U.S. Department of Energy
Hanford Site

August 10, 2020

20-SGD-0060

Ms. Alexandra K. Smith, Program Manager
Nuclear Waste Program
Washington State Department of Ecology
3100 Port of Benton Boulevard
Richland, Washington 99354

Dear Ms. Smith:

INTERIM STATUS GROUNDWATER QUALITY ASSESSMENT FOR THE SINGLE-SHELL TANK SYSTEM REPORT, DOE/RL-2019-74, REVISION 0

This letter transmits the Interim Status Groundwater Quality Assessment for the Single-Shell Tank System Report DOE/RL-2019-74, Revision 0 to the Washington State Department of Ecology.

If you have any questions, please contact me, or your staff may contact, Doug Hildebrand, of my staff, on (509) 373-9626

Sincerely,

Michael W. Cline Digitally signed by Michael W. Cline
Date: 2020.08.10 08:18:55 -07'00'

Michael W. Cline, Director
Soil and Groundwater Division
Richland Operations Office

SGD:RDH

Attachment

cc: See page 2

cc w/attach:
J. Bell, NPT
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Administrative Record
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DOE/RL-2019-74
Revision 0

Interim Status Groundwater Quality Assessment Plan for the Single-Shell Tank System

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

U.S. DEPARTMENT OF ENERGY | Richland Operations Office

P.O. Box 550
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DOE/RL-2019-74
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Interim Status Groundwater Quality Assessment Plan for the Single-Shell Tank System

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Assistant Secretary for Environmental Management

U.S. DEPARTMENT OF ENERGY Richland Operations Office
P.O. Box 550
Richland, Washington 99352

APPROVED
By Sarah Harrison at 2:05 pm, Jun 17, 2020

Release Approval Date

Contents

Appendices

Figures

Tables

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Terms

AEA	*Atomic Energy Act of 1954*
DOE	U.S. Department of Energy
DWMU	dangerous waste management unit
Ecology	Washington State Department of Ecology
EER	engineering evaluation report
EPA	U.S. Environmental Protection Agency
FWS	Field Work Supervisor
P&T	pump and treat
PQL	practical quantitation limit
QAPjP	quality assurance project plan
RCRA	*Resource Conservation and Recovery Act of 1976*
SST	single-shell tank
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989a)
WMA	waste management area

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1 Introduction

This document presents a new monitoring plan for the Single-Shell Tank (SST) System unit waste management areas (WMAs) (hereinafter referred to as SST WMAs) that are monitored under a groundwater quality assessment program: WMA B-BX-BY, WMA C, WMA S-SX, WMA T, WMA TX-TY, and WMA U. When issued into the operating record, this plan will become the principal controlling document for conducting groundwater monitoring at these WMAs under the dangerous waste regulations (WAC 173-303, "Dangerous Waste Regulations"), superseding the previous monitoring plans as follows:

- DOE/RL-2012-53, *Interim Status Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area B-BX-BY*, Rev. 1
- DOE/RL-2009-77, *Interim Status Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area C*, Rev. 1
- DOE/RL-2009-73, *Interim Status Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area S-SX*, Rev. 1
- DOE/RL-2009-66, *Interim Status Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area T*, Rev. 2
- DOE/RL-2009-67, *Interim Status Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area TX-TY*, Rev. 2
- DOE/RL-2009-74, *Interim Status Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area U*, Rev. 2

The U.S. Department of Energy (DOE) is issuing a new groundwater monitoring plan to revise the groundwater quality assessment constituents for ongoing sampling and evaluation to incorporate the monitoring requirements for those SST WMAs that are in a groundwater quality assessment into a single plan, and update the quality assurance project plan and sampling protocols.

This groundwater plan is based on the requirements for interim status facilities, as defined by the *Resource Conservation and Recovery Act of 1976* (RCRA), with regulations promulgated by the Washington State Department of Ecology (Ecology) in the *Washington Administrative Code* and the *Code of Federal Regulations* by reference (WAC 173-303-400, "Interim Status Facility Standards"; 40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Subpart F, "Ground-Water Monitoring"). This plan is required by 40 CFR 265.90(a) and (b), "Applicability," and is intended to satisfy groundwater monitoring requirements applicable to dangerous waste management units (DWMUs) that are in a groundwater quality assessment program. As required by WAC 173-303-400(3) and 40 CFR 265, Subpart F, this plan implements activities that collect information to determine if dangerous waste(s) originating from a DWMU have entered groundwater, and if so, the concentration of the dangerous waste(s) in groundwater and the rate and extent of migration.

The interim status SST System unit comprises seven inactive SST WMAs on the Hanford Site, six of which are monitored under a groundwater quality assessment program and are included in this plan. Two SST WMAs (WMA B-BX-BY and WMA C) are located in the 200 East Area (Figure 1-1), and four SST WMAs (WMA S-SX, WMA T, WMA TX-TY, and WMA U) are located in the 200 West Area (Figure 1-2). The seventh SST WMA (WMA A-AX) has also been monitored under a groundwater quality assessment program; however, no dangerous waste from the WMA was found to have impacted groundwater. Therefore, WMA A-AX will be returning to an interim status indicator evaluation program separate from the other SST WMAs and is not within the scope of this groundwater monitoring plan. In accordance with Section I.A of WA7890008967, *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste* (hereinafter referred to as the Hanford Facility RCRA Permit), the SST System unit will continue under interim status until it is incorporated into Part III, V, and/or VI of the Hanford Facility RCRA Permit (or its successor), or until interim status is terminated. Therefore, groundwater monitoring of the SST System unit, comprising seven WMAs, continues under interim status requirements. The boundary of each SST WMA is identified on the Hanford Facility RCRA Permit Part A Form for the SST System.

In 2018 and 2019, groundwater monitoring engineering evaluation reports (EERs) for DWMUs located within the Hanford Site Central Plateau were prepared as Part B (final status) permit application material for the future Revision 9 of WA7890008967, *Hanford Facility Dangerous Waste Permit (Site-Wide Permit)* (hereinafter referred to as the Hanford Sitewide Permit). Separate EERs were prepared for each of the SST WMAs. The EERs do not create any groundwater monitoring requirements; however, they contain the most comprehensive background information supporting groundwater monitoring to date for each DWMU. Detailed area-wide and unit-specific groundwater evaluations were used to assess the locations of existing wells and propose locations for new wells (as appropriate) that would detect groundwater contamination that may occur from each SST WMA.

For 200 East Area units, analysis of groundwater elevations and contaminant particle-tracking calculations, as well as an evaluation of vertical contaminant migration in groundwater, were performed to evaluate the existing monitoring well networks and propose new well networks (as appropriate) in the following reports:

- SGW-60587, *Engineering Evaluation Report for Single-Shell Tank Waste Management Area B-BX-BY Groundwater Monitoring*
- SGW-60588, *Engineering Evaluation Report for Single-Shell Tank Waste Management Area C Groundwater Monitoring*

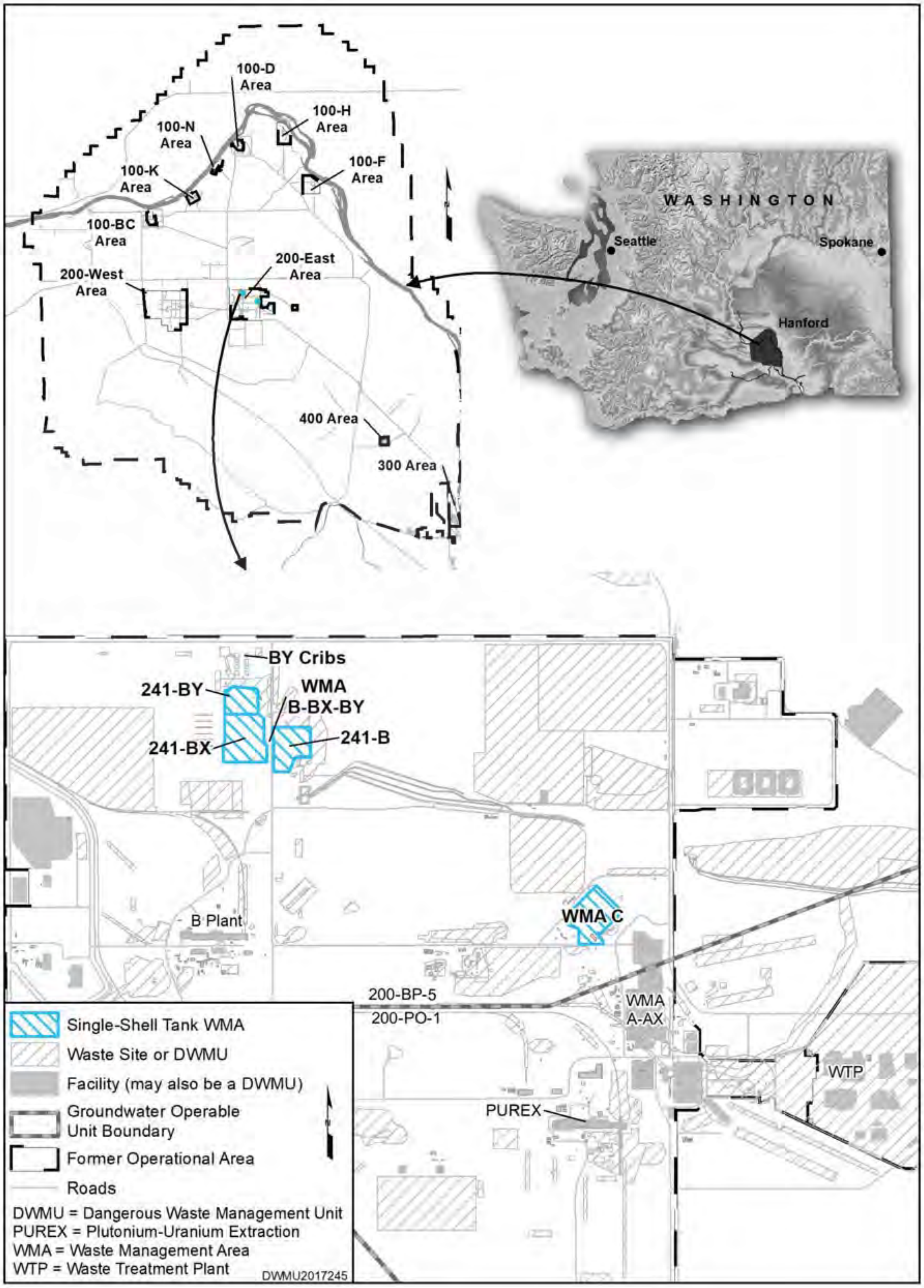


Figure 1-1. Location Map for WMA B-BX-BY and WMA C in the 200 East Area

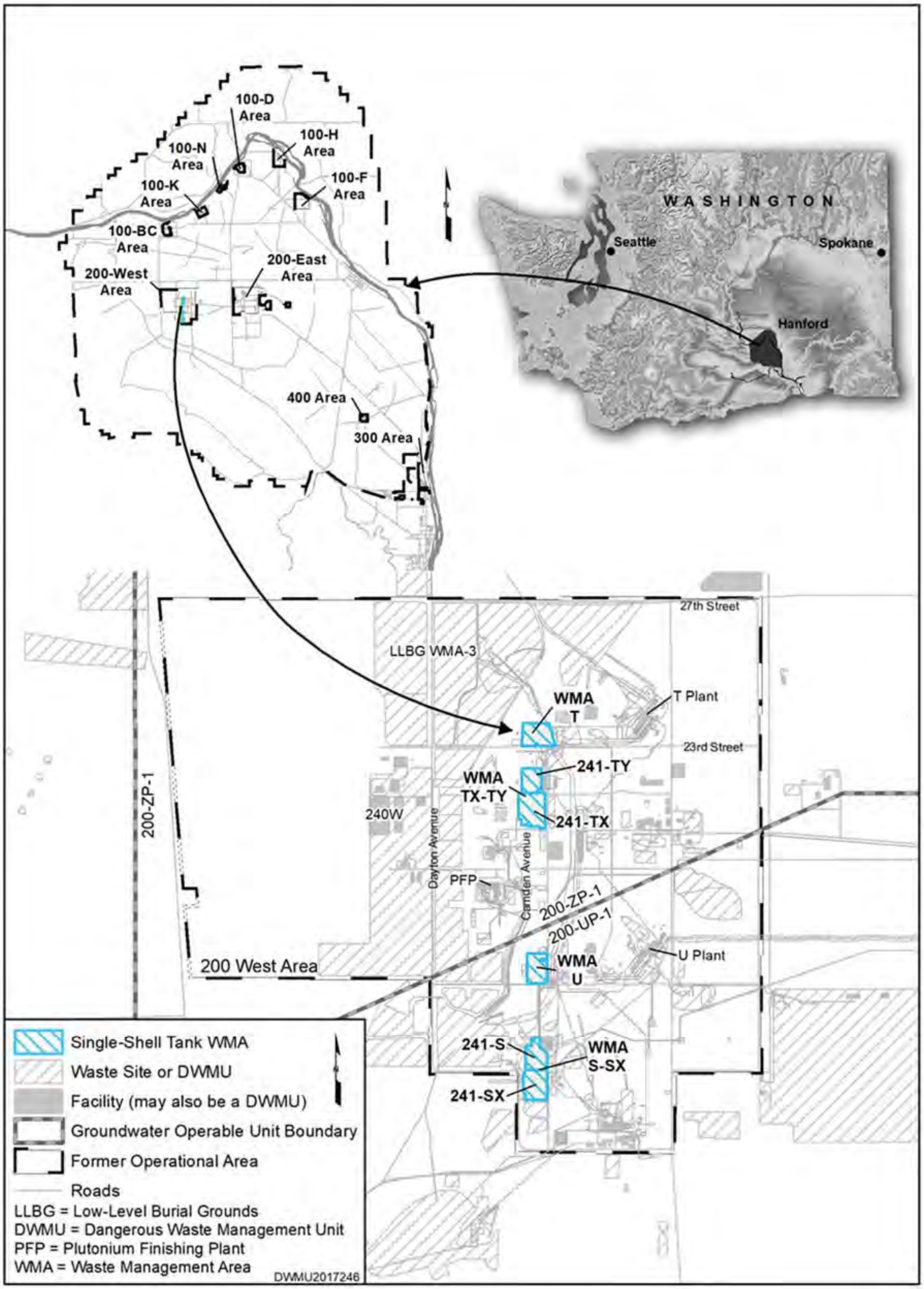


Figure 1-2. Location Map for WMA S-SX, WMA T, WMA TX-TY, and WMA U in the 200 West Area

