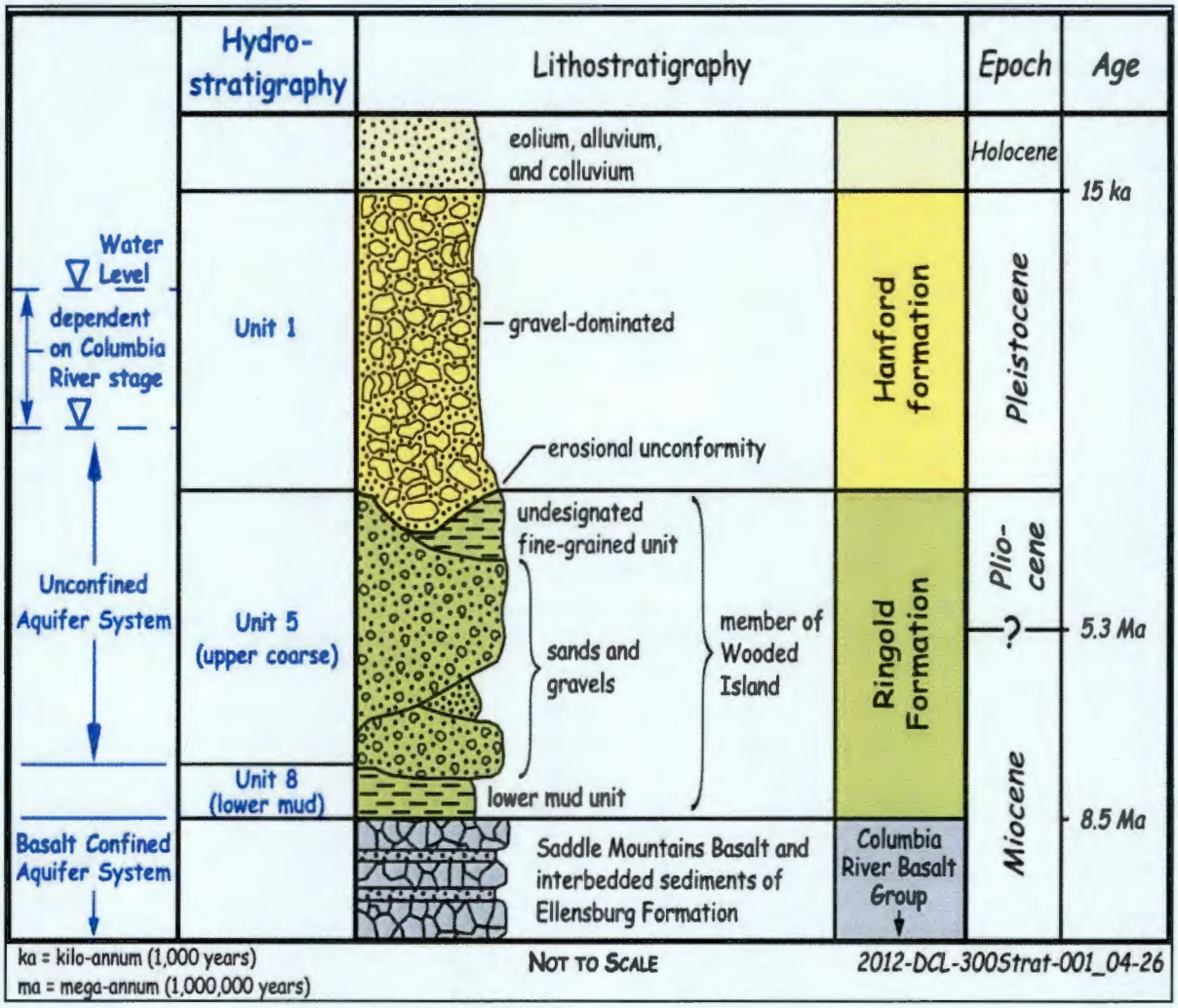


Figure 3-3 Stratigraphy of the 300 Area

A relatively fine-grained interval of Ringold Formation silt and fine sand lies at or near the top of Unit E over portions of the 300 Area Industrial Complex. The finer-grained interval locally creates an aquitard that influences the flow of groundwater within key, critical areas of the 300 Area Industrial Complex. The distribution and thickness of the finer-grained unit is highly variable across the 300 Area Industrial Complex. It is thickest (up to 10 m [33.5 ft]) as a dome-shaped feature south and east of the former South Process Pond. Borehole data suggest that this unit is not present underlying the 300 Area Process Trenches, but the data are limited. Depth discrete aquifer testing and depth discrete groundwater results from the 300-FF-5 OU Limited Field Investigation wells (PNNL-16435) indicate that uranium contaminated groundwater is significantly elevated in the saturated Hanford portion of the unconfined aquifer but drops significantly below the Ringold Formation contact within the fine-grained interval.

Geologic cross sections, which include selected wells in the 300 Area Process Trenches monitoring network and surrounding area, present the approximate stratigraphy underlying and adjacent to the site (Figures 3-4and 3-5).

3.1.4.2 Hydrogeology

The vadose zone comprises recent and backfill materials and unconsolidated gravels and sand of the Hanford formation. In the 300 Area Industrial Complex, the average thickness of the vadose zone is 10 m

(33 ft). However, the vadose zone thickness varies with the seasonal stages of the Columbia River and distance inland from the river. Rising groundwater elevations resulting from higher Columbia River stages seasonally saturate deeper portions of the vadose zone, while lower river stages result in falling groundwater elevations that dewater these same deeper portions of the vadose zone. These fluctuating groundwater elevations create the periodically rewetted zone (Figure 3-6). Generally, wells adjacent to the river within the 300 Area Industrial Complex show higher variation in response to river stage changes than wells located further from the shoreline (PNNL-22048, Section 2.4.3).

The unconfined aquifer occurs in the highly permeable, gravel dominated Hanford formation and in the underlying, less permeable sands and gravels of the Ringold Formation upper coarse unit (Ringold Formation unit E). Paleochannels carved into Ringold Formation sediments are filled with Hanford formation gravels that provide preferential pathways for groundwater flow and for intrusion of river water during periods of high river stage (DOE/RL-2010-99, Section 4.4.4.3) (Figure 3-7). The Ringold Formation lower mud unit is a confining layer (i.e., aquitard at the base of the unconfined aquifer) and is characterized by very low-permeability fine-grained sediment. This hydrologic unit prevents further downward movement of groundwater contamination to the deeper aquifers. The thickness of the unconfined aquifer along the Columbia River shoreline is about 25 m (80 ft).

3.1.4.3 Groundwater Flow Interpretation

Groundwater in the unconfined aquifer discharges to the Columbia River via upwelling through the riverbed and riverbank seeps. The flow from the unconfined aquifer is very low, compared to the flow of the river. Because the river stage fluctuates up and down, flow beneath the shoreline oscillates back and forth, with river water intruding into the unconfined aquifer and mixing with groundwater at times. When the river stage drops quickly to a low elevation, riverbank seeps appear. The rise and fall of the river stage create a dynamic zone of interaction between groundwater and river water, affecting groundwater flow patterns, contaminant transport rates, groundwater geochemistry, contaminant concentrations, and contaminant attenuation rates.

Groundwater flow velocities beneath the 300 Area Process Trenches were estimated to be 17 m/day (56 ft/day) in March 2014 and 13 m/day (43 ft/day) in June 2014 (DOE/RL-2015-07, Table B.1). Because the hydraulic gradients change direction in response to river stage, which fluctuates on seasonal and multiyear cycles, groundwater flow is not always directed toward the river. The flow direction beneath the 300 Area Process Trenches was estimated to be south-southeast in March 2014 and southwest in June 2014 (DOE/RL-2015-07, Table B-1) (Figure 3-8). Accordingly, groundwater flow direction beneath the 300 Area Process Trenches is predominantly to the south-southeast when the river stage is low (typical throughout most of the year). However, when the river stage is high (typically late spring and early summer), groundwater flow direction beneath the trenches may change to south-southwest. Figure 3-9 presents the 2014 regional water table map.

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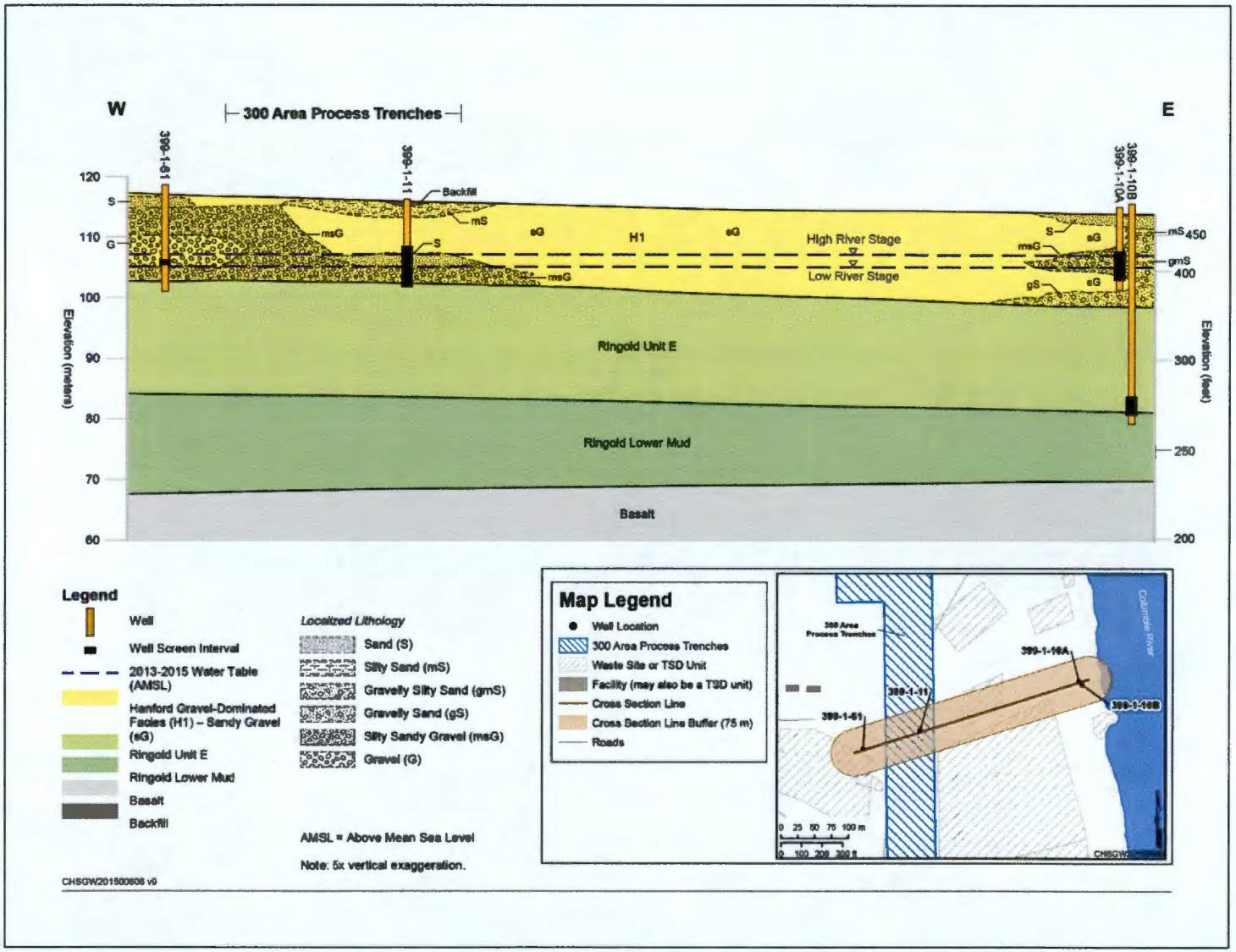


Figure 3-4 West-East Geologic Cross Section Showing the Stratigraphy Underlying the 300 Area Process Trenches

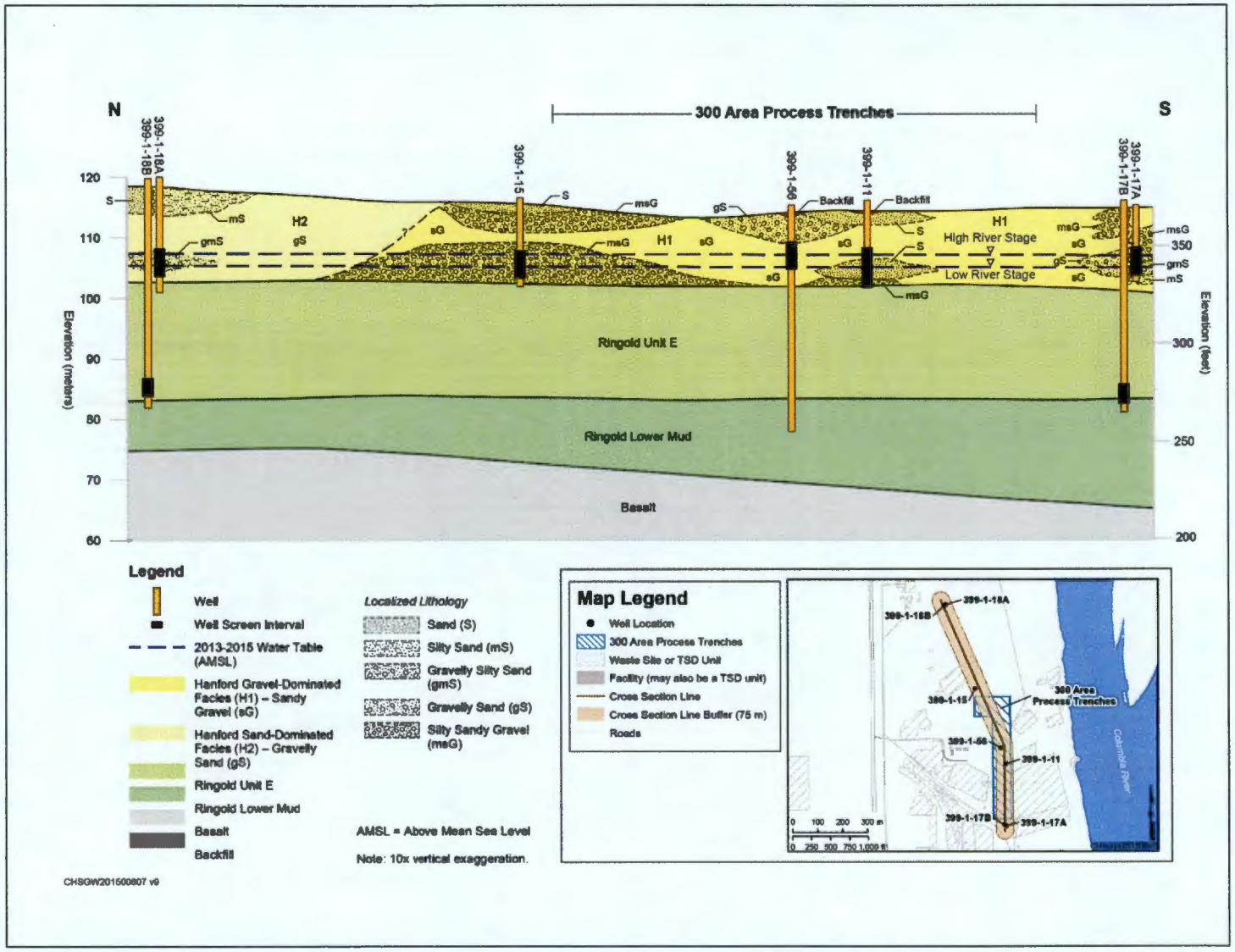
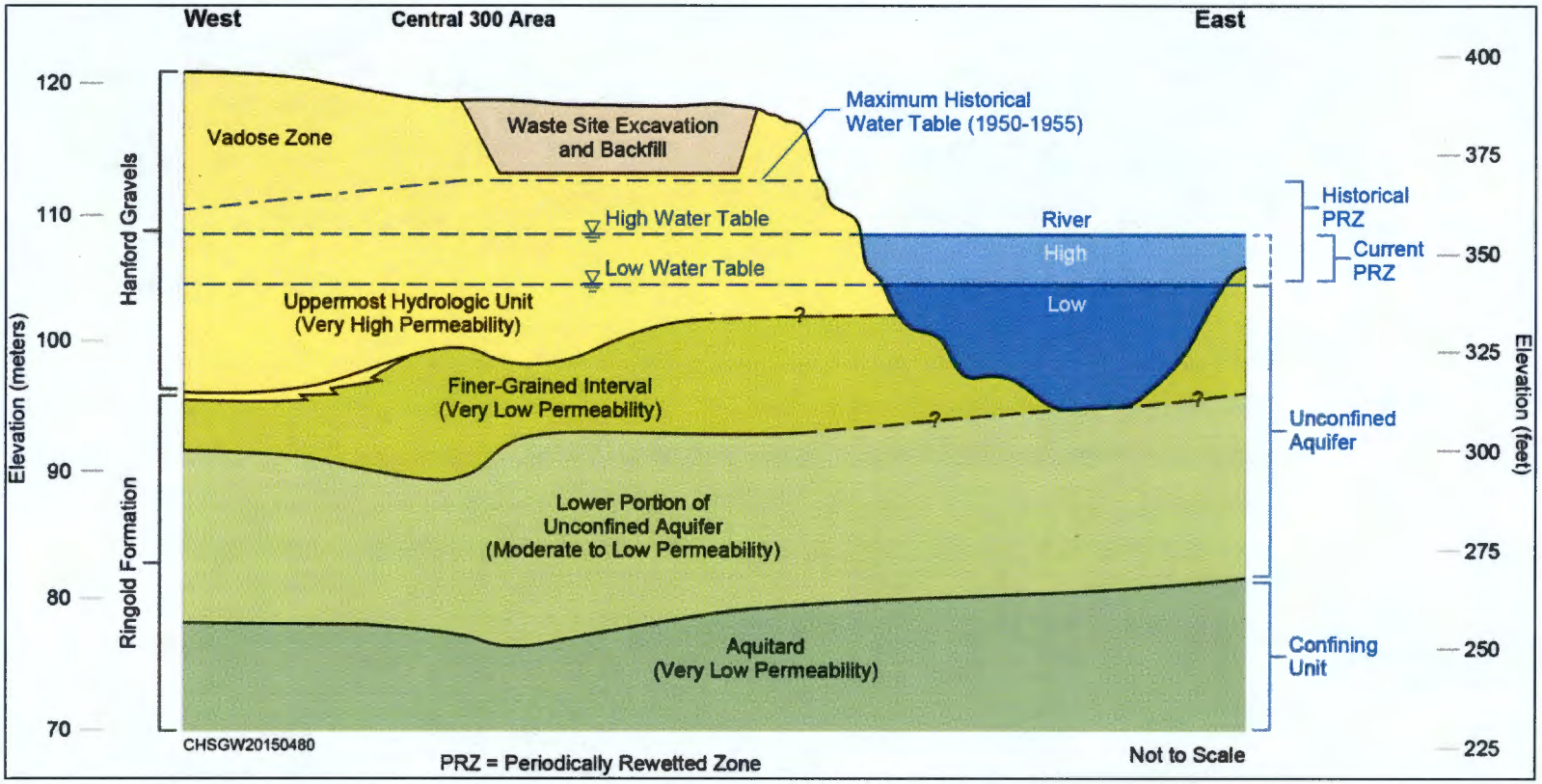


Figure 3-5 North-South Geologic Cross Section Showing the Stratigraphy Underlying the 300 Area Process Trenches



Sources: EPA and DOE, 2013, *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1.*
Modified from DOE/RL-2011-47, *Proposed Plan for Remediation of the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units.*
Elevation in NAVD88, *North American Vertical Datum of 1988.*

Figure 3-6 Principal Subsurface Features within the 300 Area Industrial Complex

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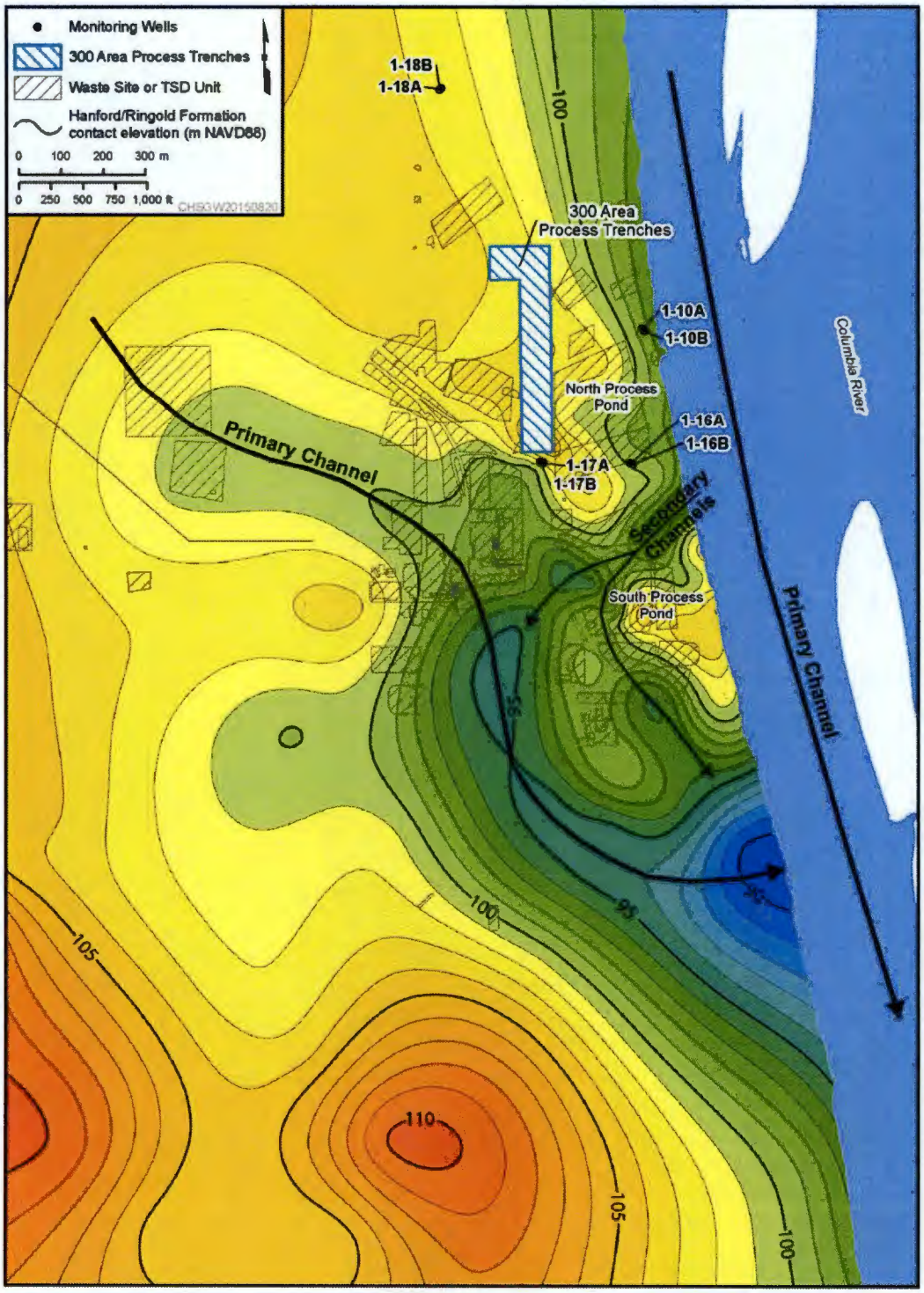


Modified from PNNL-22048, *Updated Conceptual Model for the 300 Area Uranium Groundwater Plume*. Elevation in NAVD88, *North American Vertical Datum of 1988*.

Figure 3-7 Locations of Paleochannels in the Ringold Formation Upper Surface

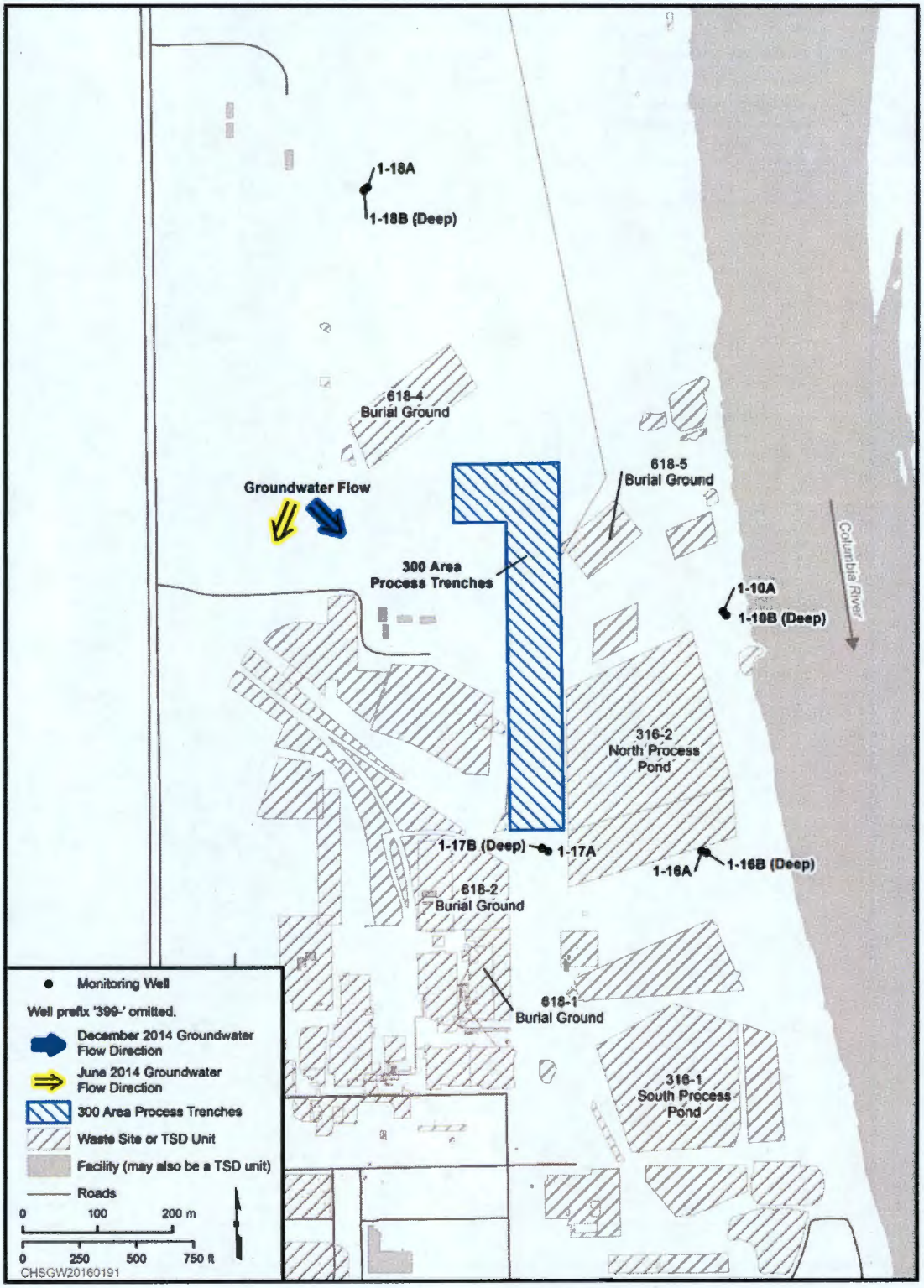
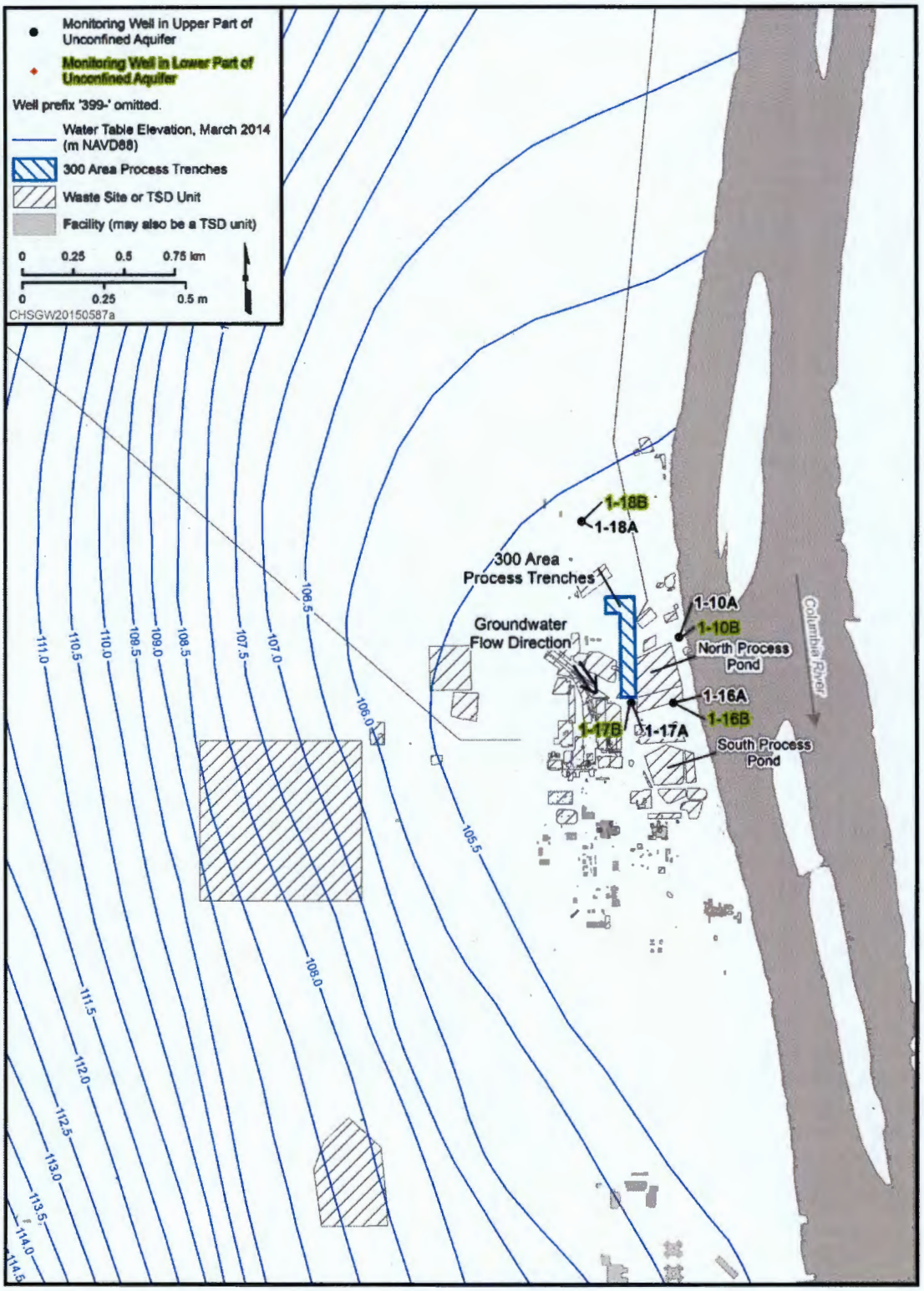


Figure 3-8 Groundwater Flow Direction at the 300 Area Process Trenches



Elevation in NAVD88, *North American Vertical Datum of 1988*.

Figure 3-9 Groundwater Contour Map for 2014

3.1.5 Summary of Previous Groundwater Monitoring

Table 3-4 lists the previous groundwater monitoring plans implemented at the 300 Area Process Trenches.

Table 3-4 Previous Monitoring Plans

Document	Date Issued	Monitoring Program
Hazardous Waste Ground-Water Monitoring Plan (Appendix E of DOE, 1985, *Closure/Post-Closure Plan 300 Area Process Trenches*)	1985	Interim Status Compliance[a]
PNL-6671, *Revised Ground-Water Monitoring Compliance Plan for the 300 Area Process Trenches*	1988	Interim Status Compliance[a]
WHC-SD-EN-AP-185, *Groundwater Monitoring Plan for the 300 Area Process Trenches*[b]	1995 (Rev. 0) 1996 (Rev. 0A)	Final Status Compliance[c] Final Status Corrective Action[d]

[a] The compliance monitoring program was developed to satisfy the requirements in 40 CFR 265.90, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Applicability," and WAC 173-303-400, "Dangerous Waste Regulations," "Interim Status Facility Standards."

[b] The compliance monitoring plan (WHC-SD-EN-AP-185, Rev. 0 and Rev. 0A) was accepted by the Washington State Department of Ecology in 1998 as the corrective action monitoring plan without revision (Ecology, 1998, "Acceptance of Certification of the 300 Area Process Trenches Clean Closure of the Soil Column and Ground Water Corrective Action Requirements"). The requirements identified in WHC-SD-EN-AP-185 (Rev. 0 and Rev. 0A) were incorporated in WA7890008967, *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste*.

[c] The compliance monitoring program satisfied the requirements of WAC 173-303-645(10), "Dangerous Waste Regulations," "Releases from Regulated Units," "Compliance Monitoring Program."

[d] The compliance monitoring program under WAC 173-303-645(10) also satisfies the requirements for a corrective action monitoring program under WAC 173-303-645(11), "Corrective Action Program."

Groundwater monitoring has been performed at the 300 Area Process Trenches since 1975 with the first major study collecting monthly samples at 29 wells during 1977 (PNL-2949, *Geology and Groundwater Quality Beneath the 300 Area, Hanford Site, Washington*). Due to known groundwater contamination, a groundwater monitoring program (presented in Appendix E of DOE, 1985, *Closure/Post-Closure Plan 300 Area Process Trenches*) began in June 1985. The program was designed as an alternate groundwater monitoring program due to known or suspected contamination of the uppermost aquifer. The well network was comprised of 16 wells (399-1-1, 399-1-2, 399-1-3, 399-1-4, 399-1-5, 399-1-6, 399-1-7, 399-1-8, 399-2-1, 399-3-7, 399-3-10, 399-4-1, 399-4-7, 399-8-2, 699-S19-E13, and 699-S30-E15A [PNL-6671]) (Figure 3-10). Samples were collected monthly and analyses included temperature, pH, conductivity, coliform, metals, anions, volatile and semivolatile organic compounds, selected organic constituents, pesticides, herbicides, total organic halogens, total organic carbon, ammonium ion, hydrazine, total alpha-emitters, total beta-emitters, gamma emitters, radium, uranium, and strontium-90.