For the 200 West Area units, particle-tracking calculations and evaluations of vertical contaminant migration in groundwater, were performed to evaluate the existing monitoring well networks and propose new well networks (as appropriate) in the following reports:

- SGW-60575, *Engineering Evaluation Report for Single-Shell Tank Waste Management Area T Groundwater Monitoring*
- SGW-60576, *Engineering Evaluation Report for Single-Shell Tank Waste Management Area TX-TY Groundwater Monitoring*
- SGW-60577, *Engineering Evaluation Report for Single-Shell Tank Waste Management Area S-SX Groundwater Monitoring*
- SGW-60578, *Engineering Evaluation Report for Single-Shell Tank Waste Management Area U Groundwater Monitoring*

Regular updates to the EERs are planned as new data become available and changes to groundwater conditions are identified. Because regular updates to the EERs will ensure that they remain the most updated source for unit-specific information related to groundwater monitoring (e.g., hydrogeologic conditions, contaminant migration conceptual models), the detailed information specific to each SST WMA that is provided in its associated EER is included only by reference in this interim status groundwater monitoring plan.

One of the primary objectives of the EERs is to identify a well network for groundwater monitoring that is required at a final status unit under WAC 173-303-645, "Releases from Regulated Units." The proposed final status networks for the SST WMAs in the EERs also meet the requirements for monitoring under the interim status regulations of WAC 173-303-400 and 40 CFR 265, Subpart F, and were incorporated into the previous groundwater quality assessment plan revisions for the WMAs (issued in 2019).

Table 1-1 identifies the locations where information that is pertinent to this groundwater monitoring plan is presented in the EERs.

Table 1-1. Locations of Pertinent Supporting/Background Information in the EERs for SST WMAs Groundwater Monitoring

Section	Title/Topic*
2.1	Background
2.1.1	Facility Description
2.1.2	Operational History
2.1.3	Single-Shell Tanks and Liquid Handling Structures within WMA
2.1.4	Unplanned Releases
2.3	Waste Characteristics
2.4	Interim Status Monitoring Network and Sampling History
3.1	Stratigraphy
3.2	Hydrogeology

Table 1-1. Locations of Pertinent Supporting/Background Information in the EERs for SST WMAs Groundwater Monitoring

Section	Title/Topic*
3.3	Groundwater Flow System
4	Contaminant Migration Conceptual Model
4.1	Vadose Zone
4.2	Soil Moisture Factors
4.3	Hydrogeologic Considerations
4.4	Groundwater Chemistry
5	Calculation Methods
6	Calculations
7	Simulation Results and Conclusions
9.3 and subsections	Proposed Groundwater Monitoring Network

*For some entries, this table provides a general representation of the section titles; see the specific EER for WMA-specific title and details.

EER = engineering evaluation report

WMA = waste management area

This groundwater monitoring plan includes the following chapters and appendices:

- Chapter 2 describes the groundwater monitoring program, including the wells in the monitoring network for each SST WMA, constituents analyzed, and sampling frequency.
- Chapter 3 describes data evaluation and reporting.
- Chapter 4 provides the schedule of implementation.
- Chapter 5 contains the references cited in this plan.
- Appendix A provides the quality assurance project plan (QAPjP) and analytical methods for sampling constituents.
- Appendix B contains sampling protocols.
- Appendix C provides information for the wells within the WMA B-BX-BY groundwater monitoring network.
- Appendix D provides information for the wells within the WMA C groundwater monitoring network.
- Appendix E provides information for the wells within the WMA S-SX groundwater monitoring network.
- Appendix F provides information for the wells within the WMA T groundwater monitoring network.

- Appendix G provides information for the wells within the WMA TX-TY groundwater monitoring network.
- Appendix H provides information for the wells within the WMA U groundwater monitoring network.
- Appendix I provides evaluation of waste constituents associated with the SST System and identification of constituents for evaluation in the groundwater quality assessment.

1.1 Regulatory Basis

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. Ecology regulatory authority over the dangerous waste components of mixed wastes began on August 19, 1987.

In May 1989, DOE, the U.S. Environmental Protection Agency (EPA), and Ecology signed the Ecology et al., 1989a, *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 SST System unit. Groundwater monitoring is conducted at WMA B-BX-BY, WMA C, WMA S-SX, WMA T, WMA TX-TY, and WMA U in accordance with WAC 173-303-400(3) (and by reference 40 CFR 265, Subpart F), which requires monitoring to determine whether the dangerous waste constituents from the unit have entered the groundwater in the uppermost aquifer underlying each of the subject SST WMAs.

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). The 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 1989, an interim status indicator parameter groundwater monitoring program (WHC-SD-EN-AP-012, *40 CFR 265 Interim-Status Ground-Water Monitoring Plan for the Single-Shell Tanks*) was initiated at each of the SST WMAs. The indicator parameter monitoring program continued until the WMAs were placed into a groundwater quality assessment monitoring program in accordance with 40 CFR 265.93(d), "Preparation, Evaluation, and Response," due to an exceedance of the critical mean of an indicator parameter (specific conductance) as described in the following subsections. Brief descriptions of the regulatory basis for the groundwater quality assessments and the associated groundwater monitoring plans and reports that have been issued for each SST WMA are provided in the following subsections. A detailed history of interim status monitoring at each WMA, including groundwater quality assessment monitoring, is available in Section 2.4 of the associated EER.

1.1.1 Waste Management Area B-BX-BY

In 1996, the critical mean for specific conductance was exceeded in a downgradient well at WMA B-BX-BY, and the WMA entered a groundwater quality assessment monitoring program. In 1998, a phase I first determination report was issued that indicated it was likely that dangerous wastes from WMA B-BX-BY had entered the groundwater (Chapter 5 in PNNL-11826, *Results of Phase I Groundwater Quality Assessment for Single-Shell Tank Waste Management Areas B-BX-BY at the Hanford Site*); however, no specific dangerous waste was identified. Elevated concentrations of technetium-99, nitrate, chloride, sulfide, and sodium were measured in well 299-E33-41 and were attributed to tank waste (Chapter 5 in PNNL-11826). Increasing technetium-99 and nitrate concentrations in WMA B-BX-BY monitoring wells 299-E33-31, 299-E33-32, and 299-E33-42 on the west boundary of the WMA were potentially related to releases from the WMA (Chapter 5 in PNNL-11826). The dangerous waste cyanide was detected in wells to the north and northeast of the 241-BY Tank Farm (wells that are in the general area of the BY Cribs); however, the source was attributed to the BY Cribs because there were no cyanide detections in well 299-E33-41, the well that was likely affected by tank waste (Section 3.4.2 in PNNL-11826). Based on these results, a phase II investigation was needed to determine the nature, extent, and source of groundwater contamination, and an updated monitoring plan was subsequently issued in 2000 (PNNL-13022, *Groundwater Quality Assessment Plan for Single-Shell Waste Management Area B-BX-BY at the Hanford Site*).

PNNL-13022 reported cyanide detections in wells located in the area of the BY Cribs but not in well 299-E33-41, which was considered likely contaminated by tank waste (Section 3.4 and Figure 3.6 in PNNL-13022). However, the local water table was flat (e.g., little discernable hydraulic gradient), which complicated determination of the source for the contaminants.

In 2012, DOE/RL-2012-53, Rev. 0, provided an initial determination that cyanide groundwater contamination was from WMA B-BX-BY, primarily due to the (then recent) cyanide detections in well 299-E33-47 located on the east boundary of the 241-B Tank Farm, history of cyanide in scavenging waste at the 241-B Tank Farm, lack of cyanide in upgradient wells, and a lack of other attributable sources (Section 2.7 in DOE/RL-2012-53, Rev. 0).

In 2019, the most recent plan (DOE/RL-2012-53, Rev. 1) was issued to revise the well network and incorporate the more recent information related to WMA B-BX-BY from the EER (SGW-60587). Cyanide was the identified dangerous waste for monitoring at WMA B-BX-BY (Table 2-1 in DOE/RL-2012-53, Rev. 1). Interim status groundwater monitoring at WMA B-BX-BY has since continued under a groundwater quality assessment program, with this combined monitoring plan being the most current. Details of the groundwater monitoring history of WMA B-BX-BY are available in Section 2.4 of SGW-60587.

1.1.2 Waste Management Area C

In 2010, the critical mean for specific conductance was exceeded in a downgradient well at WMA C, and the WMA entered a groundwater quality assessment monitoring program. Additionally, the dangerous waste cyanide had been detected in groundwater at WMA C, and no upgradient source for cyanide had been identified (Chapter 1 in DOE/RL-2009-77, Rev. 0). Although cyanide is associated with some of the tank waste at WMA C, none of the tanks that had an associated cyanide inventory were suspected or confirmed to have leaked (Section 2.9 in DOE/RL-2009-77, Rev. 0).

An evaluation of the WMA C assessment sampling results was presented in Section 9.3.4 of DOE/RL-2011-01, *Hanford Site Groundwater Monitoring Report for 2010*. Based on the evaluation, it was determined that cyanide was the only dangerous waste constituent that was impacting groundwater at WMA C (Section 9.3.4 in DOE/RL-2011-01). The 2011 annual report clarified that the presence of cyanide implied that the 241-C Tank Farm was continuing to impact groundwater (Section 3.4.13.2 in DOE/RL-2011-118, *Hanford Site Groundwater Monitoring for 2011*). Although a standalone first determination report was not issued, the informal determinations provided in DOE/RL-2009-77, Rev. 0 and subsequent annual groundwater monitoring reports have identified that cyanide groundwater contamination is attributable to WMA C.

In 2019, the most recent plan (DOE/RL-2009-77, Rev. 1) was issued to revise the well network and incorporate the more recent information related to WMA C from the EER (SGW-60588). Cyanide was the identified dangerous waste for monitoring at WMA C (Table 2-1 in DOE/RL-2009-77, Rev. 1). Interim status groundwater monitoring at WMA C has since continued under a groundwater quality assessment program, with this combined monitoring plan being the most current. Details of the groundwater monitoring history of WMA C are available in Section 2.4 of SGW-60588.

1.1.3 Waste Management Area S-SX

In 1996, the critical means for WMA S-SX were recalculated using only one of the two upgradient wells, which resulted in downgradient wells exceeding the revised critical mean of specific conductance (Chapter 1.0 and Appendix A in WHC-SD-EN-AP-191, *Assessment Groundwater Monitoring Plan for Single Shell Tank Waste Management Area S-SX*). Therefore, the WMA entered a groundwater quality assessment monitoring program.

In 1998, a phase I assessment report was issued that identified elevated concentrations of chromium, nitrate, and technetium-99 in downgradient wells (Section 3.1 in PNNL-11810, *Results of Phase I Groundwater Quality Assessment for Single-Shell Tank Waste Management Areas S-SX at the Hanford Site*). The report concluded that WMA S-SX had contributed to groundwater contamination of nitrate and chromium (Chapter 5.0 in PNNL-11810). Based on these results, a phase II investigation was needed to determine the nature, extent, and source of groundwater contamination, and an updated assessment plan was subsequently issued in 1999 (PNNL-12114, *RCRA Assessment Plan for Single-Shell Tank Waste Management Area S-SX at the Hanford Site*).

In 2001, PNNL-13441, *RCRA Groundwater Quality Assessment Report for Waste Management Area S-SX (November 1997 through April 2000)*, reported that groundwater contamination attributable to tank leaks or spills continued to persist in both the 241-S and 241-SX Tank Farms; however, the report addressed both radiological and dangerous waste (chromium) contaminants, primarily focusing on technetium-99 contamination (which was measured at concentrations that were significantly greater than the associated drinking water standard) (Summary and Chapter 6.0 in PNNL-13441).

In 2002, PNNL-13801, *Groundwater Quality Assessment Report for Waste Management Area S-SX (April 2000 through December 2001)*, reported that concentrations of technetium-99 and associated mobile tank waste contaminants (nitrate, chromium, and tritium) were increasing in two wells downgradient of the 241-S Tank Farm (Chapter 6.0 in PNNL-13801). In 2001, interim corrective measures (cutting and capping water lines and surface run-on control) had been performed, and decreases in technetium-99 concentrations were anticipated. Eight new monitoring wells had been installed, and no new significant contamination was discovered (Chapter 6.0 in PNNL-13801).