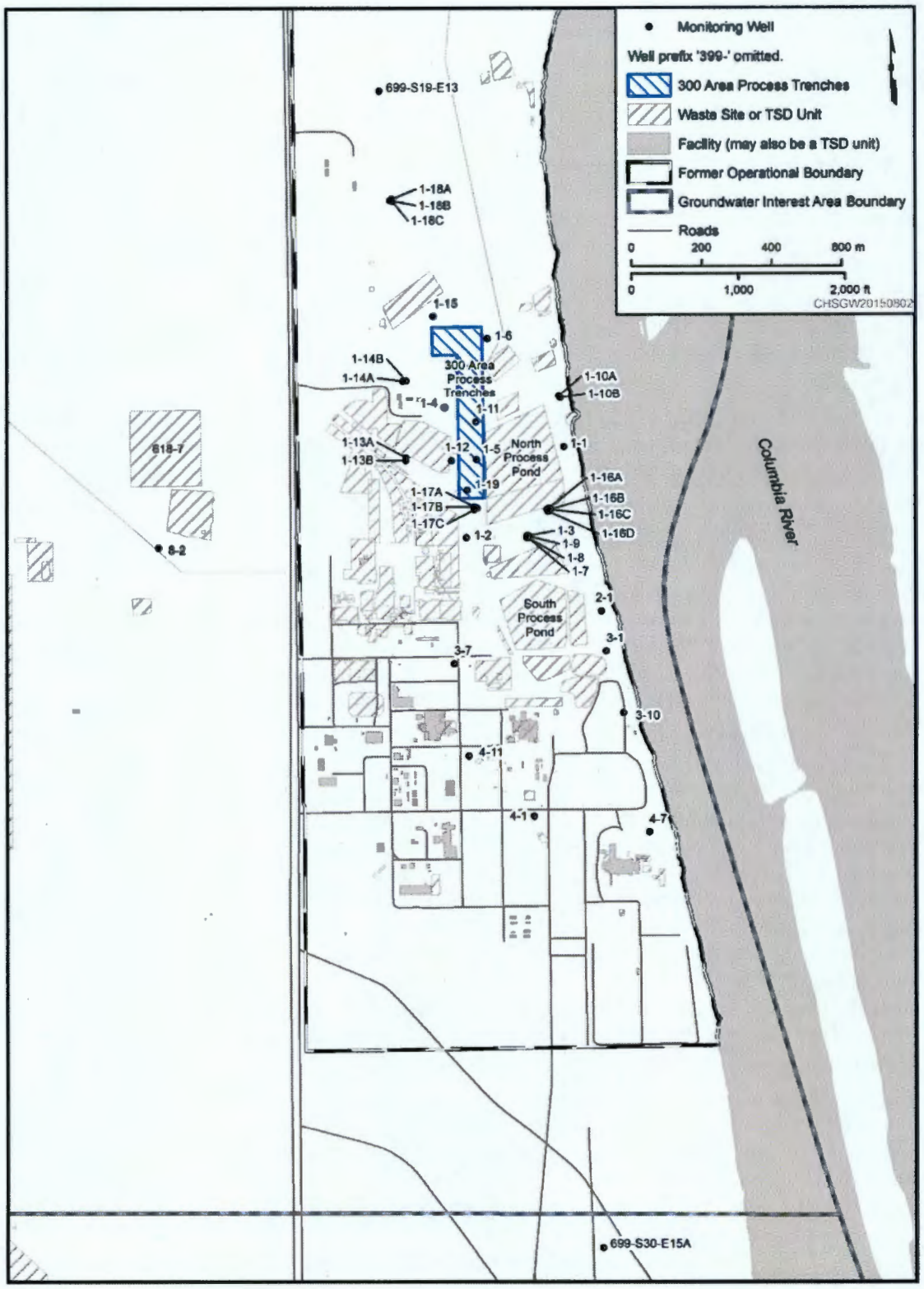


Figure 3-10 Groundwater Wells used in the 300 Area Process Trenches Monitoring Networks

The monitoring program was intended to meet 40 CFR 265.90(d), "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," and WAC 173-303-400 but was determined to have an inadequate well network by Ecology and resulted in a regulatory order (EPA and Ecology, 1986). In response to the order (Ecology and EPA, 1986), the 300 Area Process Trenches was placed in an interim status groundwater quality assessment level monitoring plan based on the finding that groundwater quality in the 300 Area had been impacted by the 300 Area Process Trenches. A revision to the 1985 groundwater monitoring plan, PNL-6671, was first issued in 1986 (as described in PNL-6716 and WHC-SD-EN-AP-185, Rev 0). Nineteen new monitoring wells were installed in 1986 and 1987 to enhance the understanding of the hydrogeology and characterize the contamination (PNL-6671). These included five well clusters, which included wells at the upper and lower portions of the unconfined aquifer ("A" and "B" wells, respectively) and at some locations, wells in the confined aquifer ("C" well) and in a basalt aquifer ("D" well). The cluster wells included 399-1-16ABCD, 399-1-17ABC, 399-1-18ABC, 399-1-14AB, and 399-1-10AB (PNL-6716). New single wells included 399-1-9, 399-1-11, 399-1-12, 399-1-13, 399-1-15, 399-1-19, and 399-4-11 (PNL-6716) (Figure 2-9).

Monitoring data from 1986 to 1988 (reported in PNL-6716) found that most of the analytes were below regulatory standards. Constituents that were regularly reported above the detection limit included gross alpha, gross beta, barium, nitrate, sodium, iron, sulfate, chloride, copper, ammonium, vanadium, potassium, chloroform, and methyl chloride. Chromium, mercury, selenium, and fluoride were reported as being above the interim primary drinking water standard at least once.

After characterization of the 300 Area Process Trenches, the monitoring plan was revised in 1988 (PNL-6671). Samples were collected from the network of 35 monitoring wells. During 1989 to 1994, wells were periodically removed from the network and the sampling schedule changed from monthly, to quarterly, and eventually to semiannually as the characterization information had been obtained and the 1991 ERA had reduced contamination in the trenches. The well network eventually dropped to 11 wells including 399-1-10, 399-1-11, 399-1-12, 399-1-14, 399-1-16A&B, 399-1-17A&B, 399-1-18A, 399-2-1, and 399-3-10 (Figure 3-10).

Volatile organic analysis results indicated that several constituents (PCE, toluene, xylene, benzene, TCE, chloroform, ethylbenzene, and *cis*-1,2-DCE) were detected downgradient of the 300 Area Process Trenches during this period. However, only TCE and *cis*-1,2-DCE were consistently above the drinking water standard of 5 and 70 µg/L, respectively. The well showing the exceedances of TCE and *cis*-1,2-DCE was 399-1-16B. Uranium continued to be detected in several wells near the 300 Area Process Trenches and was correlated to gross alpha. The ERA in 1991 reduced the concentrations of uranium significantly in the network wells such that uranium exceeded the then 20 µg/L EPA-proposed guidance in only two wells (399-1-17A and 399-1-10A). (Note: the final rule for the uranium drinking water standard, 30 µg/L, was promulgated in 2000 and became effective in 2003.) Concentrations of iron and manganese in filtered samples were consistently higher than drinking water standard for two wells (399-1-16B and 399-1-17B). Both wells are screened at the bottom of the unconfined aquifer.

The 1994 Hanford Facility RCRA Permit for the Hanford Site required groundwater monitoring programs under final status to comply with requirements of WAC 173-303-645. A final status compliance monitoring program for the 300 Area Process Trenches (WHC-SD-EN-AP-185, Rev. 0) was issued in 1995. The plan included sampling from a network of four well pairs. Three pairs are downgradient (399-1-10A, 399-1-10B, 399-1-16A, 399-1-16B, 399-1-17A, and 399-1-17B) and one pair is upgradient (399-1-18A and 399-1-18B). Samples were collected semiannually with four independent samples per event, for a total of eight samples per year. Analysis was performed for gross alpha, gross beta, uranium, *cis*-1,2-DCE, TCE, iron, manganese, and field parameters (pH, conductivity, turbidity, and temperature).

The first sample series began in December 1996 and showed that downgradient concentrations of *cis*-1,2-DCE, TCE, and uranium exceeded concentration limits identified in the monitoring plan

(WHC-SD-EN-AP-185, Rev. 0). Rev. 0A of the monitoring plan, issued in 1996, specified analysis for uranium, TCE, *cis*-1,2-DCE, and field parameters (pH, conductivity, turbidity, and temperature). Thallium, PCBs, chrysene, and benzo(a)pyrene were included in the Rev. 0A plan for a two-year monitoring period due to concern about dangerous waste leaching from the relocated sediment stockpiled at the northern ends of the trenches. Additionally, iron and manganese were monitored as part of a follow-up geochemical investigation. WHC-SD-EN-AP-185 (Rev. 0 and Rev. 0A) was accepted without change as the corrective action monitoring plan, as required by WAC 173-303-645(11), in 1998 (Ecology, 1998).

In 2001, a proposed corrective action monitoring plan was prepared (PNNL-13645). However, the Hanford Facility RCRA Permit was not updated with the proposed monitoring plan, and WHC-SD-EN-AP-185 (Rev. 0 and Rev. 0A) remained the corrective action monitoring plan.

Monitoring results since 1997 for the dangerous wastes *cis*-1,2-DCE and TCE within the well network are presented in Appendix D. For both constituents, exceedances of the concentration limit or cleanup level occur in a single well: 399-1-16B. TCE last exceeded the cleanup level of 4 µg/L established in the 300 Area ROD/ROD Amendment (EPA and DOE, 2013) in 1999.

In 2015, an evaluation of groundwater COCs in wells identified for monitoring of the CERCLA MNA remedy was performed. The evaluation found that TCE had attained the cleanup level identified in the 300 Area ROD/ROD Amendment (EPA and DOE, 2013) at each well in the 300 Area network, except for 399-4-14 (ECF-300FF5-15-0017). Based on these results, monitoring for TCE under CERCLA is required only at well 399-4-14, which does not monitor the 300 Area Process Trenches. Evaluation of *cis*-1,2-DCE found that concentrations in well 399-1-16B would not meet cleanup levels by year 2050 (ECF-300FF5-15-0017). *Cis*-1,2-DCE concentrations in this well have exceeded the concentration limit throughout the corrective action monitoring period with detections ranging from 95 to 280 µg/L. Monitoring for *cis*-1,2-DCE and TCE will continue at the 300 Area Process Trenches under the Hanford Facility RCRA Permit.

In 1987, elevated concentrations of PCE and its biodegradation products, TCE and *cis*-1,2-DCE, were observed in well 399-1-16B. PCE concentrations subsequently declined to less than the drinking water standard prior to issuance of the compliance monitoring plan in 1995 (WHC-SD-EN-AP-185, Rev. 0). The source for these concentrations has been suggested to be the 300 Area Process Trenches because these trenches are upgradient of well 399-1-16B, spills (530 L [140 gal]) of PCE were discharged to the trenches in 1982 and 1984, and the concentrations were detected and monitored by the 300 Area Process Trenches groundwater monitoring network. Numerical modeling for these constituents was performed in Appendix F of DOE/RL-2010-99 (ECF-300FF5-11-0152, *VOC Modeling in Support of 300 Area FF-5 RI/FS Document*) to evaluate the contamination and determined a different outcome.

The numerical modeling had two objectives. The first objective was to determine whether it was plausible that PCE-dense nonaqueous phase liquid (DNAPL) discharged to the 300 Area Process Trenches would infiltrate the Hanford formation and penetrate the Ringold Formation Unit E. The second objective was to assess the plausibility that PCE-DNAPL trapped in Unit E beneath the 300 Area Process Trenches could be the source of PCE, TCE, and *cis*-1,2-DCE concentrations observed in well 399-1-16B. Results of the numerical modeling indicate that it is plausible the PCE infiltrating beneath the 300 Area Process Trenches would penetrate Unit E of the Ringold Formation. However, modeling results also indicate that it does not appear plausible that the source for the concentrations observed in well 399-1-16B was the 300 Area Process Trenches.

PCBs, benzo(a)pyrene, and chrysene were not detected the 300 Area Process Trenches groundwater monitoring network during the required two years of monitoring (1996 to 1998) and do not require further monitoring (PNNL-11470, *Hanford Site Groundwater Monitoring for Fiscal Year 1996*; PNNL-11793, *Hanford Site Groundwater Monitoring for Fiscal Year 1997*; and PNNL-12086, *Hanford Site Groundwater Monitoring for Fiscal Year 1998*). Thallium was detected during the required two years of

monitoring. However, thallium was determined to be naturally occurring based on evaluation in DOE/RL-2010-99.

In 2014, elevated iron and manganese concentrations in the deep unconfined aquifer were evaluated using groundwater data from 1995 to 2014 at wells 399-1-16A, 399-1-16B, 399-1-17A, and 399-1-17B (ECF-300FF5-14-0044, Section 8). The evaluation found oxidizing conditions are present in shallower portions of the unconfined aquifer. However, deeper groundwater contains very low levels of dissolved oxygen, low or non-detectable nitrate concentrations, notably lower oxidation-reduction potential, and evidence of reductive dechlorination of chlorinated organic compounds. The differences in the observed reduction-oxidation-sensitive parameters between the shallow and deep portions of the unconfined aquifer are consistent with the higher concentrations of dissolved iron and manganese observed in the deeper groundwater at wells 399-1-16B and 399-1-17B. The elevated iron and manganese levels are likely produced by the partial reductive dissolution of iron and manganese hydroxides and oxides in the matrix of the upper Ringold Formation.

Geochemical modeling using PHREEQC, a geochemical modeling computer code developed by the United States Geological Survey, was conducted to determine whether the iron and manganese concentrations in wells 399-1-16B and 399-1-17B are consistent with equilibrium between the groundwater in the deep unconfined aquifer and reduced iron and manganese minerals such as siderite and rhodochrosite. Geochemical modeling under the assumed reduction-oxidation conditions indicate that the samples collected from 399-1-16B are saturated with calcite, amorphous ferric hydroxide, and rhodochrosite, and are slightly under-saturated to saturated with siderite. The results for 399-1-17B indicate saturated conditions with calcite, amorphous ferric hydroxide, siderite and rhodochrosite. The differences between the shallow and deep groundwater in the unconfined unit suggest that the elevated iron and manganese concentrations observed in wells 399-1-17B and 399-1-16B are consistent with iron-reducing conditions in the deeper parts of this unit. Although the modeling results cannot definitively demonstrate that the reducing conditions are naturally occurring, it supports this conclusion by demonstrating that the elevated iron and manganese concentrations observed in the deep aquifer since 1995 are consistent with naturally occurring iron and manganese minerals commonly found in uncontaminated reducing aquifers (ECF-300FF5-14-0044).

Historical releases of readily biodegradable organics (e.g., benzene, toluene, ethylbenzene, and xylenes [BTEX]) cannot be absolutely precluded as a cause for the development of more reducing conditions in the deeper unconfined aquifer. However, this is not likely due to the low observed BTEX concentrations and long term stability of the reducing conditions in the deeper aquifer, while much more oxidizing conditions have been maintained in the shallower part of the unit (ECF-300FF5-14-0044).

Based on the very low concentrations of readily biodegradable (non-chlorinated) anthropogenic organic compounds in the shallow or deep unconfined aquifer over the last 20 years, the weight of the evidence suggests that the slightly to moderately elevated levels of iron and manganese observed in wells 399-1-16B and 399-1-17B do not reflect the effects of contamination released to the aquifer (ECF-300FF5-14-0044). Because the evidence suggests that elevated iron and manganese are due to naturally occurring reducing conditions and are not attributable to 300 Area Process Trenches, further monitoring of iron and manganese is not included in this plan.

The groundwater monitoring activities at the 300 Area Process Trenches under this groundwater monitoring plan sample from a network of four well pairs. Samples are analyzed semiannually for the dangerous wastes *cis*-1,2-DCE and TCE and field parameters (pH, specific conductance, temperature, and turbidity). Water level measurements are collected each time that a sample is obtained from a network well. The network wells are also included in the annual comprehensive March water level measurement campaign (SGW-38815, *Water-Level Monitoring Plan for the Hanford Site Soil and Groundwater Remediation Project*). Groundwater monitoring results for the 300 Area Process Trenches are reported on a semiannual basis, per WAC 173-303-645(11)(g), and are summarized in the annual Hanford Site RCRA

groundwater monitoring report (e.g., DOE/RL-2016-12, *Hanford Site RCRA Groundwater Monitoring Report for 2015*).

3.1.6 Conceptual Site Model

This section describes the 300 Area Process Trenches CSM for potential contaminant transport to guide future groundwater monitoring. The CSM describes the current understanding of the contaminant release and transport.

Wastewater from the process sewer (containing fuels fabrication and other laboratory waste) was discharged to the 300 Area Process Trenches, two unlined trenches that allowed wastewater to flow directly into the ground. The trenches were in use from 1975 to 1994. The wastewater discharged to the 300 Area Process Trenches contaminated the vadose zone beneath the trenches, as well as the aquifer. The concentrations of waste constituents in the wastewater that was discharged to the 300 Area Process Trenches decreased with time. Administrative controls to prevent hazardous waste from entering the process sewer were put into effect in 1985. After that time, the amount of hazardous waste reaching the trenches was very low, even though the rate of discharge remained above 750 L/min (200 gpm) (see Section 3.1.3 for waste disposal discussion).

The Hanford formation overlies the Ringold Formation Unit E, with the contact below the water table. The Hanford formation has higher hydraulic conductivity than the Ringold Formation, thereby allowing higher groundwater flow rates. The silt and clay of the Ringold Formation lower mud unit constitute the base of the unconfined aquifer. This lower mud unit also effectively prevents groundwater contamination in the unconfined aquifer from contaminating groundwater below the lower mud unit. Hydraulic head below the mud unit is higher than above the unit, indicating that the general flow would be upward if communication were established between the confined aquifer below and unconfined aquifer above. For example, in 2014 the hydraulic heads in wells 399-1-16C and 399-1-17C, which are screened across the basalt/Ringold lower mud contact, were 8 to 9 m (26 to 30 ft) higher than the hydraulic heads in the wells screened in the shallow unconfined aquifer (399-1-16A and 399-1-17A) and the wells screened in the lower unconfined aquifer (399-1-16B and 399-1-17B).

Fluctuating river stage causes water table fluctuations, which, in turn, affect water table gradient and groundwater flow direction near the 300 Area Process Trenches. Groundwater flow direction beneath the 300 Area Process Trenches is predominantly to the south-southeast when the river stage is low (typical throughout most of the year). During high river stages (typically late spring and early summer), the water table gradient can be reversed, causing bank storage of river water and a temporary groundwater flow direction to the south or southwest. Water level fluctuations as a result of river level fluctuations do not affect *cis*-1,2-DCE because it is detected within the lower portions of the unconfined aquifer.

The 300 Area Process Trenches (316-5 waste site) are remediated and no longer pose an unacceptable risk to human health and the environment in an industrial setting (EPA and DOE, 2013). The results of a CERCLA groundwater risk evaluation found that concentrations of uranium, TCE, and *cis*-1,2-DCE present in groundwater at the 300 Area Industrial Complex provide a basis for remedial action (EPA and DOE, 2013). The only dangerous waste that continues to be detected above the concentration limit in a 300 Area Process Trenches groundwater monitoring well is *cis*-1,2-DCE. At well 399-1-16B, *cis*-1,2-DCE remains in the lower portion of the unconfined aquifer downgradient of the trenches and has been detected consistently in excess of the concentration limit (16 µg/L) (Figure 3-10). Variability in *cis*-1,2-DCE concentrations was observed from 2004 to 2007, after which time concentrations stabilized. No source for the variability has been identified. TCE concentrations have been below the cleanup level (4 µg/L) in the 300 Area Process Trenches monitoring wells since 1999 (Figure 3-10 and Appendix D).

The origin for *cis*-1,2-DCE is attributed to degradation of TCE and PCE historically disposed to nearby liquid waste sites (DOE/RL-2010-99, Appendix F). Large quantities of degreasing solutions were likely disposed to the nearby North Process Pond and South Process Pond (Figure 3-2) during the 1950s and

1960s (PNNL-17666). As reported in PNNL-17666, the infiltration of these discharges through the vadose zone was probably sufficient to cause widespread contamination of the underlying aquifer. Numerical modeling results indicate that it does not appear likely that the source of the *cis*-1,2-DCE observed in well 399-1-16B is the 300 Area Process Trenches (DOE/RL-2010-99, Appendix F).

Natural attenuation through biodegradation is evident in historical monitoring results from well 399-1-16B, where TCE has degraded to *cis*-1,2-DCE. Over the past 20 years, TCE concentrations from this well have decreased to below the cleanup level, *cis*-1,2-DCE concentrations have remained fairly stable, and vinyl chloride has remained below detection limits (Figures 3-11 and 3-12). These concentration data are consistent with conditions appropriate for anaerobic dechlorination of TCE to *cis*-1,2-DCE, but without further significant anaerobic dechlorination to vinyl chloride. Although *cis*-1,2-DCE can degrade anaerobically to vinyl chloride if appropriate microorganisms are present, *cis*-1,2-DCE can accumulate as an end product of TCE dechlorination with little or no vinyl chloride produced when these microorganisms are not present or inhibited. *Cis*-1,2-DCE can also degrade directly to carbon dioxide under aerobic conditions. The absence of *cis*-1,2-DCE and vinyl chloride in downgradient wells indicates that these contaminants are being diluted and degrading aerobically as they slowly diffuse into the higher flow, more aerobic zones of the aquifer. The limited areal and vertical extent of volatile organic compounds (VOCs) in groundwater shows that these natural attenuation processes are preventing significant migration of VOCs (DOE/RL-2010-99, Sections 4.8.4, 5.6, and 5.9; PNNL-17666, Sections 1.2 and 3.3).

3.1.7 Corrective Action and Groundwater Monitoring Requirements

The groundwater monitoring program at the 300 Area Process Trenches is conducted in accordance with the objectives identified in WAC 173-303-645, as required by the Hanford Facility RCRA Permit, Part II, Condition II.F. Corrective action groundwater monitoring is implemented in accordance with WAC 173-303-645(11), which requires the establishment and implementation of a groundwater monitoring program capable of demonstrating the effectiveness of the corrective action. This requirement states two general objectives:

The corrective action groundwater monitoring program may be based on the requirements for a compliance monitoring program under WAC 173-303-645(10) and must be as effective as that program in determining compliance with the groundwater protection standard under WAC 173-303-645(3).

Monitoring during corrective actions must be capable of determining the success of the corrective action program.

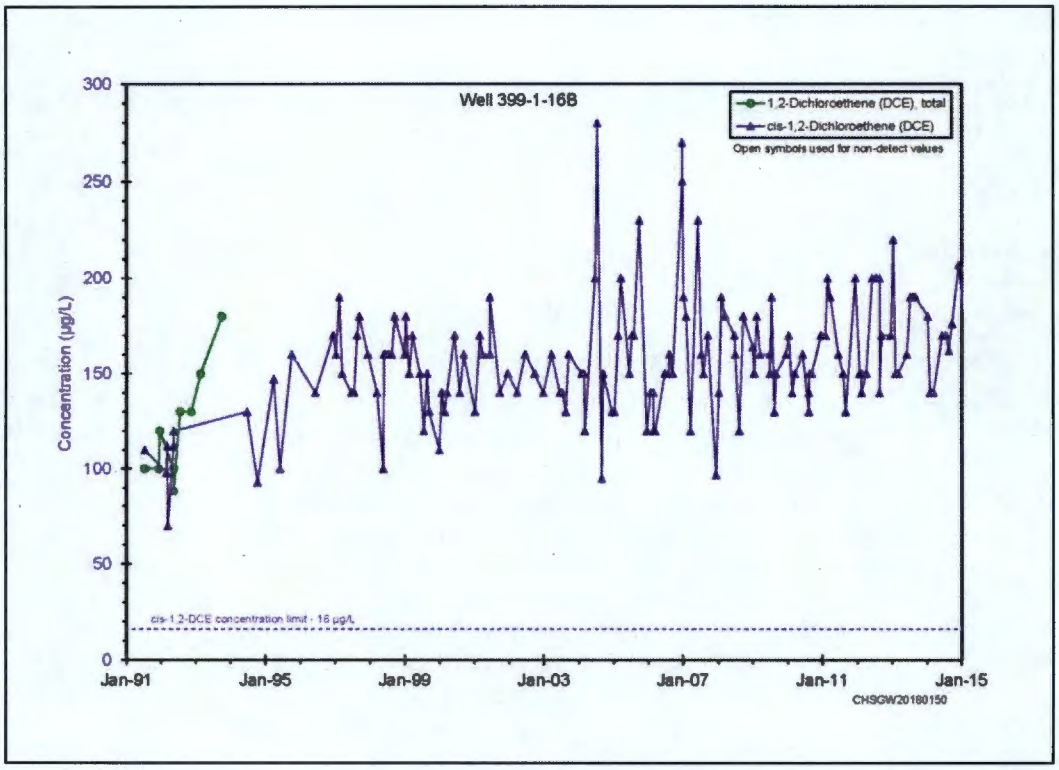


Figure 3-11 *cis*-1,2-Dichloroethene in Groundwater at Well 399-1-16B

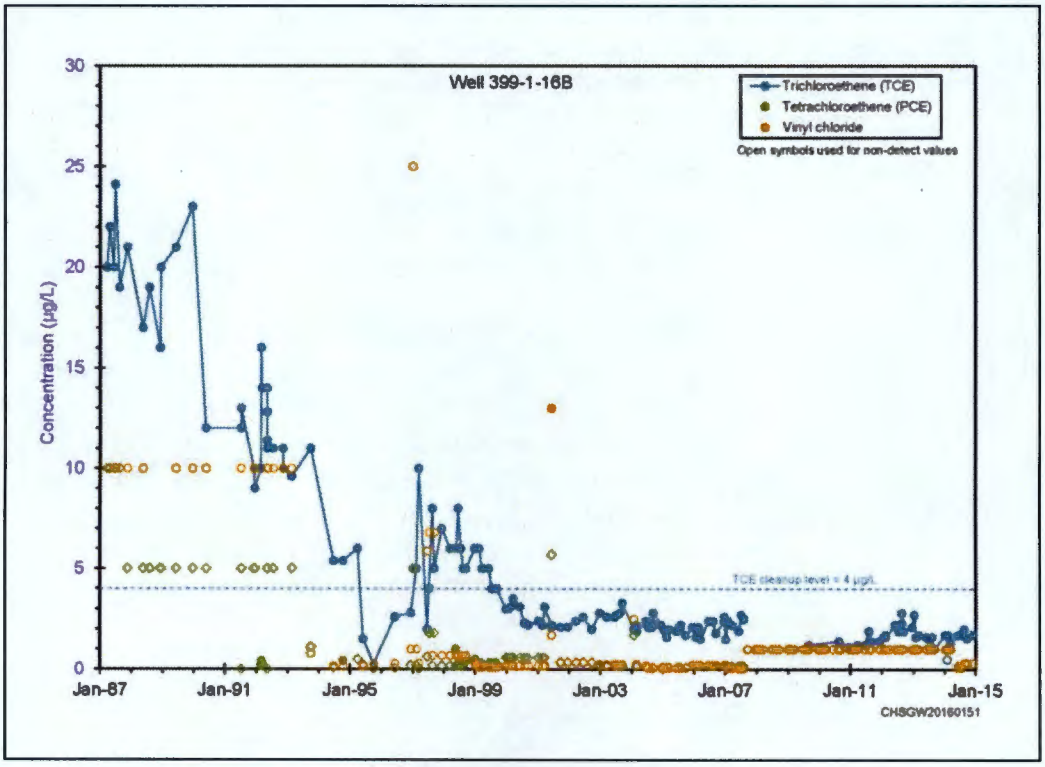


Figure 3-12 Trichloroethene, Tetrachloroethene, and Vinyl Chloride in Groundwater at Well 399-1-16B

Table 3-5 identifies where each groundwater monitoring element of the pertinent applicable regulation is addressed within this plan.

Table 3-5 Pertinent WAC 173-303-645(11) Corrective Action Groundwater Monitoring Requirements

Groundwater Monitoring Element	Pertinent Requirement*	Section Where Requirement is Addressed in Monitoring Plan
Groundwater Monitoring Program	WAC 173-303-645(11) "Corrective Action Program": (d) In conjunction with a corrective action program, the owner or operator must establish and implement a groundwater monitoring program to demonstrate the effectiveness of the corrective action program. Such a monitoring program may be based on the requirements for a compliance monitoring program under subsection (10) of this section, and must be as effective as that program in determining compliance with the groundwater protection standard under subsection (3) of this section, and in determining the success of a corrective action program under (e) of this subsection, where appropriate.	Section 3.2.1 Section 3.2.2 Section 3.2.3 Section 3.2.4 Section 3.2.5 Section 3.2.7 Section 3.3.1 Section 3.3.2
Groundwater Protection Standard	WAC 173-303-645(3) "Groundwater Protection Standard": Conditions specified in the facility permit are designed to ensure that dangerous constituents under WAC 173-303-645(4), detected in the groundwater from a regulated unit do not exceed the concentration limits under WAC 173-303-645(5), in the uppermost aquifer underlying the waste management area beyond the point of compliance under WAC 173-303-645(6), during the compliance period under WAC 173-303-645(7).	Section 3.2.2
Dangerous Constituents	WAC 173-303-645(4) "Dangerous Constituents": (a) The facility permit will specify the dangerous constituents to which the groundwater protection standard of WAC 173-303-645(3) applies.	Section 3.2.1
Concentration Limits	WAC 173-303-645(5) "Concentration Limits": (a) The facility permit will specify concentration limits in the groundwater for the dangerous constituents established under WAC 173-303-645(4) of this section.	Section 3.2.2
Point of Compliance	WAC 173-303-645(6) "Point of Compliance": The facility permit will specify the point of compliance at which the groundwater protection standard WAC 173-303-645(3) applies and at which monitoring must be conducted. The point of compliance is a vertical surface located at the hydraulically downgradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated units.	Section 3.2.3

Table 3-5 Pertinent WAC 173-303-645(11) Corrective Action Groundwater Monitoring Requirements		
Groundwater Monitoring Element	**Pertinent Requirement***	**Section Where Requirement is Addressed in Monitoring Plan**
Compliance Period	WAC 173-303-645(7) "Compliance Period": (a) The facility permit will specify the compliance period during which the groundwater protection standard of WAC 173-303-645(3) applies. The compliance period is the number of years equal to the active life of the waste management area (including any waste management activity prior to permitting, and the closure period). (c) If the owner or operator is engaged in a corrective action program at the end of the compliance period specified in (a), the compliance period is extended until the owner or operator can demonstrate that the groundwater protection standard of WAC 173-303-645(3) has not been exceeded for a period of three consecutive years.	Section 3.2.4 Section 3.3.2 Appendix D
Number and Location of Wells	WAC 173-303-645(8) "General Groundwater Monitoring Requirements": (a) The groundwater monitoring system must consist of a sufficient number of wells, installed at appropriate locations and depths to yield groundwater samples from the uppermost aquifer that: (i) Represent the quality of background groundwater that has not been affected by leakage from a regulated unit. (ii) Represent the quality of groundwater passing the point of compliance. (iii) Allow for the detection of contamination when dangerous waste or dangerous constituents have migrated from the waste management area to the uppermost aquifer.	Section 3.2.5
Well Configuration	WAC 173-303-645(8) "General Groundwater Monitoring Requirements": (c) All monitoring wells must be cased in a manner that maintains the integrity of the monitoring well bore hole. This casing must allow collection of representative groundwater samples. Wells must be constructed in such a manner as to prevent contamination of the samples, the sampled strata, and between aquifers and water bearing strata. Wells must meet the requirements applicable to resource protection wells, which are set forth in WAC 173-160, "Minimum standards for construction and maintenance of wells."	Section 3.2.5 Appendix C

Table 3-5 Pertinent WAC 173-303-645(11) Corrective Action Groundwater Monitoring Requirements		
Groundwater Monitoring Element	**Pertinent Requirement***	**Section Where Requirement is Addressed in Monitoring Plan**
Frequency of Sampling Water Level Measurements	WAC 173-303-645(8) "General Groundwater Monitoring Requirements": (f) The groundwater monitoring program must include a determination of the groundwater surface elevation each time groundwater is sampled. (g) The owner or operator will determine an appropriate sampling procedure and interval for each hazardous constituent listed in the facility permit.	Section 3.2.1 Appendix B, Section B2.2
Procedures and Techniques	WAC 173-303-645(8) "General Groundwater Monitoring Requirements": (d) The groundwater monitoring program must include at a minimum, procedures and techniques for: (i) Decontamination of drilling and sampling equipment; (ii) Sample collection; (iii) Sample preservation and shipment; (iv) Analytical procedures and quality assurance; and (v) Chain of custody control. (e) The groundwater monitoring program must include consistent sampling and analytical methods that ensure reliable groundwater sampling, accurately measure dangerous constituents and indicator parameters in groundwater samples, and provide a reliable indication of groundwater quality below the waste management area.	Appendix A, Appendix B, Chapter B2 and Sections B5.1, B5.2, and B5.3
Statistical Evaluation Statistical Methods	WAC 173-303-645(8) "General Groundwater Monitoring Requirements": (h) Groundwater monitoring data will be evaluated using a specified statistical method. The statistical test will be conducted separately for each dangerous constituent in each well. A statistical method not specified in the subsection may be submitted for approval. (i) The statistical method must be appropriate for the distribution of the dangerous constituent. The practical quantification limit used in the statistical method must be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.	Section3.3.2 Appendix A, Section A3.1

Table 3-5 Pertinent WAC 173-303-645(11) Corrective Action Groundwater Monitoring Requirements

Groundwater Monitoring Element	Pertinent Requirement*	Section Where Requirement is Addressed in Monitoring Plan
Recordkeeping and Reporting	WAC 173-303-645(8) "General Groundwater Monitoring Requirements": (j) Groundwater monitoring data collected in accordance with WAC 173-303-645(8)(g) including actual levels of constituents must be maintained in the facility operating record. The permit specifies when the data must be submitted for review.	Appendix A, Sections A2.6 and A3.9

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

* Part II, Condition II.F of the *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste* specifies that a groundwater monitoring program under final status is subject to the requirements of WAC 173-303-645. Because of previous exceedances of the prescribed concentration limits identified in the compliance monitoring plan (WHC-SD-EN-AP-185, Rev. 0), the 300 Area Process Trenches are subject to corrective action monitoring under WAC 173-303-645(11).

WAC = *Washington Administrative Code*

WAC 173-303-645(11) includes requirements for a corrective action program. Implementation of the corrective action plan is included in the 300 Area Process Trenches post-closure plan (DOE/RL-98-31). The post-closure plan (DOE/RL-98-31) specifies that the CERCLA actions for groundwater remediation under the 300-FF-5 ROD (EPA/ROD/R10-96/143) constitute the corrective action measures to be taken in accordance WAC 173-303-645(11). The CERCLA actions are not under the purview of this groundwater monitoring plan. Table 3-6 identifies where elements of corrective action under WAC 173-303-645(11) are discussed within this groundwater monitoring plan and DOE/RL-98-31. Some components of the corrective action requirements also apply to groundwater monitoring requirements and are incorporated within Table 3-5, as appropriate.

Table 3-6. Pertinent WAC 173-303-645(11) Corrective Action Requirements

Corrective Action Element	Pertinent Requirement	Section Where Requirement is Discussed in Monitoring Plan*
Corrective Action Program	WAC 173-303-645(11) "Corrective Action Program": An owner or operator required to establish a corrective action program under this section must, at a minimum, discharge the responsibilities described in this subsection. (a) Corrective action to ensure that regulated units comply with the groundwater protection standard under WAC 173-303-645(3). The groundwater protection standard will be specified in the facility permit, including: (i) A list of the dangerous constituents and parameters identified under WAC 173-303-645(4);	Section 3.2.1 Section 3.2.2 Section 3.2.3 Section 3.2.4

Table 3-6. Pertinent WAC 173-303-645(11) Corrective Action Requirements

Corrective Action Element	Pertinent Requirement	Section Where Requirement is Discussed in Monitoring Plan*
	(ii) Concentration limits under WAC 173-303-645(5), for each of those dangerous constituents and parameters; (iii) The compliance point under WAC 173-303-645(6); and (iv) The compliance period under WAC 173-303-645(7).	
Corrective Action	WAC 173-303-645(11) "Corrective Action Program": (b) The owner or operator must implement a corrective action program that prevents dangerous constituents and parameters from exceeding their respective concentration limits at the compliance point by removing the dangerous waste constituents and parameters or treating them in place. The permit will specify the specific measures that will be taken. (c) The owner or operator must begin corrective action within a reasonable time period after the groundwater protection standard is exceeded. The department will specify that time period in the facility permit. (e) In addition to the other requirements of this section, the owner or operator must conduct a corrective action program to remove or treat in place any dangerous constituents or parameters under subsection (4) of this section, that exceed concentration limits under subsection (5) of this section, in groundwater between the compliance point under subsection (6) of this section, and the downgradient facility property boundary; and beyond the facility boundary, where necessary to protect human health and the environment, unless the owner or operator demonstrates to the satisfaction of the department that, despite the owner's or operator's best efforts, the owner or operator was unable to obtain the necessary permission to undertake such action. The owner/operator is not relieved of all responsibility to clean up a release that has migrated beyond the facility boundary where off-site access is denied. On-site measures to address such releases will be determined on a case-by-case basis. For a facility seeking or required to have a permit, the corrective action measures to be taken must be specified in the permit. (f) The owner or operator must continue corrective action measures during the compliance period to the extent necessary to ensure that the groundwater protection standard is not exceeded. If the owner or operator is conducting corrective action at the end of the compliance period, he must continue that corrective action for as long as necessary to achieve compliance with the groundwater protection standard. The owner or operator may terminate corrective action measures taken beyond the period equal to the active life of the waste management area (including	Section 3.1.2 Section 3.2.4

Table 3-6. Pertinent WAC 173-303-645(11) Corrective Action Requirements

Corrective Action Element	Pertinent Requirement	Section Where Requirement is Discussed in Monitoring Plan*
	the closure period) if he can demonstrate, based on data from the groundwater monitoring program under (d) of this subsection, that the groundwater protection standard of subsection (3) of this section, has not been exceeded for a period of three consecutive years.	
Recordkeeping and Reporting	WAC 173-303-645(11) "Corrective Action Program": (g) The owner or operator must report in writing to the department on the effectiveness of the corrective action program. The owner or operator must submit these reports semiannually. (h) If the owner or operator determines that the corrective action program no longer satisfies the requirements of this section, he must, within forty-five days, submit an application for a permit modification to make any appropriate changes to the program.	Section 3.3.4

Note: The references cited in this table are listed in the reference section (Chapter 5) of this plan.
WAC = *Washington Administrative Code*

3.2 GROUNDWATER MONITORING PROGRAM

This chapter describes the corrective action groundwater monitoring program for the 300 Area Process Trenches consisting of dangerous waste constituent, concentration limit, point of compliance, compliance period, a monitoring well network, and sampling and analysis protocols. The monitoring program presented herein has been revised from that presented in the previous plan (WHC-SD-EN-AP-185, Rev. 0 and Rev. 0A), and supersedes the monitoring program of the previous plan.

3.2.1 Constituents List and Sampling Frequency

Table 3-7 presents the wells in the groundwater monitoring network, constituents analyzed as required for corrective action monitoring, and sampling frequency for monitoring of the 300 Area Process Trenches. The dangerous waste constituents *cis*-1,2-DCE and TCE will be sampled and analyzed semiannually with collection scheduled during low river stage (typically September to November) and high river stage (typically May through June). TCE concentrations have been less than the concentration limit since 1999. Based on recent evaluation of cis-1,2-DCE in well 399-1-16B (ECF-300FF5-15-0017), the groundwater concentration will not reach the concentration level by 2050. Therefore, semiannual sampling, consisting of a single sample per sampling event, is sufficient to monitor the dangerous wastes. Field parameters (pH, conductivity, turbidity, and temperature) will also be sampled semiannually. Water level measurements at each monitoring well will be determined each time a sample is obtained (WAC 173-303-645(8)(f)).

Maintenance problems and sampling logistics resulting from multiple factors including environmental (i.e., inclement weather) and access restrictions (i.e., heightened fire danger, area access restriction due to work by other Hanford contractors such as in the tank farms) sometimes delay scheduled sampling events. Sampling events are scheduled by month. The Field Work Supervisor (FWS) determines the specific times within a given month that a well will be sampled. If a well cannot be sampled at the times determined by the FWS, then the FWS and Sampling Management and Reporting group, along with the project scientist, will consult on how best to recover or reschedule the sampling event as close to the

original sampling date as possible. If it is observed during the pre-sampling walkdown that one or more network wells cannot be sampled, then sampling of the well network will not begin and management will be notified. Depending on the situation, the network sampling will be rescheduled within a short time frame (such as 3 to 4 weeks). In some cases, it may not be obvious that sampling cannot be performed until a well is accessed (e.g., an issue with a pump).

Missed sampling events that are not rescheduled within the same month are given top priority when rescheduling sampling for the following month. In the event that a sampling delay has occurred and the representativeness of the samples is in question, DOE-RL and Ecology may agree to resampling wells. DOE-RL will provide informal notification to Ecology if sampling of the network is expected to be delayed for longer than 4 weeks. Ecology may provide input in a timely fashion to DOE-RL on how to proceed. Missed or cancelled sampling events are reported to DOE-RL and are documented in the semiannual monitoring reports required by WAC 173-303-645(11)(g), and the annual Hanford Site RCRA groundwater monitoring report (e.g., DOE/RL-2016-12).

Table 3-7 Monitoring Well Network for the 300 Area Process Trenches

Well Name	Purpose	WAC Compliant	Dangerous Waste Constituents and Field Parameters*						
				Dangerous Waste Constituents		Field Parameters			
			Water Level	*cis*-1,2-DCE	Trichloro-ethene	pH	Specific Conductance	Temperature	Turbidity
399-1-10A	Downgradient	Y	S	S	S	S	S	S	S
399-1-10B	Downgradient	Y	S	S	S	S	S	S	S
399-1-16A	Downgradient	Y	S	S	S	S	S	S	S
399-1-16B	Downgradient	Y	S	S	S	S	S	S	S
399-1-17A	Downgradient	Y	S	S	S	S	S	S	S
399-1-17B	Downgradient	Y	S	S	S	S	S	S	S
399-1-18A	Upgradient	Y	S	S	S	S	S	S	S
399-1-18B	Upgradient	Y	S	S	S	S	S	S	S

* Monitoring as required under WAC 173-303-645(11), "Dangerous Waste Regulations," "Releases from Regulated Units," "Corrective Action Program."

cis-1,2-DCE = *cis*-1,2-dichloroethene

S = to be sampled semiannually

WAC = *Washington Administrative Code*

Y = well is constructed as a resource protection well (WAC 173-160, "Minimum Standard for Construction and Maintenance of Wells")

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3.2.2 Concentration Limit

A dangerous waste constituent from a regulated waste unit may not exceed the concentration limit established by the Hanford Facility RCRA Permit (WAC 173-303-645(5)). The concentration limits for *cis*-1,2-DCE and TCE in the previous plan (WHC-SD-EN-AP-185, Rev. 0 and Rev. 0A) were 70 and 5 µg/L, respectively, based on 40 CFR 141.61(a), "National Primary Drinking Water Regulations," "Maximum Contaminant Levels for Organic Contaminants." The concentration limits were applied during compliance monitoring to determine whether corrective action was necessary, as required by WAC 173-303-645(10).

Concentration limits of dangerous waste constituents during corrective action are required in WAC 173-303-645(11). The concentration limits for *cis*-1,2-DCE and TCE at the 300 Area Process Trenches in this plan are updated to 16 and 4 µg/L, respectively, which are the cleanup levels identified in the 300 Area ROD/ROD Amendment (EPA and DOE 2013). The concentration limits are based on WAC 173-340-720(4), "Model Toxics Control Act—Cleanup," "Groundwater Cleanup Standards," "Method B Cleanup Levels for Potable Groundwater," cleanup levels.

Because of the previous exceedances of the concentration limit for *cis*-1,2-DCE and TCE and the ongoing remedial action, any concentration limit exceedances at the point of compliance during the remediation period do not require additional action. Estimated timeframes for cleanup level attainment for *cis*-1,2-DCE and TCE are not provided in the 300 Area ROD/ROD Amendment (EPA and DOE, 2013). However, an evaluation of cis-1,2-DCE in well 399-1-16B (the only well at which the concentration limit is exceeded) estimated that cis-1,2-DCE will not be less than 16 µg/L by year 2050 (ECF-300FF5-15-0017, Table 7.1). As part of the CERCLA remedial action, evaluation of cis-1,2-DCE and TCE concentrations in wells identified in DOE/RL-2014-42 will be prepared to support the Hanford Site CERCLA 5-year reviews (DOE/RL-2014-42, Section 3.5.1.2). The effectiveness of the MNA remedy will be assessed as part of the CERCLA 5-year review process.

3.2.3 Point of Compliance

The point of compliance is defined in WAC 173-303-645(6) as a "…vertical surface located at the hydraulically downgradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated units." This is the location in the uppermost aquifer where groundwater monitoring takes place and the groundwater protection standard applies. As identified in the previous plan (WHC-SD-EN-AP-185, Rev. 0 and Rev. 0A), the point of compliance for the 300 Area Process Trenches is the downgradient monitoring wells. The downgradient monitoring wells are 399-1-10A, 399-1-10B, 399-1-16A, 399-1-16B, 399-1-17A, and 399-1-17B.

The point of compliance wells will be monitored to assess the progress of the corrective action (CERCLA remedial action). Concentrations of *cis*-1,2-DCE and TCE in these wells will be evaluated relative to the concentration limits, in accordance with Section 3.2.4.

3.2.4 Compliance Period

The compliance period is defined in WAC 173-303-645(7)(a) as the number of years equal to the active life of the waste management area (including any waste management activity prior to permitting and the closure period). The 300 Area Process Trenches began operation in 1973 and were closed in 1998, which is a total of 24 years. Therefore, the compliance period for the 300 Area Process Trenches is equal to 24 years and will end in year 2022.

Under WAC 173-303-645(7)(c), if a corrective action program is ongoing at the end of the compliance period (year 2022), then the corrective action must continue for as long as necessary to achieve

compliance with the concentration limit. The compliance period is extended until it is demonstrated that the concentration limit has not been exceeded for a period of three consecutive years.

Based on the CERCLA evaluation of *cis*-1,2-DCE results from well 399-1-16B (ECF-300FF5-15-0017, Table 7.1), the concentration is not estimated to be less than the concentration limit of 16 µg/L by year 2050. Therefore, the compliance period for the 300 Area Process Trenches will be extended past year 2022 until it is demonstrated that the concentration limit has not been exceeded for a period of three consecutive years.

For TCE, monitoring will continue through the compliance period (year 2022). If the TCE concentration is less than the concentration limit for the three year period before the end of the compliance period (years 2019 through 2022), then TCE monitoring will be discontinued at the end of the compliance period. If concentrations are not less than the concentration limit in year 2022 (or have not been less than the concentration limit for three consecutive years), then monitoring will continue until it is demonstrated that the concentration limit has not been exceeded for a period of three consecutive years.

Evaluation methodology for the sampling results is detailed in Section 3.3.2. Dangerous waste concentrations will be determined with either a 95 percent upper confidence limit (UCL) calculation (for data sets containing detections above the concentration limit) or by visual observation (or data sets containing non-detects and/or detections below the concentration limit). Based on current evaluations of TCE and *cis*-1,2-DCE at well 399-1-16B, it is assumed that TCE concentrations will be less than the concentration limit, and thereby require no further monitoring, before concentrations of *cis*-1,2-DCE will be less than the concentration limit. When it is demonstrated that the concentrations of *cis*-1,2-DCE have not exceeded the concentration limit for three consecutive years, then corrective action monitoring will be discontinued, and the site will be removed from the Hanford Facility RCRA Permit.

3.2.5 Monitoring Well Network

The current 300 Area Process Trenches monitoring network, which was identified in the previous monitoring plan, consists of two upgradient and six downgradient wells. Figure 3-2 shows the groundwater monitoring network and Table 3-8 summarizes information on the wells.

The four well pairs from the previous monitoring plan are retained in this updated plan. The well pairs monitor the upper portion ("A" wells) and the lower portion ("B" wells) of the unconfined aquifer. Three well pairs are downgradient (399-1-10A, 399-1-10B, 399-1-16A, 399-1-16B, 399-1-17A, and 399-1-17B) and one pair is upgradient (399-1-18A and 399-1-18B). Of the downgradient wells, only 399-1-16B currently exceeds the concentration limit for *cis*-1,2-DCE (Figure 3-11 and Appendix D).

Table 3-8 Attributes for Wells in the 300 Area Process Trenches Groundwater Monitoring Network

Well Name	Completion Date	Easting[a] (m)	Northing[a] (m)	Screen Top (m [ft] bgs)	Screen Bottom (m [ft] bgs)	Water Depth (below Top of Casing) (m [ft])	Water Depth Corrected for Length of Casing above Ground Surface (m [ft] bgs)	Remaining Water Column in Screened Interval (m [ft])	Water Table Measurement Date
399-1-10A	1986	594346.53	116733.99	7.5 (24.5)	12.0 (39.5)	9.4 (30.7)	8.8 (29.0)	3.2 (10.5)	03/19/2015
399-1-10B	1991	594350.85	116728.79	31.9 (104.5)	34.9 (114.5)	10.0 (32.7)	9.0 (29.6)	25.9 (84.9)	03/19/2015
399-1-16A	1986	594318.11	116414.16	9.9 (32.5)	14.5 (47.5)	11.9 (38.9)	11.5 (37.6)	3.0 (9.9)	03/19/2015
399-1-16B	1987	594324.69	116411.62	32.0 (105.0)	35.1 (115.0)	11.7 (38.4)	11.4 (37.3)	23.7 (77.7)	03/19/2015
399-1-17A	1986	594112.87	116413.79	7.6 (25.0)	12.2 (40.0)	10.6 (34.6)	9.9 (32.3)	2.3 (7.7)	03/19/2015
399-1-17B	1986	594104.82	116417.72	30.5 (100.0)	33.5 (110.0)	10.6 (34.9)	9.9 (32.6)	23.6 (77.5)	03/19/2015
399-1-18A[b]	1986	593870.64	117301.57	11.9 (39.0)	16.5 (54.0)	14.3 (46.9)	13.4 (43.8)	3.1 (10.2)	03/19/2015
399-1-18B[b]	1987	593866.06	117297.23	33.1 (108.5)	36.1 (118.5)	14.0 (45.8)	13.1 (43.1)	23.0 (75.4)	03/19/2015

a. Coordinates are in NAD83, *North American Datum of 1983*.

b. Well is upgradient.

bgs = below ground surface

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The three downgradient well pairs (399-l-10A, 399-1-10B, 399-l-16A, 399-1-16B, and 399-l-17A, 399-1-17B) are east, southeast, and south, respectively, of the 300 Area Process Trenches to intercept any groundwater contaminants emanating from the site and flowing with the groundwater in directions consistent with historical data. The upgradient well pair (399-l-18A and 399-1-18B) was chosen because it was close to the 300 Area Process Trenches but not too close to the trenches to encounter contaminants temporarily flowing in a reverse direction during elevated river stage. The network in the previous plan was identified to fulfill the requirements of a compliance monitoring program with downgradient and upgradient wells and throughout the unconfined aquifer. The network is retained in this updated plan to ensure adequate monitoring of groundwater affected by the 300 Area Process Trenches dangerous waste constituents and to provide upgradient concentrations for comparison, as needed. These eight wells are constructed to WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," standards.

If a well is within approximately 2 years of going dry, a replacement well will be proposed; such wells are negotiated annually by Ecology, DOE, and EPA under Tri-Party Agreement Milestone (Ecology et al., 1989) M-24-00. At the 300 Area Process Trenches, the water table is not declining and is directly affected by the Columbia River. Dry well conditions are unlikely.

Construction details and pertinent information for the wells are provided in Appendix C.

3.2.6 Differences between This Plan and Previous Plan

Table 3-9 identifies the main differences between this plan and the previous groundwater monitoring plan.

Table 3-9 Main Differences between this Plan and Previous Plan

Type of Change	Previous Plan[a]	Current Plan	Justification Summary
Constituents	Dangerous waste constituents of concern: • TCE • *cis*-1,2-DCE Other constituent: • Uranium Geochemical evaluation: • Iron • Manganese Two-year monitoring requirement: • Thallium • PCBs • Chrysene • Benzo(a)pyrene Field parameters: • pH • Conductivity • Turbidity • Temperature	Dangerous Wastes: • *cis*-1,2-DCE • TCE Field parameters: • pH • Conductivity • Turbidity • Temperature	The following constituents are not included the current monitoring plan: 1. Uranium – conducted under CERCLA. 2. Iron and manganese – elevated concentrations are due to naturally occurring reducing conditions 3. PCBs, chrysene, benzo(a)pyrene – not detected during the monitoring period 4. Thallium – determined to be naturally occurring

Table 3-9 Main Differences between this Plan and Previous Plan			
Type of Change	**Previous Plan[a]**	**Current Plan**	**Justification Summary**
Concentration Limit	Based on maximum contaminant levels: *cis*-1,2-DCE: 70 µg/L TCE: 5 µg/L	Based on cleanup levels in 300 Area ROD/ROD Amendment (EPA and DOE, 2013) *cis*-1,2-DCE: 16 µg/L TCE: 4 µg/L	Updated to cleanup levels in the 300 Area ROD/ROD Amendment (EPA and DOE, 2013)
Point of Compliance	Downgradient wells	Same	No change
Sampling Frequency	Semiannual with 4 independent samples (8 samples per year)	Semiannual (2 samples per year)	Concentrations of *cis*-1,2-DCE and TCE have decreased over time and are expected to further attenuate
Well Network	4 well pairs screened at the top and bottom of unconfined aquifer. Downgradient: • 399-1-10A, -10B • 399-1-16A, -16B • 399-1-17A, -17B Upgradient: • 399-1-18A, -18B	Same	No change
Groundwater Flow Direction	East or southeast during low river stage and south or southwest during high river stage	Same	No change
Type of Groundwater Monitoring Program	Compliance, corrective action[b]	Corrective Action	No change
Compliance Period	As defined in WAC 173-303-645(7): Number of years equal to the active life of the waste management area (including any waste management activity prior to permitting and the closure period). If corrective action is engaged at the end of the compliance period, then the compliance	Based on computation per WAC 173-303-645(7), the compliance period for 300 Area Process Trenches is 24 years and will end in 2022 (Section 3.2.4). Monitoring for both dangerous wastes will be performed through the compliance period. At the end of the compliance period, if concentrations of TCE in the point of compliance wells are less	Identifies the end of the compliance period and requirement to demonstrate that further monitoring is not required.

Table 3-9 Main Differences between this Plan and Previous Plan			
Type of Change	**Previous Plan[a]**	**Current Plan**	**Justification Summary**
	period is extended until it can be demonstrated that the concentration limit has not been exceeded for a period of three consecutive years.	than the concentration limit (and have been for the final three consecutive years (2019 to 2022), then TCE monitoring will be discontinued. If corrective action is ongoing at the end of the compliance period (year 2022), then the compliance period will be extended until it is demonstrated that the concentration limit has not been exceeded for a period of three consecutive years. The concentration of *cis*-1,2-DCE is not expected to reach the concentration limit by 2022. Therefore, the compliance period will be extended until it can be demonstrated that the concentration limit has not been exceeded for a period of three consecutive years, after which corrective action monitoring will be discontinued. When the compliance period is complete, 300 Area Process Trenches will be removed from the Hanford Facility RCRA Permit.	
Statistical Evaluation	Tolerance interval (under the compliance monitoring plan)	95 percent UCL on the mean, targeting 8 to 10 samples. Calculation of the 95 percent UCL is not performed for data sets that are less than the concentration limit. Also, the practical quantitation limit must be less than the concentration limit	Evaluation methods will be used to determine if the corrective action (CERCLA remedial action) is progressing as expected and demonstrate that the concentration limit has been achieved. See Section 3.3.2 for details.

Table 3-9 Main Differences between this Plan and Previous Plan

Type of Change	Previous Plan[a]	Current Plan	Justification Summary

Reference: EPA and DOE, 2013, *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1.*

[a] WHC-SD-EN-AP-185 (Rev. 0 and Rev. 0A), *Groundwater Monitoring Plan for the 300 Area Process Trenches.*

[b] The previous monitoring plan (WHC-SD-EN-AP-185, Rev. 0 and Rev. 0A) was written as a final status compliance monitoring plan. After the requirements for the 300 Area Process Trenches changed to corrective action monitoring, the plan was determined to be acceptable for corrective action monitoring by the Washington State Department of Ecology (Ecology, 1998, "Acceptance of Certification of the 300 Area Process Trenches Clean Closure of the Soil Column and Ground Water Corrective Action Requirements").

CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
cis-1,2-DCE = *cis*-1,2-dichloroethene
PCB = polychlorinated biphenyl
RCRA = *Resource Conservation and Recovery Act of 1976*
ROD = record of decision
TCE = trichloroethene
UCL = upper confidence level
WAC = *Washington Administrative Code*

The previous monitoring plan (WHC-SD-EN-AP-185, Rev. 0 and Rev. 0A) monitored uranium, TCE, and *cis*-1,2-DCE as dangerous waste constituents of concern. Iron and manganese were included for a follow-up geochemical evaluation. Thallium, PCBs, chrysene, and benzo(a)pyrene were monitored for a two-year period. Field parameters (pH, conductivity, turbidity, and temperature) were also included.

The 300 Area ROD/ROD Amendment (EPA and DOE, 2013) identified *cis*-1,2-DCE and TCE as contaminants of concern in groundwater because concentrations exceeded drinking water standards. The remedy for both contaminants is MNA. Cleanup levels for *cis*-1,2-DCE (16 µg/ L) and TCE (4 µg/ L) are provided in the 300 Area ROD/ROD Amendment (EPA and DOE, 2013) for the 300-FF-5 OU. Concentrations of TCE in the 300 Area Process Trenches monitoring network have not exceeded the cleanup level for TCE since 1999. A 2015 evaluation under CERCLA found that TCE had attained the cleanup level identified in the 300 Area ROD/ROD Amendment (EPA and DOE, 2013) at each well in the 300 Area network, except for 399-4-14 (ECF-300FF5-15-0017). Based on these results, EPA approved that monitoring for TCE under CERCLA is required at well 399-4-14 only. This well does not monitor 300 Area Process Trenches (DOE/RL-2015-42).

This revised plan monitors only *cis*-1,2-DCE, TCE, and field parameters. Monitoring of uranium is conducted under the CERCLA remedial action and is not included in this monitoring plan. PCBs, benzo(a)pyrene, and chrysene were not detected the 300 Area Process Trenches groundwater monitoring network during the required two years of monitoring and do not require further monitoring. Thallium was detected during the required two years of monitoring. However, thallium was determined to be naturally occurring based on the evaluation in DOE/RL-2010-99. Based on data analysis and modeling results in ECF-300FF5-14-0044, elevated concentrations of iron and manganese in the deep unconfined aquifer are attributed to naturally occurring reducing conditions. Iron and manganese are not included in this plan.

The concentration limits for *cis*-1,2-DCE and TCE in WHC-SD-EN-AP-185 (Rev. 0 and Rev. 0A) of 70 and 5 µg/L, respectively, was based on 40 CFR 141.61(a). The concentration limits for *cis*-1,2-DCE and TCE in this monitoring plan are updated to the cleanup levels of 16 and 4 µg/L, respectively (EPA and DOE, 2013). Because of the previous exceedances of the concentration limit for *cis*-1,2-DCE and the ongoing remedial action, any concentration limit exceedances at the point of compliance during the remediation period do not require additional action.

The sampling frequency in the previous monitoring plan met the requirements of compliance monitoring under WAC 173-303-645(10) and included semiannual sampling, with four independent samples collected at each sampling event, for a total of eight samples per year. Since approval of the plan in 1995, the 300 Area Process Trenches have undergone remediation and concentrations of *cis*-1,2-DCE have decreased and further attenuation of *cis*-1,2-DCE is expected. The remedial action (MNA) chosen for *cis*-1,2-DCE and TCE in the 300 Area ROD/ROD Amendment (EPA and DOE, 2013) will monitor groundwater in the 300 Area Industrial Complex until the cleanup level is attained. Based on recent evaluation of *cis*-1,2-DCE in well 399-1-16B (ECF-300FF5-15-0017, Table 7.1), the concentration will not reach the concentration limit by year 2050. Therefore, the more frequent sampling performed under the previous plan is not necessary for corrective action monitoring and semiannual sampling, consisting of a single sample per sampling event, is included in this updated monitoring plan (see Section 4.2 for details).

The previous plan did not define the compliance period specific to the 300 Area Process Trenches. The compliance period is determined in this plan and extends to year 2022 (Section 3.2.4). However, the concentration of *cis*-1,2-DCE is not expected to reach the concentration limit by year 2022. Therefore, the compliance period will be extended until it can be demonstrated that the concentration limit has not been exceeded for a period of three consecutive years, after which corrective action monitoring will be discontinued and the site will be removed from the Hanford Facility RCRA Permit.

The previous plan included a tolerance interval method for statistical evaluation of the compliance monitoring data. The current plan is updated with a confidence interval statistical method that will be used to determine if the corrective action (CERCLA remedial action) is progressing as expected and demonstrate that the concentration limit has been achieved. Nonstatistical evaluation of the results will be used for data sets that are below the concentration limit and have a practical quantitation limit less than the concentration limit.

3.2.7 Sampling and Analysis Protocol

In accordance with the Hanford Facility RCRA Permit, the groundwater protection regulations of WAC 173-303-645 dictate the groundwater sampling and analysis requirements applicable to final status TSD units. The QAPjP outlining the project management structure, data generation and acquisition, analytical procedures, and quality control is provided in Appendix A. Appendix B provides the sampling protocols (e.g., sampling methods, sample handling and custody, management of waste, and health and safety considerations).

3.3 DATA EVALUATION AND REPORTING

This chapter discusses the evaluation and interpretation of data.

3.3.1 Data Review

The data review and verification tasks are discussed in the QAPjP (Appendix A).

3.3.2 Statistical Evaluation

The objective of the corrective action monitoring program is to monitor the concentration trends to demonstrate the effectiveness of the corrective action. Accordingly, the objective of the statistical evaluation during the corrective action is to monitor the concentration trends of the dangerous wastes to confirm that the corrective action is progressing as expected.

In corrective action monitoring, a UCL of the mean can be compared to a fixed regulatory limit to determine with prescribed confidence whether the mean concentration of the target population (population of interest) significantly exceeds the fixed limit (EPA, 1989, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Interim Final Guidance*; EPA 530/R-09-007, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance*). UCLs of

the mean are routinely calculated using ProUCL (EPA, 2013), a software package developed for EPA that has undergone expansions and upgrades, including the most recent in 2013.

The 95 percent UCL of the mean, hereafter referred to as a 95 percent UCL, calculated with ProUCL, Version 5.0.00 (EPA, 2013) is the statistic used to evaluate groundwater data collected under this monitoring plan. Revised versions of ProUCL will be used as they become available. ProUCL calculates an appropriate 95 percent UCL considering data distribution, data set size, skewness of the data, and percentage of nondetects. The ProUCL technical guide recommends data sets include a minimum of eight to ten independent results, with at least four detections within the data set. Replicate samples are not considered independent.

The most recent eight to ten independent monitoring results of each dangerous waste constituent (*cis*-1,2-DCE and TCE) from the 300 Area Process Trenches monitoring wells are the data sets used to compute a 95 percent UCL on an intrawell basis. When available, results from the last nine or ten independent sampling events (whichever is the maximum number of results) from a given well are used for the calculation.

The wells in this plan were previously monitored at a semiannual frequency with four independent samples per event (eight independent samples per year). The sampling frequency is changed to semiannual with a single sample per event (two independent samples per year) in this updated plan. Therefore, the entire last year of results collected at the frequency under the previous plan (eight samples per year) will be included in initial data sets used to calculate the 95 percent UCL, until eight semiannual samples are available. This will provide a sufficient number of sample results for calculation and will retain the full final year of sample results collected under the previous plan as a set, as opposed to including results that represent only a partial year. Once eight semiannual results are available (e.g., four years of sampling under this plan), the results collected under the previous monitoring plan will no longer be included in data sets.

Not all data sets require computation of a 95 percent UCL. When the sample results in the data set comprising eight to ten semiannual samples (or additional samples collected under the previous monitoring plan as described above) are less than the concentration limit, a nonstatistical or visual analysis of the data (such as presented in Appendix D) is appropriate. In these cases, each result in the data set must be less than the concentration limit. In addition, the practical quantitation limit for each sample in the data set must not exceed the concentration limit.

The 95 percent UCL calculations are performed as necessary for the 300 Area Process Trenches point of compliance well results to support preparation of the semiannual reports required by WAC 173-303-645(11)(g). These reports will be used to monitor the concentration trends to demonstrate the effectiveness of the corrective action. Any calculated 95 percent UCL values will be compared to the concentration limits in these reports.

As discussed in Section 3.2.4, if a corrective action program is ongoing at the end of the compliance period (year 2022), then the corrective action must continue and the compliance period is extended until it is demonstrated that the concentration limit has not been exceeded for a period of three consecutive years. However, for TCE it is possible that concentrations will be less than the concentration limit for the three consecutive year period before the end of the compliance period (years 2019 through 2022). In this case, monitoring will be discontinued at the end of the compliance period.

The sample frequency may be adjusted during the final three consecutive year time period to obtain additional sample results (eight to ten) for calculation of a 95 percent UCL. After three years of samples are collected, the data will be evaluated as described above. Calculation of a 95 percent UCL, if required, will be performed using the last eight to ten independent samples collected at a given well. The resulting 95 percent UCL is compared to the concentration limit to determine whether the dangerous waste

constituent is below the concentration limit. If the 95 percent UCL is below the concentration limit, then monitoring will be discontinued.

Evaluations of the performance monitoring under the CERCLA remedy (MNA) will be provided in 300-FF-5 OU project reports, as needed (DOE/RL-2014-42) and will be prepared to support the sitewide CERCLA five-year review. Performance monitoring results for the 300-FF-5 OU will be reported at least biennially (DOE/RL-2014-42). The results of CERCLA evaluations for *cis*-1,2-DCE and TCE may be used to supplement the evaluations described above, which are performed to monitor the concentration trends to demonstrate the effectiveness of the corrective action.

3.3.3 Interpretation

Data are used to interpret groundwater conditions at the 300 Area Process Trenches. Interpretive techniques may include the following:

- **Hydrographs:** Graph water levels versus time to determine decreases and increases and seasonal or manmade fluctuations in groundwater levels.
- **Water table maps:** Use water table elevations from multiple wells to construct contour maps and estimate flow directions. Groundwater flow is assumed to be perpendicular to the equal potential lines 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 relate to changes in water level or groundwater flow directions.

3.3.4 Reporting

The effectiveness of the corrective action program is reported twice each year as required by WAC 173-303-645(11)(g). Results from this monitoring plan are reported in both the semiannual corrective action groundwater report and the annual Hanford Site RCRA groundwater monitoring report (e.g., DOE/RL-2016-12).

In accordance with WAC 173-303-645(11)(h), if it is determined by DOE that the corrective action program no longer satisfies the requirements of the corrective action program under WAC 173-303-645(11), an application for a permit modification to make any appropriate changes to the program will be submitted within 45 days.

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APPENDIX A
QUALITY ASSURANCE PROJECT PLAN

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APPENDIX A
QUALITY ASSURANCE PROJECT PLAN

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TERMS

DOE	United States Department of Energy
DOE-RL	United States Department of Energy, Richland Operations Office
DQA	data quality assessment
DQI	data quality indicator
DUP	duplicate (laboratory)
EB	equipment blank
ECO	Environmental Compliance Officer
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
FSO	Field Sample Operations
FTB	full trip blank
FWS	Field Work Supervisor
FXR	field transfer blank
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document* (DOE/RL-96-68)
HEIS	Hanford Environmental Information System
LCS	laboratory control sample
MB	method blank
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
N/A	not applicable
PQL	practical quantitation limit
QA	quality assurance
QAPjP	quality assurance project plan
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
S&GRP	Soil and Groundwater Remediation Project
SAF	Sampling Authorization Form
SMR	Sample Management and Reporting
SPLIT	field split
SUR	surrogate
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989a)
Tri-Party Agreement Action Plan	*Hanford Federal Facility Agreement and Consent Order Action Plan* (Ecology et al., 1989b)
TSD	treatment, storage, and disposal
VOC	volatile organic compound

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A1 INTRODUCTION

A quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection. It includes planning, implementation, and assessment of sampling tasks, field measurements, laboratory analysis, and data review. This chapter describes the applicable environmental data collection requirements and controls based on the quality assurance (QA) elements found in EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5) and DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD). Sections 6.5 and 7.8 of the Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan* (Tri-Party Agreement Action Plan) require the QA/quality control (QC) and sampling and analysis activities to specify QA requirements for treatment, storage, and disposal (TSD) units, as well as for past practice processes. This QAPjP also describes the applicable requirements and controls based on guidance provided in Ecology Publication No. 04-03-030, *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, and EPA/240/R-02/009, *Guidance for Quality Assurance Project Plans* (EPA QA/G-5). This QAPjP is intended to supplement the contractor's environmental QA program plan.

This QAPjP is divided into the following five chapters, which describe the quality requirements and controls applicable to the 300 Area Process Trenches groundwater monitoring activities:

- Chapter A2, Project Management
- Chapter A3, Data Generation and Acquisition
- Chapter A4, Assessment and Oversight
- Chapter A5, Data Review and Usability
- Chapter A6, References

A2 PROJECT MANAGEMENT

This chapter addresses the management approaches planned, project goals, and planned output documentation.

A2.1 Project/Task Organization

Project organization (regarding routine groundwater monitoring) is described in the following subsections and illustrated in Figure A-1.