In 2011, a new groundwater quality assessment plan was issued (DOE/RL-2009-73, Rev. 0) to update the well network and monitoring constituents.

In 2019, the most recent plan (DOE/RL-2009-73, Rev. 1) was issued to revise the well network and incorporate the more recent information related to WMA S-SX from the EER (SGW-60577). Chromium was the identified dangerous waste for monitoring at WMA S-SX (Table 2-1 in DOE/RL-2009-73, Rev. 1). Interim status groundwater monitoring at WMA S-SX has since continued under a groundwater quality assessment program, with this combined monitoring plan being the most current. Details of the groundwater monitoring history of WMA S-SX are available in Section 2.4 of SGW-60577.

1.1.4 Waste Management Area T

In 1992, the critical mean for specific conductance was exceeded in a downgradient well at WMA T. Therefore, WMA T, along with WMA TX-TY, entered a joint groundwater quality assessment monitoring program in 1993 (Section 4.2 in WHC-SD-EN-AP-132, *Interim-Status Groundwater Quality Assessment Plan for the Single Shell Tank Waste Management Areas T and TX-TY*).

In 1998, a phase I assessment report for WMA T and TX-TY was issued (PNNL-11809, *Results of Phase I Groundwater Quality Assessment for Single-Shell Tank Waste Management Areas T and TX-TY at the Hanford Site).* For WMA T, the report attributed elevated specific conductance and nitrate to past-practice waste disposal activities and not from a source in WMA T (Section 4.1.1 in PNNL-11809). However, WMA T was identified as the most likely source for groundwater contamination, including chromium and nitrate above the drinking water standard (Section 5.0 in PNNL-11809).

In 2001, a revised assessment plan (PNNL-12057, *RCRA Assessment Plan for Single-Shell Tank Waste Management Area T at the Hanford Site*) was issued that addressed groundwater monitoring for WMA T only (WMA TX-TY continued in assessment under a separate plan). The objective of the revised plan (PNNL-12057) was to address continued assessment of groundwater quality and to determine the concentrations of groundwater contamination and the rate and extent of contaminant migration (Section 1.2 in PNNL-12057).

New groundwater quality assessment plans were subsequently issued in 2005 (PNNL-15301, *RCRA Assessment Plan for Single-Shell Tank Waste Management Area T*) and 2011 (DOE/RL-2009-66, Rev. 0) to update the well network and monitoring constituents (DOE/RL-2009-66, Rev. 0, only).

In 2019, the most recent plan (DOE/RL-2009-66, Rev. 2) was issued to revise the well network and incorporate the more recent information related to WMA T from the EER (SGW-60575). Chromium was the identified dangerous waste for monitoring at WMA T (Table 2-1 in DOE/RL-2009-66, Rev. 2). Interim status groundwater monitoring at WMA T has since continued under a groundwater quality assessment program, with this combined monitoring plan being the most current. Details of the groundwater monitoring history of WMA T are available in Section 2.4 of SGW-60575.

1.1.5 Waste Management Area TX-TY

In 1992, the critical mean for specific conductance was exceeded in a downgradient well at WMA TX-TY. Therefore, WMA TX-TY, along with WMA T, entered a joint groundwater quality assessment monitoring program in 1993 (Section 4.2 in WHC-SD-EN-AP-132).

In 1998, a phase I assessment report for WMA T and WMA TX-TY was issued (PNNL-11809). For WMA TX-TY, the report concluded that elevated nitrate, calcium, and magnesium concentrations were consistent with a source within WMA TX-TY, and that there was no direct evidence of an upgradient source (Section 4.2.2 in PNNL-11809).

In 2001, a revised assessment plan (PNNL-12072, *RCRA Assessment Plan for Single-Shell Tank Waste Management Area TX-TY at the Hanford Site*) was issued that addressed groundwater monitoring for WMA TX-TY only (WMA T continued in assessment under a separate plan). The objective of the revised plan (PNNL-12072) was to address continued assessment of groundwater quality and to determine the concentrations of groundwater contamination and the rate and extent of contaminant migration (Section 1.2 in PNNL-12072).

In 2002, a second assessment report (PNNL-14004, *RCRA Groundwater Quality Assessment Report for Single-Shell Tank Waste Management Area TX-TY (January 1998 through December 2001)*) identified elevated chromium in a replacement well drilled in 1998 (Section 4.1.2.1 in PNNL-14004). The report provided the rate and extent of contaminant migration and concentration of the contaminant (chromium), and did not eliminate WMA TX-TY as a source for the downgradient chromium contamination (Section 7.0 in PNNL-14004).

New groundwater quality assessment plans were subsequently issued in 2007 (PNNL-16005, *RCRA Assessment Plan for Single-Shell Tank Waste Management Area TX-TY*) and 2011 (DOE/RL-2009-67, Rev. 0) to update the well network and monitoring constituents.

In 2019, the most recent plan (DOE/RL-2009-67, Rev. 2) was issued to revise the well network and incorporate the more recent information related to WMA TX-TY from the EER (SGW-60576). Chromium was the identified dangerous waste for monitoring at WMA TX-TY (Table 2-1 in DOE/RL-2009-67, Rev. 2). Interim status groundwater monitoring at WMA TX-TY has since continued under a groundwater quality assessment program, with this combined monitoring plan being the most current. Details of the groundwater monitoring history of WMA TX-TY are available in Section 2.4 of SGW-60576.

1.1.6 Waste Management Area U

In 1999, the critical mean for specific conductance was exceeded in a downgradient well at WMA U, and the WMA entered a groundwater quality assessment monitoring program in 2000 (Section 4.2 in PNNL-13185, *Groundwater Quality Assessment Plan for Single-Shell Tank Waste Management Area U at the Hanford Site*).

In 2000, a first determination report (PNNL-13282, *Groundwater Quality Assessment for Waste Management Area U: First Determination*) identified that elevated concentrations of chromium and nitrate (and technetium-99) had been historically present in downgradient wells and were increasing in one of the downgradient wells (Section 1.1 in PNNL-13282). The report concluded that the elevated specific conductance was the result of nonhazardous constituents, principally bicarbonate, calcium, chloride, magnesium, sodium, and sulfate that had leached from the vadose by infiltrated surface water in the southern part of WMA U (Section 6.0 in PNNL-13282). While upgradient sources of nitrate were found, such as the cribs and trenches associated with the Plutonium Finishing Plant (Section 4.2.3 in PNNL-13282), there was no evidence for upgradient sources of chromium (or technetium-99) (Section 6.0 in PNNL-13282). In 2001, PNNL-13612, *Groundwater Quality Assessment Plan for Single-Shell Tank Waste Management Area U*, was issued to address the second phase of the assessment, which was to delineate the concentrations of groundwater contamination and the rate and extent of contaminant migration (Section 1.0 in PNNL-13612).

A new groundwater quality assessment plan was issued in 2011 (DOE/RL-2009-74, Rev. 0) to update the well network and monitoring constituents.

In 2019, the most recent plan (DOE/RL-2009-74, Rev. 2) was issued to revise the well network and incorporate the more recent information related to WMA U from the EER (SGW-60575). Chromium was the identified dangerous waste for monitoring at WMA U (Table 2-1 in DOE/RL-2009-74, Rev. 2). Interim status groundwater monitoring at WMA U has since continued under a groundwater quality assessment program, with this combined monitoring plan being the most current. Details of the groundwater monitoring history of WMA U are available in Section 2.4 of SGW-60578.

1.2 Monitoring Objectives

The objective of the groundwater monitoring program at WMA B-BX-BY, WMA C, WMA S-SX, WMA T, WMA TX-TY, and WMA U is to determine the groundwater concentration of any dangerous waste originating from each WMA and the rate and extent of migration. This groundwater monitoring plan addresses those applicable dangerous waste requirements for interim status units where an impact to groundwater has been identified. The regulatory requirements applicable to this interim status groundwater monitoring plan are found in WAC 173-303-400(3) and 40 CFR 265.90 through 265.94, "Recordkeeping and Reporting." Table 1-2 identifies where each groundwater quality assessment monitoring element of the pertinent regulations is addressed within this plan.

Table 1-2. Pertinent Interim Status Facility Groundwater Quality Assessment Monitoring Requirements

Groundwater Monitoring Element	Pertinent Requirement*	Section Where Requirement is Addressed in Monitoring Plan
Applicability	40 CFR 265.90, "Applicability": (a) Within one year after the effective date of these regulations, the owner or operator of a surface impoundment, landfill, or land treatment facility which is used to manage hazardous waste must implement a ground-water monitoring program capable of determining the facility's impact on the quality of ground water in the uppermost aquifer underlying the facility, except as §265.91 and paragraph (c) of this section provide otherwise. (b) Except as paragraphs (c) and (d) of this section provide otherwise, the owner or operator must install, operate, and maintain a ground-water monitoring system which meets the requirements of §265.91, and must comply with §§265.92 through 265.94. This ground-water monitoring program must be carried out during the active life of the facility, and for disposal facilities, during the post-closure care period as well.	Chapter 1
Number and location of wells	40 CFR 265.91, "Ground-water monitoring system": (a) A ground-water monitoring system must be capable of yielding ground-water samples for analysis and must consist of: (1) Monitoring wells (at least one) installed hydraulically upgradient (i.e., in the direction of increasing static head) from the limit of the waste management area. Their number, locations, and depths must be sufficient to yield ground-water samples that are: (i) Representative of background ground-water quality in the uppermost aquifer near the facility; and (ii) Not affected by the facility; and (2) Monitoring wells (at least three) installed hydraulically downgradient (i.e., in the direction of decreasing static head) at the limit of the waste management area. Their number, locations, and depths must ensure that they immediately detect any statistically significant amounts of hazardous waste or hazardous waste constituents that migrate from the waste management area to the uppermost aquifer.	Section 2.3 and Tables 2-10 through 2-15
Well configuration	40 CFR 265.91: (c) All monitoring wells must be cased in a manner that maintains the integrity of the monitoring well borehole. This casing must be screened or perforated, and packed with gravel or sand where necessary to enable sample collection at depths where appropriate aquifer flow zones exist. The annular space (i.e., the space between the borehole and well casing) above the sampling depth must be sealed with a suitable material (e.g., cement grout or bentonite slurry) to prevent contamination of samples and the ground-water.	Section 2.3 and Appendices C through H

Table 1-2. Pertinent Interim Status Facility Groundwater Quality Assessment Monitoring Requirements

Groundwater Monitoring Element	Pertinent Requirement*	Section Where Requirement is Addressed in Monitoring Plan
	Additional requirements from WAC 173-303-400(3)(c)(v)(C), "Dangerous Waste Regulations," "Interim Status Facility Standards": Groundwater monitoring wells must be designed, constructed, and operated so as to prevent ground-water contamination. Chapter 173-160 of the WAC may be used as guidance in the installation of wells.	
Water-level measurements	40 CFR 265.92, "Sampling and Analysis": (e) Elevation of the ground-water surface at each monitoring well must be determined each time a sample is obtained.	Section 2.1 and Appendix B, Section B2.2
Constituents to be sampled Frequency of sampling Number, location, depth of wells	40 CFR 265.93, "Preparation, Evaluation, and Response": (d)(3) The plan to be submitted under §265.90(d)(1) or paragraph (d)(2) of this section must specify: (i) The number, location, and depth of wells; (ii) Sampling and analytical methods for those hazardous wastes or hazardous constituents in the facility; (iii) Evaluation procedures, including any use of previously-gathered groundwater quality information; and (iv) A schedule of implementation.	Sections 2.1, 2.2, 2.3, 3.2, and 3.3, Chapter 4 Appendix A, Section A3 and Appendix B, Sections B2 through B5
Determination of contaminant concentration and migration	40 CFR 265.93: (d)(4) The owner or operator must implement the ground-water quality assessment plan which satisfies the requirements of paragraph (d)(3) of this section, and, at a minimum, determine: (i) The rate and extent of migration of the hazardous waste or hazardous waste constituents in the ground-water; and (ii) The concentrations of the hazardous waste or hazardous waste constituents in the ground-water.	Sections 3.2 and 3.5
Recordkeeping and reporting	40 CFR 265.93: (d)(5) The owner or operator must make his first determination under paragraph (d)(4) of this section, as soon as technically feasible, and prepare a report containing an assessment of groundwater quality. This report must be placed in the facility operating record and be maintained until closure of the facility. (d)(6) If the owner or operator determines, based on the results of the first determination under paragraph (d)(4) of this section, that no hazardous waste or hazardous waste constituents from the facility have entered the ground water, then he may reinstate the indicator evaluation program. If the owner or operator reinstates the indicator evaluation program, he must so notify the Regional Administrator in the report submitted under paragraph (d)(5) of this section. (d)(7) If the owner or operator determines, based on the first determination under paragraph (d)(4) of this section, that	Section 3.5 Appendix A, Sections A2.5 and A3.9

Table 1-2. Pertinent Interim Status Facility Groundwater Quality Assessment Monitoring Requirements

Groundwater Monitoring Element	Pertinent Requirement*	Section Where Requirement is Addressed in Monitoring Plan
	hazardous waste or hazardous waste constituents from the facility have entered the ground-water, then he: (i) Must continue to make the determinations required under paragraph (d)(4) of this section on a quarterly basis until final closure of the facility, if the ground-water quality assessment plan was implemented prior to final closure of the facility Additional requirements from WAC 173-303-400(3)(c)(v)(E), "Dangerous Waste Regulations," "Interim Status Facility Standards": A copy of the report must be submitted to the department within 15 days. (e) Notwithstanding any other provision of this subpart, any groundwater quality assessment to satisfy the requirements of 265.93(d)(4) which is initiated prior to final closure of the facility must be completed and reported in accordance with 265.93(d)(5). 40 CFR 265.94, "Recordkeeping and Reporting": (b) If the groundwater is monitored to satisfy the requirements of §265.93(d)(4), the owner or operator must: (1) Keep records of the analyses and elevations specified in the plan, which satisfies the requirements of §265.9(d)(3) throughout the active life of the facility, and, for disposal facilities throughout the post-closure care period was well; and (2) Annually, until final closure of the facility, submit to the Regional Administrator a report containing the results of his or her groundwater quality assessment program which includes, but is not limited to, the calculated (or measured) rate of migration of hazardous water or hazardous waste constituent in the groundwater during the reporting period. This information must be submitted no later than March 1 following each calendar year.	