A2.1.1 DOE-RL Manager

Hanford Site cleanup is the responsibility of United States Department of Energy, Richland Operations Office (DOE-RL)-. The DOE-RL Manager is responsible for authorizing the contractor to perform activities at the Hanford Site under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*; *Resource Conservation and Recovery Act of 1976* (RCRA); *Atomic Energy Act of 1954*; and Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement).

A2.1.2 DOE-RL Project Lead

The DOE-RL Project Lead is responsible for providing day-to-day oversight of the contractor's performance of the work scope, working with the contractor to identify and work through issues, and providing technical input to the DOE-RL management.

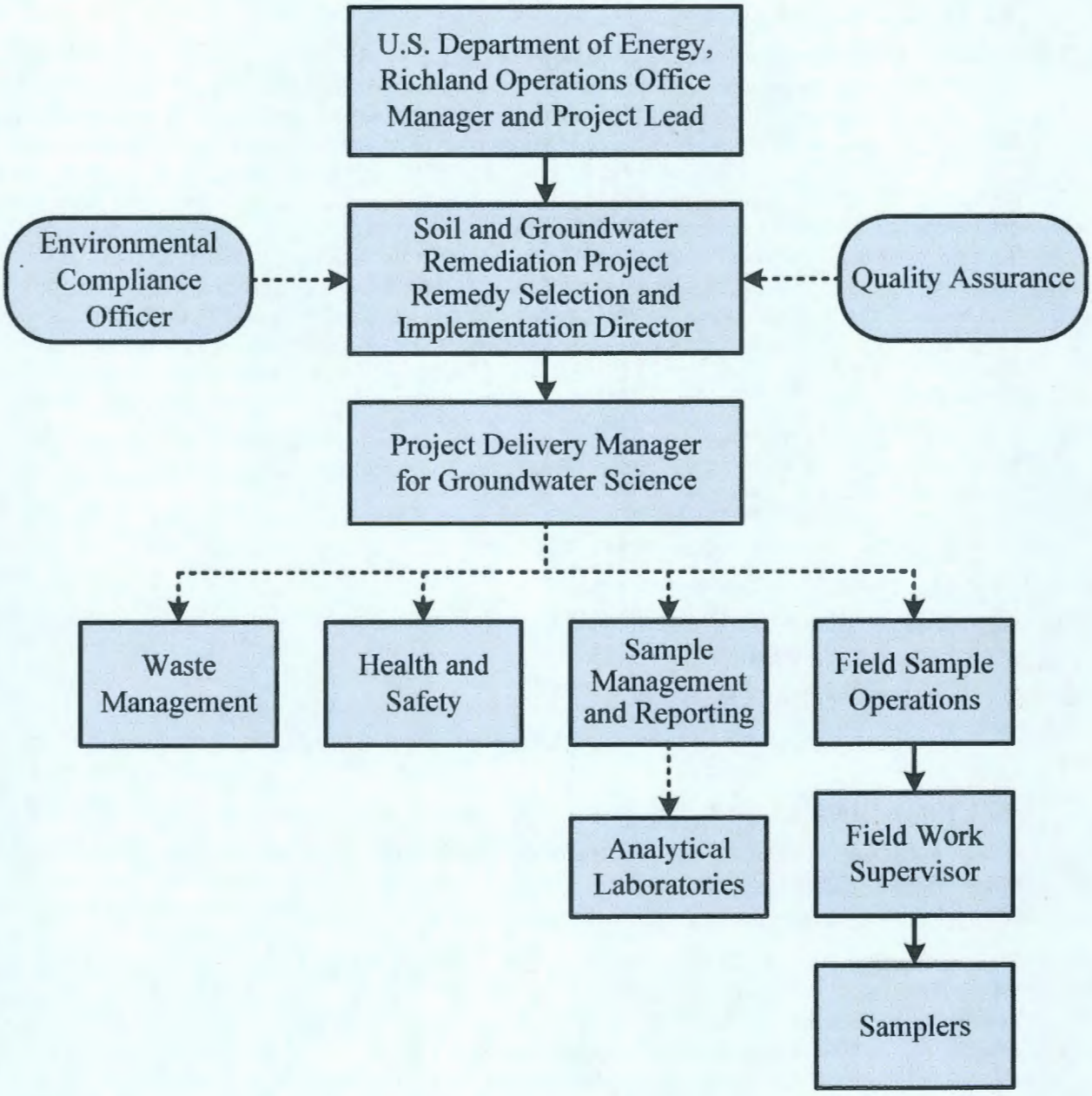

Figure A-1 Project Organization

A2.1.3 Soil and Groundwater Remediation Project Remedy Selection and Implementation Director

The Soil and Groundwater Remediation Project (S&GRP) Remedy Selection and Implementation Director provides oversight and coordinates with DOE-RL and primary contractor management in support of sampling and reporting activities. The Remedy Selection and Implementation Director also provides support to the Project Delivery Manager for Groundwater Science to ensure that work is performed safely and cost effectively.

A2.1.4 Project Delivery Manager for Groundwater Science

The Project Delivery Manager for Groundwater Science is responsible for direct management of activities performed to meet TSD unit groundwater monitoring requirements. The Project Delivery Manager for Groundwater Science coordinates with, and reports to, DOE-RL and primary contractor management regarding TSD unit groundwater monitoring requirements. The Project Delivery Manager for Groundwater Science (or designee) works closely with the Environmental Compliance Officer (ECO), QA, Health and Safety, and Sample Management and Reporting (SMR) group to integrate these and other technical disciplines in planning and implementing the work scope. The Project Delivery Manager for Groundwater Science assigns scientists to provide technical expertise.

A2.1.5 Sample Management and Reporting Group

The SMR group oversees offsite analytical laboratories, coordinates laboratory analytical work to ensure that laboratories conform to the requirements of this plan, and verifies that laboratories are qualified for performing Hanford Site analytical work. The SMR group generates field sampling documents, labels, and instructions for field sampling personnel and develops the Sampling Authorization Form (SAF), which provides information and instruction to the analytical laboratories. The SMR group ensures that field sampling documents are revised to reflect approved changes. The SMR group receives analytical data from the laboratories, ensures it is appropriately reviewed, performs data entry into the Hanford Environmental Information System (HEIS) database, and arranges for data validation and recordkeeping. The SMR group is responsible for resolving sample documentation deficiencies or issues associated with Field Sample Operations (FSO), laboratories, or other entities. The SMR group is responsible for informing the Project Delivery Manager for Groundwater Science of any issues reported by the analytical laboratories.

A2.1.6 Field Sample Operations

FSO is responsible for planning and coordinating field sampling resources and provides the Field Work Supervisor (FWS) for routine groundwater sampling operations. The FWS directs the nuclear chemical operators (samplers), who collect groundwater samples in accordance with this groundwater monitoring plan and corresponding standard procedures and work packages. The FWS ensures that deviations from field sampling documents or issues encountered in the field are documented appropriately (e.g., in the field logbook). The FWS ensures that samplers are appropriately trained and available. Samplers collect samples in accordance with sampling documentation. Samplers also complete field logbooks, data forms, and chain-of-custody forms, including any shipping paperwork, and enable delivery of the samples to the analytical laboratory.

Pre-job briefings are conducted by FSO, in accordance with work management and work release requirements, to evaluate activities and associated hazards by considering the following factors:

- Objective of the activities
- Individual tasks to be performed
- Hazards associated with the planned tasks
- Controls applied to mitigate the hazards
- Environment in which the job will be performed
- Facility where the job will be performed
- Equipment and material required

A2.1.7 Quality Assurance

The QA point of contact provides independent oversight and is responsible for addressing QA issues on the project and overseeing implementation of the project QA requirements. Responsibilities include

reviewing project documents, including the QAPjP, and participating in QA assessments on sample collection and analysis activities, as appropriate.

A2.1.8 Environmental Compliance Officer

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

A2.1.9 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 internal primary contractor work requirements.

A2.1.10 Waste Management

Waste Management is responsible for identifying waste management sampling/characterization requirements, to ensure regulatory compliance and for interpreting data to determine waste designations and profiles. Waste Management communicates policies and procedures and ensures project compliance for storage, transportation, disposal, and waste tracking in a safe and cost-effective manner.

A2.1.11 Analytical Laboratories

The analytical laboratories analyze samples, in accordance with established procedures and the requirements of this plan, and provide necessary data packages containing analytical and QC results. Laboratories provide explanations of results to support data review and in response to resolution of analytical issues. Statements of work flow down quality requirements consistent with the HASQARD (DOE/RL-98-68). The laboratories are evaluated under the DOE Consolidated Audit Program and must be accredited by the Washington State Department of Ecology (Ecology) for the analyses performed for S&GRP.

A2.2 Problem Definition/Background

The purpose of this groundwater monitoring plan is to satisfy WA7890008967, *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste,* Part II, Condition II.F, which specifies groundwater monitoring under WAC 173-303-645, "Dangerous Waste Regulations," "Releases from Regulated Units," for final status facilities. More specific information on the activities to satisfy these requirements is provided in the main text of this monitoring plan, such as in Chapter 1 and Sections 3.1.7, 3.2.1, 3.2.2, 3.2.3, 3.2.4, 3.2.5, and 3.2.6. Background information on monitoring is also provided in the main text Sections 3.1.2, 3.1.5, and 3.2.6.

A2.3 Project/Task Description

The focus of this plan is to monitor for dangerous waste in accordance with WAC 173-303-645(11), evaluate the well network, and interpret analytical results. The dangerous wastes and field parameters to be monitored, along with the monitoring wells and frequency of sampling, are provided in the main text (Chapter 3.2). Information on the collection and analyses of groundwater from the monitoring network is provided in this appendix and in Appendix B.

A2.4 Quality Assurance Objectives and Criteria

The QA objective of this plan is to ensure that the generation of analytical data of known and appropriate quality is acceptable and useful in order to meet the evaluation requirements stated in the monitoring plan. In support of this objective, data descriptors known as data quality indicators (DQIs) are used to help determine the acceptability and usefulness of the data to the user. Principal DQIs are precision, accuracy,

representativeness, comparability, completeness, bias, and sensitivity. These DQIs are defined for the purposes of this document in Table A-1.

Data quality is defined by the degree of rigor in the acceptance criteria assigned to the DQIs. The applicable QC guidelines, DQI acceptance criteria, and levels of effort for assessing data quality are dictated by the intended use of the data and the requirements of the analytical method. DQIs are evaluated during the data quality assessment (DQA) process (Section A5.3).

A2.5 Special Training/Certification

Workers receive a level of training that is commensurate with their responsibility for collecting and transporting groundwater samples according to the dangerous waste training plan maintained for the TSD unit to meet the requirements of WAC 173-303-330, "Personnel Training." The FWS, in coordination with line management, will ensure that special training requirements for field personnel are met.

Training has been instituted by the contractor management team to meet training and qualification programs that satisfy multiple training drivers imposed by applicable *Code of Federal Regulations* and *Washington Administrative Code* requirements. Training records are maintained for each employee in an electronic training record database. The contractor's training organization maintains the training records system. Line management confirms that an employee's training is appropriate and up-to-date prior to performing any field work.

A2.6 Documents and Records

The Project Delivery Manager for Groundwater Science (or designee) is responsible for ensuring that the current version of the groundwater monitoring plan is used and providing any updates to field personnel. Version control is maintained by the administrative document control process. Table A-2 defines the types of changes that may impact the groundwater monitoring plan and the associated approvals, notifications, and documentation requirements. Elements of the monitoring plan that are required by WAC 173-303-645 (e.g., water-level measurements will be collected each time a sample is obtained) cannot be changed.

Table A-1 Data Quality Indicators

Data Quality Indicator (QC Element)[a]	Definition	Determination Methodologies	Corrective Actions
Precision (field duplicates, laboratory sample duplicates, and matrix spike duplicates)	Precision measures the agreement among a set of replicate measurements. Field precision is assessed through the collection and analysis of field duplicates. Analytical precision is estimated by duplicate/replicate analyses, usually on laboratory control samples, spiked samples, and/or field samples. The most commonly used estimates of precision are the relative standard deviation and, when only two samples are available, the relative percent difference.	Use the same analytical instrument to make repeated analyses on the same sample. Use the same method to make repeated measurements of the same sample within a single laboratory. Acquire replicate field samples for information on sample acquisition, handling, shipping, storage, preparation, and analytical processes and measurements.	If duplicate data do not meet objective: • Evaluate apparent cause (e.g., sample heterogeneity). • Request reanalysis or re-measurement. • Qualify the data before use.
Accuracy (laboratory control samples, matrix spikes, and surrogates)	Accuracy is the closeness of a measured result to an accepted reference value. Accuracy is usually measured as a percent recovery. QC analyses used to measure accuracy include standard recoveries, laboratory control samples, spiked samples, and surrogates.	Analyze a reference material or reanalyze a sample to which a material of known concentration or amount of pollutant has been added (a spiked sample).	If recovery does not meet objective: • Qualify the data before use. • Request reanalysis or re-measurement.
Representativeness (field duplicates)	Sample representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. It is dependent on the proper design of the sampling program and will be satisfied by ensuring that the	Evaluate whether measurements are made and physical samples collected in such a manner that the resulting data appropriately reflect the environment or condition being measured or studied.	If results are not representative of the system sampled: • Identify the reason for results not being representative. • Flag for further review. • Review data for usability. • If data are usable, qualify the data for limited use and define the portion of the system that the data represent.

Table A-1 Data Quality Indicators

Data Quality Indicator (QC Element)[a]	Definition	Determination Methodologies	Corrective Actions
	approved plans were followed during sampling and analysis.		• If data are not usable, flag as appropriate. • Redefine sampling and measurement requirements and protocols. • Resample and reanalyze, as appropriate.
Comparability (field duplicate, field splits, laboratory control samples, matrix spikes, and matrix spike duplicates)	Comparability expresses the degree of confidence with which one data set can be compared to another. It is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the approved plans are followed and that proper sampling and analysis techniques are applied.	Use identical or similar sample collection and handling methods, sample preparation and analytical methods, holding times, and quality assurance protocols.	If data are not comparable to other data sets: • Identify appropriate changes to data collection and/or analysis methods. • Identify quantifiable bias, if applicable. • Qualify the data as appropriate. • Resample and/or reanalyze if needed. • Revise sampling/analysis protocols to ensure future comparability.
Completeness (no QC element; addressed in data quality assessment)	Completeness is a measure of the amount of valid data collected compared to the amount of data planned. Measurements are considered to be valid if they are unqualified or qualified as estimated data during validation. Field completeness is a measure of the number of samples collected versus the number of samples planned. Laboratory completeness is a measure of the number of valid measurements compared to the total number of measurements planned.	Compare the number of valid measurements completed (samples collected or samples analyzed) with those established by the project's quality criteria (data quality objectives or performance/ acceptance criteria).	If data set does not meet the completeness objective: • Identify appropriate changes to data collection and/or analysis methods. • Identify quantifiable bias, if applicable. • Resample and/or reanalyze if needed. • Revise sampling/analysis protocols to ensure future completeness.
Bias (equipment blanks, field transfer blanks, full trip blanks, laboratory control	Bias is the systematic or persistent distortion of a measurement process that causes error in one direction (e.g., the sample measurement is	Sampling bias may be revealed by analysis of replicate samples. Analytical bias may be assessed by comparing a measured value	For sampling bias: • Properly select and use sampling tools. • Institute correct sampling and subsampling procedures to limit

Table A-1 Data Quality Indicators

Data Quality Indicator (QC Element)[a]	Definition	Determination Methodologies	Corrective Actions
samples, matrix spikes, and method blanks)	consistently lower than the sample's true value). Bias can be introduced during sampling, analysis, and data evaluation. Analytical bias refers to deviation in one direction (i.e., high, low, or unknown) of the measured value from a known spiked amount.	in a sample of known concentration to an accepted reference value or by determining the recovery of a known amount of contaminant spiked into a sample (matrix spike).	preferential selection or loss of sample media. • Use sample handling procedures, including proper sample preservation, that limit the loss or gain of constituents to the sample media. • Analytical data that are known to be affected by either sampling or analytical bias are flagged to indicate possible bias. • Laboratories that are known to generate biased data for a specific analyte are asked to correct their methods to remove the bias as best as practicable. Otherwise, samples are sent to other laboratories for analysis.
Sensitivity (method detection limit, practical quantitation limit, and relative percent difference)	Sensitivity is an instrument's or method's minimum concentration that can be reliably measured (i.e., instrument detection limit or limit of quantitation).	Determine the minimum concentration or attribute to be measured by an instrument (instrument detection limit) or by a laboratory (limit of quantitation). The lower limit of quantitation[b] is the lowest level that can be routinely quantified and reported by a laboratory.	If detection limits do not meet objective: • Request reanalysis or re-measurement using methods or analytical conditions that will meet required detection or limit of quantitation. • Qualify/reject the data before use.

Source: SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V, as amended.*

[a] Acceptance criteria for QC elements are provided in Table A-5.

[b] For purposes of this groundwater monitoring plan, the lower limit of quantitation is interchangeable with the practical quantitation limit.

QC = quality control

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Table A-2 Change Control for Monitoring Plans		
Type of Change	**Action**	**Documentation**
Site-specific constituents or increased sampling frequency that does not affect the requirements of WAC 173-303-645.	Project Delivery Manager for Groundwater Science approves temporary change; provides informal notification to DOE-RL.	SMR group's integrated groundwater monitoring schedule
Unintentional impact to groundwater monitoring plan that impacts the corrective action monitoring requirements of WAC 173-303-645, including one-time missed well sampling due to operational constraints, delayed sample collection, broken pump, lost bottle set, missed sampling of indicator parameters, and loss of samples in transit.	Project Delivery Manager for Groundwater Science provides electronic notification to DOE-RL. DOE-RL provides informal notification to Ecology as appropriate.	Annual Hanford Site RCRA groundwater monitoring report
Planned change to groundwater monitoring activities that impacts the corrective action monitoring requirements of WAC 173-303-645, including addition or deletion of supporting constituents, change of sampling frequency for supporting constituents, or changes to well network.	Project Delivery Manager for Groundwater Science obtains DOE-RL approval; revise monitoring plan as appropriate.	Revised groundwater monitoring plan and modification to Hanford Facility RCRA Permit
Anticipated unavoidable changes.	Project Delivery Manager for Groundwater Science provides electronic notification to DOE-RL; revise monitoring plan as appropriate.	Annual Hanford Site RCRA groundwater monitoring report Permanent changes require revised groundwater monitoring plan and modification to Hanford Facility RCRA Permit
References: Hanford Facility RCRA Permit (WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste*) WAC 173-303-645, "Dangerous Waste Regulations," "Releases from Regulated Units"		
DOE-RL = United States Department of Energy, Richland Operations Office Ecology = Washington State Department of Ecology RCRA = *Resource Conservation and Recovery Act of 1976* SMR = Sample Management and Reporting		

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 FWS, SMR, and any field crew supervisors are responsible for ensuring that field instructions are maintained and aligned with any revisions or approved changes to the groundwater monitoring plan. The SMR group will ensure that any deviations from the plan are reflected in revised field sampling documents for the samplers and analytical laboratory. The FWS or appropriate field crew supervisors will ensure that deviations from the plan or problems encountered in the field are documented appropriately (e.g., in the field logbook).

The Project Delivery Manager for Groundwater Science, FWS, or designee is responsible for communicating field corrective action requirements and ensuring that immediate corrective actions are applied to field activities. The Project Delivery Manager for Groundwater Science is also responsible for ensuring that project files are setup, as appropriate, and/or maintained. The project files will contain project records or references to their storage locations. Project files generally include, as appropriate, the following information:

- Operational records and logbooks
- Data forms
- Global positioning system data (a copy will be provided to the SMR group)
- Inspection or assessment reports and corrective action reports
- Field summary reports
- Interim progress reports
- Final reports
- Forms required by WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," and the master drilling contract

The following records are managed and maintained by SMR personnel:

- Completed field sampling logbooks
- Groundwater sample reports and field sample reports
- Completed chain-of-custody forms
- Sample receipt records
- Laboratory data packages
- Analytical data verification and validation reports
- Analytical data "case file purges" (i.e., raw data purged from laboratory files) provided by offsite analytical laboratories

The laboratory is responsible for maintaining, and having available upon request, the following items:

- Analytical logbooks
- Raw data and QC sample records
- Standard reference material and/or proficiency test sample data
- Instrument calibration information

- Training records for employees, as they relate to analytical methods.
- Laboratory state accreditation records
- Laboratory audit records

Convenience copies of laboratory analytical results are maintained in the HEIS database. Records may be stored in either electronic (e.g., in the managed records area of the Integrated Document Management System) or hard copy format (e.g., DOE Records Holding Area). 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 (Ecology et al., 1989a) will be managed in accordance with the requirements therein. Records of analyses required by WAC 173-303-645(11), as well as associated groundwater surface elevations required by WAC 173-303-645(8) are to be maintained throughout the active life of a facility and post-closure care period.

The results of corrective action groundwater monitoring are reported twice each year as required by WAC 173-303-645(11). Groundwater monitoring results are also presented in the annual Hanford Site RCRA groundwater monitoring report (e.g., DOE/RL-2016-12, *Hanford Site RCRA Groundwater Monitoring Report for 2015*).

A3 DATA GENERATION AND ACQUISITION

This chapter 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. Requirements for instrument calibration and maintenance, supply inspections, and data management are also addressed.

A3.1 Analytical Method Requirements

Analytical method requirements for samples collected are presented in Table A-3. Updated United States Environmental Protection Agency (EPA) methods may be substituted for the analytical methods identified in Table A-3.

Table A-3 Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable Practical Quantitation Limit[b] (µg/L)
Dangerous Waste Constituents		
Volatile Organic Compounds		
cis-1,2-Dichloroethene	EPA 8260	5
Trichloroethene		1
Site-Specific Measurements		
Field Parameters		
pH	Field measurement Instrument/meter	N/A
Specific Conductance		N/A
Temperature		N/A
Turbidity		N/A

Note: Analytical methods and highest allowable PQLs provided in this table do not represent EPA requirements but are intended solely as guidance.

[a] For four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*. Equivalent methods may be substituted.

[b] Highest allowable practical quantitation limits are specified in contracts with analytical laboratories. Actual quantitation limits vary by laboratory and may be lower. Method detection limits are three to five times lower than quantitation limits.

EPA = U.S. Environmental Protection Agency

N/A = not applicable

PQL = practical quantitation limit

A3.2 Field Analytical Methods

Field screening and survey data will be measured in accordance with HASQARD (DOE/RL-96-68) requirements (as applicable). Field analytical methods may also be performed in accordance with manufacturer manuals. Table A-3 provides the parameters (if any) identified for field measurements. Appendix B provides further discussion on field measurements.

A3.3 Quality Control

QC requirements specified in the plan must be followed in the field and analytical 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 sampling variability. Laboratory QC samples estimate the precision, bias, and matrix effects of the analytical data. Field and laboratory QC samples are summarized in Table A-4. Acceptance criteria for field and laboratory QC are shown in Table A-5. Data will be qualified and flagged in HEIS, as appropriate.

Table A-4 QC Requirements		
Sample Type	**Frequency**	**Characteristics Evaluated**
Field QC		
Field Duplicates	One in 20 well trips	Precision, including sampling and analytical variability
Field Splits	As needed When needed, the minimum is one for every analytical method, for analyses performed.	Precision, including sampling, analytical, and interlaboratory
Full Trip Blanks	One in 20 well trips	Cross-contamination from containers or transportation
Field Transfer Blanks	One each day that volatile organic compounds are sampled	Contamination from sampling site
Equipment Blanks	As needed If only disposable equipment is used or equipment is dedicated to a particular well, then an EB is not required; otherwise, one for every 20 samples[a]	Adequacy of sampling equipment decontamination and contamination from nondedicated equipment
Analytical QC[b]		
Laboratory Sample Duplicates	One per analytical batch[c]	Laboratory reproducibility and precision
Matrix Spikes	One per analytical batch[c]	Matrix effect/laboratory accuracy
Matrix Spike Duplicates	One per analytical batch[c]	Laboratory accuracy and precision
Laboratory Control Samples	One per analytical batch[c]	Laboratory accuracy
Method Blanks	One per analytical batch[c]	Laboratory contamination
Surrogates	One per analytical batch[c]	Recovery/yield

Note: The information in this table does not represent EPA requirements but is intended solely as guidance.

[a] For portable pumps, equipment blanks are collected one for every 10 well trips. Whenever a new type of nondedicated equipment is used, an equipment blank will be collected every time sampling occurs until it can be shown that less frequent collection of equipment blanks is adequate to monitor the decontamination methods for the nondedicated equipment.

[b] Batching across projects is allowed for similar matrices (e.g., all Hanford groundwater).

[c] Unless not required by, or different frequency is called out in, laboratory analysis methods.

EPA = U.S. Environmental Protection Agency

QC = quality control

Table A-5 Laboratory Quality Control and Acceptance Criteria			
Analyte	**Quality Control**	**Acceptance Criteria**	**Corrective Action**
Volatile Organic Compounds			
Volatile organic compounds by gas chromatography/mass spectrometry (*cis*-1,2-dichloroethene and trichloroethene)	MB	<MDL[a] <5% sample concentration	Flagged with "B"
	LCS	70 to 130% Recovery	Review Data[b]
	DUP[c]/MSD[c]	≤20% RPD[d]	Review Data[b]
	MS/MSD	70 to 130% Recovery	Flag with "T"
	SUR	70 to 130% Recovery	Review Data[b]
	EB, FTB, FXR	<2 times MDL[a]	Flag with "Q"
	Field Duplicate/SPLIT	≤20% RPD[d]	Review Data[b]

Note: The information in this table does not represent EPA requirements but is intended solely as guidance.

This table only applies to laboratory analyses. Specific conductance, pH, temperature, and turbidity are not listed as they are measured in the field.

[a] For common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the acceptance criteria is < 5 times the MDL.

[b] 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), failed field QC (Q flag), or rejected (R flag).

[c] Either a DUP or a MSD is to be analyzed to determine measurement precision.

[d] Applies when at least one result is greater than the laboratory PQL (chemical analyses).

DUP = laboratory sample duplicate	MS = matrix spike
EB = equipment blank	MSD = matrix spike duplicate
EPA = U.S. Environmental Protection Agency	PQL = practical quantitation limit
FTB = full trip blank	QC = quality control
FXR = field transfer blank	RPD = relative percent difference
LCS = laboratory control sample	SPLIT = field split
MB = method blank	SUR = surrogate
MDL = method detection limit	

Data Flags:

B = possible laboratory contamination: analyte was detected in the associated method blank.

Q = problem with associated field QC blank: results were out of limits.

T = result may be biased: associated matrix spike result was outside the acceptance limits (gas chromatograph/mass spectrometry only).

A3.3.1 Field Quality Control Samples

Field QC samples are collected to evaluate the potential for cross-contamination and provide information pertinent to field sampling variability and laboratory performance to help ensure that reliable data are obtained. Field QC samples include field duplicates, field split (SPLIT) samples, and three types of field blanks (full trip blanks [FTBs], field transfer blanks [FXRs], and equipment blanks [EBs]). Field blanks are typically prepared using high-purity reagent water. QC sample definitions and their required frequency for collection are described below:

Field duplicates: independent samples collected as close as possible to the same time and same location as the scheduled sample, and intended to be identical. Field duplicates are placed in separate sample containers and analyzed independently. Field duplicates are used to determine precision for both sampling and laboratory measurements.

Field splits (SPLITs): two samples collected as close as possible to the same time and same location and intended to be identical. SPLITs will be stored in separate containers and analyzed by different laboratories for the same analytes. SPLITs are interlaboratory comparison samples used to evaluate comparability between laboratories.

Full trip blanks (FTBs): bottles prepared by the sampling team before travel to the sampling site. The preserved bottle set is identical to the set that will be collected in the field. It is filled with high-purity reagent water[12], and the bottles are sealed and transported (unopened) to the field in the same storage containers used for samples collected that day. Collected FTBs are typically analyzed for the same constituents as the samples from the associated sampling event. FTBs are used to evaluate potential contamination of the samples attributable to the sample bottles, preservative, handling, storage, and transportation.

Field transfer blanks (FXRs): preserved volatile organic analysis sample vials filled with high-purity reagent water at the sample collection site where volatile organic compounds (VOCs) are collected. Samples will be prepared during sampling to evaluate potential contamination attributable to field conditions. After collection, FXR sample vials will be sealed and placed into the same storage containers with samples collected the same day for the associated sampling event. FXR samples will be analyzed for VOCs only.

Equipment blanks (EBs): Reagent water passed through or poured over the decontaminated sampling equipment identical to the sample set collected and placed in sample containers, as identified on the SAF. EB sample bottles are placed in the same storage containers with samples from the associated sampling event. EB samples will be analyzed for the same constituents as samples from the associated sampling event. EBs are used to evaluate the effectiveness of the decontamination process and these samples are not required for disposable sampling equipment.

A3.3.2 Laboratory Quality Control Samples

Internal QA/QC programs are maintained by laboratories used by the project. Laboratory QA includes a comprehensive QC program that includes the use of laboratory sample duplicates (DUPs), matrix spikes (MSs), matrix spike duplicates (MSDs), laboratory control samples (LCSs), method blanks (MBs), and surrogates (SURs). These QC analyses are required by EPA methods (e.g., those in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*) and will be run at the frequency specified in the respective references unless superseded by agreement. QC checks outside of control limits are documented in analytical laboratory reports during DQAs, if performed. Laboratory QC checks and their typical frequencies are listed in Table A-4. Acceptance criteria are shown in Table A-5. Descriptions of the various types of laboratory QC samples are as follows:

Laboratory sample duplicate (DUP): an intralaboratory replicate sample that is used to evaluate the precision of a method in a given sample matrix.

[12] High-purity water that is generally defined as water that has been distilled, deionized, or any combination of distillation, deionization, reverse osmosis, activated carbon filtration, ion exchange, particulate filtration, or other polishing techniques (DOE/RL-96-68).

Matrix spike (MS): an aliquot of a sample spiked with a known concentration of target analyte(s). MS is used to assess the bias of a method in a given sample matrix. Spiking occurs prior to sample preparation and analysis.

Matrix spike duplicate (MSD): a replicate spiked aliquot of a sample that is subjected to the entire sample preparation and analytical process. MSD results are used to determine the bias and precision of a method in a given sample matrix.

Laboratory control sample (LCS): a control matrix (e.g., reagent water) spiked with analytes representative of the target analytes or a certified reference material that is used to evaluate laboratory accuracy.

Method blank (MB): an analyte-free matrix to which the same reagents are added in the same volumes or proportions as used in the sample processing. The MB is carried through the complete sample preparations and analytical procedure and is used to quantify contamination resulting from the analytical process.

Surrogate (SUR): a compound added to every sample in the analysis batch (field samples and QC samples) prior to preparation. SURs are typically similar in chemical composition to the analyte being determined, but they are not normally encountered. SURs are expected to respond to the preparation and measurement systems in a manner similar to the analytes of interest. Because SURs are added to every standard, sample, and QC sample, they are used to evaluate overall method performance in a given matrix. SURs are used only in organic analyses.

Laboratories are required to analyze samples within the holding times specified in Table A-6. In some instances, constituents in the samples not analyzed within the holding times may be compromised by volatilization, decomposition, or other chemical changes. Data from samples analyzed outside of the holding times are flagged in the HEIS database with an "H."

Table A-6 Preservation and Holding Time Guidelines for Laboratory Analyses

Constituent/Parameter	Preservation*	Holding Time
Dangerous Waste Constituent		
Volatile organic compounds (*cis*-1,2-dichloroethene and trichloroethene)	Store ≤6°C, adjust pH to <2 with sulfuric acid or hydrochloric acid	14 Days

Notes: The container type for a sample is available on the chain-of-custody.

The information in this table does not represent EPA requirements but is intended solely as guidance.

This table only applies to laboratory analyses. Specific conductance, pH, temperature, and turbidity are not listed because they are measured in the field.

* For preservation identified as stored at ≤6°C, the sample should be protected against freezing unless it is known that freezing will not impact the sample integrity.

A3.4 Measurement Equipment

Each user of the measuring equipment is responsible to ensure that equipment is functioning as expected, properly handled, and properly calibrated at required frequencies in accordance with methods governing control of the measuring equipment. Onsite environmental instrument testing, inspection, calibration, and maintenance will be recorded in accordance with approved methods. Field screening instruments will be used, maintained, and calibrated in accordance with manufacturer specifications and other approved methods.

A3.5 Instrument and Equipment Testing, Inspection, and Maintenance

Collection, measurement, and testing equipment should meet applicable standards (e.g., ASTM International, formerly the American Society for Testing and Materials) or should have been evaluated as acceptable and valid in accordance with instrument-specific methods, requirements, and specifications. Software applications will be acceptance tested prior to use in the field.

Measurement and testing equipment used in the field or in the laboratory will be subject to preventive maintenance measures to ensure minimization of downtime. Laboratories must maintain and calibrate their equipment. Maintenance requirements (e.g., documentation of routine maintenance) will be included in the individual laboratory and onsite organization's QA plan or operating protocols, as appropriate. Maintenance of laboratory instruments will be performed in a manner consistent with applicable Hanford Site requirements.

A3.6 Instrument/Equipment Calibration and Frequency

Field equipment calibration is discussed in Appendix B. Analytical laboratory instruments are calibrated in accordance with the laboratory's QA plan and applicable Hanford Site requirements.

A3.7 Inspection/Acceptance of Supplies and Consumables

Consumables, supplies, and reagents will be reviewed in accordance with test methods in SW-846 and will be appropriate for their use. Supplies and consumables used in support of sampling and analysis activities are procured in accordance with internal work requirements and processes. Responsibilities and interfaces necessary to ensure that items procured/acquired for the contractor meet the specific technical and quality requirements must be in place. The procurement system ensures that purchased items comply with applicable procurement specifications. Supplies and consumables are checked and accepted by users prior to use.

A3.8 Nondirect Measurements

Data obtained from sources, such as computer databases, programs, literature files, and historical databases, will be technically reviewed to the same extent as data generated as part of any sampling and analysis QA/QC effort. Data used in evaluations will be identified by source.

A3.9 Data Management

The SMR group, in coordination with the Project Delivery Manager for Groundwater Science, is responsible for ensuring that analytical data are appropriately reviewed, managed, and stored in accordance with applicable programmatic requirements governing data management methods. Records of data analyses and groundwater surface elevations are maintained as required by WAC 173-303-645(8)(j).

Electronic data access, when appropriate, will be through a Hanford Site database (e.g., HEIS). Where electronic data are not available, hard copies will be provided in accordance with Section 9.6 of the Tri-Party Agreement Action Plan (Ecology et al., 1989b).

Laboratory errors are reported to the SMR group through an established process. For reported laboratory errors, a sample issue resolution form will be initiated in accordance with applicable methods. This process is used to document analytical errors and establish their resolution with the Project Delivery

Manager for Groundwater Science. The sample issue resolution forms become a permanent part of the analytical data package for future reference and records management.

A4 ASSESSMENT AND OVERSIGHT

Assessment and oversight activities address the effectiveness of project implementation and associated QA/QC activities. The purpose of assessment is to ensure that the QAPjP is implemented as prescribed.

A4.1 Assessments and Response Actions

Random surveillances and assessments verify compliance with the requirements outlined in this plan, project field instructions, the QAPjP, methods, and regulatory requirements. Deficiencies identified by these assessments will be reported in accordance with existing programmatic requirements. The project line management chain coordinates the corrective actions/deficiency resolutions in accordance with the QA program, corrective action management program, and associated methods implementing these programs. When appropriate, corrective actions will be taken by the Project Delivery Manager for Groundwater Science.

Oversight activities in the analytical laboratories, including corrective action management, are conducted in accordance with laboratory QA plans. The SMR group oversees offsite analytical laboratories and verifies that laboratories are qualified to perform Hanford Site analytical work.

A4.2 Reports to Management

Program and project management (as appropriate) will be made aware of deficiencies identified by self-assessments, corrective actions from ECOs, and findings from QA assessments and surveillances. Issues reported by the laboratories are communicated to the SMR group, which then initiates a sample issue resolution form. This process is used to document analytical or sample issues and establish resolution with the Project Delivery Manager for Groundwater Science.

A5 DATA REVIEW AND USABILITY

This chapter addresses QA activities that occur after data collection. Implementation of these activities determines whether the data conform to the specified criteria, thus satisfying the project objectives.

A5.1 Data Review and Verification

Data review and verification are performed to confirm that sampling and chain-of-custody documentation are complete. This review includes linking sample numbers to specific sampling locations, and reviewing sample collection dates and sample preparation and analysis dates to assess whether holding times, if any, have been met. Furthermore, a review of QC data is used to determine whether analyses have met the data quality requirements specified in this plan.

The criteria for verification include, but are not limited to, review for contractual compliance (samples were analyzed as requested), use of the correct analytical method, transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight, and correct application of conversion factors. Field QA/QC results also will be reviewed to ensure that they are usable.

The project scientist, assigned by the Project Delivery Manager for Groundwater Science, will perform a data review to help determine if observed changes reflect improved/degraded groundwater quality or potential data errors, which may result in submittal of a request for data review on questionable data. The laboratory may be asked to check calculations or re-analyze the sample, or the well may be resampled. Results of the request for data review process are used to flag the data appropriately in the HEIS database and/or to add comments.

A5.2 Data Validation

Data validation is performed at the discretion of the Project Delivery Manager for Groundwater Science and under the direction of the SMR group. It is based on the results of the QC samples for an individual

network, discussions with the project scientist, and discussions with the laboratory services manager. If defined as appropriate, data validation (third party) will be performed at a minimum frequency of 5 percent and be based on EPA functional guidelines.

A5.3 Reconciliation with User Requirements

The DQA process compares completed field sampling activities to those proposed in corresponding sampling documents and provides an evaluation of the resulting data. The purpose of the DQA is to determine whether quantitative data are of the correct type and are of adequate quality and quantity to meet the project data quality needs. For routine groundwater monitoring performed through this groundwater monitoring plan, the DQA is captured in the DQA appendix associated with the annual Hanford Site RCRA groundwater report (e.g., DOE/RL-2016-12), which evaluates field and laboratory QC and the usability of data. Further DQAs will be performed at the discretion of the Project Delivery Manager for Groundwater Science and documented in a report overseen by the SMR group.

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APPENDIX B
SAMPLING PROTOCOL

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APPENDIX B
SAMPLING PROTOCOL

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TERMS

DOE	United States Department of Energy
DOT	United States Department of Transportation
FWS	Field Work Supervisor
gpm	gallons per minute
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document* (DOE/RL-96-68)
IATA	International Air Transport Association
NTU	nephelometric turbidity unit
QA	quality assurance
QC	quality control
SMR	Sample Management and Reporting

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B1 INTRODUCTION

Groundwater monitoring at the Hanford Site, as defined by the *Resource Conservation and Recovery Act of 1976* and implemented in WAC 173-303, "Dangerous Waste Regulations," has been conducted since the mid-1980's. Hanford Site groundwater sampling methods contain extensive requirements for sampling precautions to be taken; equipment and its use; cleaning and decontamination; records and documentation; and sample collection, management, and control activities. Together, Appendices A and B provide the sampling and analysis essentials necessary for the groundwater monitoring plan: sample collection, sample preservation and holding times, chain-of-custody control, analytical procedures, and field and laboratory quality assurance (QA)/quality control (QC).

This appendix provides more specific elements of the sampling protocols and techniques used for the groundwater monitoring plan. Chapter 3.2 of the groundwater monitoring plan identifies the monitoring wells that will be sampled, constituents to be analyzed, and sampling frequency for the groundwater monitoring at the 300 Area Process Trenches.

B2 SAMPLING METHODS

Sampling may include, but is not limited to, the following methods:

- Field screening measurements
- Groundwater sampling
- Water level measurements

Groundwater samples will be collected in accordance with the current revision of applicable operating methods. Groundwater samples are collected after field measurements of purged groundwater have stabilized:

- **pH** – two consecutive measurements agree within 0.2 pH units
- **Temperature** – two consecutive measurements agree within 0.2°C (32.3°F)
- **Conductivity** – two consecutive measurements agree within 10 percent of each other
- **Turbidity** – less than 5 nephelometric turbidity units (NTUs) prior to sampling (or project scientist's recommendation)

Unless any special requirements are requested from project scientists, wells are typically purged using the equivalent volume as that of three borehole diameters multiplied by the length of the saturated portion of the well screen. Stable field readings are also required as specified above. The default pumping rate is 7.6 to 45.4 L/min (2 to 12 gallons per minute [gpm]), depending on the pump although this is not practical at every well. On occasions when the purge volume is extraordinarily large, wells are purged for a minimum of 1 hour and are then sampled once stable field readings are obtained.

Field measurements (except for turbidity) are obtained using of a flow-through cell. Groundwater is pumped directly from the well to the flow-through cell. At the beginning of the sample event, field crews attach a clean, stainless-steel sampling manifold to the riser discharge. The manifold has two valves and two ports: one port is used only for purgewater, and the other port is used to supply water to the flow-through cell. Probes are inserted into the flow-through cell to measure pH, temperature, and conductivity. Turbidity is measured by inserting a sample vial into a turbidimeter. The purgewater is then discharged to the purgewater truck.

Once field measurements have stabilized, the hose supplying water to the flow-through cell is disconnected and a clean, stainless-steel drop leg is attached for sampling. The flow rate is reduced during sampling to minimize loss of volatiles (if any) and prevent over filling the bottles. Sample bottles are filled in a sequence designed to minimize loss of volatiles (if any). Filtered samples are collected after collection of the unfiltered samples. For some constituents (e.g., metals), both filtered and unfiltered

samples are collected. If additional samples require filtration (e.g., at turbidity greater than 5 NTUs), an inline, disposable 0.45 μm filter is used.

Typically, three traditional types (i.e., Grundfos[13], Hydrostar[14], and submersible electrical pumps) of environmental grade sampling pumps are used for groundwater sampling at Hanford Site monitoring wells. In addition, low-purge-volume, adjustable-rate bladder pumps may be used. Individual pumps are selected based on the unique characteristics of the well and the sampling requirements.

A small number of wells will not support pumping of samples because of low yield or the physical characteristics of the well. In these cases, a grab sample may be obtained. In cases where there is not sufficient yield, purgewater activities are not performed.

Low-purge-volume sampling methodology for the collection of groundwater samples is also being implemented at the Hanford Site. Low-flow purging and sampling uses a low-purge-volume, adjustable-rate bladder pump with flow rates typically on the order of 0.1 to 0.5 L/min (0.26 to 0.13 gpm). This methodology is intended to minimize excessive movement of water from the soil formation into the well. The objective is to pump in a manner that minimizes stress (drawdown) to the system. Purge volumes for wells using low-purge bladder pumps are determined on a well-specific basis based on drawdown, pumping rate, pump and sample line volume, and volume required to obtain stable field conditions prior to collecting samples.

For certain types of samples, preservatives are required. Preservatives, based on the analytical methods used, are added to the collection bottles before their use in the field. Samples may require filtering in the field, as noted on the chain-of-custody form.

To ensure sample and data usability, sampling associated with this groundwater monitoring plan will be performed in accordance with the requirements of DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD), pertaining to sample collection, collection equipment, and sample handling.

Sample preservation and holding-time requirements are specified for groundwater samples in Appendix A, Table A-6. These requirements are in accordance with the analytical method specified in Appendix A, Table A-3. The container types, preservatives, and volumes will be identified on the chain-of-custody form. This groundwater monitoring plan defines a sample as a filled sample bottle for purposes of starting the clock for holding-time restrictions.

Holding time is the maximum allowable period between sample collection and analysis. Exceeding required holding times could result in changes in constituent concentrations due to volatilization, decomposition, or other chemical alterations. Required holding times depend on the constituent and are listed in analytical method compilations such as APHA/AWWA/WEF, 2012, *Standard Methods for the Examination of Water and Wastewater*, and SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition; Final Update V*. Recommended holding times are also provided in HASQARD (DOE/RL-96-68) and in applicable laboratory contracts.

B2.1 Decontamination of Sampling Equipment

Sampling equipment will be decontaminated in accordance with sampling equipment decontamination methods. To prevent potential contamination of the samples, care should be taken to use decontaminated equipment for each specific sampling activity.

Special care should be taken to avoid the following common ways in which cross-contamination or background contamination may compromise the samples:

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[13] Grundfos® is a registered trademark of Grundfos Holding A/S Corporation, Bjerringbro, Denmark.

[14] Hydrostar® is a registered trademark of KYB Corporation, Tokyo, Japan.

- Improperly storing or transporting sampling equipment and sample containers.
- Contaminating the equipment or sample bottles by setting the equipment/sample bottle on or near potential contamination sources (e.g., uncovered ground).
- Handling bottles or equipment with dirty hands or gloves.
- Improperly decontaminating equipment before sampling or between sampling events.

Decontamination of sampling equipment and pumps is performed using high-purity water[15] in each step. In general, three rinse cycles are performed to decontaminate sampling equipment: a detergent rinse, an acid rinse, and a water rinse. During the detergent rinse, the equipment is washed in a phosphate-free detergent solution, followed by rinsing with water in three sequential containers. After the third water rinse, equipment that is stainless-steel or glass is rinsed in a 1M nitric acid solution (pH less than 2). Equipment is then rinsed with water in three sequential containers (the water rinses following the acid rinse are conducted in separate water containers that are not used for detergent rinse). Following the final water rinse, equipment is rinsed in hexane and then placed on a rack to dry. Dry equipment is loaded into a drying oven. The oven is set at 50°C (122°F) for items that are not metal or glass or at 100°C (212°F) for metal or glass. Once reaching temperature, equipment is baked for 20 minutes and then cooled. The equipment is then removed from the oven, and the equipment is enclosed in clean, unused aluminum foil using surgeon's gloves. The wrapped equipment is stored in a custody-locked, controlled-access area.

To decontaminate sampling pumps that are not permanently installed, the pump cowling is first removed, washed (if needed) in phosphate-free detergent solution, and then reinstalled on the pump. The pump is then submerged in phosphate-free detergent solution, and 11.4 L (3 gal) of solution is pumped through the unit and disposed. Detergent solution is then circulated through the submerged pump for 5 minutes. The pump is removed from solution and rinsed with water. The pump is submerged in water and 30.3 L (8 gal) of water is pumped through the unit and disposed. The pump is removed from the water and the intake and housing are covered with plastic sleeving. The cleaning is documented on a tag that is affixed to the pump, and the tag will include the following information:

- Date pump cleaned
- Pump identification
- Comments
- Signature of person performing decontamination

B2.2 Water Levels

Each time a sample is obtained, measurement of the groundwater surface elevation at each monitoring well is required by WAC 173-303-645(8)(f), "Dangerous Waste Regulations," "Releases from Regulated Units," "General Groundwater Monitoring Requirements." Using a calibrated depth measurement tape, the depth-to-water is recorded in each well prior to sampling. When two consecutive measurements are taken that agree within 6 mm (0.24 in.); the final determined measurement is recorded, along with the date and time for the specific event. The depth to groundwater is subtracted from the elevation of a reference point (usually the top of the casing) to obtain the water-level elevation. The top of the casing is a known elevation reference point because it has been surveyed to local reference data.

B3 DOCUMENTATION OF FIELD ACTIVITIES

Logbooks or data forms are required for field activities and will be used in accordance with HASQARD (DOE/RL-96-68) requirements. A logbook must be identified with a unique project name and number. The individual(s) responsible for logbooks will be identified in the front of the logbook, and only

[15] High-purity water that is generally defined as water that has been distilled, deionized, or any combination of distillation, deionization, reverse osmosis, activated carbon filtration, ion exchange, particulate filtration, or other polishing techniques (DOE/RL-96-68).

authorized persons may make entries in logbooks. Logbook entries will be reviewed by the sampling Field Work Supervisor (FWS), cognizant scientist/engineer, or other responsible manager; the review will be documented with a signature and date. Logbooks will be permanently bound, waterproof, and ruled with sequentially numbered pages. Pages will not be removed from logbooks for any reason. Entries will be made in indelible ink. Corrections will be made by marking through the erroneous data with a single line, entering the correct data, and initialing and dating the changes.

Data forms may be used to collect field information; however, information recorded on data forms must follow the same requirements as those for logbooks. The data forms must be referenced in the logbooks.

A summary of information to be recorded in logbooks or on data forms is as follows:

- Day and date; time task started; weather conditions; and names, titles, and organizations of personnel performing the task.
- Purpose of visit to the task area.
- Site activities in specific detail (e.g., maps and drawings) or the forms used to record such information (e.g., soil boring log or well completion log). Also, details of any field tests that were conducted; reference to any forms that were used, other data records, and methods followed in conducting the activity.
- Details of any field calibrations and surveys that were conducted. Reference any forms that were used, other data records, and the methods followed in conducting the calibrations and surveys.
- Details of any samples collected and the preparation (if any) of splits, duplicates, matrix spikes, or blanks. Reference the methods followed in sample collection or preparation; list location of sample collected, sample type, each label or tag numbers, sample identification, sample containers and volume, preservation method, packaging, chain-of-custody form number, and analytical request form number pertinent to each sample or sample set; and note the time and the name of the individual to whom custody of samples was transferred.
- Time, equipment type, serial or identification number, and methods followed for decontaminations and equipment maintenance performed. Reference the page number(s) of any logbook where detailed information is recorded.
- Any equipment failures or breakdowns that occurred, with a brief description of repairs or replacements.

B3.1 Corrective Actions and Deviations for Sampling Activities

The Project Delivery Manager for Groundwater Science, FWS, appropriate field crew supervisors, and Sample Management and Reporting (SMR) personnel must document deviations from protocols, issues pertaining to sample collection, chain-of-custody forms, target analytes, contaminants, sample transport, or noncompliant monitoring. Examples of deviations include samples not collected due to field conditions.

As appropriate, such deviations or issues will be documented (e.g., in the field logbook) in accordance with internal corrective action methods. The Project Delivery Manager for Groundwater Science, FWS, field crew supervisors, or SMR personnel will be responsible for communicating field corrective action requirements and ensuring that immediate corrective actions are applied to field activities.

Changes in sample activities that require notification, approval, and documentation will be performed as specified in Appendix A, Table A-2.

B4 CALIBRATION OF FIELD EQUIPMENT

Onsite environmental instruments are calibrated in accordance with the manufacturer's operating instructions, internal work requirements and processes, and/or field instructions that provide direction for equipment calibration or verification of accuracy by analytical methods. Calibration records shall include

the raw calibration data, identification of the standards used, associated reports, date of analysis, and analyst's name or initials. The results from all instrument calibration activities are recorded in accordance with the HASQARD requirements (DOE/RL-96-68).

Field instrumentation, calibration, and QA checks will be performed as follows:

- Prior to initial use of a field analytical measurement system.
- At the frequency recommended by the manufacturer or methods, or as required by regulations.
- Upon failure to meet specified QC criteria.
- Daily calibration checks will be performed and documented for each instrument used. These checks will be made on standard materials sufficiently like the matrix under consideration for direct comparison of data. Analysis times will be sufficient to establish detection efficiency and resolution.
- Using standards for calibration that are traceable to a nationally recognized standard agency source or measurement system. Manufacturer's recommendations for storage and handling of standards (if any) will be followed.

B5 SAMPLE HANDLING

Sample handling and transfer will be in accordance with established methods to preclude loss of identity, damage, deterioration, and loss of sample. Custody seals or custody tape will be used to verify that sample integrity has been maintained during sample transport. The custody seal will be inscribed with the sampler's initials and date.

A sampling and analytical database is used to track samples from the point of collection through the laboratory analysis process.

B5.1 Containers

Samples shall be collected, where and when appropriate, in break-resistant containers. The field sample collection record shall indicate the laboratory lot number of the bottles used in sample collection. When commercially pre-cleaned containers are used in the field, the name of the manufacturer, lot identification, and certification shall be retained for documentation.

Containers shall be capped and stored in an environment that minimizes the possibility of sample container contamination. If contamination of the stored sample containers occurs, corrective actions shall be implemented to prevent reoccurrences. Contaminated sample containers cannot be used for a sampling event. Container sizes may vary depending on laboratory-specific volumes/requirements for meeting analytical detection limits. Container types and sample amounts/volumes are identified on the chain-of-custody form.

B5.2 Container Labeling

Each sample is identified by affixing a standardized label or tag to the container. This label or tag shall contain the sample identification number. The label shall identify or provide reference to associate the sample with the date and time of collection, preservative used (if applicable), analysis required, and collector's name or initials. Sample labels may be either preprinted or handwritten in indelible or waterproof ink.

B5.3 Sample Custody

Sample custody will be maintained in accordance with existing protocols to ensure that sample integrity is maintained throughout the analytical process. Chain-of-custody protocols will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained. A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples shipped to any laboratory.

Shipping requirements will determine how sample shipping containers are prepared for shipment. The analyses requested for each sample will be indicated on the accompanying chain-of-custody form. Each time the responsibility for custody of the sample changes, new and previous custodians will sign the record and note the date and time. The field sampling team will make a copy of the signed record before sample shipment and transmit the copy to the SMR group.

The following minimum information is required on a completed chain-of-custody form:

- Project name
- Collectors' names
- Unique sample number
- Date and time of collection
- Matrix
- Preservatives
- Chain of possession information (i.e., signatures and printed names of each individual involved in the transfer of sample custody and storage locations, and dates/times of receipt and relinquishment)
- Requested analyses (or reference thereto)
- Shipped-to information (i.e., analytical laboratory performing the analysis)

Samplers should note any anomalies with the samples. If anomalies are found, samplers should inform the SMR group; so special direction for analysis can be provided to the laboratory if deemed necessary.

B5.4 Sample Transportation

Packaging and transportation instructions shall comply with applicable transportation regulations and United States Department of Energy (DOE) requirements. Regulations for classifying, describing, packaging, marking, labeling, and transporting hazardous materials, hazardous substances, and hazardous wastes are enforced by the United States Department of Transportation (DOT) as described in 49 CFR 171, "Transportation," "General Information, Regulations, and Definitions," through 49 CFR 177, "Carriage by Public Highway." [16] Carrier-specific requirements defined in the current edition of International Air Transport Association (IATA) *Dangerous Goods Regulations* shall also be used when preparing sample shipments conveyed by air freight providers.

Samples containing hazardous constituents shall be considered hazardous material in transportation and transported according to DOT/IATA requirements. If the sample material is known or can be identified, then it will be classified, described, packaged, marked, labeled, and shipped according to the specific instructions for that material. Appropriate laboratory notifications will be made, if necessary, through the SMR project coordinator.

B6 MANAGEMENT OF WASTE

Waste materials are generated during sample collection, processing, and subsampling activities. Waste will be managed in accordance with DOE/RL-2000-56, *Waste Management Plan for the 300-FF-5 Operable Unit*. For waste designation purposes, wells listed in Table 3-7 in the main text of the monitoring plan may be surveyed in the Hanford Environmental Information System, and the maximum concentration for each analyte within the most recent 5 years will be evaluated for use in creating a waste profile, if required.

[16] Transportation regulations 49 CFR 174, "Carriage by Rail," and 49 CFR 176, "Carriage by Vessel," are not applicable, as these two transportation methods are not used.

Miscellaneous solid waste that has contacted suspect dangerous waste will be managed as dangerous waste. Purgewater and decontamination fluids will be collected and managed in accordance with DOE/RL-2011-41, *Hanford Site Strategy for Management of Investigation Derived Waste*; and DOE/RL-2009-80, *Investigation Derived Waste Purgewater Management Work Plan*. Waste materials requiring collection will be placed in containers appropriate for the material and the receiving facility in accordance with the applicable waste management or waste control plan and applicable substantive federal and/or state requirements.

Packaging and labeling during waste storage and transportation will meet WAC 173-303 and DOT requirements, as appropriate. Packaging exceptions to DOT requirements may be used for onsite waste shipments if documented as such and if the packaging provides an equivalent degree of safety during transportation.

Offsite analytical laboratories are responsible for the disposal of unused sample quantities.

B7 HEALTH AND SAFETY

DOE established the hazardous waste operations safety and health program pursuant to the *Price-Anderson Amendments Act of 1988* to ensure the safety and health of workers involved in mixed-waste site activities. The program was developed to comply with the requirements of 10 CFR 851, "Worker Safety and Health Program," which incorporates the standards of 29 CFR 1910.120, "Occupational Safety and Health Standards," "Hazardous Waste Operations and Emergency Response" 10 CFR 830, "Nuclear Safety Management"; and 10 CFR 835, "Occupational Radiation Protection." The health and safety program defines the chemical, radiological, and physical hazards and specifies the controls and requirements for daily work activities on the overall Hanford Site. Personnel training; control of industrial safety and radiological hazards; personal protective equipment; site control; and general emergency response to spills, fire, accidents, injury, site visitors, and incident reporting are governed by the health and safety program.

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303-645, "Releases from Regulated Units."

APPENDIX C
WELL CONSTRUCTION

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APPENDIX C
WELL CONSTRUCTION

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TABLE

Table C-1 Hydrogeologic Monitoring Unit Classification Scheme ..... **Error! Bookmark not defined.**
Table C-2 Sampling Interval Information for Wells within the 300 Area Process Trenches Network ..... **Error! Bookmark not defined.**

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C1 INTRODUCTION

This appendix provides the following information for the 300 Area Process Trenches groundwater monitoring wells:

- Well name
- Hydrogeologic unit to be monitored (the portion of the aquifer that is located at the well screen or perforated casing) (Table C-1)
- The following sampling interval information, as shown in Table C-2:
  - Elevation at top of the screen or perforated interval
  - Elevation at the bottom of the screen or perforated interval
  - Open interval length (i.e., difference between elevations of top and bottom of the screen or perforated interval)

Figures C-1 through C-8 provide the well construction and completion summary for 399-1-10A, 399-1-10B, 399-1-16A, 399-1-16B, 399-1-17A, 399-1-17B, 399-1-18A, and 399-1-18B.

Table C-1 Hydrogeologic Monitoring Unit Classification Scheme

Unit	Description
LU	**Lower Unconfined.** Open interval begins at greater than 15.2 m (50 ft) below the water table and below the middle coarse hydrogeologic unit or within 15.2 m (50 ft) of the top of basalt and does not extend more than 3 m (10 ft) below the top of basalt.
TU	**Top of Unconfined.** Screened across the water table or the top of the open interval is within 1.5 m (5 ft) of the water table, and the bottom of the open interval is no more than 10.7 m (35 ft) below the water table.

Table C-2 Sampling Interval Information for Wells within the 300 Area Process Trenches Network

Well Name	Hydrogeologic Unit Monitored	Elevation Top of Open Interval (m [ft] NAVD88)	Elevation Bottom of Open Interval (m [ft] NAVD88)	Open Interval Length (m [ft])
399-1-10A	TU	106.9 (350.5)	102.3 (335.5)	4.6 (15.0)
399-1-10B	LU	82.7 (271.0)	79.6 (261.0)	3.1 (10.0)
399-1-16A	TU	107.0 (350.8)	102.4 (335.8)	4.6 (15.0)
399-1-16B	LU	84.8 (278.1)	81.8 (268.1)	3.1* (10.0)
399-1-17A	TU	107.8 (353.2)	103.2 (338.2)	4.6 (15.0)
399-1-17B	LU	85.0 (278.6)	81.9 (268.6)	3.1 (10.0)
399-1-18A	TU	107.3 (351.9)	102.7 (336.9)	4.6 (15.0)
399-1-18B	LU	85.9 (281.8)	82.9 (271.8)	3.1* (10.0)

Reference: NAVD88, *North American Vertical Datum of 1988*.

Note: See Table 3-8 in main text for depth of remaining water column.

* The open interval length is 3.1 m (10.0 ft) in length. Construction records for the well are reported in standard units (feet), which are converted to meters for this table. Due to rounding of the metric unit, the computed open interval length based on the top and bottom elevation differs slightly from the actual open interval length.

TU = Top of Unconfined, as described in Table C-1

LU = Bottom of Unconfined, as described in Table C-1

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 300 Area Water Supply
Driller's Name: Cordon
Drilling Company: Associated Drillers
Date Started: 13Nov86

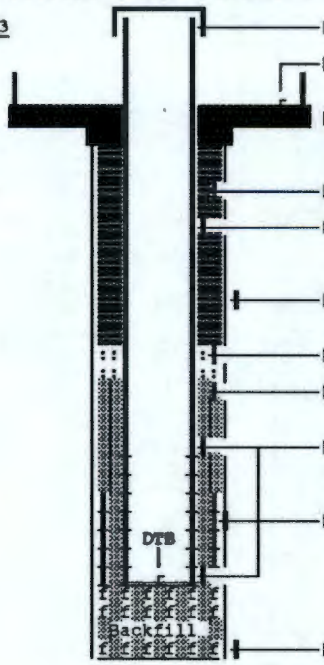
Sample Method: Drive barrel
Additives Used: Not documented
WA State Lic Nr: 0079
Company Location:
Date Complete: 22Nov86

WELL NUMBER: 399-1-10A
TEMPORARY WELL NO: S-3
Hanford Coordinates: N/S S 22,293 E/W E 14,413
State RN 57,083.8 RE 16,018.6
Coordinates: N Not documented E Not doc
Start Card #: Not documented T___ R___ S___
Elevation Ground surface: 371.94-ft Brass cap

Depth to water: 29.0-ft Nov86
(Ground surface) 29.4-ft 17Dec93

GENERALIZED STRATIGRAPHY Log
Geologist's

0-10: Coarse to medium SAND
10-20: Sandy GRAVEL
20-30: Silty, sandy GRAVEL
30-35: Silty, sandy PEBBLES



Elevation of reference point: [373.65-ft] (top of casing)
Height of reference point above ground surface [1.71-ft]
Depth of surface seal [0-13.5-ft]
Type of surface seal: Portland cement 4-ft x 4-ft x 6-in(nom) extending 3-ft into annulus.
Bentonite crumbles to 13.5-ft
6-in ID stainless steel casing, +1.7-24.5-ft
Hole diameter, 0-45.0-ft, 11-in nominal
Volclay bentonite pellets, 13.5-18.5-ft
Silica sand pack, 18.5--39.5-ft, 8-12-mesh
6-in stainless steel screen 24.5-39.5-ft, #40-slot
10-in telescoping screen, 29.5-39.5-ft
DTB=Depth to bottom, 39.1-ft, 12Feb92
Borehole drilled depth: [45.0-ft]

Drawing By: RKL/3-01-10A.ASB
Date : 12Jan94
Reference : HANFORD WELLS WHC-SD-EN-DP-071

Figure C-1 Well 399-1-10A Construction and Completion Summary

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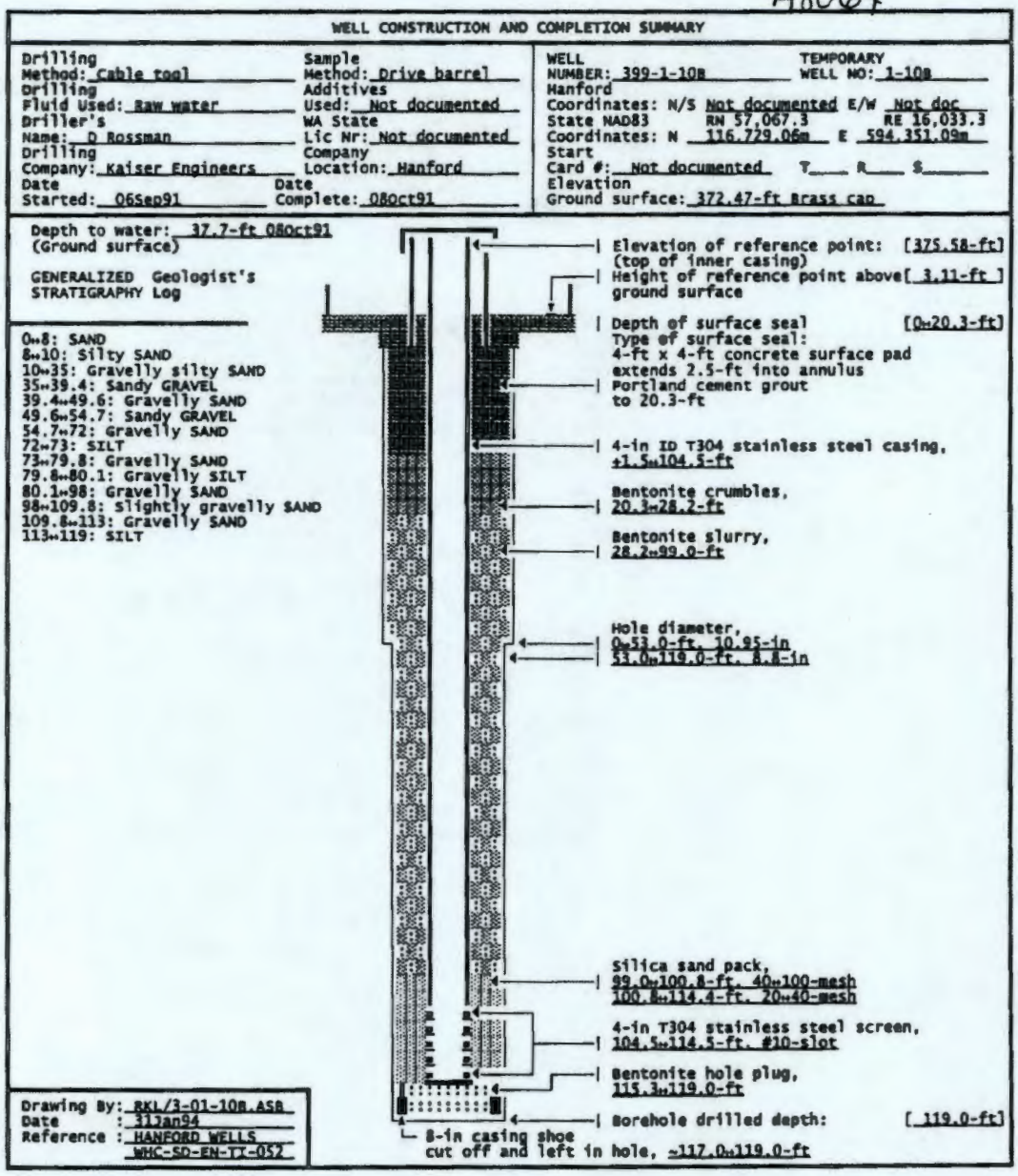


Figure C-2 Well 399-1-10B Construction and Completion Summary

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 300 Area Water Supply
Driller's Name: Amos
Drilling Company: Associated Drillers
Date Started: 01Dec86

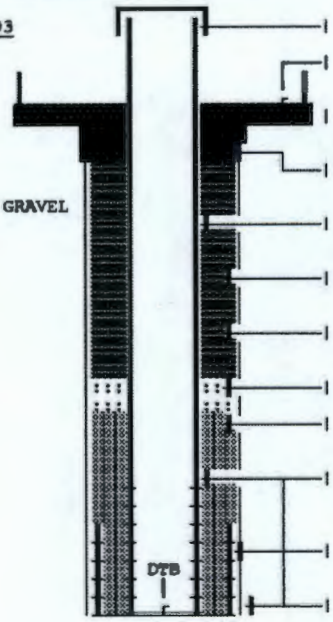
Sample Method: Drive barrel
Additives Used: Not documented
WA State Lic Nr: 1224
Company Location:
Date Complete: 04Dec86

WELL NUMBER: 399-1-16A
TEMPORARY WELL NO: C-1A
Hanford Coordinates: N/S S 23,341 E/W E 14,304
State RN 56,035.6 RE 15,910.1
Coordinates: N Not documented E Not documented
Start Card #: Not documented T___ R___ S___
Elevation Ground surface: 380.21-ft Brass cap

Depth to water: 40.0-ft Dec86
(Ground surface) 38.1-ft 17Dec93

GENERALIZED STRATIGRAPHY Geologist's Log

0-15: Silty, sandy GRAVEL
15-20: Clayey, sandy GRAVEL
20-30: Silty, sandy GRAVEL
30-35: Silty, gravelly SAND
35-45: Silty SAND with CLAY and GRAVEL
45-TD: Silty, gravelly SAND



Elevation of reference point: [381.51-ft] (top of casing)
Height of reference point above ground surface [1.30-ft]
Depth of surface seal [0-5.0-ft]
Type of surface seal: 4-ft x 4-ft concrete surface pad
Cement to 5.0-ft
6-in ID stainless steel casing, +1.3-32.5-ft
Bentonite crumbles, 5.0-21.0-ft
Hole diameter, 0-47.5-ft, 11-in nominal
Bentonite pellets, 21.0-24.8-ft
Silica sand pack, 24.8-47.5-ft, 10-20-mesh
6-in stainless steel screen, 32.5-47.5-ft, #20-slot
10-in telescoping screen, 37.5-47.5-ft, #40-slot
Borehole drilled depth: [47.5-ft]
DTB=Depth to bottom, 47.8-ft, 04Dec90

Drawing By: RKL/3-01-16A.ASB
Date : 12Jan94
Reference : HANFORD WELLS WHC-SD-EN-DP-071