Notes: The references cited in this table are provided in Chapter 5 of this plan.

In accordance with WAC 173-303-400(3)(b), "Dangerous Waste Regulations," "Interim Status Facility Standards," for the purposes of applying the interim status standards of 40 CFR 265, Subpart F, "Ground-Water Monitoring," the federal terms "Regional Administrator" means the "Department" and "Hazardous" means "Dangerous."

In accordance with Section I.A of WA7890008967, *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit*, *Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste* (Hanford Facility RCRA Permit), the SST System unit will continue to be considered an interim status unit until is it incorporated into Part III, V, and/or VI of the Hanford Facility RCRA Permit, or until interim status is terminated. Therefore, groundwater monitoring continues under interim status requirements.

*RCRA regulatory requirements for interim status treatment, storage, and disposal units are found in WAC 173-303-400(3), "Dangerous Waste Regulations," "Interim Status Facility Standards," and 40 CFR 265.90, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Applicability," through 40 CFR 265.94, "Recordkeeping and Reporting," which are applicable to this groundwater monitoring plan.

2 Groundwater Monitoring Program

This chapter describes the groundwater quality assessment monitoring program for the WMAs in the SST System unit, including the constituents to be monitored, sampling frequency, monitoring well networks, and sampling and analysis protocols. A summary of the differences between this plan comprising six SST WMAs and the previous WMA-specific groundwater monitoring plans is also provided.

2.1 Monitoring Constituents and Sampling Frequency

Under this plan, three types of constituents are included for monitoring as follows:

- SST System waste constituents for groundwater quality assessment (Section 2.1.1)
- Supporting constituents, well casing corrosion constituents, and field measurements (Section 2.1.2)
- Constituents for 1 year of sampling at newly drilled wells (Section 2.1.3)

The analytical methods associated with the constituents in this plan are provided in Appendix A. Samples for metals that are analyzed by either method 6010 or 6020 in Table A-3 will be collected as both filtered and unfiltered samples.

Consistent with the requirements of 40 CFR 265.92(e), water-level measurements at each monitoring well will be determined each time that a sample is obtained.

2.1.1 Single-Shell Tank System Waste Constituents for Groundwater Quality Assessment

This section identifies the SST System-specific waste constituents that will be monitored and evaluated for the groundwater quality assessment at the SST WMAs. The waste constituents were identified based on the chemical data needs for component closure of the SSTs in the associated data quality objectives report (RPP-23403, *Single-Shell Tank Component Closure Data Quality Objectives*). An overview of the evaluation process for the SST System chemicals identified from RPP-23403 is provided in this section; details of the evaluation are presented in Appendix I.

The chemical parameters identified as needed to support SST component closures and associated risk assessments included major constituent categories that can be analyzed by specific analytical methods: inorganics, semivolatile organic compounds, and volatile organic compounds (Section 4.1 in RPP-23403). Specific or "primary" constituents were identified from the SST System Part A Form and underlying hazardous constituents (40 CFR 268.48, "Land Disposal Restrictions," "Universal Treatment Standards"). Secondary constituents (constituents that can be detected with the prescribed analytical methods but are not on the primary list) are to be added to the primary list in the event it affected the risk assessment.

Not every chemical prescribed as a data need for SST component closure is a dangerous waste. The objective of interim status groundwater quality assessment monitoring is to monitor for releases of dangerous waste(s) from a regulated unit; therefore, the primary and secondary chemical constituents were evaluated to identify dangerous wastes. Those chemicals that are identified from the waste codes in the SST System Part A Form (11-NWP-054, "Approval of the Single-Shell Tank System Dangerous Waste Permit Application Part A Form, Revision 13") or are constituents in Appendix 5 of Ecology Publication No. 97-407, *Chemical Test Methods For Designating Dangerous Waste WAC 173-303-090 & -100*, were identified and evaluated for inclusion as groundwater quality assessment monitoring at each of the SST WMAs (Appendix I).

The chemicals were checked for analytical availability at commercial laboratories. The constituents in Appendix 5 of Ecology Publication 97-407 are routinely analyzed at commercial laboratories; however, analysis for some of the dangerous wastes identified in the SST System Part A Form are either specialty analyses with availability at only a single laboratory or are not available. It is necessary to have a backup laboratory available for constituents required in an interim status groundwater monitoring plan; therefore, constituents that were available at only one commercial laboratory (or at no commercial laboratory) were excluded as SST System waste constituents.

Table 2-1 provides the groundwater quality assessment waste constituents for the SST System.

As discussed in Sections 1.1.1 through 1.1.6, each of the SST WMAs has an associated dangerous waste that was previously detected in groundwater and attributed to the WMA (chromium at WMA S-SX, WMA T, WMA TX-TY, and WMA U; cyanide at WMA B-BX-BY and WMA C). These dangerous wastes are included as waste constituents in the SST System groundwater quality assessment (Table 2-1) and will continue to be monitored.

Table 2-1. Groundwater Quality Assessment Constituents for the SST System

Waste Constituent	CAS Number
Inorganics	
Antimony	7440-36-0
Arsenic	7440-38-2
Barium	7440-39-3
Beryllium	7440-41-7
Cadmium	7440-43-9
Chromium	7440-47-3
Cobalt	7440-48-4
Copper	7440-50-8
Cyanide[a]	57-12-5
Lead	7439-92-1
Mercury	7439-97-6
Nickel	7440-02-0
Selenium	7782-49-2
Silver	7440-22-4
Thallium	7440-28-0
Tin	7440-31-5
Vanadium	7440-62-2
Zinc	7440-66-6
Semivolatile Organic Compounds	
1,2,4-Trichlorobenzene	120-82-1
1,2-Dichlorobenzene (o-Dichlorobenzene)	95-50-1
1,4-Dioxane (1,4-Diethylene dioxide)	123-91-1

Table 2-1. Groundwater Quality Assessment Constituents for the SST System

Waste Constituent	CAS Number
2,4,5-Trichlorophenol	95-95-4
2,4,6-Trichlorophenol	88-06-2
2,4-Dinitrotoluene	121-14-2
2-Chlorophenol	95-57-8
2-Methylphenol (o-Cresol)	95-48-7
2-Nitrophenol (o-Nitrophenol)	88-75-5
3-Methylphenol (m-Cresol)[b]	108-39-4
4-Chloro-3-methylphenol (p-Chloro-m-cresol)	59-50-7
4-Methylphenol (p-Cresol)[b]	106-44-5
Acenaphthene	83-32-9
Acetophenone	98-86-2
Benzo[a]pyrene	50-32-8
Butyl benzyl phthalate (Benzyl butyl phthalate)	85-68-7
Dibenz[a,h]anthracene (Dibenzanthracene, 1,2,5,6-)	53-70-3
Di-n-butyl phthalate	84-74-2
Di-n-octylphthalate	117-84-0
Diphenylamine	122-39-4
Fluoranthene	206-44-0
Hexachlorobenzene	118-74-1
Hexachlorobutadiene	87-68-3
Hexachloroethane	67-72-1
m-Dichlorobenzene (1,3-Dichlorobenzene)	541-73-1
Naphthalene	91-20-3
Nitrobenzene	98-95-3
n-Nitrosodimethylamine (Dimethyl nitrosamine)	62-75-9
n-Nitrosodi-n-butylamine	924-16-3
n-Nitroso-di-n-dipropylamine (n-Nitrosodipropylamine; Di-n-propylnitrosamine)	621-64-7
n-Nitrosomethylethalamine (Ethanamine, n-methyl-n-nitroso-)	10595-95-6
n-Nitrosomorpholine	59-89-2
Pentachloronitrobenzene	82-68-8
Pentachlorophenol	87-86-5

Table 2-1. Groundwater Quality Assessment Constituents for the SST System

Waste Constituent	CAS Number
Phenol	108-95-2
Pyrene	129-00-0
Pyridine	110-86-1
Volatile Organic Compounds	
1,1 Dichloroethane	75-34-3
1,1,1-Trichloroethane	71-55-6
1,1,2,2-Tetrachloroethane	79-34-5
1,1,2-Trichloro-1,2,2-trifluoroethane (Trichlorotrifluoroethane)	76-13-1
1,1,2-Trichloroethane	79-00-5
1,1-Dichloroethene (1,1-Dichloroethylene)	75-35-4
1,2-Dibromoethane	106-93-4
1,2-Dichloroethane	107-06-2
1,2-Dichloropropane	78-87-5
1-Butanol (n-Butyl alcohol)	71-36-3
2-Butanone (Methyl ethyl ketone; MEK)	78-93-3
2-Hexanone (Methyl butyl ketone [MBK])	591-78-6
2-Propanone (Acetone)	67-64-1
4-Methyl-2-pentanone (Methyl isobutyl ketone [MIBK])	108-10-1
Acetonitrile (Methyl cyanide)	75-05-8
Acrolein	107-02-8
Acrylonitrile	107-13-1
Allyl chloride	107-05-1
Benzene	71-43-2
Carbon disulfide	75-15-0
Carbon tetrachloride	56-23-5
Chlorobenzene	108-90-7
Chloroethane	75-00-3
Chloroform	67-66-3
cis-1,3-Dichloropropene	10061-01-5
Dichlorodifluoromethane	75-71-8
Ethyl acetate	141-78-6

Table 2-1. Groundwater Quality Assessment Constituents for the SST System

Waste Constituent	CAS Number
Ethyl ether (Diethyl ether)	60-29-7
Ethylbenzene	100-41-4
Isobutanol (Isobutyl alcohol)	78-83-1
Methacrylonitrile (2-propenenitrile, 2-Methyl-)	126-98-7
Methyl bromide (Bromomethane)	74-83-9
Methyl chloride (Chloromethane)	74-87-3
Methylene chloride	75-09-2
p-Dichlorobenzene (1,4-Dichlorobenzene)	106-46-7
Propionitrile (Ethyl cyanide)	107-12-0
Styrene	100-42-5
Tetrachloroethene (Tetrachloroethylene, Perchloroethylene)	127-18-4
Toluene	108-88-3
trans-1,3-Dichloropropene	10061-02-6
Trichloroethylene (Trichloroethene [TCE])	79-01-6
Trichlorofluoromethane	75-69-4
Vinyl chloride (Chloroethene, Chloroethylene)	75-01-4
Xylenes (total)	1330-20-7
Alcohols	
Methanol	67-56-1
Herbicides	
Dinoseb (2-sec-Butyl-4,6-dinitrophenol)	88-85-7
Pesticides	
Aldrin	309-00-2
alpha-BHC	319-84-6
beta-BHC	319-85-7
Dieldrin	60-57-1
Endrin	72-20-8
gamma-BHC (Lindane)	58-89-9
Heptachlor	76-44-8
Isodrin	465-73-6
Toxaphene	8001-35-2

Table 2-1. Groundwater Quality Assessment Constituents for the SST System

Waste Constituent	CAS Number
Polychlorinated Biphenyls	
Aroclor 1016	12674-11-2
Aroclor 1221	11104-28-2
Aroclor 1232	11141-16-5
Aroclor 1242	53469-21-9
Aroclor 1248	12672-29-6
Aroclor 1254	11097-69-1
Aroclor 1260	11096-82-5

a. Cyanide will be analyzed as both free and total cyanide.

b. 3-Methylphenol (m-cresol) and 4-methylphenol (p-cresol) will be analyzed by 3 & 4 methylphenol (CAS number 65794-96-9)

CAS = Chemical Abstracts Service

The groundwater quality assessment waste constituents for the SST System (Table 2-1) are sampled quarterly at each network well at each WMA in this plan. Sample results for the groundwater quality assessment waste constituents are evaluated to determine if dangerous waste(s) from the SST WMAs have entered groundwater, and if so, to support determining the concentration of the waste(s) and the rate and extent of contamination.

2.1.2 Supporting Constituents, Well Casing Corrosion Constituents, and Field Measurements

Supporting constituents, stainless steel well casing corrosion constituents[1], and field measurements (Table 2-2) are collected for information only and will be sampled quarterly at each of the WMA network wells.