Figure C-3 Well 399-1-16A Construction and Completion Summary

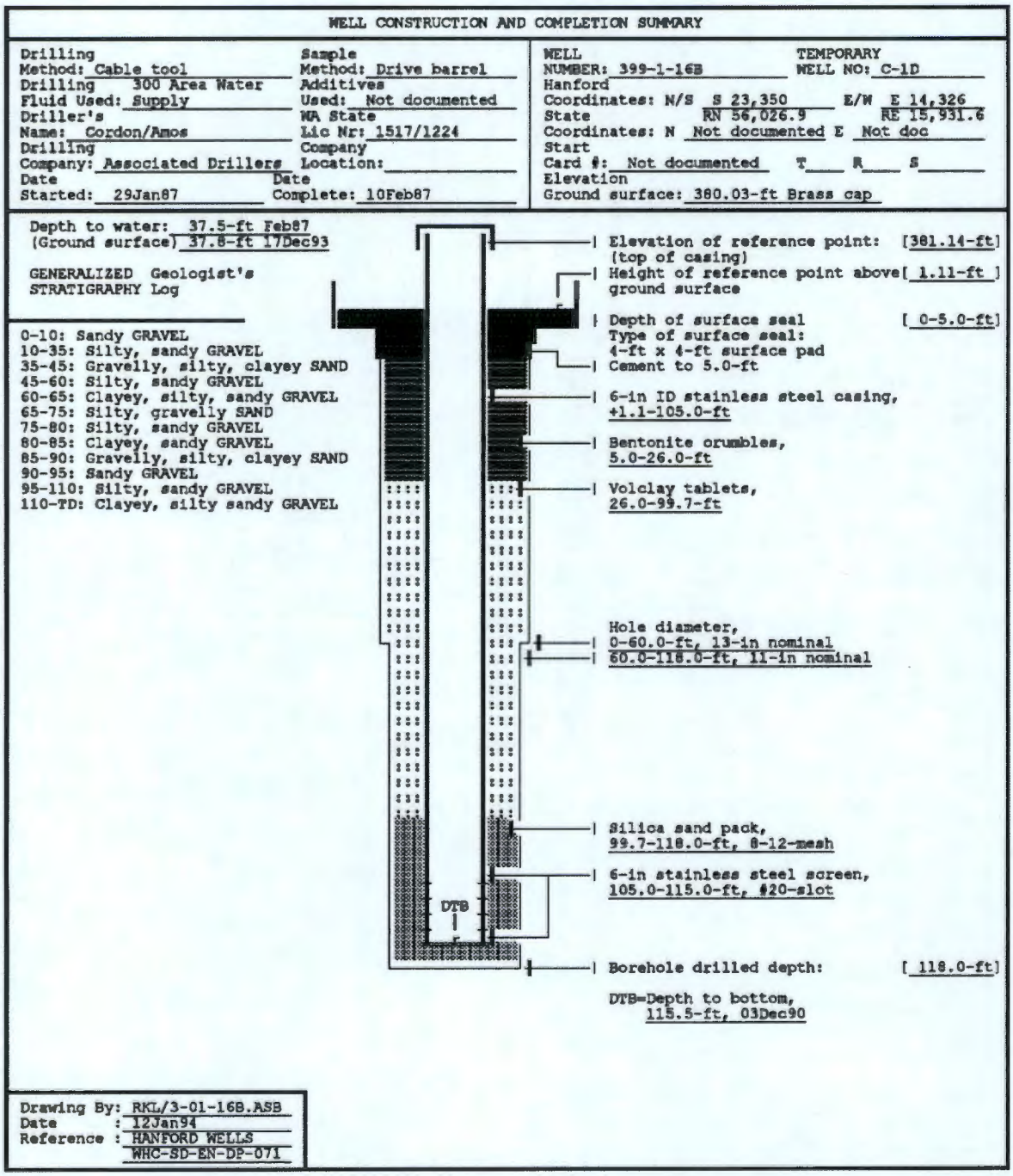


Figure C-4 Well 399-1-16B Construction and Completion Summary

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 300 Area Water Supply
Driller's Name: Cordon
Drilling Company: Associated Drillers
Date Started: 08Nov86

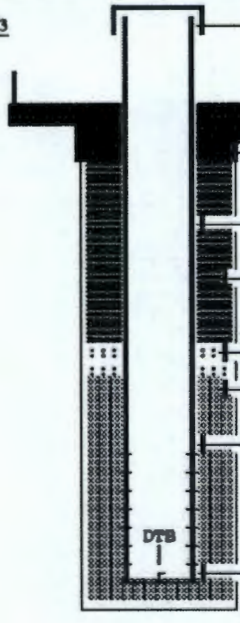
Sample Method: Drive barrel
Additives Used: Not documented
WA State Lic Nr: 0079
Company Location:
Date Complete: 13Nov86

WELL NUMBER: 399-1-17A
TEMPORARY WELL NO: C-2A
Hanford Coordinates: N/S S 23,331 E/W E 13,630
State RN 56,045.7 RE 15,236.2
Coordinates: N Not documented E Not doc
Start Card #: Not documented T___ R___ S___
Elevation Ground surface: 375.13-ft Brass cap

Depth to water: 32.3-ft Nov86
(Ground surface) 33.2-ft 17Dec93

GENERALIZED Geologist's STRATIGRAPHY Log

0-10: Sandy GRAVEL
10-25: Silty, sandy GRAVEL
25-35: Silty, gravelly SAND
35-40: Silty SAND



Elevation of reference point: [377.47-ft]
(top of casing)
Height of reference point above ground surface [2.3-ft]
Depth of surface seal [0-5.0-ft]
Type of surface seal:
4-ft x 4-ft concrete pad.
Cement to 5.0-ft
6-in ID stainless steel casing, 5.0-25.0-ft
Bentonite crumbles, 5.0-19.4-ft
Hole diameter, 0-41.0-ft, 11-in nominal
Volclay bentonite pellets, 19.4-21.6-ft
Silica sand pack, 21.6-41.0-ft
6-in stainless steel screen, 25.0-40.0-ft, #40-slot
Borehole drilled depth: [41.0-ft]
DTB=Depth to bottom, 41.5-ft, 03Dec90

Drawing By: RKL/3-01-17A.ASB
Date : 12Jan94
Reference : HANFORD WELLS WHC-SD-EN-DP-071

Figure C-5 Well 399-1-17A Construction and Completion Summary

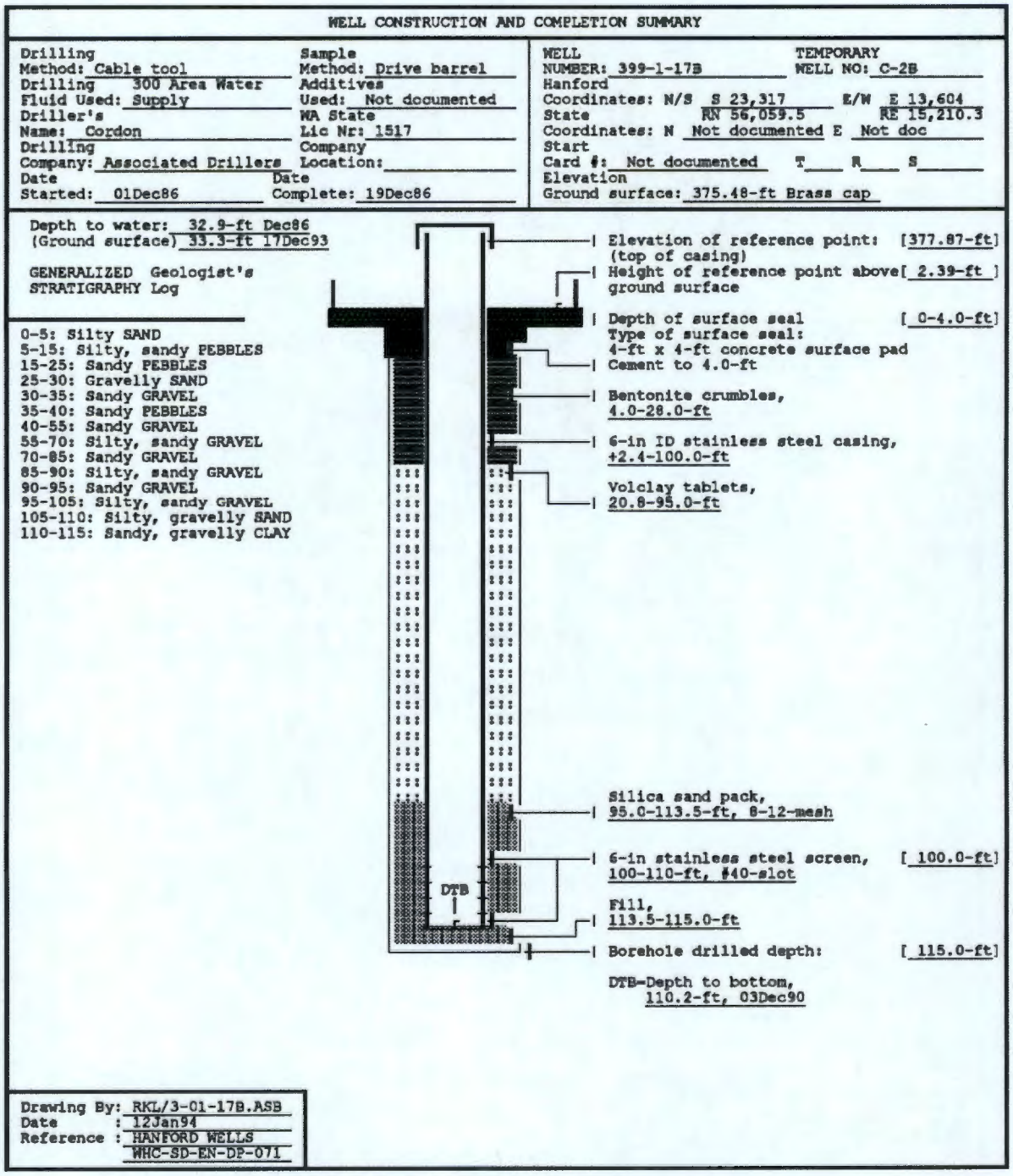


Figure C-6 Well 399-1-17B Construction and Completion Summary

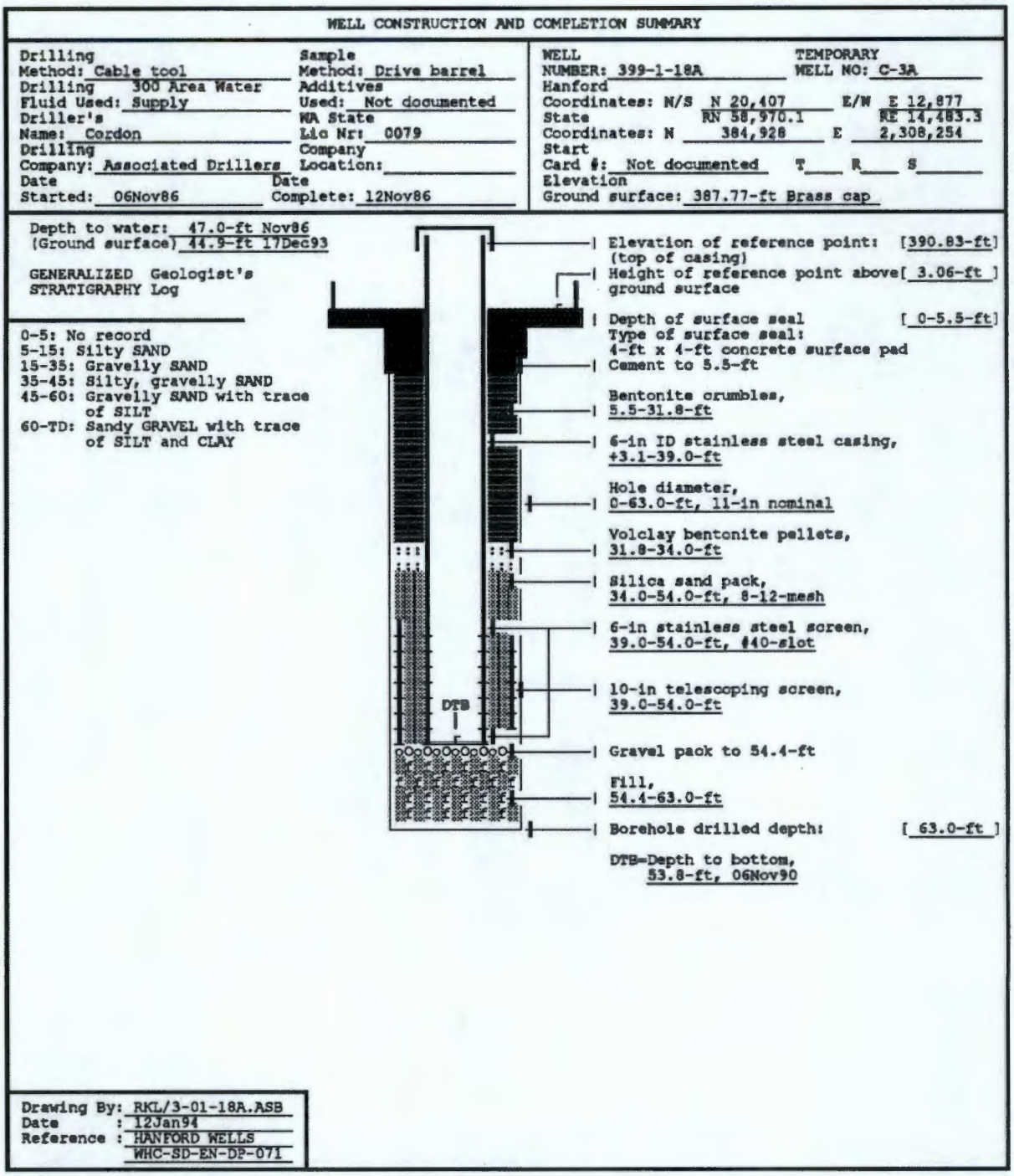


Figure C-7 Well 399-1-18A Construction and Completion Summary

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 300 Area Water Supply
Driller's Name: Cordon
Drilling Company: Associated Drillers
Date Started: 13Nov86

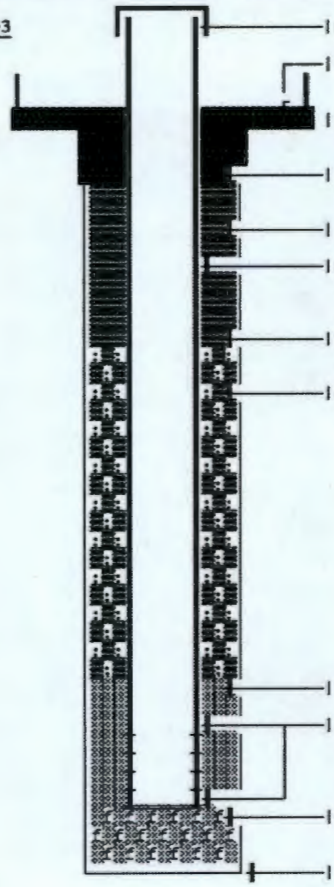
Sample Method: Drive barrel
Additives Used: Not documented
WA State Lic Nr: 0079
Company Location:
Date Complete: 20Jan87

WELL NUMBER: 399-1-18B
TEMPORARY WELL NO: C-3B
Hanford Coordinates: N/S S 20,420 RN 58,956.5 E/W E 12,865 RE 14,470.8
State Coordinates: N Not documented E Not doc
Start Card #: Not documented T___ R___ S___
Elevation Ground surface: 387.24-ft Brass cap

Depth to water: 42.5-ft Jan87
(Ground surface) 44.0-ft 17Dec93

GENERALIZED STRATIGRAPHY Geologist's Log

0-5: Not documented
5-11: SAND
11-15: SAND and GRAVEL
15-25: Sandy GRAVEL
25-30: Silty, sandy GRAVEL
30-40: Sandy GRAVEL with trace of SILT
40-50: Silty, sandy GRAVEL
50-55: Pebbly SAND
55-60: Sandy, silty GRAVEL
60-65: Pebbly SAND
65-85: Silty, sandy GRAVEL
85-90: Sandy SILT
90-95: Silty, sandy GRAVEL
95-115: Sandy, silty GRAVEL
115-120: Silty, sandy GRAVEL
120-125: Sandy, clayey GRAVEL
125 : Sandy, gravelly CLAY



Elevation of reference point: [389.94 ft] (top of casing)
Height of reference point above ground surface [2.70-ft]
Depth of surface seal [0-5.0-ft]
Type of surface seal: 4-ft x 4-ft concrete surface pad
Cement to 5.0-ft
Bentonite crumbles, 5.0-34.0-ft
6-in ID stainless steel casing, +2.7-108.5-ft
Hole diameter, 0-125.0-ft, 11-in nominal
Volclay grout, 34.0-105.0-ft
Silica sand pack, 105.0-118.0-ft, 8-12-mesh
6-in stainless steel screen, 108.5-118.5-ft, #40-slot
Fill, 118.0-125.0-ft
Borehole drilled depth: [125.0-ft]

Drawing By: RKL/3-01-18B.ASB
Date : 12Jan94
Reference : HANFORD WELLS WHC-SD-EN-DP-071

Figure C-8 Well 399-1-18B Construction and Completion Summary

C2 REFERENCE

NAVD88, 1988, *North American Vertical Datum of 1988*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Spring, Maryland. Available at: http://www.ngs.noaa.gov/.

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APPENDIX D
DANGEROUS WASTE CORRECTIVE ACTION MONITORING RESULTS

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APPENDIX D
DANGEROUS WASTE CORRECTIVE ACTION MONITORING RESULTS

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TERMS

cis-1,2-DCE	*cis*-1,2-dichloroethene
TCE	trichloroethene

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D1 INTRODUCTION

This appendix presents the corrective action monitoring results of the 300 Area Process Trenches dangerous wastes trichloroethene (TCE), and *cis*-1,2-dichloroethene (*cis*-1,2-DCE) in the groundwater monitoring well network. Corrective action monitoring of 300 Area Process Trenches commenced in 1997. The 300 Area Process Trenches specific concentration limits identified in Part VI, Post-Closure Unit 1 of the Hanford Facility *Resource Conservation and Recovery Act of 1976* Permit (WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit*) for each dangerous waste are also presented.

The 300 Area Process Trenches corrective action monitoring network comprises four well pairs:

- 399-1-10A, 399-1-10B
- 399-1-16A, 399-1-16B
- 399-1-17A, 399-1-17B
- 399-1-18A, 399-1-18B

Figures D-1 through D-4 present the results of *cis*-1,2-DCE monitoring for each of the well pairs with the concentration limit (16 µg/L) identified in Section 3.2.2. Figures D-5 through D-8 present the results of TCE monitoring for each of the well pairs with the concentration limit (4 µg/L) identified in Section 3.2.2.

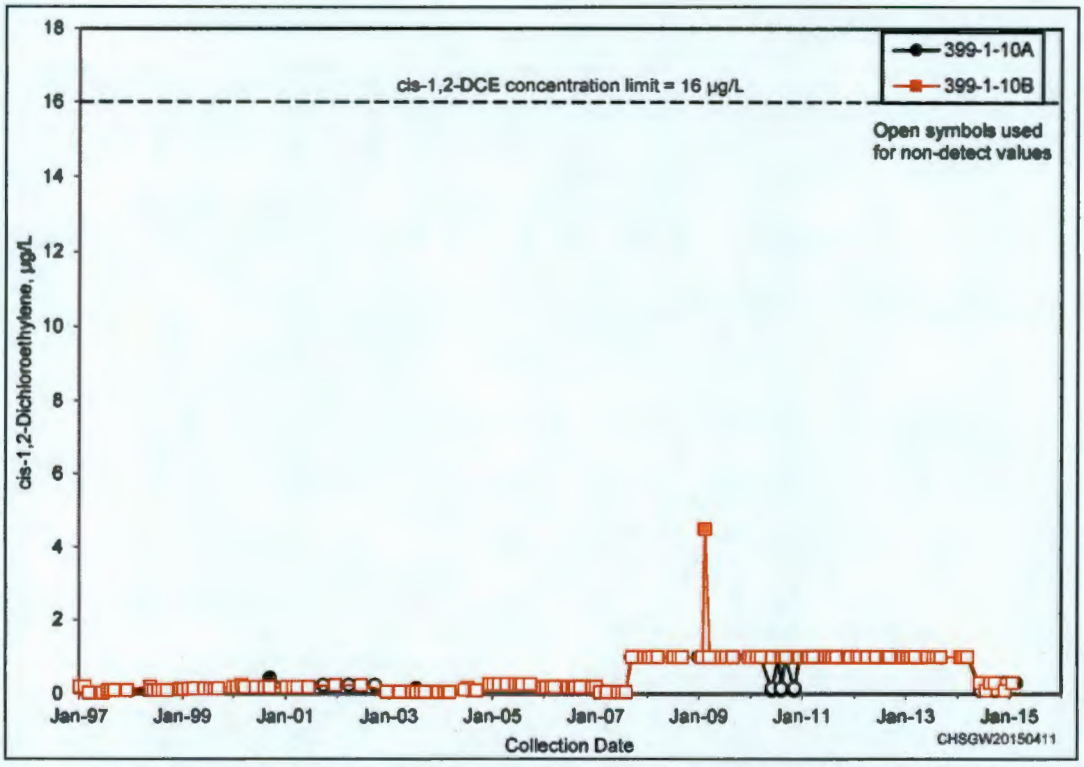

Figure D-1 Corrective Action Monitoring Results of *cis*-1,2-DCE at Wells 399-1-10A and 399-1-10B

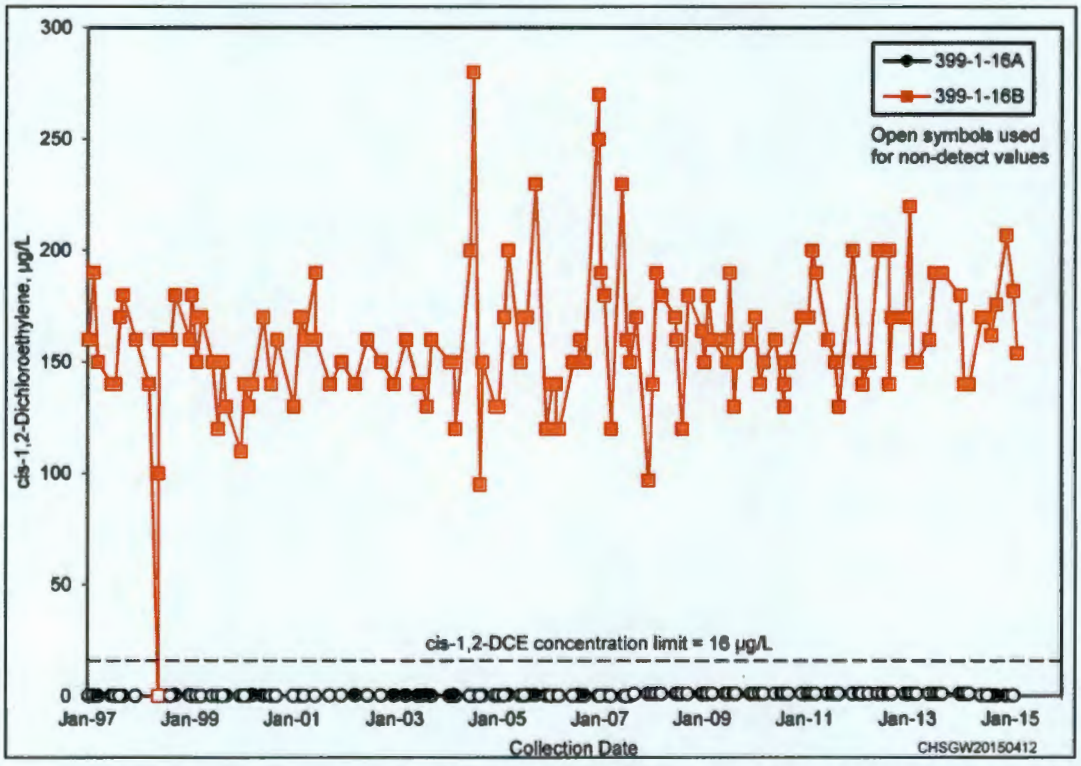

Figure D-2 Corrective Action Monitoring Results of *cis*-1,2-DCE at Wells 399-1-16A and 399-1-16B

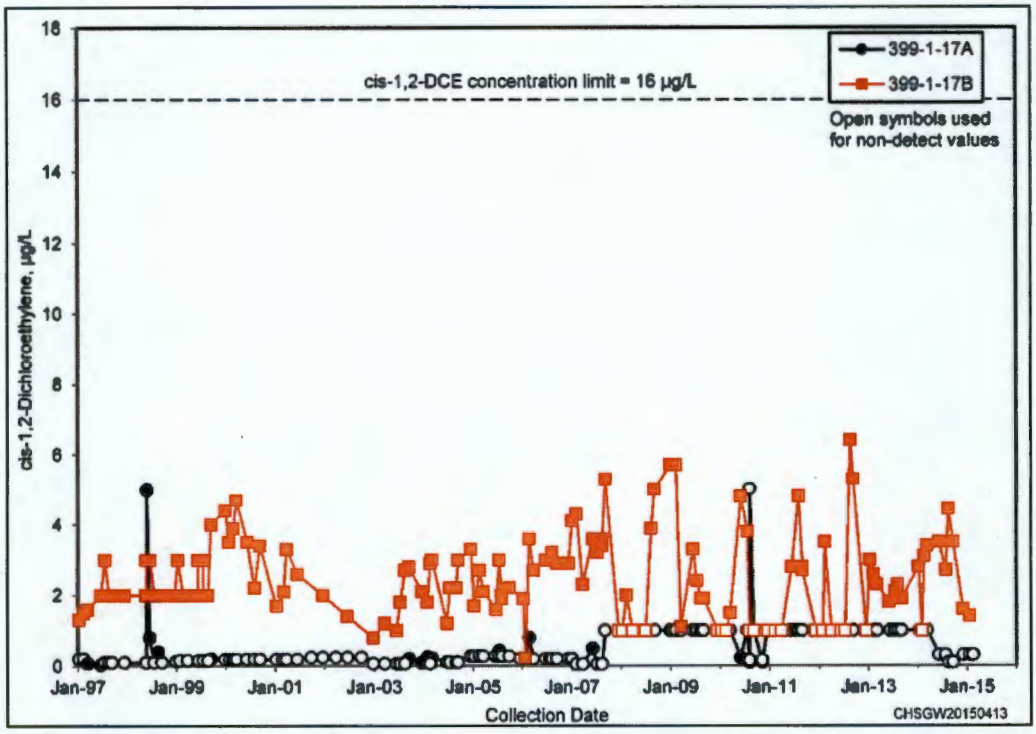

Figure D-3 Corrective Action Monitoring Results of *cis*-1,2-DCE at Wells 399-1-17A and 399-1-17B

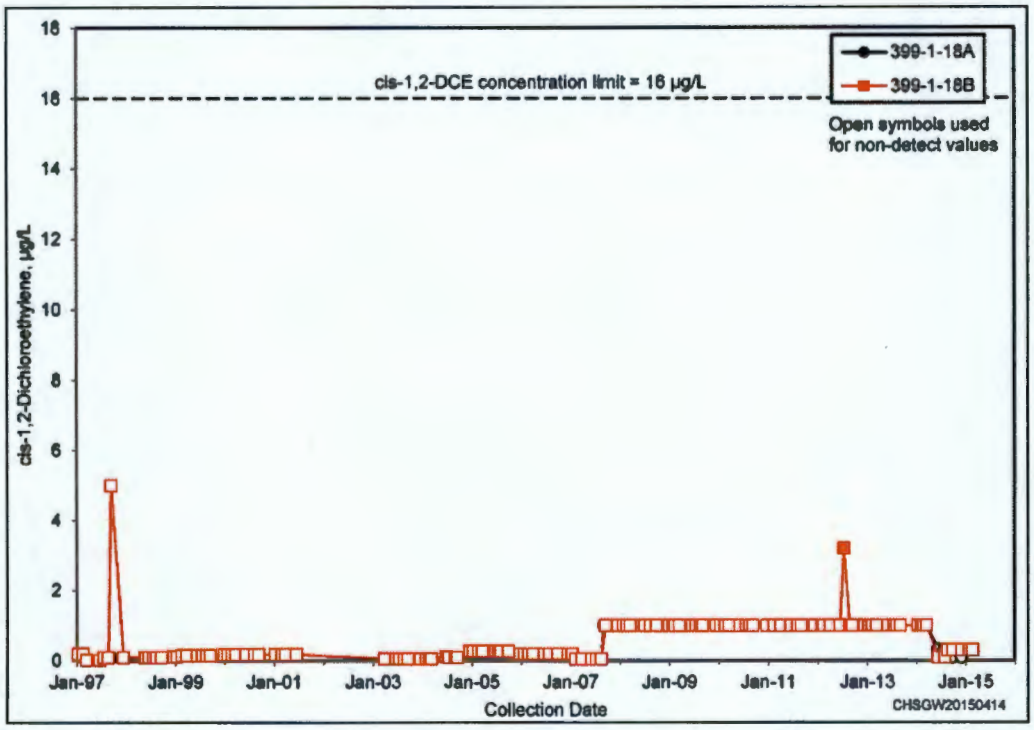

Figure D-4 Corrective Action Monitoring Results of *cis*-1,2-DCE at Wells 399-1-18A and 399-1-18B

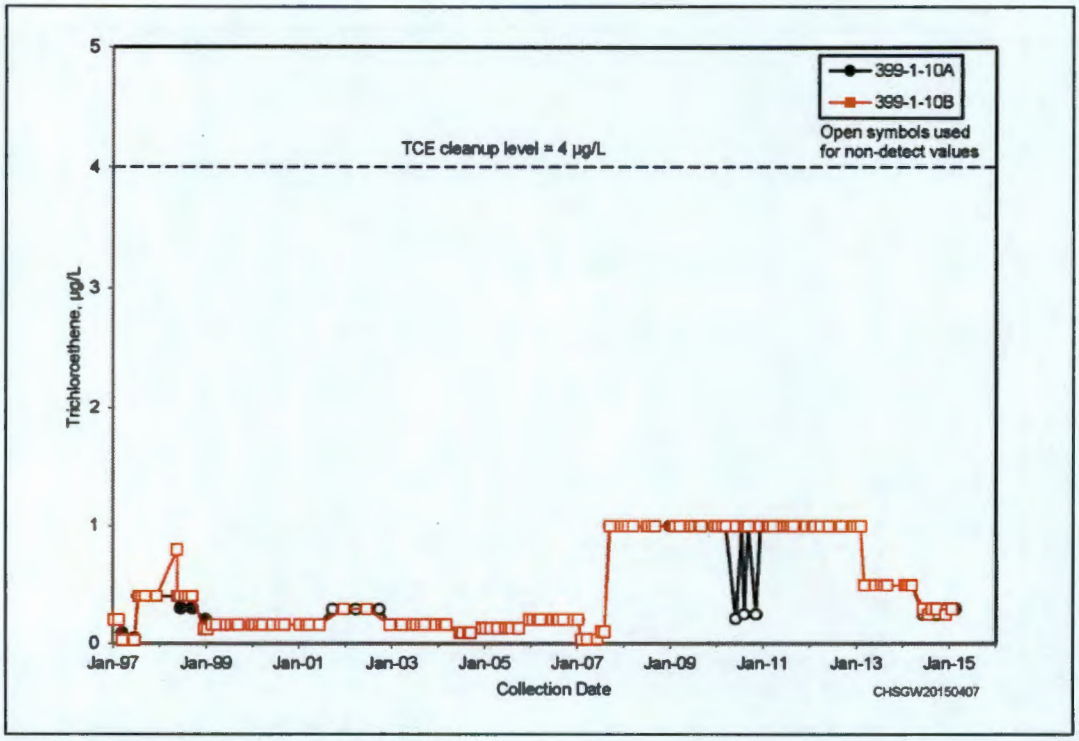

Figure D-5 Corrective Action Monitoring Results of TCE at Wells 399-1-10A and 399-1-10B

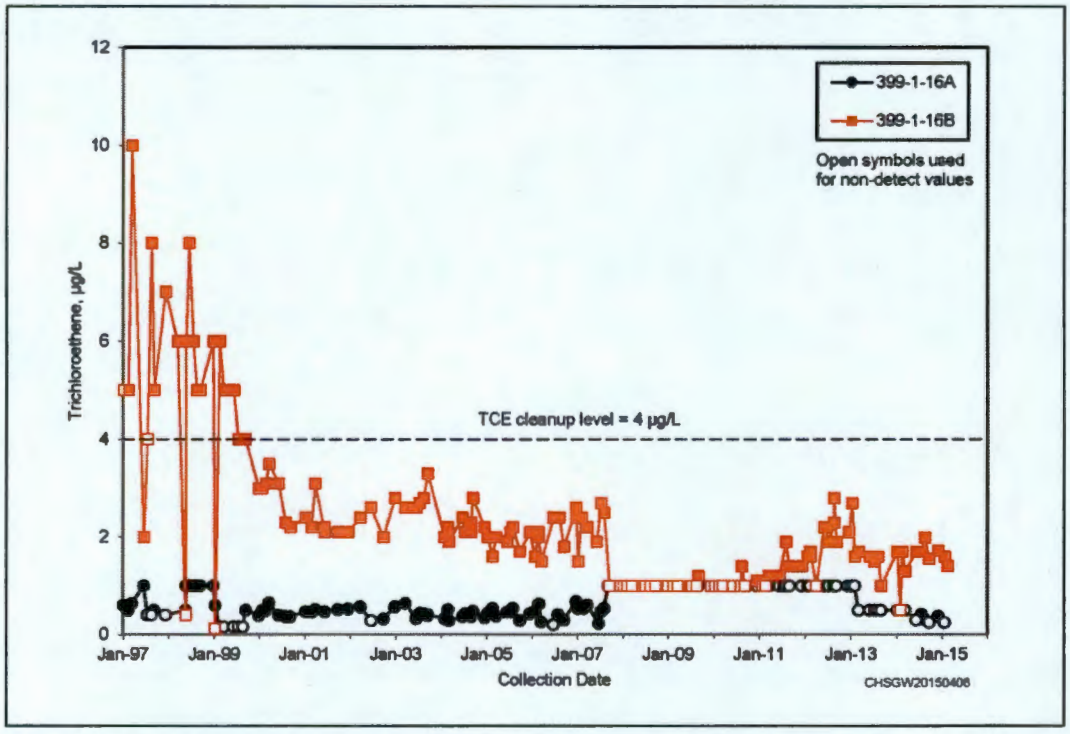

Figure D-6 Corrective Action Monitoring Results of TCE at Wells 399-1-16A and 399-1-16B

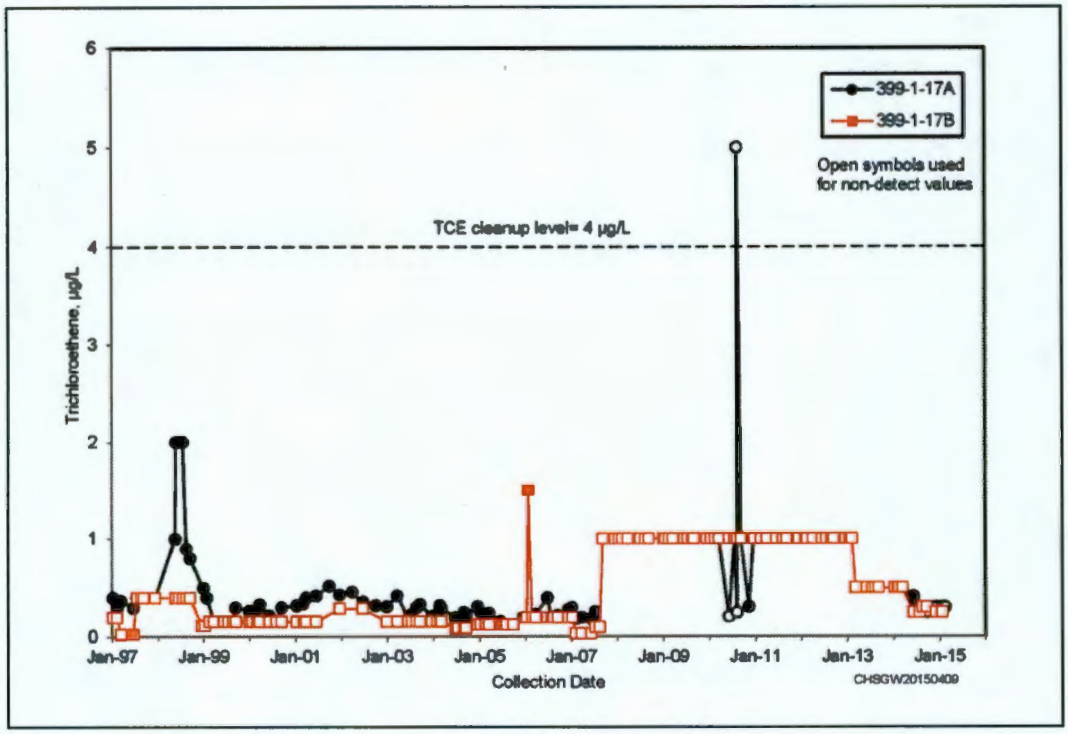

Figure D-7 Corrective Action Monitoring Results of TCE at Wells 399-1-17A and 399-1-17B

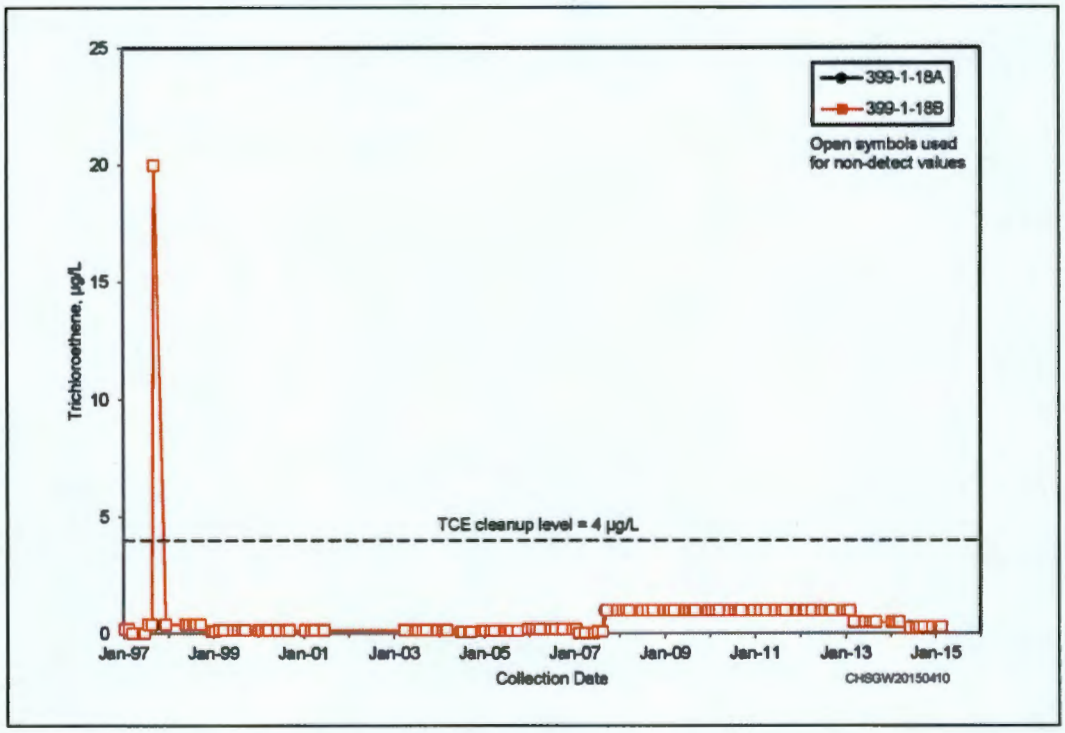

Figure D-8 Corrective Action Monitoring Results of TCE at Wells 399-1-18A and 399-1-18B

D2 REFERENCES

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq. Available at: http://www.epw.senate.gov/rcra.pdf.