Supporting constituents provide additional information on groundwater chemistry and include alkalinity, anions (chloride, nitrate, and sulfate), and metals (calcium, magnesium, potassium, and sodium). To support the groundwater quality assessment evaluation of chromium results, hexavalent chromium (filtered) will be collected as a supporting constituent at each of the WMAs.

Chromium, iron, manganese, molybdenum, and nickel will be analyzed to identify well casing corrosion (Section 2.1.4).

Field measurements include dissolved oxygen, pH, specific conductance, temperature, turbidity, and water-level measurements.

[1] For the purpose of evaluating for stainless steel corrosion in wells, chromium and nickel results are used for information only. Evaluation of chromium and nickel results as groundwater quality assessment constituents in Table 2-1, or as dangerous waste present in groundwater and attributed to a WMA, will be performed separately, as appropriate.

Table 2-2. Additional Sampling Constituents for SST WMAs

Constituent or Measurement	CAS Number
Supporting Constituents	
Alkalinity	N/A
Calcium	7440-70-2
Chloride	16887-00-6
Hexavalent chromium (filtered)	18540-29-9
Magnesium	7439-95-4
Nitrate	14797-55-8
Potassium	7440-09-7
Sodium	7440-23-5
Sulfate	14808-79-8
Stainless Steel Casing Corrosion Constituents	
Chromium	7440-47-3
Iron	7439-89-6
Manganese	7439-96-5
Molybdenum	7439-98-7
Nickel	7440-02-0
Field Measurements	
Dissolved oxygen	N/A
pH	N/A
Specific conductance	N/A
Temperature	N/A
Turbidity	N/A
Water level	N/A

CAS = Chemical Abstracts Service
N/A = not applicable

2.1.3 Sampling at Newly Drilled Wells and Existing Wells Added to the Network

Chapters 5 through 7 of the groundwater monitoring EERs evaluated the ability of the monitoring network that was used in 2016 at each WMA to detect contamination from the unit, and made recommendations for revised monitoring networks based on the results. The revised networks (which are used in this monitoring plan) include new proposed wells for WMA B-BX-BY, WMA C, WMA T, WMA TX-TY, and WMA U. A replacement-in-kind well is included for the WMA B-BX-BY network; other replacement wells are possible at any of the WMAs depending on future conditions.

Once installed, new wells (which also includes replacement wells) will be sampled quarterly for the constituents identified in Appendix 5 of Ecology Publication No. 97-407 (Table 2-3) during the first 1-year monitoring period to evaluate for any dangerous waste constituents or inadvertent contamination that occurred from the well drilling process (e.g., introduction of oil, grease, or other well construction materials used during drilling operations). This 1-year period of monitoring at new wells will be performed concurrently with monitoring for groundwater quality assessment constituents, supporting constituents, stainless steel casing corrosion constituents, and field measurements. At the discretion of DOE, monitoring for constituents identified in Table 2-3 (or a subset of the constituents) may continue at newly installed wells beyond the 1-year period if deemed necessary.

Table 2-3. Appendix 5 of Ecology Publication No. 97-407 Constituents

Constituent	CAS Number	Constituent	CAS Number
Inorganic Constituents			
Antimony	7440-36-0	Mercury	7439-97-6
Arsenic	7440-38-2	Nickel	7440-02-0
Barium	7440-39-3	Selenium	7782-49-2
Beryllium	7440-41-7	Silver	7440-22-4
Cadmium	7440-43-9	Sulfide	18496-25-8
Chromium	7440-47-3	Thallium	7440-28-0
Cobalt	7440-48-4	Tin	7440-31-5
Copper	7440-50-8	Vanadium	7440-62-2
Cyanide*	57-12-5	Zinc	7440-66-6
Lead	7439-92-1	--	--
Volatile Organic Compounds			
1,1-Dichloroethane	75-34-3	Carbon tetrachloride	56-23-5
1,1-Dichloroethene (1,1-Dichloroethylene)	75-35-4	Chlorobenzene	108-90-7
1,1,1-Trichloroethane	71-55-6	Chloroethane	75-00-3
1,1,1,2-Tetrachloroethane	630-20-6	Chloroform	67-66-3
1,1,2-Trichloroethane	79-00-5	Chloroprene	126-99-8
1,1,2,2-Tetrachloroethane	79-34-5	Dibromochloromethane	124-48-1
1,2-Dibromo-3-chloropropane	96-12-8	p-Dichlorobenzene (1,4-Dichlorobenzene)	106-46-7
1,2-Dibromoethane	106-93-4	Dichlorodifluoromethane	75-71-8
1,2-Dichloroethane	107-06-2	Ethylbenzene	100-41-4
1,2-Dichloropropane	78-87-5	Ethyl methacrylate	97-63-2
trans-1,2-Dichloroethylene	156-60-5	Isobutanol (Isobutyl alcohol)	78-83-1
1,2,3-Trichloropropane	96-18-4	Methacrylonitrile	126-98-7

Table 2-3. Appendix 5 of Ecology Publication No. 97-407 Constituents

Constituent	CAS Number	Constituent	CAS Number
cis-1,3-Dichloropropene	10061-01-5	Methyl bromide (Bromomethane)	74-83-9
trans-1,3-Dichloropropene	10061-02-6	Methyl chloride (Chloromethane)	74-87-3
trans-1,4-Dichloro-2-butene	110-57-6	Methyl iodide (Iodomethane)	74-88-4
2-Butanone (Methyl ethyl ketone; MEK)	78-93-3	Methyl methacrylate	80-62-6
2-Propanone (Acetone)	67-64-1	Methylene bromide (Dibromomethane)	74-95-3
2-Hexanone (Methyl butyl ketone)	591-78-6	Methylene chloride	75-09-2
4-Methyl-2-pentanone (Methyl isobutyl ketone)	108-10-1	Propionitrile (Ethyl cyanide)	107-12-0
Acetonitrile (Methyl cyanide)	75-05-8	Styrene	100-42-5
Acrolein	107-02-8	Tetrachloroethene	127-18-4
Acrylonitrile	107-13-1	Toluene	108-88-3
Allyl chloride	107-05-1	Trichloroethene (TCE)	79-01-6
Benzene	71-43-2	Trichlorofluoromethane	75-69-4
Bromodichloromethane	75-27-4	Vinyl acetate	108-05-4
Bromoform	75-25-2	Vinyl chloride (Chloroethene)	75-01-4
Carbon disulfide	75-15-0	Xylenes (total)	1330-20-7
Semivolatile Organic Compounds			
1-Naphthylamine	134-32-7	Dimethyl phthalate	131-11-3
1,2-Dichlorobenzene (o-Dichlorobenzene)	95-50-1	Di-n-butyl phthalate	84-74-2
1,2,4-Trichlorobenzene	120-82-1	m-Dinitrobenzene	99-65-0
1,2,4,5-Tetrachlorobenzene	95-94-3	Di-n-octylphthalate	117-84-0
1,4-Dioxane	123-91-1	Dinoseb (2-sec-Butyl-4,6-dinitrophenol)	88-85-7
1,4-Naphthoquinone	130-15-4	Diphenylamine	122-39-4
2-Acetylaminofluorene	53-96-3	Disulfoton	298-04-4
2-Chloronaphthalene	91-58-7	Ethyl methanesulfonate	62-50-0
2-Chlorophenol	95-57-8	Famphur	52-85-7
2-Methylphenol (o-cresol)	95-48-7	Fluoranthene	206-44-0
2-Methylnaphthalene	91-57-6	9H-Fluorene (Fluorene)	86-73-7
2-Naphthylamine	91-59-8	Hexachlorobenzene	118-74-1
2-Nitrophenol (o-Nitrophenol)	88-75-5	Hexachlorobutadiene	87-68-3
2-Picoline	109-06-8	Hexachlorocyclopentadiene	77-47-4

Table 2-3. Appendix 5 of Ecology Publication No. 97-407 Constituents

Constituent	CAS Number	Constituent	CAS Number
2,3,4,6-Tetrachlorophenol	58-90-2	Hexachloroethane	67-72-1
2,4-Dichlorophenol	120-83-2	Hexachlorophene	70-30-4
2,4-Dimethylphenol	105-67-9	Hexachloropropene	1888-71-7
2,4-Dinitrophenol	51-28-5	Indeno(1,2,3-cd)pyrene	193-39-5
2,4-Dinitrotoluene	121-14-2	Isodrin	465-73-6
2,4,5-Trichlorophenol	95-95-4	Isophorone	78-59-1
2,4,6-Trichlorophenol	88-06-2	Isosafrole	120-58-1
2,6-Dichlorophenol	87-65-0	Kepone	143-50-0
2,6-Dinitrotoluene	606-20-2	Methapyrilene	91-80-5
3-Methylcholanthrene	56-49-5	Methyl methanesulfonate	66-27-3
3-Methylphenol (m-Cresol)	108-39-4	Methyl parathion	298-00-0
4-Methylphenol (p-cresol)	106-44-5	Naphthalene	91-20-3
3,3′-Dichlorobenzidine	91-94-1	Nitrobenzene	98-95-3
3,3′-Dimethylbenzidine	119-93-7	o-Nitroaniline (2-Nitroaniline)	88-74-4
4-Aminobiphenyl	92-67-1	m-Nitroaniline (3-Nitroaniline)	99-09-2
4-Bromophenyl phenyl ether	101-55-3	p-Nitroaniline (4-Nitroaniline)	100-01-6
4-Chloro-3-methylphenol (p-Chloro-m-cresol)	59-50-7	p-Nitrophenol (4-Nitrophenol)	100-02-7
4-Chlorophenyl phenyl ether	7005-72-3	n-Nitrosodi-n-butylamine	924-16-3
4-Nitroquinoline 1-oxide	56-57-5	n-Nitrosodiethylamine	55-18-5
4,6-Dinitro-o-cresol (4,6-Dinitro-2-methyl phenol)	534-52-1	n-Nitrosodimethylamine	62-75-9
5-Nitro-o-toluidine	99-55-8	n-Nitrosodiphenylamine	86-30-6
7,12-Dimethylbenz[a]anthracene	57-97-6	n-Nitroso-di-n-dipropylamine (n-Nitrosodipropylamine; Di-n-propylnitrosamine)	621-64-7
Acenaphthene	83-32-9	n-Nitrosomethylethalamine	10595-95-6
Acenaphthylene	208-96-8	n-Nitrosomorpholine	59-89-2
Acetophenone	98-86-2	n-Nitrosopiperidine	100-75-4
Aniline	62-53-3	n-Nitrosopyrrolidine	930-55-2
Anthracene	120-12-7	Parathion	56-38-2
Aramite	140-57-8	Pentachlorobenzene	608-93-5
Benz[a]anthracene (Benzo[a]anthracene)	56-55-3	Pentachloroethane	76-01-7

Table 2-3. Appendix 5 of Ecology Publication No. 97-407 Constituents

Constituent	CAS Number	Constituent	CAS Number
Benz[e]acephenanthrylene (Benzo[b]fluoranthene)	205-99-2	Pentachloronitrobenzene	82-68-8
Benzo[k]fluoranthene	207-08-9	Pentachlorophenol	87-86-5
Benzo[ghi]perylene	191-24-2	Phenacetin	62-44-2
Benzo[a]pyrene	50-32-8	Phenanthrene	85-01-8
Benzyl alcohol	100-51-6	Phenol	108-95-2
Bis(2-chloroethoxy)methane	111-91-1	p-Phenylenediamine	106-50-3
Bis(2-chloroethyl)ether	111-44-4	Phorate	298-02-2
Bis(2-chloro-1-methylethyl) ether (2,2'-Oxybis(1-chloropropane))	108-60-1	Pronamide	23950-58-5
Bis(2-ethylhexyl) phthalate	117-81-7	Pyrene	129-00-0
Butylbenzylphthalate	85-68-7	Pyridine	110-86-1
p-Chloroaniline (4-Chloroaniline)	106-47-8	Safrole	94-59-7
Chlorobenzilate	510-15-6	Tetraethyl dithiopyrophosphate	3689-24-5
Chrysene	218-01-9	o-Toluidine	95-53-4
Diallate	2303-16-4	O,O,O-Triethyl phosphorothioate	126-68-1
Dibenz[a,h]anthracene	53-70-3	sym-Trinitrobenzene	99-35-4
Dibenzofuran	132-64-9	Aroclor 1016	12674-11-2
m-Dichlorobenzene (1,3-Dichlorobenzene)	541-73-1	Aroclor 1221	11104-28-2
Diethyl phthalate	84-66-2	Aroclor 1232	11141-16-5
O,O-Diethyl O-2-pyrazinyl phosphorothioate	297-97-2	Aroclor 1242	53469-21-9
Dimethoate	60-51-5	Aroclor 1248	12672-29-6
p-(Dimethylamino)azobenzene	60-11-7	Aroclor 1254	11097-69-1
alpha, alpha-Dimethylphenethylamine	122-09-8	Aroclor 1260	11096-82-5
Pesticides			
4,4′-DDD	72-54-8	Endosulfan I	959-98-8
4,4′-DDE	72-55-9	Endosulfan II	33213-65-9
4,4′-DDT	50-29-3	Endosulfan sulfate	1031-07-8
Aldrin	309-00-2	Endrin	72-20-8
alpha-BHC	319-84-6	Endrin aldehyde	7421-93-4
beta-BHC	319-85-7	Heptachlor	76-44-8
delta-BHC	319-86-8	Heptachlor epoxide	1024-57-3

Table 2-3. Appendix 5 of Ecology Publication No. 97-407 Constituents

Constituent	CAS Number	Constituent	CAS Number
gamma-BHC (Lindane)	58-89-9	Methoxychlor	72-43-5
Chlordane	57-74-9	Toxaphene	8001-35-2
Dieldrin	60-57-1	--	--
Herbicides			
2,4-D; 2,4-Dichlorophenoxyacetic acid	94-75-7	Silvex; 2,4,5-TP	93-72-1
2,4,5-T; 2,4,5-Trichlorophenoxyacetic acid	93-76-5	--	--
Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans			
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	Pentachlorodibenzofurans	30402-15-4
Hexachlorodibenzo-p-dioxins	34465-46-8	Tetrachlorodibenzo-p-dioxins	41903-57-5
Hexachlorodibenzofurans	55684-94-1	Tetrachlordibenzofurans	55722-27-5
Pentachlorodibenzo-p-dioxins	36088-22-9	--	--

Note: This table identifies the constituents in Appendix 5 of Ecology Publication No. 97-407, *Chemical Test Methods For Designating Dangerous Waste WAC 173-303-090 & -100*.

*Cyanide will be analyzed as both free and total cyanide.

CAS = Chemical Abstracts Service

N/A = not applicable

In the event that the well network is modified and an existing well[2] is added to the network, the newly added existing well will also be sampled quarterly for the constituents identified in Appendix 5 of Ecology Publication No. 97-407 (Table 2-3) during the first 1-year monitoring period to evaluate for any dangerous waste constituents.

At the discretion of DOE, monitoring for constituents identified in Appendix 5 of Ecology Publication No. 97-407 (or a subset of the constituents) may be continued beyond 1 year if deemed necessary.

Sample results for first-year well sampling of the constituents identified in Appendix 5 of Ecology Publication No. 97-407 are used for information only[3].

2.1.4 Well Casing Corrosion

Groundwater chemistry is routinely reviewed and evaluated for corrosion of stainless steel well casing. If the groundwater chemistry data for a well demonstrate a consistent upward trend over time for stainless steel corrosion constituents (chromium, iron, manganese, molybdenum, and nickel) in proportionate concentrations as found in stainless steel, it may be an indicator of corrosion. These data are used to

[2] "Existing well" refers to any well that is already installed and was not drilled specifically for the respective monitoring network.

[3] For the purpose of sampling for Appendix 5 of Ecology Publication 97-407 constituents, sample results are used for information only. However, constituents that are also identified in Table 2-1 are evaluated as groundwater quality assessment constituents or as dangerous waste present in groundwater and attributed to a WMA, as appropriate.

provide a better understanding of the potential condition of the network wells and are used for information only[4].

2.2 Single-Shell Tank Waste Management Area-Specific Sample Tables

This section provides sampling information specific to each SST WMA, including the wells in the groundwater monitoring network, constituents to be analyzed, and the sampling frequency for monitoring.

The standardized groundwater quality assessment waste constituents for the SST System (Table 2-1) used in this plan significantly expand the number of constituents sampled at each of the WMAs relative to their respective previous plan. Other differences exist between the standardized supporting constituents and field measurements in this plan applicable to each of the SST WMAs (Section 2.1.2) relative to their respective previous plan. Molybdenum had not been previously used as an indicator of stainless steel casing corrosion but is included in this plan; this difference is applicable to each of the SST WMAs. Such differences in sampling constituents at each WMA are summarized in the respective subsections that follow and Section 2.4.

2.2.1 Waste Management Area B-BX-BY

Table 2-4 presents the WMA B-BX-BY sampling information. In the previous groundwater assessment plan (DOE/RL-2012-53, Rev. 1), the identified dangerous waste constituent (cyanide), supporting constituents (alkalinity, anions, and metals), corrosion constituents, and field measurements (pH, specific conductance, and water-level measurements) were sampled at a quarterly frequency. In comparison to the previous plan, the sampling constituent changes comprise the expanded groundwater quality assessment constituents; addition of hexavalent chromium (filtered) as a supporting constituent; and addition of dissolved oxygen, temperature, and turbidity as field measurements.

The well network for WMA B-BX-BY is the same as the network identified in the EER for final status groundwater monitoring and includes one new proposed downgradient well:WMA_B-BX-BY_PW1 (Section 7.4 in SGW-60587) (identification for the proposed well is D0062). Well 299-E33-20 was installed in 1956 and does not meet the construction standards in WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"; therefore, a replacement-in-kind well will be installed. Once installed, the new well and the replacement well will be sampled quarterly for the constituents identified in Appendix 5 of Ecology Publication No. 97-407 (Table 2-3) for a 1-year period.

2.2.2 Waste Management Area C

Table 2-5 presents the WMA C sampling information. In the previous groundwater assessment plan (DOE/RL-2009-77, Rev. 1), the identified dangerous waste constituent (cyanide), supporting constituents (alkalinity, anions, and metals), corrosion constituents, and field measurements (pH, specific conductance, and water-level measurements) were sampled at a quarterly frequency. In comparison to the previous plan, the sampling constituent changes comprise expansion of the groundwater quality assessment constituents; removal of nitrite as a supporting constituent; addition of hexavalent chromium (filtered) as a supporting constituent; and addition of dissolved oxygen, temperature, and turbidity as field measurements.

[4] For the purpose of evaluating for stainless steel corrosion in wells, chromium and nickel results are used for information only. Evaluation of chromium and nickel results as dangerous waste previously attributed to a WMA or groundwater quality assessment constituents (as appropriate) is performed separately.

Table 2-4. Monitoring Well Network and Sample Schedule for WMA B-BX-BY

			Sampling Constituents[a]							
			SST System Waste Constituents	Supporting and Casing Corrosion Constituents and Field Measurements (Table 2-2)						New Well[b]
Well	Purpose	WAC Compliant	Table 2-1	Alkalinity (Total)	Anions[c]	Metals[d]	Hexavalent Chromium (Filtered)	Corrosion Constituents[e]	Field Measurements[f]	Table 2-3
299-E33-31	Upgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-E33-32	Upgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-E33-38	Upgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-E33-42	Upgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-E33-334	Upgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-E33-20[g]	Downgradient	N	Q	Q	Q	Q	Q	Q	Q	N/A
299-E33-41	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-E33-44	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-E33-47	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-E33-48	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-E33-49	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-E33-335	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-E33-337	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-E33-338	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-E33-339	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A

Table 2-4. Monitoring Well Network and Sample Schedule for WMA B-BX-BY

Well	Purpose	WAC Compliant	Sampling Constituents[a]							
			SST System Waste Constituents	Supporting and Casing Corrosion Constituents and Field Measurements (Table 2-2)						New Well[b]
			Table 2-1	Alkalinity (Total)	Anions[c]	Metals[d]	Hexavalent Chromium (Filtered)	Corrosion Constituents[e]	Field Measurements[f]	Table 2-3
WMA_ B-BX-BY_PW-1 (D0062)	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	Q

a. Samples for metals that are analyzed by either method 6010 or 6020 in Table A-3 will be collected as both filtered and unfiltered samples.

b. Sampling for the constituents identified in Appendix 5 of Ecology Publication No. 97-407, *Chemical Test Methods For Designating Dangerous Waste WAC 173-303-090 & -100* (Table 2-3), will be performed quarterly during the first 1-year monitoring period at newly drilled wells. This sampling will apply to new well WMA_B-BX-BY_PW-1 (D0062) and the future replacement well for 299-E33-20. Sampling for these constituents will be discontinued after completion of the first year of monitoring. At the discretion of the U.S. Department of Energy, monitoring for constituents identified in Table 2-3 (or a subset of the constituents) may continue at newly installed wells beyond the 1-year period if deemed necessary.

c. Anions include chloride, nitrate, and sulfate.

d. Metals include calcium, magnesium, potassium, and sodium.

e. Well casing corrosion constituents include chromium, iron, manganese, molybdenum, and nickel.

f. Field measurements include dissolved oxygen, pH, specific conductance, temperature, turbidity, and water-level measurement.

g. Well is not compliant with the construction standards in WAC 173-160, "Minimum Standard for Construction and Maintenance of Wells," and a replacement-in-kind well will be installed. The replacement-in-kind well will be sampled as described in Section 2.1.3 after installation (footnote b). After the replacement-in-kind well is ready for sampling, well 299-E33-20 will be removed from the network and no longer monitored under this plan.

N = well is not constructed as a resource protection well (WAC 173-160, "Minimum Standard for Construction and Maintenance of Wells")

N/A = not applicable

Q = to be sampled quarterly

SST = single-shell tank

WAC = *Washington Administrative Code*

Y = well is, or will be, constructed as a resource protection well (WAC 173-160)

Table 2-5. Monitoring Well Network and Sample Schedule for WMA C

Well	Purpose	WAC Compliant	Sampling Constituents[a]							
			SST System Waste Constituents	Supporting and Casing Corrosion Constituents and Field Measurements (Table 2-2)						New Well[b]
			Table 2-1	Alkalinity (Total)	Anions[c]	Metals[d]	Hexavalent Chromium (Filtered)	Corrosion Constituents[e]	Field Measurements[f]	Table 2-3
299-E27-12	Upgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-E27-15	Upgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-E27-22	Upgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-E27-26	Upgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-E27-13	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-E27-14	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-E27-21	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-E27-23	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-E27-24 (Deep)	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-E27-155 (Deep)	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
WMA_C_PW-1 (D0044)	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	Q

Table 2-5. Monitoring Well Network and Sample Schedule for WMA C

Well	Purpose	WAC Compliant	Sampling Constituents[a]							
			SST System Waste Constituents	Supporting and Casing Corrosion Constituents and Field Measurements (Table 2-2)						New Well[b]
			Table 2-1	Alkalinity (Total)	Anions[c]	Metals[d]	Hexavalent Chromium (Filtered)	Corrosion Constituents[e]	Field Measurements[f]	Table 2-3
WMA_C_PW-2 (D0045)	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	Q

a. Samples for metals that are analyzed by either method 6010 or 6020 in Table A-3 will be collected as both filtered and unfiltered samples.

b. Sampling for the constituents identified in Appendix 5 of Ecology Publication No. 97-407, *Chemical Test Methods For Designating Dangerous Waste WAC 173-303-090 & -100* (Table 2-3), will be performed quarterly during the first 1-year monitoring period at newly drilled wells. Sampling for these constituents will be discontinued after completion of the first year of monitoring. At the discretion of the U.S. Department of Energy, monitoring for constituents identified in Table 2-3 (or a subset of the constituents) may continue at newly installed wells beyond the 1-year period if deemed necessary.

c. Anions include chloride, nitrate, and sulfate.

d. Metals include calcium, magnesium, potassium, and sodium.

e. Well casing corrosion constituents include chromium, iron, manganese, molybdenum, and nickel.

f. Field measurements include dissolved oxygen, pH, specific conductance, temperature, turbidity, and water-level measurement.

N/A = not applicable

Q = to be sampled quarterly

SST = single-shell tank

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”)

The well network for WMA C is the same as the network identified in the EER for final status groundwater monitoring and includes two new proposed downgradient wells, WMA_C_PW1 and WMA_C_PW2 (Section 7.4 in SGW-60588) (identifications for the proposed wells are D0044 and D0045, respectively). Once installed, the new wells will be sampled quarterly for the constituents identified in Appendix 5 of Ecology Publication No. 97-407 (Table 2-3) for a 1-year period.

2.2.3 Waste Management Area S-SX

Table 2-6 presents the WMA S-SX sampling information. In the previous groundwater assessment plan (DOE/RL-2009-73, Rev. 1), the identified dangerous waste constituent (chromium), supporting constituents (alkalinity, anions, hexavalent chromium [filtered], and metals), corrosion constituents, and field measurements (pH, specific conductance, temperature, turbidity, and water-level measurements) were sampled at a quarterly frequency. In comparison to the previous plan, the sampling constituent changes comprise expansion of the groundwater quality assessment constituents and addition of dissolved oxygen as a field measurement.

The well network for WMA S-SX is the same as the network identified in the EER for final status groundwater monitoring (Section 7.3 in SGW-60588), with the exception of well 299-W23-19, which is removed from the network. Water-level measurements cannot be collected from well 299-W23-19 because the well is located within the 241-SX Tank Farm security fence, adjacent to tank SX-115, within a radiological control area. The pump discharge line and electrical wires for the sampling pump in this well pass through an underground pipe into a vault located outside the tank farm boundary. This allows the well to be sampled from the vault without field personnel entering the radiological control area. However, this configuration does not allow for water-level measurements to be collected, as routine access to the wellbore itself is not available. Because water-level measurements are required to be taken each time samples are collected, well 299-W23-19 is not included in the monitoring network.

2.2.4 Waste Management Area T

Table 2-7 presents the WMA T sampling information. In the previous groundwater assessment plan (DOE/RL-2009-66, Rev. 2), the identified dangerous waste constituent (chromium), supporting constituents (alkalinity, anions, hexavalent chromium [filtered], and metals), corrosion constituents, and field measurements (dissolved oxygen, pH, specific conductance, temperature, turbidity, and water-level measurements) were sampled at a quarterly frequency. In comparison to the previous plan, the sampling constituent changes comprise expansion of the groundwater quality assessment constituents and removal of fluoride as a supporting constituent.