WA7890008967, *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste*, Revision 8c, as amended, Washington State Department of Ecology. Available at: http://www.ecy.wa.gov/programs/nwp/permitting/hdwp/rev/8c/index.html.

DEPARTMENT OF
ECOLOGY
State of Washington

Response to Comments

300 Area Process Trenches and 183-H Solar Evaporation Basins Groundwater Monitoring Plans Permit Modification Request for the *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste* –

January 23 through March 24, 2017

Summary of a public comment period and responses to comments

May 2017
Publication no. 17-05-004

PUBLICATION AND CONTACT INFORMATION

This publication is available on the Department of Ecology's (Ecology) website at https://fortress.wa.gov/ecy/publications/SummaryPages/1705004.html

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Response to Comments

300 Area Process Trenches and 183-H Solar Evaporation Basins Groundwater Monitoring Plans Permit Modification Request for the *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste*

January 23 through March 24, 2017

Department of Ecology
Nuclear Waste Program
3100 Port of Benton Boulevard
Richland, Washington 99354

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INTRODUCTION

The Washington State Department of Ecology's Nuclear Waste Program (NWP) manages dangerous waste within the state by writing permits to regulate its treatment, storage, and disposal.

When a new permit or a significant modification to an existing permit is proposed, NWP holds a public comment period to allow the public to review the change and provide formal feedback. (See Washington Administrative Code [WAC] 173-303-830 for types of permit changes.)

The Response to Comments is the last step before issuing the final permit, and its purpose is to:

- Specify which provisions, if any, of a permit will become effective upon issuance of the final permit, providing reasons for those changes.
- Describe and document public involvement actions.
- List and respond to all significant comments received during the public comment period and any related public hearings.

This Response to Comments is prepared for:

Comment period:	300 Area Process Trenches and 183-H Solar Evaporation Basins Groundwater Monitoring Plans Permit Modification Request for the *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste* – January 23 through March 24, 2107
Permit:	*Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit for the Treatment, Storage, and Disposal of Dangerous Waste*, Part VI – Post-Closure Unit Group 1 (WA7890008967), 300 Area Process Trenches and Post-Closure Unit Group 2 (WA7890008967), and 183-H Solar Evaporation Basins
Permittees	United State Department of Energy, Richland Operations Office and CH2M Hill Plateau Remediation Company
Original issuance date:	183-H Solar Evaporation Basins – August 29, 1994
	300 Area Process Trenches – November 25, 1996
Draft effective date:	June 22, 2017

To see more information related to the Hanford Site and nuclear waste in Washington, please visit our website: www.ecy.wa.gov/programs/nwp.

REASONS FOR ISSUING THE PERMIT

This Class 2 modification revises the *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of*

Dangerous Waste (Site-wide Permit) dangerous waste requirements for the 300 Area Process Trenches and the 183-H Solar Evaporation Basins Treatment, Storage, and Disposal (TSD) units. The proposed changes are needed to update information regarding groundwater monitoring activities, described in the post-closure section of the Site-wide Permit (Part VI – Post Closure Units).

300 Area Process Trenches: Liquid waste discharges to the trenches ceased in 1994. Because residual contamination remained in the groundwater following closure activities, post-closure groundwater monitoring was necessary.

183-H Solar Evaporation Basins: Waste shipments ceased in 1985, but waste remained in the basins in the 100-H Area until closure was completed in 1995. Because residual contamination remained in the soil following closure activities, post-closure groundwater monitoring was necessary.

The proposed modifications apply to the groundwater monitoring plans for Post-Closure Unit Group 1 (300 Area Process Trenches) and Post-Closure Unit Group 2 (183-H Solar Evaporation Basins). The modification revises information about the constituents to be monitored, sampling frequency, monitoring well networks, concentration limits, statistical evaluation processes, and the compliance period.

Public Comment Period for Class 2 Permit Modification Request to Site-wide Permit, Revision 8C

On January 17, 2017, the U.S. Department of Energy, Richland Operations Office (USDOE-RL) submitted a Class 2 permit modification request to add the revised Final Status Groundwater Monitoring Plans for the 300 APT and the 183-H SEB to the post-closure section of the Site-wide Permit, Revision 8C.

The complete submittal from USDOE-RL contained the Class 2 permit modification request, which included both groundwater monitoring plans.

PUBLIC INVOLVEMENT ACTIONS

The Nuclear Waste Program encouraged public comment on the 300 Area Process Trenches and the 183-H Solar Evaporation Basins Final Status Groundwater monitoring plans during a 60-day public comment period held January 23 through March 24, 2017.

The following actions were taken to notify and involve the public:

- A public notice announcing the comment period was mailed to 1,502 interested members of the public.
- Copies of the public notice were distributed to members of the public at Hanford Advisory Board meetings.
- A public announcement legal classified advertisement was placed in the Tri-City Herald on January 23, 2017.
- A notice announcing the start of the comment period was sent to the Hanford-Info email list, which has 1,451 recipients.
- The comment period was posted as an event on Ecology's Hanford Education & Outreach Facebook page.

USDOE-RL held a public meeting on February 28, 2017, at 5:30 pm at the Richland Public Library. No members of the public attended, and no comments were collected.

The Hanford information repositories located in Richland, Spokane, and Seattle, Washington, and Portland, Oregon, received the following documents for public review:

- Public notice
- Transmittal letter
- DOE Public Notice (focus sheet) for the proposed 300 Area Process Trenches and 183-H Solar Evaporation Basins Final Status Groundwater Monitoring Plans Permit Modification
- Draft 300 Area Process Trenches and 183-H Solar Evaporation Basins Final Status Groundwater Monitoring Plans Permit Modification

The following public notices for this comment period are in Appendix A of this document:

1. DOE Public notice (focus sheet)
2. Classified advertisement in the *Tri-City Herald*
3. Notice sent to the Hanford-Info email list
4. Event posted on Ecology Hanford Education & Outreach Facebook page

LIST OF COMMENTERS

Commenter Identification:

The table below lists the names of organizations or individuals who submitted a comment on the 300 Area Process trenches and 183-H Solar Evaporation Basins Final Status Groundwater Monitoring Plans Permit modification and where you can find Ecology's response to the comments.

Commenter	Organization	Comment Number	Page Number
Carol Panfilio	Citizen	1	5
Mike Conlan	Citizen	2	5
Marlene George Acting Program Manager	Yakama Nation Environmental Restoration / Waste Management Program	3 - 4	6 - 18

RESPONSE TO COMMENTS

Description of Comments:

The Department of Ecology Nuclear Waste Program accepted comments on the 300 Area Process trenches and 183-H Solar Evaporation Basins Final Status Groundwater Monitoring Plans January 23 through March 24, 2017.

This section provides summary of comments that we received during the public comment period and our responses, as required by RCW 34.05.325(6)(a)(iii). Comments are grouped by individual and each comment is addressed separately. Ecology's responses directly follow each comment in italic font. Verbatim copies of all written comments are attached in Appendix B.

Comment # 1 from Carol Panfilio, Citizen, dated January 23, 2017

Just make sure that all Class 2 modifications with any new regulations, and technical advancements are utilized in the Hanford Dangerous Waste Permit approval. We are counting on the Washington State Department of Ecology to do what's right and best for every citizen of Washington State.

Ecology Response: *Ecology will ensure that the permit modification process is followed.*

Comment # 2 from Mike Conlan, Citizen, dated January 28, 2017

1) Remove all nuclear waste,

2) Do not allow anymore nuclear waste into the facility,

3) Replace all the single storage tanks,

4) Stop all the nuclear leakage entering the Columbia River.

Ecology Response:

1) Ecology is working to ensure long-term storage, treatment, and disposal of waste is protective of human health and the environment.

2) The proposed permit changes are not to allow new waste, but to better manage the monitoring of groundwater in waste disposal areas that have been cleaned up and are in post-closure monitoring.

3) Single-shell tanks are not in the scope of this comment period. Ecology does agree the tanks pose a threat. We believe a better approach to addressing it is to remove the waste from single-shell tanks and put it in the more compliant double-shell tanks to prepare for eventual treatment in the Waste Treatment and Immobilization Plant which is now being built.

4) Stopping any potential nuclear waste from impacting the Columbia River is why the 300 Area Process Trenches and the 183-H Solar Evaporation Basins were closed. The Final Status Groundwater Monitoring Plans for these two units the way the remaining RCRA constituents in groundwater are being monitored through post-closure care of these units.

Comment # 3 from Marlene George, Yakama Nation, dated March 22, 2017

Attachment #1
Final Status Groundwater Monitoring Plan for the 300 Area Process Trenches & the 183-H Solar Evaporation Basins, DOE/RL-2015-29, Revision 0 & DOE/RL-2015-28, Revision 0
General Comments regarding issues identified in both Groundwater Monitoring Plans:

- As there are Tribal Cultural Resources in both the 100-H and 300 Areas, which include cemeteries, archeological sites, traditional cultural properties as well as significant Treaty resources such as salmon redds, spawning areas, traditional fisheries and biological resources in the riparian zone and terraces, using Industrial Use designation of these lands over a general time frame past 100 years closure is unacceptable considering the disruption of cultural and Treaty resources in the area. Disruption that prevents/alters the use of TCPs and impacts significant cultural resources is potentially an adverse effect which must be mitigated through an MOA in compliance with the National Historic Preservation Act and the implementing 36CFR800. Adverse effects can only be determined with consultation of with Yakama Nation.

Ecology Response:

Ecology recognizes that USDOE has authority to make land use designations for the Hanford Site. The nature of this permit modification is to change the frequency and location of monitoring activities. The changes to the Groundwater Monitoring plans did not cause any physical disruptions in either unit.

- The YN-ER/WM Program believes that there are some incorrect applications of regulations, which need correction, and re-evaluation of risks to groundwater. WAC 173-303-720(4)(b)(ii) (2007) indicates that WAC 173-340 Method B for potable groundwater applies for the protection of surface water beneficial uses, and references WAC 173-340-730; in this way, water quality standards are incorporated in WAC 173-340-720, WAC 173-340-730 (3)(b)(i) also gives the relationship of water quality standards and WAC 173-340. We believe the aquatic water quality criteria do apply to the ground water because the property abuts the surface water and should be applied at 100-H. YN requests use of a concentration limit of 10ug/L Surface Water Aquatic Life Fresh/Chronic 173-201A WAC values in determining compliance and completion of corrective actions and groundwater monitoring for the 183-H unit.

Ecology Response:

The value of 48 µg/L proposed in the groundwater monitoring plan meets the groundwater standard for hexavalent chromium as required under MTCA Method B standards. The total chromium value that is enforced in the Site-wide Permit is 122 µg/L. Therefore, a more restrictive standard will be enforced in the new groundwater monitoring plan for the 183-H SEB.

The required concentration limit is based on WAC 173-303-645 Table 1 which is listed as 50 µg/L for total chromium. The groundwater monitoring plan is using a more stringent concentration

limit based on MTCA Method B (WAC 173-340-720). The site is some distance away from the river, and river water does not travel this far inland. Therefore, using the aquatic standard is not appropriate.

- YN requests the following changes be made for both RCRA TSD units' groundwater monitoring plans: Wells that are located at the boundary of groundwater plumes should be maintained and monitored for ongoing closure monitoring or remedial action monitoring. Adequate placement, appropriate screening, and ongoing monitoring of wells at the plume boundary are necessary to adequately monitor changes in plume aerial and vertical extent. Discontinuing monitoring at boundary wells compromises plume delineation by requiring point of compliance location to be estimated rather than directly bounded by data.

Ecology Response:

These are Dangerous Waste groundwater monitoring plans and are required, per WAC 173-303-645(6) "Point of Compliance," to monitor for releases from the regulated unit using wells immediately downgradient of the regulated unit. That is the approach taken for these Dangerous Waste groundwater monitoring plans as required by the Dangerous Waste Regulations (WAC 173-303).

- WAC 173-303 Dangerous Waste Regulations do not parse out contaminants or groundwater from the soil unit. YN believes that as long as corrective actions for Uranium are ongoing, the 300 APT cannot be removed from the Permit. Corrective actions for this constituent whose source is the 300 APT TSD are being deferred to the CERCLA ROD for the 300-FF-5 GW OU, but this does not relieve Ecology of continued oversight of this corrective action through the Permit. YN requests edits to any text related to removal of the site from the Hanford RCRA permit to indicate Ecology's continued oversight through the permit for this corrective action. (See pg. 3-4.)

Ecology Response:

Ecology has no authority to regulate uranium under the Site-wide Permit at Hanford. The 300 APT are not being removed from the Permit.

- YN requests clarification as to the regulatory path which allows Ecology to delete Uranium as a COC for both the 183-H SEB & the 300 Area Process Trenches RCRA Groundwater Monitoring plan simply on the basis that corrective action is implemented under the a CERCLA remedial action (e.g. EPA/ROD/R 10-96/ 143, 1996). Uranium should remain in both the 183-H SEB & 300 APT groundwater monitoring plans due to its toxicity (WAC 173-303.)

Ecology Response:

Ecology has no authority to regulate uranium under the Site-wide Permit at Hanford.

- Integration of corrective action at both the 183-H and 300 APT with remedial actions at these operable units was previously defined in the Permit with corrective action deferred to the CERCLA program for the 100-HR-3 & 300-FF-5 Groundwater OUs. The use of alternative for GW monitoring and corrective action is authorized under WAC 173-303-645(e) with qualifications and may not be applied without meeting these criteria. For clarification, YN request identification of the other solid waste management units that have likely contributed to the release of ground water contaminates identified in these GW monitoring plans and the RCRA permits for both TSDs.

Ecology Response:

The broader CERCLA remedial action is used to address contaminants of concern at both the 183-H SEB and 300 APT because groundwater corrective action is not being applied as alternative requirements in accordance with WAC 173-303-645(1)(f). The permittee has not applied for alternative requirements through a permit modification process for either unit.

These two Dangerous Waste groundwater monitoring plans are located inside CERCLA operable units that are undergoing remediation. The remediation strategy is being applied throughout the entire operable unit, including the portion of the regulated unit that addresses certain dangerous waste constituents to meet the appropriate performance standards as defined in the groundwater monitoring plans. These decisions were based on the Post-Closure plan and during closure of both units back in 1997. No decisions have been made to change the closure/post-closure strategy of these units.

- YN requests, for both TSDs, inclusion of set schedules for sampling and include well names, etc. Any sampling events that are missed should be rescheduled within the month they were planned. Sampling is only semi-annually, which puts a burden on resources, but also requires effective planning ahead of schedule (e.g. proper maintenance of equipment) and contingency built into the schedule for such unplanned events.

Ecology Response:

As required by WAC 173-303-645(11)(g), the permittee must report in writing to Ecology on the effectiveness of the corrective action program.

Currently, annual sampling is being conducted at 183-H SEB. The groundwater monitoring plan changes this requirement to semi-annually, as noted in your comment, to comply with this reporting period. For the 300 APT, the process was always semi-annual sampling and reporting, and it remains a semi-annual sampling and reporting process.

Planning for sampling is conducted well in advance of the actual sampling event. The goal to sample all wells within the monitoring network over a one-week period has been effectively applied to provide representative groundwater samples.

- Identify the probable source of PCE, TCE, and *cis*-1, 2-DCE concentrations observed in well 399-1-16B and how the PCE contaminant is being monitored. (See pg 2-21.)

Ecology Response:

The probable source, as stated in the groundwater monitoring plan for the 300 APT, is from the nearby North Process Pond and South Process Pond use during the 1950s and 1960s (PNNL-17666).

Only 140 gallons of PCE have been disposed to the 300 APT. All these units (process ponds and trenches) are probable sources. The PCE has naturally degraded to TCE and cis-1,2-DCE. PCE is below the method detection limit of 0.3 µg/L. Both TCE and 1,2-DCE are monitored in the groundwater.

- YN requests identification and inclusion of the monitoring plan used for the monitoring of the 183-H alkalinity, anions, and metals by attachment or references to the Groundwater Monitoring Plan for the 183-H SEB (to demonstrate full compliance with WAC 173-303-645.)

Ecology Response:

Monitoring for alkalinity, anions, and the various metals is not required under WAC 173-303-645(4), (10), or (11). Therefore, these constituents are not listed in the plan. Chromium and, in particular hexavalent chromium, is the only metal that is required to be monitored based on the waste received at 183-H SEB. Nitrate is also included as 183-H SEB received a large inventory of nitrates.

- YN requests inclusion of the following wells H4-8, H4-65, and H4- 1 2A into the 183-H RCRA monitoring plan network to capture any unusually high river flow year's influences and spreading of contaminates.

Ecology Response:

According to the proposed groundwater monitoring plan for 183-H SEB, well H4-8 is still in the monitoring well network. Well H4-12A is replaced with well 199-H4-85, which is located closer to the 183-H SEB and is installed in the unconfined aquifer.

Well 199-H4-65 is not located in the direction of groundwater flow from the 183-H SEB. As a result, well 199-H4-89 provides a better location to monitor for hexavalent chromium migrating to the river from this regulated unit and it will be a part of the monitoring network.

- YN requests collection of both unfiltered and filtered samples. Revise future data collection to ensure that well sampling is directly comparable between all wells (e.g. both filtered and unfiltered hexavalent chromium samples are collected at every well that is sampled.)

Ecology Response:

Unfiltered samples do not provide the appropriate hexavalent chromium data. Using EPA Method 6020 for filtered samples, or EPA Method 7196 for unfiltered samples, provides the appropriate data for determining hexavalent chromium.

Unfiltered samples of chromium cannot be compared to the performance standard of 48 µg/L, as both the trivalent chromium and hexavalent chromium are combined in the sample. Filtered samples from all the wells could be compared to one another. Even using EPA Method 7196 for hexavalent chromium, the laboratory filters the sample in the preparatory process for the method. Filtered samples will be used for the EPA Method 6020.

Comment # 4 from Marlene George, Yakama Nation, dated March 22, 2017

Appendix A Quality Assurance Project Plan

The following comments are identified for the 300 APT but similar concerns are noted for the 183-H TSO. Please consider both documents in view of these concerns.

- A2.1.6 Field Sample Operations & The FWS:

  YN request edits to stat the FSO/FWS will ensure and document that Ecology has been notified of any discrepancies in the sample collection or analyses and the FWS will work with Ecology on rescheduling missed sampling events.

Ecology Response:

As stated in Chapter 3 of the Groundwater Monitoring Plans, USDOE will notify Ecology of any missed sampling event that cannot be performed as planned. It states,

"DOE-RL will provide informal notification to Ecology if sampling of the network is expected to be delayed for longer than 4 weeks. Ecology may provide input in a timely fashion to DOE-RL on how to proceed. Missed or cancelled sampling events are reported to DOE-RL, and are documented in the semiannual monitoring reports required by WAC 173-303-645(11)(g), and the annual Hanford Site RCRA groundwater monitoring report (e.g., DOE/RL-2016-12)."

Documentation is provided in the semi-annual report and in the annual Hanford Site-Wide RCRA groundwater monitoring report as required by WAC 173-303-645. DOE/RL will discuss any missed or delayed sampling events with Ecology.

- A2. 1.8 Environmental Compliance Officer: YN requests clarification that the ECO is also responsible for minimization of adverse impacts to Cultural Resources. If there is someone else responsible for this task, please identify.

Ecology Response:

The Environmental Compliance Officer is responsible to ensure minimization of adverse impacts to Cultural Resources occur. This information is implied in the text. No changes will occur in the document.

- A2. 1.10 Waste Management: YN requests clarify of path for documentation of this information in the 300 APT unit specific operating files and links to the RCRA permit.

Ecology Response:

This section describes the role of the waste management organization and is indirectly a part of this groundwater monitoring plan. All waste, which mainly includes Personal Protective Equipment (PPE) such as latex gloves and other outer ware, are appropriately managed and disposed accordingly.

Ecology does not provide links to the RCRA Site-wide Permit in the Groundwater Monitoring Plans. The Site-wide Permit is linked through the Ecology Internet site at (http://www.ecy.wa.gov/programs/nwp/permitting/hdwp/rev/8c/index.html).

- A2.6 Documents and Records:

  YN requests edits to clarify that the Ecology permitted version of the groundwater monitoring plan is the version the Project Delivery Manager for Groundwater Science is responsible for maintaining through the administrative document control process.

Ecology Response:

Ecology responsible for maintaining the groundwater monitoring plan through the administrative document control process, and the document is a part of the Site-wide Permit. Ecology maintains configuration control of the Groundwater Monitoring Plan once it is put into the Site-wide Permit. The Project Delivery Manager for Groundwater Science is responsible for making any changes to the Groundwater Monitoring Plan that may be required. These changes are managed through the Site-wide Permit modification process. The permittee has to request the most recent controlled version of the Groundwater Monitoring Plan from Ecology.

- YN requests edits to clarify that the information will be documented in the Hanford Facility Operating Records and maintained until final closure of the facility including completion of any required post closure care or corrective action.

Ecology Response:

Based on the Part I Standard Facility Site-wide Permit Condition I.E.10, this information is documented in the Hanford Facility Operating Records.

- A3.3 Quality Control:

  To be able to demonstrate quality objectives for comparability of data, the YN-ER/WM Program requests all laboratories involved in sample analysis meet and use the same QC/QA acceptance criteria and procedures.

Ecology Response:

Analytical work will be performed in compliance with the guidance in the Hanford Analytical Services Quality Assurance Requirements Document (DOE/RL-96-68, Rev. 4). Analytical methods and procedures will be performed at laboratories that are accredited by the State of

Washington. Groundwater sampling and analysis procedures are detailed in Appendix A of the groundwater monitoring plans for the 300 APT and the 183-H SEB.

- A4. 1 Assessments and Response Actions

  YN requests the "existing programmatic requirements" be clarified or referenced in the groundwater monitoring plan.

Ecology Response:

The surveillances and assessments and the "existing programmatic requirements" mentioned in Section A4 of the 300 APT Class II Permit Modification (Monitoring Plan revision) pertain to non-regulatory/internal CHPRC company program activities. The programmatic requirements are the practices used within CHPRC to assess their management processes and adherence to internal procedures, and make improvements.

- YN requests clarification of the types of corrective actions that may be taken by the Project Delivery Manager for Groundwater Science and how these are to be communicated to Ecology.

Ecology Response:

These "corrective actions" mentioned in Section A4 pertain to non-regulatory/internal CHPRC company program activities. The type or nature of any corrective action is directly dependent on the condition(s) or situation encountered. If, as an example, the condition(s) encountered are related to staff training, the training plan/program would be revised, the staff subjected to the revised training and the training addendum updated in the Site-wide Permit.

- YN requests clarification of the oversight process the SMR group uses to verify that laboratories are qualified to perform Han ford Site analytical work.

Ecology Response:

Analytical work will be performed in compliance with the guidance in the Hanford Analytical Services Quality Assurance Requirements Document (DOE/RL-96-68, Rev. 4). Analytical methods and procedures will be performed at laboratories that are accredited by the State of Washington. Groundwater sampling and analysis procedures are detailed in Appendix A of the groundwater monitoring plans for the 300 APT and the 183-H SEB. If the laboratory report(s) seem questionable, the oversight process provides another level of verification to validate and ensure the correct data are being reported.

- A3.3.2 Laboratory Quality Control Samples
- YN requests additional sampling within the sampling quarter for those samples that have exceeded required holding times.

Ecology Response:

Analytical work will be performed in compliance with the guidance in the Hanford Analytical Services Quality Assurance Requirements Document (DOE/RL-96-68, Rev. 4). Analytical methods and procedures will be performed at laboratories that are accredited by the State of Washington. Groundwater sampling and analysis procedures are detailed in Appendix A of the groundwater monitoring plans for the 300 APT and the 183-H SEB.

- YN request clarification as to whether matrix spike results and laboratory blanks will be used to correct sample results.

Ecology Response:

Analytical work will be performed in compliance with the guidance in the Hanford Analytical Services Quality Assurance Requirements Document (DOE/RL-96-68, Rev. 4). Analytical methods and procedures will be performed at laboratories that are accredited by the State of Washington. Groundwater sampling and analysis procedures are detailed in Appendix A of the groundwater monitoring plans for the 300 APT and the 183-H SEB.

- A4. I Assessments and Response Actions: YN requests clarification as to what are the 'existing programmatic requirements.'

Ecology Response:

The surveillances and assessments and the "existing programmatic requirements" mentioned in Section A4 of the 300 APT Class II Permit Modification (Monitoring Plan revision) pertain to non-regulatory/internal CHPRC company program activities. The programmatic requirements are the practices CHPRC uses to assess their management processes and adherence to internal procedures, and make improvements.

- A5.3 Reconciliation with User Requirements: YN requests clarification as to how reports/report results on discretionary DQAs will be communicated to Ecology.

Ecology Response:

Analytical work will be performed in compliance with the guidance set forth in the Hanford Analytical Services Quality Assurance Requirements Document (DOE/RL-96-68, Rev. 4). Analytical methods and procedures will be performed at laboratories that are accredited by the State of Washington. Groundwater sampling and analysis procedures are detailed in Appendix A of the groundwater monitoring plans for 300 APT and 183-H SEB.

- Table A- 1. Data Quality Indicators: General comments:
  - No changes to data collection or analysis methods through this groundwater monitoring plan should be made without Ecology approving the changes. All modifications of the plan should be consistent with the WAC 173-303-830 process. YN requests the WAC modification process be followed.

Ecology Response:

Analytical work will be performed in compliance with the guidance in the Hanford Analytical Services Quality Assurance Requirements Document (DOE/RL-96-68, Rev. 4).

Analytical methods and procedures will be performed at laboratories that are accredited by the State of Washington.

Groundwater sampling and analysis procedures are detailed in Appendices A and B of the groundwater monitoring plans for the 300 APT and the 183-H SEB. The same or similar analytical methods will be used and the data collection will follow the same or similar procedures. If a change to the Groundwater Monitoring Plans is required, it will follow the modification process in WAC 173-303-830, Appendix I(C).

- YN requests that no data be rejected due to inability to meet detection limits and ask that lab with high equipment detection limits are not used to do analyses. See comment on Table A-3.

Ecology Response:

Analytical work will be performed in compliance with the guidance in the Hanford Analytical Services Quality Assurance Requirements Document (DOE/RL-96-68, Rev. 4). Analytical methods and procedures will be performed at laboratories that are accredited by the State of Washington.

Groundwater sampling and analysis procedures are detailed in Appendix A of the groundwater monitoring plans for the 300 APT and the 183-H SEB.

- YN requests edits to the *Definition of Representativeness* to state: Sample representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition *at the time of sampling.* It is dependent on the proper design of the sampling program and will be satisfied by ensuring that the approved plans were followed during sampling and analysis *and based upon adequate selection of number of sampling locations, accurately defined media, and defined sampling and analytical methods.*

Ecology Response:

Ecology will not change the definition of sample representativeness. The proposed changes add phrases that are already included in the current language of a properly designed sampling program, following approved sampling and analysis procedures.

- YN requests edits to *Determination of Methodologies* to state: Evaluate whether measurements are made and physical samples collected in such a manner that the resulting data appropriately reflect the environment or condition being measured or studied *and consistent with WAC 173-303 definition of representative sampling.*

Ecology Response:

Ecology will not change the documents, because the WAC 173-303 definition of "representative sample" says that "a sample which can be expected to exhibit the average properties of the sample source." Nothing in the comment language contradicts this definition.

- Table A-2:
  General comments:
  - YN requests clarification of the *change type* process that utilized temporary wells, increased sampling frequencies, addition of other constituents. Some of these changes would trigger a Permit modification requiring public review opportunities. Notification to DOE-RL alone is not sufficient.

Ecology Response:

Ecology agrees that some of these changes would trigger a Site-wide Permit modification requiring public review opportunities. The language that requires removal of wells and other actions that would trigger a Site-wide Permit modification will be removed from the table located in Appendix A of both Groundwater Monitoring Plans.

- Information regarding actions to rectify *unintentional impact* to groundwater monitoring plan that impacts the corrective action monitoring requirements: YN requests clarification and edits to state: Ecology will be notified within seven working days of deviations of CA monitoring requirements. Ecology with consultation with DOE will determine and provide schedule, etc. for corrections.

Ecology Response:

The seven working days criteria is not required by WAC 173-303-645 for groundwater corrective action monitoring (WAC 173-303-645(11)). USDOE has to notify Ecology when a sampling event has been missed that will take longer than 4 weeks to resample, as stated in Chapter 3.

- YN requests edits to the *documentation* column to state Ecology will be notified of all failures to comply with the CA monitoring plan requirements within seven working days, and this will be documented in the operating record of the RCRA TSD.

Ecology Response:

The seven working days criteria is not required by WAC 173-303-645 for groundwater corrective action monitoring (WAC 173-303-645(11)). USDOE has to notify Ecology when a sampling event has been missed that will take longer than 4 weeks to resample as stated in Chapter 3.

- YN requests clarification and edits of what are *anticipated unavoidable changes.* Edit *Action* column to state Ecology will be notified within seven working days and this will be documented in the operating record of the RCRA TSD.

Ecology Response:

"Anticipated unavoidable changes" may include CERCLA remedial activities that prevent access to the well for sampling. These are usually known in advance, and the permittees must notify Ecology of these occurrences. They are temporary in nature, and the duration of the delay could keep the sampling event from occurring. However, these sampling events are rescheduled. As stated, a permanent unavoidable change would require a Site-wide Permit modification.

- Table 2-1. Estimated Non-radiological Chemical Waste Inventory for the 300 Area Process Trenches & Table 2-2. Flow History for the 300 Area Process Trenches:
  - YN requests DOE provide discussion/clarification as to what seems to be a disconnect with flow volumes and chemical waste inventory volumes.

Ecology Response:

Table 2-1 provides the inventory that was released to the 300 APT trenches during certain periods of time. Table 2-2 provides the total volume released to the 300 APT annually. Not all the total volume released to the trenches contained dangerous waste.

- Clarify how it is possible to have high volumes of yearly flow and relatively low volumes of chemical waste inventory. (e.g., What portion of flow volume has no contamination-if this is possible?)

Ecology Response:

Most of the inventory has no dangerous waste constituents. Between 1975 and 1985, most of the disposed liquid had no or small quantities of dangerous waste constituents. No liquid with dangerous waste constituents was disposed after 1985, as shown in Table 2-1.

The chemical makeup of the effluent discharges are provide in Section 2.3. The volume of effluent discharged to the 300 APT is provided in Table 2-2. The quantity of liquid effluent discharged is composed of mostly non-contaminated effluent with minor amounts of contaminated effluent.

- Table A-3. Analytical Requirements for Ground water Analysis:
  - YN requests clarification of use of values cited in the column 'Highest Allowable Practical Quantitation Limits." TCE PQL value appears too high. MTCA GW Method B cancer value standard for TCE is 0.54ug/L. Ecology guidance *(Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies- Publication # 04-03-030)* states the lowest concentration of interest for constituents is usually equated with the limit of detection. It is important that detection limits (i.e. Method Quantitation Limits) be below decision limits since precision is poor near these limits and decision s should not be based on imprecise data.

Ecology Response:

The PQL does not represent the limit of detection or method detection limit. The PQLs are usually higher. The listed PQLs are below the decision limits of 4 µg/L for TCE and 16 µg/L for 1,2-DCE. The method detection limit for TCE is 0.3 µg/L, which is below the 0.54 µg/L MTCA standard as stated.

- Laboratories performing analysis must be capable of reporting results below the concentration limit and below the most stringent cleanup levels to ensure precise results at the reference level (standard or criteria.) YN supports use of the most stringent cleanup levels for groundwater. This includes application of cleanup levels protective of surface waters and aquatic life.

Ecology Response:

Analytical work will be performed in compliance with the guidance set forth in the Hanford Analytical Services Quality Assurance Requirements Document (DOE/RL-96-68, Rev. 4). Analytical methods and procedures will be performed at laboratories that are accredited by the State of Washington. Groundwater sampling and analysis procedures are detailed in Appendix A of the groundwater monitoring plans for the 300 APT and the 183-H SEB.

The MTCA Method B cleanup values for unrestricted land use being compared to groundwater sampling results are based on current science, available data, and the regulations in effect at this time.

- Table A-4. QC Requirements:
  - The YN-ER/WM Program requests clarification on basis for only 1 per 20 well trips for replicate/duplicate samples. Please provide a schedule and describe the well sampling process more clearly such that it indicates which wells will have duplicate samples per each sampling cycle (i.e. semi-annually.)

Ecology Response:

A "well trip" can be defined as any time the well is accessed for sampling. This would apply to both successful and unsuccessful attempts. A field duplicate is used to determine precision. For groundwater monitoring, field duplicates are taken at a frequency of 1 in 20 well trips (i.e., 5% of the well trips) performed within any given month.

To determine the number of field duplicates required, the groundwater monitoring schedule is finalized one month at a time, and the number of well trips is noted. One in 20 of the well trips are calculated using the overall number of well trips in a month. For example, if the month has 181 wells scheduled, then 10 field duplicates are collected.

The contaminants/methods and wells chosen for the field duplicate are based on professional judgment and historical data. Constituents/methods are identified based on what is known to have been detected in the groundwater at the wells being sampled that month. A custom query is performed to identify which wells to use for QC duplicate samples. The query determines which wells undergoing sampling that month have had positive results within the last 5 years for the constituent chosen; thus ensuring the field duplicate is collected from a well that will return data on that constituent.

Once a well is used for one constituent, it is eliminated from the list of potential wells for use in collecting field duplicates, so that the maximum number of positive hits for QC evaluation can be obtained.

- Footnote 'a': The YN-ER/WM Program recommends the use of only dedicated sampling equipment.

Ecology Response:

All of the 300 APT wells have dedicated sampling equipment. Some of the wells in the 183-H SEB do not have dedicated sampling equipment because of the small diameter well casing or low water column in the well. These wells are sampled using non-dedicated sampling equipment as discussed in Appendix B.

APPENDIX A: COPIES OF ALL PUBLIC NOTICES

Public notices for this comment period:

1. DOE Public notice (focus sheet)
2. Classified advertisement in the *Tri-City Herald*
3. Notice sent to the Hanford-Info email list
4. Event posted on Ecology Hanford Education & Outreach Facebook page

Fact Sheet

Public Comment Period on Proposed Updates to Dangerous Waste Permit for Hanford Site

The U.S. Department of Energy Richland Operations Office (DOE-RL) is holding a 60-day public comment period on proposed modifications to the Hanford Facility Site-wide Dangerous Waste Permit. The Class 2 modification will revise the groundwater monitoring plans for the 300 Area Process Trenches and the 183-H Solar Evaporation Basins.

January 2017 **U.S. Department of Energy**

Background

This proposed Class 2 modification revises the Hanford Facility Site-wide Permit dangerous waste requirements for the 300 Area Process Trenches and the 183-H Solar Evaporation Basins Treatment, Storage, and Disposal (TSD) units.

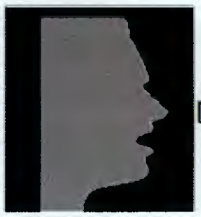
The proposed changes are needed to update information regarding groundwater monitoring activities, described in the post-closure section of the permit (Part VI – Post Closure Units).

300 Area Process Trenches: Liquid waste discharges to the trenches ceased in 1994. Because residual contamination remained in the groundwater following closure activities, post-closure groundwater monitoring was necessary.

183-H Solar Evaporation Basins: Waste shipments ceased in 1985, but remained in the basins in the 100-H Area until closure was completed in 1995. Because residual contamination remained in the soil following closure activities, post-closure groundwater monitoring was necessary.

***Class 2 Permit Modifications** are periodic updates to the Hanford Facility Site-wide Dangerous Waste Permit, such as response to new regulations, technological advancements, and variations in waste types or quantities. All Class 2 changes require approval from the Washington State Department of Ecology.*

The proposed modifications apply to Post-Closure Unit Group 1 (300 Area Process Trenches) Groundwater Monitoring Plan, and Post-Closure Unit Group 2 (183-H Solar Evaporation Basins), Groundwater Monitoring Plan. The modification revises information about the constituents to be monitored, sampling frequency, monitoring well networks, concentration limits, statistical evaluation processes, and the compliance period.



Public Comment

DOE-RL wants your feedback on these proposed modifications. The public comment period will run from **January 23, 2017 to March 24, 2017.**

A public meeting will be held Tuesday, February 28 at 5:30 pm at the Richland Public Library.

Summary of Proposed Changes

The proposed changes are attachments to the permit modification request. Those attachments are undergoing public comment.

The DOE-RL contact person for this permit change is Richard Buel, (509) 376-3375. The Washington State Department of Ecology contact person is Randy Bradbury, (509) 372-7954.

The permittees' compliance history during the life of the permit being modified is available from the Washington State Department of Ecology contact person.

Copies of the proposed permit modification and supporting documentation are available at the Administrative Record, 2440 Stevens Drive, Richland, WA and also at the Public Information Repositories listed below.

Ecology previously did a State Environmental Policy Act (SEPA) determination of non-significance, dated Dec. 19, 1997, for each project.

300 Area Process Trenches (2002)

183-H Solar Evaporation Basins (2002)

How can you become involved

A 60-day public comment period on *proposed Class 2 modifications to Part VI of the Hanford Facility Site-wide Dangerous Waste Permit will run from* ***January 23, through March 24, 2017.*** A public meeting will be held February 28, 2017 at 5:30 pm, at the Richland Public Library, 955 Northgate Street in Richland, WA.

Please submit comments by March 24, 2017 to:

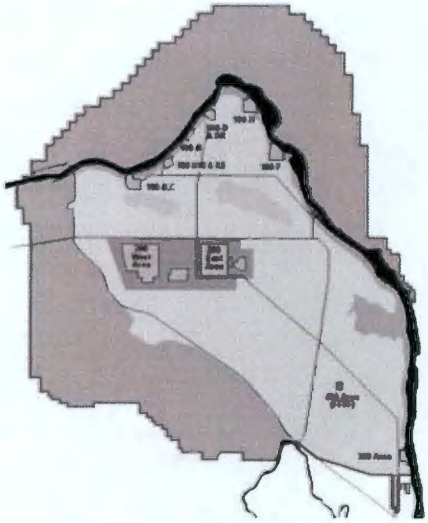
Washington State Department of Ecology
3100 Port of Benton Boulevard
Richland, WA 99354
Email: Hanford@ecy.wa.gov

The documents are available for review at the Public Information Repositories listed below:

Portland State University Government Information Branford Price Millar Library 1875 SW Park Avenue Portland, OR 97207-1151 Attn: Claudia Weston (503) 725-4542 Map: http://www.pdx.edu/map.html	University of Washington Suzzallo Library Government Publications Dept. Box 352900 Seattle, WA 98195-2900 Attn: Hilary Reinert (206) 543-5597 Map: http://tinyurl.com/m8ebj	U.S. Department of Energy Public Reading Room Washington State University, Tri-Cities Consolidated Information Ctr., Rm. 101-L 2770 Crimson Way Richland, WA 99352 Attn: Janice Parthree (509) 372-7443 Map: http://www.tricity.wsu.edu/campusmaps/campusmap.pdf	Gonzaga University Foley Center Library East 502 Boone Avenue Spokane, WA Attn: John Spencer (509) 313-6110 Map: http://tinyurl.com/2c6bpm	Ecology Nuclear Waste Program Resource Center 3100 Port of Benton Blvd. Richland, WA 93354 509-372-7950 Online: www.ecy.wa.gov/programs/nwp/commentperiods.htm

Administrative Record and Public Information Repository:
Address: 2440 Stevens Center Place, Room 1101, Richland, WA.
Phone: 509-376-2530 **AR Website:** http://pdw.hanford.gov/arpir/
Hanford Events Calendar: http://www.hanford.gov/pageAction.cfm/calendar

Hanford
Public Involvement Opportunity



We want to hear from you on the proposed permit modifications for the Hanford Site!

Comment Period: January 23 – March 24, 2017
Public Meeting: Feb. 28, 2017, 5:30 pm at the Richland Public Library

Class 2 Permit Modification Fact Sheet
U.S. Department of Energy
Richland Operations Office
P.O. Box 550, A7-75
Richland, WA 99352

Tri-City restaurant inspections through Jan. 13

BY WENDY CULVERWELL
wculverwell@tricityherald.com

Each week, the Tri-City Herald publishes results for restaurants that score 25 or more "red" points on their Benton-Franklin Health District inspections, triggering automatic revisits.

By law, all establishments selling food are subject to inspection, from full-service restaurants to coffee carts.

Establishments are rated on a state point system that's based on the federal food code for the conditions in the restaurant at the time of the unannounced inspection. The point scale ranges up to 415 points.

Red points reflect more concerning issues requiring immediate inspection. An establishment receiving 25 or more red points on a routine inspection must be re-inspected. Blue points indicate situations that need to be fixed, but not immediately. Restaurants receiving 10 or more red points when re-inspected are inspected again.

Past restaurant inspections can be viewed at the health district's website, bfhd.wa.gov/foo-d/index.php.

For questions or concerns regarding reports, call the health district at 509-460-4205.

ESTABLISHMENTS NEEDING RE-INSPECTION

Allona's Euro-Bake, 4525 Road 68, Suite C, Pasco, Jan. 12, routine (25 Red, 0 Blue)

Notes: Improper hot holding (below 130 degrees).

Arby's, 1310 N. Columbia Center Blvd., Kennewick, Jan. 12, routine (35 Red, 5 Blue)

Notes: Person in charge not actively controlling food safety risks; food worker cards not 100 percent; no cold water in men's restroom hand sink; improper cold holding (between 42 degrees and 45 degrees) and no digital thermometer available.

Sahara Pizza, 6916 W. Argent, Suite C, Pasco, Jan. 12, routine (30 Red, 0 Blue)

Notes: Food worker cards not 100 percent; improper cooling.

ESTABLISHMENTS NOT NEEDING RE-INSPECTION

Dutch Bros. Coffee, 2601 W. Court St., Pasco, Jan. 13, routine (5 Red, 2 Blue)

Little Caesars, 4911 N. Road 68, Pasco, Jan. 13, routine (10 Red, 0 Blue)

Papa John's Pizza, 6303 Burden Blvd., Pasco, Jan. 13, routine (10 Red, 0 Blue)

Taco Bell, 2404 W. Court St., Pasco, Jan. 13, routine (15 Red, 2 Blue)

Wendy Culverwell: 509-582-1514, @WendyCulverwell

MEETING AGENDAS

JAN. 23

Richland Economic Development Committee, 3 p.m. workshop, 4 p.m., meeting, 975 George Washington Way: business license reserve program and city's commercial improvement program.

Hanford Area Economic Investment Fund, 4 p.m., Ben Franklin Transit, 1000 Columbia Park Trail, Richland: loan reviews.

Kennewick Planning Commission, 6:30 p.m., 210 W. Sixth Ave.: public hearings on 2017 comprehensive plan (capital facilities and utilities).

Pasco City Council, 7 p.m. special meeting and workshop meeting to follow, City Hall, 525 N. Third Ave.: hold public hearing on Transportation Improvement Plan amendment; and discuss a special permit for long-term dwelling units at the Thunderbird Motel, a Basin Disposal Inc. rate increase and a bid award for the Columbia Water Supply project.

Kiona-Benton City School Board, 7 p.m., 1108 Dale Ave.: Lego league stipend, revising the 2016-17 school calendar and approval of early retirement notification.

Columbia School Board, 7 p.m. 718 Maple St, Burbank.: homeless students policy, students in foster care policy and enrollment.

JAN. 24

Benton PUD Commission, 9 a.m., 2721 W. 10th Ave., Kennewick. approve pilot electric vehicle public charging station rate schedule.

Benton County Commission, 9 a.m., courthouse, 601 Seventh St., Prosser: approve $1.3 million contract to remodel former county assessor's office in Kennewick to serve the Office of Public Defense (consent calendar), and replace 80 sheriff's deputies portable radios.

Franklin PUD Commission, 1 p.m., 1411 W. Clark St., Pasco: reached outdated mandatory retirement age requirement and revise salary ranges for nonunion employees.

Richland City Council workshop, 6 p.m., 505 Swift Blvd., electric vehicle project status.

West Richland City Council, 6 p.m., Sandberg Event Center, 331 S. 41st, West Richland: wastewater user agreements with Vinmotion and Red Mountain Wine Estates (consent agenda).

Joint meeting West Richland City Council and Benton Rural Electric Board, 6:15 p.m., Sandberg Event Center, 331 S. 41st, West Richland: LED retrofit project, Red Mountain interchange update.

Kennewick City Council special meeting and workshop, 6:30 p.m., 210 W. Sixth Ave.: Hanford Communities Update; snow and ice removal update.

Prosser Budget & Finance Committee, 6:30 p.m., 601 Seventh St.: payroll checks, vacation buyouts, clean checks.

Pasco School Board, 6:30 p.m., 1215 W. Lewis St.: curriculum update, purchasing portables and fiscal year and report.

Richland School District, 6:30 p.m., 615 Snow Ave.: deputy superintendent search update, graduation discussion, planning for 2017-18 school year.

JAN. 25

Richland Planning Commission, 7 p.m., manager's conference room, 975 George Washington Way: comprehensive plan update.

Kennewick School Board, 5:30 p.m., 1000 W. Fourth Ave.: discussion about graduation data, graduation statistics for the 2015-16 school year and a capital fund update.

Richland Public Facilities District, 5:30 p.m., The Reach, 1943 Columbia Park Trail, Richland: CEO report; hiring committee report.

Franklin County Commission, 9 a.m., 1016 N. Fourth Ave., Pasco: consolidation of 911 services.

JAN. 26

Benton County Emergency Services, 7:30 a.m., 651 Truman, Richland: election of officers' 911 consolidation.

Port of Pasco Commission, 10:30 a.m., Osprey Pointe: container crane surplus and auction agreement.

Richland Parks and Recreation Commission, 6 p.m., 505 Swift Blvd.: Freedom Park master plan, field use fees and 2017 goals.

Richland Hearing Examiner, 6 p.m., 505 Swift Blvd.: hearings on Quail Ridge preliminary plat, Wild Canyon preliminary plat and rezone.

BENTON AND FRANKLIN COUNTIES

Pilot program expands kids' access to mental and behavioral health care

BY SARA SCHILLING
sschilling@tricityherald.com

THE PARTNERSHIP ACCESS LINE, OR PAL, IS A TELEPHONE-BASED MENTAL HEALTH CONSULTATION SYSTEM FOR PRIMARY CARE PROVIDERS IN WASHINGTON AND WYOMING.

When Dr. Robert Hilt was working as a pediatrician in Kitsap County, he would sometimes want to consult with a child psychiatrist about a patient.

But in two years of practice, "I never successfully got (in touch with one), despite many attempts to do so," Hilt said.

He's now a child psychiatrist himself, and he helped create a program at Seattle Children's Hospital that addresses that issue.

The Partnership Access Line, or PAL, is a telephone-based mental health consultation system for primary care providers in Washington and Wyoming.

It's been successful. And now Hilt and his colleagues are trying an expansion with the pilot program under way in Benton and Franklin counties.

Called PAL Plus, the program aims to increase access to mental and behavioral health treatment for underserved and low-income children. It includes in-person counseling.

The one-year pilot recently got off the ground. With it, "I'm hopeful we have a chance to help some kids who wouldn't get help otherwise," said Hilt, who serves as PAL director.

PAL Plus is for Benton and Franklin county kids ages 5 to 18 who are on Washington insurance such as Medicaid, diagnosed with mild-to-moderate depression or disruptive behavior, and aren't already enrolled in mental health services. The point of entry is the child's pediatrician or other primary care provider.

The goal is "to equip primary care providers in Benton and Franklin counties with an evidence-supported system of mental and behavioral care that provides rapidly accessed direct mental health support for their patients exhibiting either signs of depression or significant disruptive behavior," according to the program.

The young patients will have access to a local therapist, who'll be supported by child and adolescent psychiatrists and psychologists at Seattle Children's and the University of Washington School of Medicine.

PAL Plus is partnering with Tri-City providers Catholic Family & Child Service and Lourdes Counseling Center for screening and therapy services.

The need is significant. A 2015 report from Mental Health in America found that 46 percent of kids in the state who needed mental health services didn't get them.

And the Tri-City area has about 275,000 people but only six mental health facilities recognized by the Substance Abuse and Mental Health Services Administration that treat children, PAL Plus information said.

More and more, primary care providers are the first place a family goes for help with a child's mental or behavioral health issue, Hilt said. That's especially true in rural areas, where access can be a greater challenge.

State Sen. Sharon Brown, R-Kennewick, who advocated for PAL Plus on the Senate Health Care Committee, said lack of access to mental and behavioral health care for kids and adults has far-reaching consequences.

"Thanks to the commitment of local providers, Seattle Children's and the people of Benton and Franklin Counties, we have an opportunity to help children and families in the area with a care model that directly addresses this issue," Brown said in a statement.

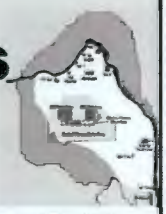
Hilt said he's optimistic about PAL Plus. It has the potential to truly help.

"It's evidence-supported interventions that are provided earlier, before issues get entrenched," he said.

For more information, go to seattlechildrens.org and search "PAL Plus."

Sara Schilling: 509-582-1529, @SaraTCHerald

DOE Wants Your Input



The U.S. Department of Energy Richland Operations Office (DOE-RL) is holding a 60-day public comment period on proposed modifications to the Hanford Facility Site-wide Dangerous Waste Permit. The Class 2 modification will revise the groundwater monitoring plans for the 300 Area Process Trenches and the 183-H Solar Evaporation Basins. A 60-day public comment period runs from January 23, 2017 to March 24, 2017. The public meeting will be held on ***February 28, 2017, 5:30 pm at the Richland Public Library,*** *955 Northgate Street in Richland, WA. The permittee's compliance history during the life of the permit being modified is available from the Department of Ecology contact person.*

For More Information Please Contact Rich Buel, DOE-RL, (509) 376-3375.

Please submit comments by March 24, 2017 to Randy Bradbury:

Washington State Department of Ecology
3100 Port of Benton Boulevard
Richland, WA 99354
Email: Hanford@ecy.wa.gov
Phone: 509-372-7950

The proposed permit modification can be viewed online http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0072945H and in hardcopy at 2440 Stevens Center Place, Room 1101, Richland, WA

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VOICE OF THE MID-COLUMBIA

From: ^TPA <TPA@RL.GOV>
Sent: Monday, January 23, 2017 12:44 PM
To: HANFORD-INFO@LISTSERV.WA.GOV
Subject: Provide Your Input on Hanford Permit Changes for the 300 Area Process Trenches and 183-H Solar Evaporation Basins
Attachments: 183-H_300 area trenches Fact_Sheet_Final_1-13-2017.pdf

This is a message from the U.S. Department of Energy

The U.S. Department of Energy Richland Operations Office (DOE-RL) is holding a 60-day comment period on proposed changes to the Hanford Facility Site-wide Dangerous Waste Permit.

The proposed modification changes groundwater monitoring requirements for the 300 Area Process Trenches and the 183-H Solar Evaporation Basins Treatment, Storage, and Disposal (TSD) units. The changes will be processed as a Class 2 modification which requires a 60-day comment period and public meeting led by the permittee (DOE). The public comment period runs from January 23 through March 24, 2017.

DOE-RL and the Washington State Department of Ecology want your feedback on these proposed modifications! Submit comments by March 24, 2017, in writing, by mail, or electronically (preferred) to:

Washington State Department of Ecology
3100 Port of Benton Boulevard
Richland, WA 99354
Email: Hanford@ecy.wa.gov

A meeting to discuss the proposed permit modifications is scheduled for 5:30 p.m. on February 28 at the Richland Public Library, 955 Northgate Drive. More information can be found on the Hanford events calendar.

The DOE-RL contact person for this permit change is Richard Buel, (509) 376-3375. The Washington State Department of Ecology contact person is Randy Bradbury, (509) 372-7954.

The permittees' compliance history during the life of the permit being modified is available from the Washington State Department of Ecology contact person.

Copies of the proposed permit modification and supporting documentation are available at the Administrative Record, 2440 Stevens Drive, Richland, WA or online: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0072945H

This change is a Class 2 permit modification. Class 2 modifications are periodic updates to the Hanford Dangerous Waste Permit, such as response to new regulations, technological advancements, and variations in waste types or quantities. All Class 2 changes require approval from the Washington State Department of Ecology.

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Published by Ginger Wieman [?] January 23

Public Comment Period - Tell us what you think! The US Dept. of Energy proposes a Class 2 modification regard ng groundwater monitorng activites at the site of the former 300 Area Process Trenches, and the 183-H Solar Evaporation Basins. More information can be found here by following the link. http://www.hanford.gov/pageAction.cfm/calendar...

772 people reached

Boost Post

Like Comment Share

Rochelle Juetze, Randy Bradbury and Heather John

1 share

Write a comment...

APPENDIX B: COPIES OF ALL WRITTEN COMMENTS

From: Madya <madyapan@yahoo.com>
Sent: Wednesday, January 25, 2017 8:54 PM
To: Hanford (ECY)
Subject: Class 2 Modifications to Hanford Dangerous Waste Permit

Just make sure that all Class 2 modifications with any new regulations, and technological advancements are utilized in the Hanford Dangerous Waste Permit approval. We are counting on the Washington State Department of Ecology to do what's right and best for every citizen of Washington State.

Carol Panfilio

From: Mike <mikeconlan@hotmail.com>
Sent: Saturday, January 28, 2017 1:31 PM
To: Hanford (ECY)
Subject: RE: Input on Hanford Permit Changes for the 300 Area Process Trenches and 183-H Solar Evaporation Basins

1. Remove all nuclear waste,

2. Do not allow anymore nuclear waste into the facility,

3. Replace all the single storage tanks,

4. Stop all the nuclear leakage entering the Columbia River.

Mike Conlan

Redmond WA

Confederated Tribes and Bands
of the Yakama Nation ERWM

Established by the
Treaty of June 9, 1855

March 22, 2017

Randy Bradbury
Washington State Department of Ecology
3100 Port of Benton Blvd
Richland, WA 99354
Hanford@ecy.wa.gov

Subject: Final Status Groundwater Monitoring Plan for the 300 Area Process Trenches & the 183-H Solar Evaporation Basins, DOE/RL-2015-29, Revision 0 & DOE/RL-2015-28, Revision 0

Dear Mr. Bradbury:

The YN-ER/WM Program (YN) appreciated the opportunity to comment on these documents. Attached are our general and specific comments and requests for changes.

We look forward to discussing our concerns.

Sincerely,

Marlene George,
Acting Projects Manager, Yakama Nation-ER/WM Program

Attachment: #1

Attachment #1:

Final Status Groundwater Monitoring Plan for the 300 Area Process Trenches & the 183-H Solar Evaporation Basins, DOE/RL-2015-29, Revision 0 & DOE/RL-2015-28, Revision 0 General Comments regarding issues identified in both Groundwater Monitoring Plans:

- As there are Tribal Cultural Resources in both the 100-H and 300 Areas, which include cemeteries, archaeological sites, traditional cultural properties as well as significant Treaty resources such as salmon redds, spawning areas, traditional fisheries and biological resources in the riparian zone and terraces, any Industrial Use designation of these lands over a general time frame past 100 years closure is unacceptable considering the disruption of cultural and Treaty resources in the area. Disruption that prevents/alters the use of TCPs and impacts significant cultural resources is potentially an adverse effect which must be mitigated through an MOA in compliance with the National Historic Preservation Act and the implementing 36CFR800. Adverse effects can only be determined with consultation with Yakama Nation.
- The YN-ER/WM Program believes there are some incorrect applications of regulations, which need correction, and re-evaluation of risks to the groundwater. WAC 173-340-720(4)(b)(ii) (2007) indicates that WAC 173-340 Method B for potable groundwater applies for the protection of surface water beneficial uses, and references WAC 173-340-730; in this way, water quality standards are incorporated in WAC 173-340-720. WAC 173-340-730(3)(b)(i) also gives the relationship of water quality standards and WAC 173-340. We believe the aquatic water quality criteria do apply to the ground water because the property abuts the surface water and should be applied at 100-H. YN requests use of a concentration limit of 10ug/L Surface Water Aquatic Life Fresh/Chronic 173-201A WAC values in determining compliance and completion of corrective actions and groundwater monitoring for the 183-H unit.
- YN requests the following changes to be made for both RCRA TSD units' groundwater monitoring plans: Wells that are located at the boundary of groundwater plumes should be maintained and monitored for ongoing closure monitoring or remedial action monitoring. Adequate placement, appropriate screening, and ongoing monitoring of wells at the plume boundary are necessary to adequately monitor changes in plume aerial and vertical extent. Discontinuing monitoring at boundary wells compromises plume delineation by requiring the point of compliance location to be estimated rather than directly bounded by data.
- WAC 173-303 Dangerous Waste Regulations do not parse out contaminants or groundwater from the soil unit. YN believes that as long as corrective actions for Uranium are ongoing, the 300 APT cannot be removed from the Permit. Corrective actions for this constituent whose source is the 300 APT TSD are being deferred to the CERCLA ROD for the 300-FF-5 GW OU, but this does not relieve Ecology of continued oversight of this corrective action through the Permit. YN requests edits to any text related to removal of the site from the Hanford RCRA permit to indicate Ecology's continued oversight through the permit for this corrective action. (See pg. 3-4.)
- YN requests clarification as to the regulatory path which allows Ecology to delete Uranium as a COC for both the 183-H SEB & the 300 Area Process Trenches RCRA Groundwater Monitoring plan simply on the basis that corrective action is implemented under the a CERCLA remedial action (e.g. EPA/ROD/R10-96/143, 1996). Uranium should remain in both the 183-H SEB & 300 APT groundwater monitoring plans due to its toxicity (WAC 173-303.)
- Integration of corrective action at both the 183-H and 300 APT with remedial actions at these operable units was previously defined in the Permit with corrective action deferred

to the CERCLA program for the 100-HR-3 & 300-FF-5 Groundwater OUs. The use of alternative for GW monitoring and corrective action is authorized under WAC 173-303-645(e) with qualifications and may not be applied without meeting these criteria. For clarification, YN request identification of the other solid waste management units that have likely contributed to the release of ground water contaminates identified in these GW monitoring plans and the RCRA permits for both TSDs.

- YN requests, for both TSDs, inclusion of set schedules for sampling and include well names, etc. Any sampling events that are missed should be rescheduled within the month they were planned. Sampling is only semi-annually, which puts a burden on resources, but also requires effective planning ahead of schedule (e.g. proper maintenance of equipment) and contingency built into the schedule for such unplanned events.
- Identify the probable source of PCE, TCE, and *cis*-1, 2-DCE concentrations observed in well 399-1-16B and how the PCE contaminant is being monitored. (See pg 2-21.)
- YN requests identification and inclusion of the monitoring plan used for the monitoring of the 183-H alkalinity, anions, and metals by attachment or references to the Groundwater Monitoring Plan for the 183-H SEB (to demonstrate full compliance with WAC 173-303-645.)
- YN requests inclusion of the following wells H4-8, H4-65, and H4-12A into the 183-H RCRA monitoring plan network to capture any unusually high river flow year's influences and spreading of contaminates.
- YN requests collection of both unfiltered and filtered samples. Revise future data collection to ensure that well sampling is directly comparable between all wells (e.g. both filtered and unfiltered hexavalent chromium samples are collected at every well that is sampled.)

Appendix A Quality Assurance Project Plan

The following comments are identified for the 300 APT but similar concerns are noted for the 183-H TSD. Please consider both documents in view of these concerns.

A2.1.6 Field Sample Operations & The FWS:

YN request edits to stat the FSO/FWS will ensure and document that Ecology has been notified of any discrepancies in the sample collection or analyses and the FWS will work with Ecology on rescheduling missed sampling events.

A2.1.8 Environmental Compliance Officer: YN requests clarification that the ECO is also responsible for minimization of adverse impacts to Cultural Resources. If there is someone else responsible for this task, please identify.

A2.1.10 Waste Management: YN requests clarify of path for documentation of this information in the 300 APT unit specific operating files and links to the RCRA permit.

A2.6 Documents and Records:

- YN requests edits to clarify that the Ecology permitted version of the groundwater monitoring plan is the version the Project Delivery Manager for Groundwater Science is responsible for maintaining through the administrative document control process.
- YN requests edits to clarify that the information will be documented in the Hanford Facility Operating Records and maintained until final closure of the facility including completion of any required post closure care or corrective action.

A3.3 Quality Control:

- To be able to demonstrate quality objectives for comparability of data, the YN-ER/WM Program requests all laboratories involved in sample analysis meet and use the same QC/QA acceptance criteria and procedures.

A4.1 Assessments and Response Actions

- YN requests the "existing programmatic requirements" be clarified or referenced in the groundwater monitoring plan.
- YN requests clarification of the types of corrective actions that may be taken by the Project Delivery Manager for Groundwater Science and how these are to be communicated to Ecology.
- YN requests clarification of the oversight process the SMR group uses to verify that laboratories are qualified to perform Hanford Site analytical work.

A3.3.2 Laboratory Quality Control Samples

- YN requests additional sampling within the sampling quarter for those samples that have exceeded required holding times.
- YN request clarification as to whether matrix spike results and laboratory blanks will be used to correct sample results.

A4.1 Assessments and Response Actions: YN requests clarification as to what are the 'existing programmatic requirements.'

A5.3 Reconciliation with User Requirements: YN requests clarification as to how reports/report results on discretionary DQAs will be communicated to Ecology.

Table A-1. Data Quality Indicators:

General comments:

- No changes to data collection or analysis methods through this groundwater monitoring plan should be made without Ecology approving the changes. All modifications of the plan should be consistent with the WAC 173-303-830 process. YN requests the WAC modification process be followed.
- YN requests that no data be rejected due to inability to meet detection limits and ask that lab with high equipment detection limits are not used to do analyses. See comment on Table A-3.
- YN requests edits to the *Definition of Representativeness* to state: Sample representativeness expresses the
  degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition *at the time of sampling*. It is dependent on the proper design of the sampling program and will be satisfied by ensuring that the approved plans were followed during sampling and analysis *and based upon adequate selection of number of sampling locations, accurately defined media, and defined sampling and analytical methods.*
- YN requests edits to *Determination of Methodologies* to state: Evaluate whether measurements
  are made and physical samples collected in such a manner that the resulting data appropriately reflect the environment or condition being measured or studied *and consistent with WAC 173-303 definition of representative sampling.*

Table A-2:

General comments:

- YN requests clarification of the *change type* process that utilized temporary wells, increased sampling frequencies, addition of other constituents. Some of these changes would trigger a Permit modification requiring public review opportunities. Notification to DOE-RL alone is not sufficient.
- Information regarding actions to rectify *unintentional impact* to groundwater monitoring plan that impacts the corrective action monitoring requirements: YN requests clarification and edits to state: Ecology will be notified within seven working days of deviations of

CA monitoring requirements. Ecology with consultation with DOE will determine and provide schedule, etc for corrections.

- YN requests edits to the *documentation* column to state Ecology will be notified of all failures to comply with the CA monitoring plan requirements within seven working days, and this will be documented in the operating record of the RCRA TSD.
- YN requests clarification and edits of what are *anticipated unavoidable changes*. Edit *Action* column to state Ecology will be notified within seven working days and this will be documented in the operating record of the RCRA TSD.

Table 2-1. Estimated Non-radiological Chemical Waste Inventory for the 300 Area Process Trenches & Table 2-2. Flow History for the 300 Area Process Trenches:

- YN requests DOE provide discussion/clarification as to what seems to be a disconnect with flow volumes and chemical waste inventory volumes.
- Clarify how it is possible to have high volumes of yearly flow and relatively low volumes of chemical waste inventory. (e.g., What portion of flow volume has no contamination-if this is possible?)

Table A-3. Analytical Requirements for Groundwater Analysis:

- YN requests clarification of use of values cited in the column 'Highest Allowable Practical Quantitation Limits." TCE PQL value appears too high. MTCA GW Method B cancer value standard for TCE is 0.54ug/L. Ecology guidance (*Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies- Publication # 04-03-030)* states the lowest concentration of interest for constituents is usually equated with the limit of detection. It is important that detection limits (i.e. Method Quantitation Limits) be below decision limits since precision is poor near these limits and decisions should not be based on imprecise data.

- Laboratories performing analysis must be capable of reporting results below the concentration limit and below the most stringent cleanup levels to ensure precise results at the reference level (standard or criteria.) YN supports use of the most stringent cleanup levels for groundwater. This includes application of cleanup levels protective of surface waters and aquatic life.

Table A-4. QC Requirements:

- The YN-ER/WM Program requests clarification on basis for only 1 per 20 well trips for replicate/duplicate samples. Please provide a schedule and describe the well sampling process more clearly such that it indicates which wells will have duplicate samples per each sampling cycle (i.e. semi-annually.)
- Footnote 'a': The YN-ER/WM Program recommends the use of only dedicated sampling equipment.

REFERENCES

References for this comment period:

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