The well network for WMA T is the same as the network identified in the EER for final status groundwater monitoring and includes three new proposed downgradient wells: WMA T_PW1, WMA T_PW2, and WMA T_PW3 (Section 7.4 in SGW-60575) (identifications for the proposed wells are D0017, D0018, and D0019, respectively). Once installed, the new wells will be sampled quarterly for the constituents identified in Appendix 5 of Ecology Publication No. 97-407 (Table 2-3) for a 1-year period.

Table 2-6. Monitoring Well Network and Sample Schedule for WMA S-SX

Well	Purpose	WAC Compliant	Sampling Constituents[a]						
			SST System Waste Constituents	Supporting and Casing Corrosion Constituents and Field Measurements (Table 2-2)					
			Table 2-1	Alkalinity (Total)	Anions[b]	Metals[c]	Hexavalent Chromium Filtered)	Corrosion Constituents[d]	Field Measurements[e]
299 W23-20	Upgradient	Y	Q	Q	Q	Q	Q	Q	Q
299 W23-21	Upgradient	Y	Q	Q	Q	Q	Q	Q	Q
299 W22-80	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q
299 W22-81	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q
299 W22-84	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q
299 W22-85	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q
299 W22-93	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q
299 W22-94	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q
299 W22-113	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q
299 W22-115	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q
299 W22-116	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q

a. Samples for metals that are analyzed by either method 6010 or 6020 in Table A-3 will be collected as both filtered and unfiltered samples.

b. Anions include chloride, nitrate, and sulfate.

c. Metals include calcium, magnesium, potassium, and sodium.

d. Well casing corrosion constituents include chromium, iron, manganese, molybdenum, and nickel.

e. Field measurements include dissolved oxygen, pH, specific conductance, temperature, turbidity, and water-level measurement.

N/A = not applicable
Q = to be sampled quarterly
SST = single-shell tank
WAC = *Washington Administrative Code*
Y = well is constructed as a resource protection well (WAC 173-160, “Minimum Standard for Construction and Maintenance of Wells”)

Table 2-7. Monitoring Well Network and Sample Schedule for WMA T

Well	Purpose	WAC Compliant	Sampling Constituents[a]							
			SST System Waste Constituents	Supporting and Casing Corrosion Constituents and Field Measurements (Table 2-2)						New Well[b]
			Table 2-1	Alkalinity (Total)	Anions[c]	Metals[d]	Hexavalent Chromium (Filtered)	Corrosion Constituents[e]	Field Measurements[f]	Table 2-3
299-W10-28	Upgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-W10-24	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-W11-39	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-W11-40	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-W11-41	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-W11-42	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
WMA T_PW1 (D0017)	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	Q
WMA-T_PW2 (D0018)	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	Q
WMA-T_PW3 (D0019)	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	Q

a. Samples for metals that are analyzed by either method 6010 or 6020 in Table A-3 will be collected as both filtered and unfiltered samples.

b. Sampling for the constituents identified in Appendix 5 of Ecology Publication No. 97-407, *Chemical Test Methods For Designating Dangerous Waste WAC 173-303-090 & -100* (Table 2-3), will be performed quarterly during the first 1-year monitoring period at newly drilled wells. Sampling for these constituents will be discontinued after completion of the first year of monitoring. At the discretion of the U.S. Department of Energy, monitoring for constituents identified in Table 2-3 (or a subset of the constituents) may continue at newly installed wells beyond the 1-year period if deemed necessary.

c. Anions include chloride, nitrate, and sulfate.

d. Metals include calcium, magnesium, potassium, and sodium.

Table 2-7. Monitoring Well Network and Sample Schedule for WMA T

			Sampling Constituents[a]							
			SST System Waste Constituents	Supporting and Casing Corrosion Constituents and Field Measurements (Table 2-2)						New Well[b]
Well	Purpose	WAC Compliant	Table 2-1	Alkalinity (Total)	Anions[c]	Metals[d]	Hexavalent Chromium (Filtered)	Corrosion Constituents[e]	Field Measurements[f]	Table 2-3

e. Well casing corrosion constituents include chromium, iron, manganese, molybdenum, and nickel.

f. Field measurements include dissolved oxygen, pH, specific conductance, temperature, turbidity, and water-level measurement.

N/A = not applicable

Q = to be sampled quarterly

SST = single-shell tank

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")

2.2.5 Waste Management Area TX-TY

Table 2-8 presents the WMA TX-TY sampling information. In the previous groundwater assessment plan (DOE/RL-2009-67, Rev. 2), the identified dangerous waste constituent (chromium), supporting constituents (alkalinity, anions, hexavalent chromium [filtered], and metals), corrosion constituents, and field measurements (dissolved oxygen, pH, specific conductance, temperature, turbidity, and water-level measurements) were sampled at a quarterly frequency. In comparison to the previous plan, the sampling constituent changes comprise expansion of the groundwater quality assessment constituents and removal of fluoride and aluminum as supporting constituents.

The well network for WMA TX-TY is the same as the network identified in the EER for final status groundwater monitoring and includes two new proposed upgradient wells, WMA_TX-TY_PW1 and WMA_TX-TY_PW2 (identifications for the proposed wells are D0020 and D0021, respectively). Due to their proximity to 200 West pump and treat (P&T) system extraction wells, current upgradient wells 299-W15-44 and 299-W15-765 will be replaced with the proposed wells. (Section 7.4 in SGW-60576). However, the proposed upgradient wells are not yet installed. Until the proposed upgradient wells are installed and ready for sampling, the existing wells (299-W15-44 and 299-W15-765) will be used as upgradient wells in this monitoring plan. After WMA_TX-TY_PW1 and WMA_TX-TY_PW2 (D0020 and D0021) are ready for sampling, wells 299-W15-44 and 299-W15-765 will be removed from the network.

Once installed, new wells WMA_TX-TY_PW1 and WMA_TX-TY_PW2 (D0020 and D0021) will be sampled quarterly for the constituents identified in Appendix 5 of Ecology Publication No. 97-407 (Table 2-3) for a 1-year period.

2.2.6 Waste Management Area U

Table 2-9 presents the WMA U sampling information. In the previous groundwater assessment plan (DOE/RL-2009-74, Rev. 2), the identified dangerous waste constituent (chromium), supporting constituents (alkalinity, anions, hexavalent chromium [filtered], and metals), corrosion constituents, and field measurements (dissolved oxygen, pH, specific conductance, temperature, turbidity, and water-level measurements) were sampled at a quarterly frequency. In comparison to the previous plan, the sampling constituent changes comprise expansion of the groundwater quality assessment constituents and addition of dissolved oxygen as a field measurement.

The well network for WMA U is the same as the network identified in the EER for final status groundwater monitoring and includes one new proposed upgradient well, WMA_U_PW1 (Section 7.4 in SGW-60578) (the identification for the proposed well is D0016). Once installed, the new well will be sampled quarterly for the constituents identified in Appendix 5 of Ecology Publication No. 97-407 (Table 2-3) for a 1-year period.

Table 2-8. Monitoring Well Network and Sample Schedule for WMA TX-TY

Well	Purpose	WAC Compliant	Sampling Constituents[a]							
			SST System Waste Constituents	Supporting and Casing Corrosion Constituents and Field Measurements (Table 2-2)						New Well[b]
			Table 2-1	Alkalinity (Total)	Anions[c]	Metals[d]	Hexavalent Chromium (Filtered)	Corrosion Constituents[e]	Field Measurements[f]	Table 2-3
WMA_TX-TY_PW1 (D0020)	Upgradient	Y	Q	Q	Q	Q	Q	Q	Q	Q
WMA_TX-TY_PW2 (D0021)	Upgradient	Y	Q	Q	Q	Q	Q	Q	Q	Q
299-W15-44[g]	Upgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-W15-765[g]	Upgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-W10-26	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-W10-27	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-W14-13	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-W14-14	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-W14-15	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-W14-18	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A

Table 2-8. Monitoring Well Network and Sample Schedule for WMA TX-TY

Well	Purpose	WAC Compliant	Sampling Constituents[a]							
			SST System Waste Constituents	Supporting and Casing Corrosion Constituents and Field Measurements (Table 2-2)						New Well[b]
			Table 2-1	Alkalinity (Total)	Anions[c]	Metals[d]	Hexavalent Chromium (Filtered)	Corrosion Constituents[e]	Field Measurements[f]	Table 2-3
299-W14-19	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A

a. Samples for metals that are analyzed by either method 6010 or 6020 in Table A-3 will be collected as both filtered and unfiltered samples.

b. Sampling for the constituents identified in Appendix 5 of Ecology Publication No. 97-407, *Chemical Test Methods For Designating Dangerous Waste WAC 173-303-090 & -100* (Table 2-3), will be performed quarterly during the first 1-year monitoring period at newly drilled wells. Sampling for these constituents will be discontinued after completion of the first year of monitoring. At the discretion of the U.S. Department of Energy, monitoring for constituents identified in Table 2-3 (or a subset of the constituents) may continue at newly installed wells beyond the 1-year period if deemed necessary.

c. Anions include chloride, nitrate, and sulfate.

d. Metals include calcium, magnesium, potassium, and sodium.

e. Well casing corrosion constituents include chromium, iron, manganese, molybdenum, and nickel.

f. Field measurements include dissolved oxygen, pH, specific conductance, temperature, turbidity, and water-level measurement.

g. Proposed wells WMA_TX-TY_PW1 and WMA_TX-TY_PW2 are the only upgradient wells identified for the network. Because these two wells are not yet installed, existing upgradient wells will be included for monitoring until the new upgradient wells are ready for sampling. Evaluation of the previous well network identified that wells 299-W15-44 and 299-W15-765 are upgradient; therefore, these wells will be used for upgradient monitoring. After WMA_TX-TY_PW1 and WMA_TX-TY_PW2 are ready for sampling, wells 299-W15-44 and 299-W15-765 will be removed from the network and no longer monitored under this plan.

N/A = not applicable

Q = to be sampled quarterly

SST = single-shell tank

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")

Table 2-9. Monitoring Well Network and Sample Schedule for WMA U

Well	Purpose	WAC Compliant	Sampling Constituents[a]							
			SST System Waste Constituents	Supporting and Casing Corrosion Constituents and Field Measurements (Table 2-2)						New Well[b]
			Table 2-1	Alkalinity (Total)	Anions[c]	Metals[d]	Hexavalent Chromium (Filtered)	Corrosion Constituents[e]	Field Measurements[f]	(Table 2-3)
299-W18-40	Upgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
WMA_U_PW1 (D0016)	Upgradient	Y	Q	Q	Q	Q	Q	Q	Q	Q
299-W18-260	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-W19-41	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-W19-42	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-W19-44	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-W19-45	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A
299-W19-47	Downgradient	Y	Q	Q	Q	Q	Q	Q	Q	N/A

a. Samples for metals that are analyzed by either method 6010 or 6020 in Table A-3 will be collected as both filtered and unfiltered samples.

b. Sampling for the constituents identified in Appendix 5 of Ecology Publication No. 97-407, *Chemical Test Methods For Designating Dangerous Waste WAC 173-303-090 & -100* (Table 2-3), will be performed quarterly during the first 1-year monitoring period at newly drilled wells. Sampling for these constituents will be discontinued after completion of the first year of monitoring. At the discretion of the U.S. Department of Energy, monitoring for constituents identified in Table 2-3 (or a subset of the constituents) may continue at newly installed wells beyond the 1-year period if deemed necessary.

c. Anions include chloride, nitrate, and sulfate.

d. Metals include calcium, magnesium, potassium, and sodium.

e. Well casing corrosion constituents include chromium, iron, manganese, molybdenum, and nickel.

f. Field measurements include dissolved oxygen, pH, specific conductance, temperature, turbidity, and water-level measurement.

N/A = not applicable

Q = to be sampled quarterly

SST = single-shell tank

Table 2-9. Monitoring Well Network and Sample Schedule for WMA U

Well	Purpose	WAC Compliant	Sampling Constituents[a]							
			SST System Waste Constituents	Supporting and Casing Corrosion Constituents and Field Measurements (Table 2-2)						New Well[b]
			Table 2-1	Alkalinity (Total)	Anions[c]	Metals[d]	Hexavalent Chromium (Filtered)	Corrosion Constituents[e]	Field Measurements[f]	(Table 2-3)

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")

2.2.7 Sample Schedule Impacts from Well Maintenance and Sampling Logistics

Well maintenance (e.g., pump repairs, periodic well cleaning, and redevelopment) and sampling logistics resulting from multiple factors, including environmental (e.g., inclement weather) and access restrictions (e.g., heightened fire danger, area access restriction due to work by other Hanford Site 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 sampling schedule for a well within a given month. If a well cannot be sampled at the times determined by the FWS, then the FWS and Sample Management and Reporting group, along with the project scientist, consult to determine 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 does not begin and management is notified. Depending on the situation, the network sampling is rescheduled as soon as feasible to meet the schedule set forth in this plan. 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 scheduling sampling for the following month. In the event that a sampling delay has occurred and the representativeness of the samples is in question, DOE and Ecology may agree to resampling wells. DOE 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 on how to proceed. Missed or canceled sampling events are reported to DOE and are documented in the annual Hanford Site RCRA groundwater monitoring report (e.g., DOE/RL-2019-65, *Hanford Site RCRA Groundwater Monitoring Report for 2019*).

2.3 Monitoring Well Networks

This section provides the monitoring well networks for each of the SST WMAs.

If a well is within approximately 2 years of going sample dry, a replacement well is proposed; such wells that are proposed for installation at the Hanford Site are negotiated annually by Ecology, DOE, and EPA under Tri-Party Agreement Milestone M-24-00 (Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*).

Construction details and pertinent information for the wells in each SST WMA network are provided in Appendices C through H.

2.3.1 Waste Management Area B-BX-BY

The groundwater well network identified for interim status monitoring of WMA B-BX-BY is the same as that proposed for final status monitoring in SGW-60587 and consists of 5 upgradient wells (299-E33-31, 299-E33-32, 299-E33-38, 299-E33-42, and 299-E33-334) and 11 downgradient wells (299-E33-20, 299-E33-41, 299-E33-44, 299-E33-47, 299-E33-48, 299-E33-49, 299-E33-335, 299-E33-337, 299-E33-338, 299-E33-339, and proposed well WMA_B-BX-BY_PW-1 [D0062]) (Section 9.3 in SGW-60587). The network wells were selected through the methodology presented in Chapters 5 through 7 of SGW-60587, based on known groundwater conditions.

The groundwater flow direction toward the southeast was used in the WMA B-BX-BY EER to identify a monitoring well network (Section 9.3 in SGW-60587). Specific details regarding the selection of each well location are presented in Sections 9.3.1 through 9.3.16 of SGW-60587. Figure 2-1 presents the groundwater monitoring network to be used in this plan. Information on the wells comprising the WMA B-BX-BY network is summarized in Table 2-10.

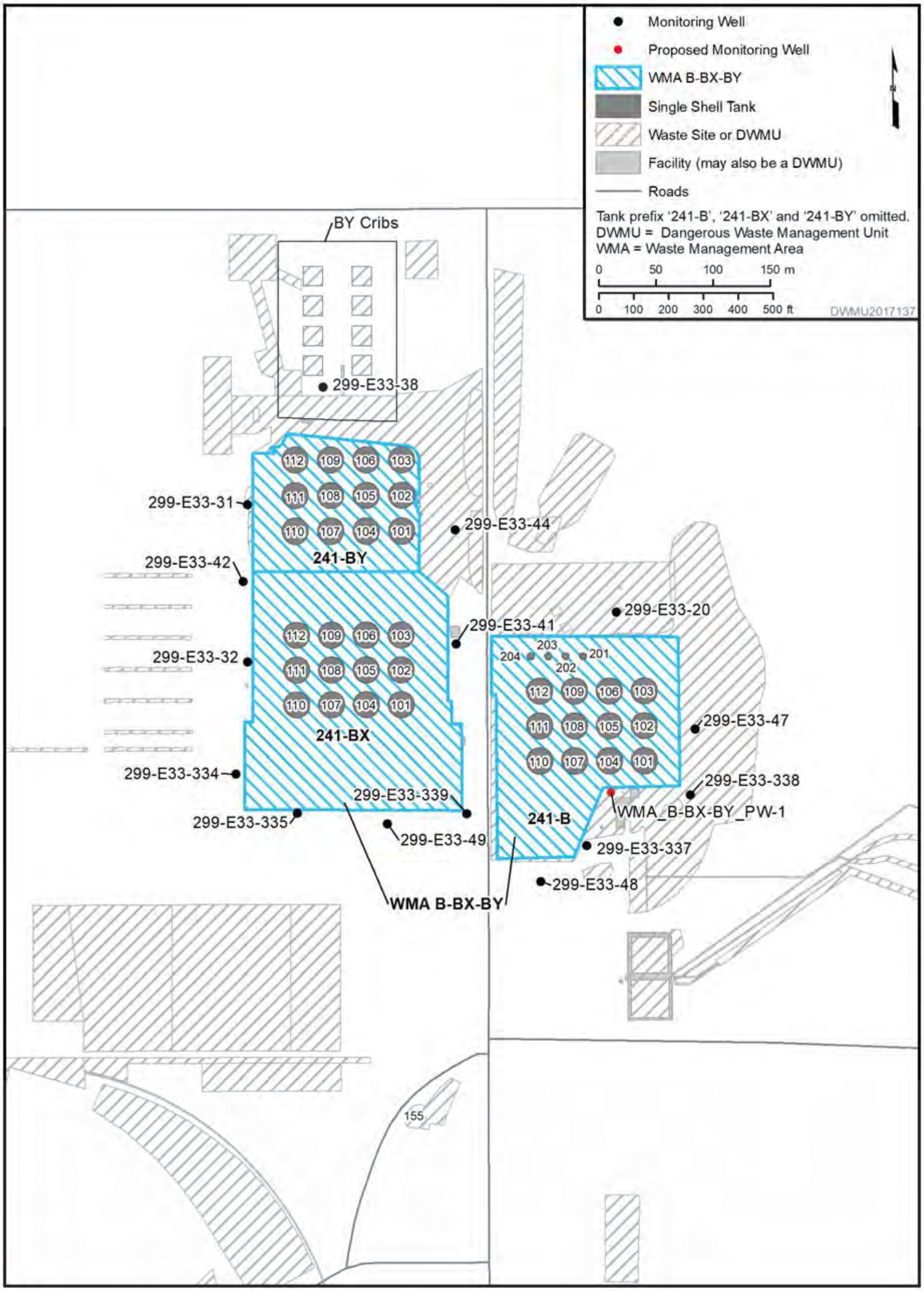


Figure 2-1. WMA B-BX-BY Monitoring Well Network

Table 2-10. Attributes for Wells in the WMA B-BX-BY Groundwater Monitoring Network

Well Name	Completion Date	Easting[a] (m)	Northing[a] (m)	Top of Casing Elevation (m [ft]) (NAVD88)	Water Table Elevation (m [ft]) (NAVD88)	Depth to Water (m [ft] bgs)	Depth of Water in Screen (m [ft])	Water-Level Date
299-E33-20[b]	7/5/1956	573847.60	137397.91	199.16 (653.40)	121.62 (399.01)	76.6 (251.2)	2.9 (9.5)	8/19/2019
299-E33-31	9/11/1989	573524.98	137491.44	198.37 (650.82)	121.62 (399.01)	75.8 (248.8)	2.2 (7.1)	9/30/2019
299-E33-32	9/5/1989	573524.83	137354.02	202.20 (663.38)	121.62 (399.01)	79.6 (261.3)	1.9 (6.1)	9/30/2019
299-E33-38	4/1/1991	573591.16	137594.49	193.63 (635.26)	121.70 (399.28)	71.3 (234.0)	1.7 (5.6)	9/30/2019
299-E33-41	3/28/1991	573707.19	137369.94	200.63 (658.25)	121.62 (399.00)	78.0 (255.8)	1.6 (5.2)	9/30/2019
299-E33-42	11/6/1991	573520.99	137424.38	200.45 (657.63)	121.62 (399.002)	77.8 (255.2)	1.4 (4.6)	9/30/2019
299-E33-44	9/26/1998	573706.41	137469.16	196.77 (645.58)	121.61 (398.99)	74.4 (244.2)	2.7 (8.8)	9/30/2019
299-E33-47	8/5/2004	573916.48	137295.46	198.53 (651.33)	121.64 (399.08)	76.1 (249.7)	4.4 (14.4)	8/16/2019
299-E33-48	9/9/2004	573781.45	137162.07	203.36 (667.19)	121.64 (399.08)	81.0 (265.6)	6.0 (19.6)	8/16/2019
299-E33-49	8/9/2004	573647.48	137212.80	204.00 (669.30)	121.65 (399.12)	81.6 (267.7)	4.8 (15.8)	8/16/2019
299-E33-334	1/5/2000	573514.72	137256.37	204.21 (669.97)	121.63 (399.06)	81.7 (267.9)	4.5 (14.8)	8/20/2019
299-E33-335	2/10/2000	573568.44	137222.23	204.26 (670.15)	121.62 (399.01)	81.8 (268.4)	3.6 (11.7)	5/6/2019
299-E33-337	8/3/2001	573821.80	137193.87	202.72 (665.08)	121.64 (399.08)	80.3 (263.6)	5.1 (16.8)	8/16/2019
299-E33-338	8/31/2001	573912.07	137238.24	201.11 (659.80)	121.64 (399.07)	78.6 (258.0)	3.9 (12.9)	8/19/2019
299-E33-339	8/17/2001	573716.86	137221.51	203.03 (666.11)	121.63 (399.03)	80.7 (264.7)	4.5 (14.6)	9/30/2019

Table 2-10. Attributes for Wells in the WMA B-BX-BY Groundwater Monitoring Network

Well Name	Completion Date	Easting[a] (m)	Northing[a] (m)	Top of Casing Elevation (m [ft]) (NAVD88)	Water Table Elevation (m [ft]) (NAVD88)	Depth to Water (m [ft] bgs)	Depth of Water in Screen (m [ft])	Water-Level Date
WMA_B-BX-BY_PW-1 (D0062)	TBD	573842.98	137240.21	TBD	TBD	TBD	TBD	TBD

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

Note: Proposed well coordinates are estimates and are subject to modification based on final well location survey.

a. Coordinates are in Washington State Plane (south zone), NAD83, *North American Datum of 1983*; 1991 adjustment.

b. Well is not compliant with the construction standards in WAC 173-160, "Minimum Standard for Construction and Maintenance of Wells," and a replacement-in-kind well will be installed.

bgs = below ground surface

TBD = to be determined. Information will be obtained after well construction.

A groundwater removal action under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* in the WMA B-BX-BY area (P&T for uranium and technetium-99) is currently in operation. The action began in September 2015 as a treatability test and transitioned to a removal action in 2016 under the action memorandum (DOE/RL-2016-41, *Action Memorandum for 200-BP-5 Operable Unit Groundwater Extraction*). In 2018, the removal action work plan for the 200-BP-5 Operable Unit was issued (DOE/RL-2017-11, *Removal Action Work Plan for the 200-BP-5 Operable Unit Groundwater Extraction*). Operation of the P&T affects groundwater flow conditions at WMA B-BX-BY and may affect the gradient designations for the monitoring well network. Flow conditions at WMA B-BX-BY will be evaluated as part of the continued quarterly determinations (Section 3.5). Any change in well gradient designations will be included in the quarterly determination reports.

2.3.2 Waste Management Area C

The groundwater well network identified for interim status monitoring of WMA C is the same as that proposed for final status monitoring in SGW-60588 and consists of four upgradient wells (299-E27-12, 299-E27-15, 299-E27-22, and 299-E27-26) and eight downgradient wells (299-E27-13, 299-E27-14, 299-E27-21, 299-E27-23, 299-E27-24 [deep], 299-E27-155 [deep], and proposed wells WMA_C_PW-1 and WMA_C_PW-2 [D0044 and D0045]) (Section 9.3 in SGW-60588). The groundwater chemistry in the vicinity of WMA C indicates that some measurements (e.g., chloride, cyanide, and specific conductance) exhibit elevated concentrations in the deeper part of the unconfined aquifer in some locations. Based on these observations, it is appropriate to maintain and monitor groundwater in the existing monitoring wells completed in the lower part of the aquifer (i.e., 299-E27-24, 299-E27-26, and 299-E27-155) (Section 9.3 in SGW-60588). The network wells were selected through the methodology presented in Chapters 5 through 7 of SGW-60588, based on known groundwater conditions.

The groundwater flow direction at WMA C is to the south-southeast (Section 9.3 in SGW-60588). Specific details regarding the selection of each of the well locations are presented in Sections 9.3.1 through 9.3.12 of SGW-60588. Figure 2-2 presents the groundwater monitoring network to be used in this plan. Information on the wells comprising the WMA C network is summarized in Table 2-11.

2.3.3 Waste Management Area S-SX

The groundwater well network identified for interim status monitoring of WMA S-SX is the same as that proposed for final status monitoring in SGW-60577, with the exception of well 299-W23-19 which is not accessible for water-level measurements and is not included in the network. The monitoring network consists of two upgradient wells (299-W23-20 and 299-W23-21) and nine downgradient wells (299-W22-80, 299-W22-81, 299-W22-84, 299-W22-85, 299-W22-93, 299-W22-94, 299-W22-113, 299-W22-115, and 299-W22-116) (Section 9.3 in SGW-60577). The network wells were selected through the methodology presented in Chapters 5 through 7 of SGW-60577, based on known groundwater conditions.

The groundwater flow direction at WMA S-SX is to the east (Section 9.3 in SGW-60577). Specific details regarding the selection of each of the well locations are presented in Sections 9.3.1 through 9.3.12 of SGW-60577. Figure 2-3 presents the groundwater monitoring network to be utilized in this plan. Information on the wells comprising the WMA S-SX network is summarized in Table 2-12.

2.3.4 Waste Management Area T

The groundwater well network identified for interim status monitoring of WMA T is the same as that proposed for final status monitoring in SGW-60575 and consists of one upgradient well (existing well 299-W10-28) and eight downgradient wells (existing wells 299-W10-24, 299-W11-39, 299-W11-40, 299-W11-41, and 299-W11-42 and proposed wells WMA-T_PW1, WMA-T_PW2, and WMA-T_PW3 [D0017, D0018, and D0019]) (Section 9.3 in SGW-60575). The network wells were selected through the methodology presented in Chapters 5 through 7 of SGW-60575, based on known groundwater conditions.

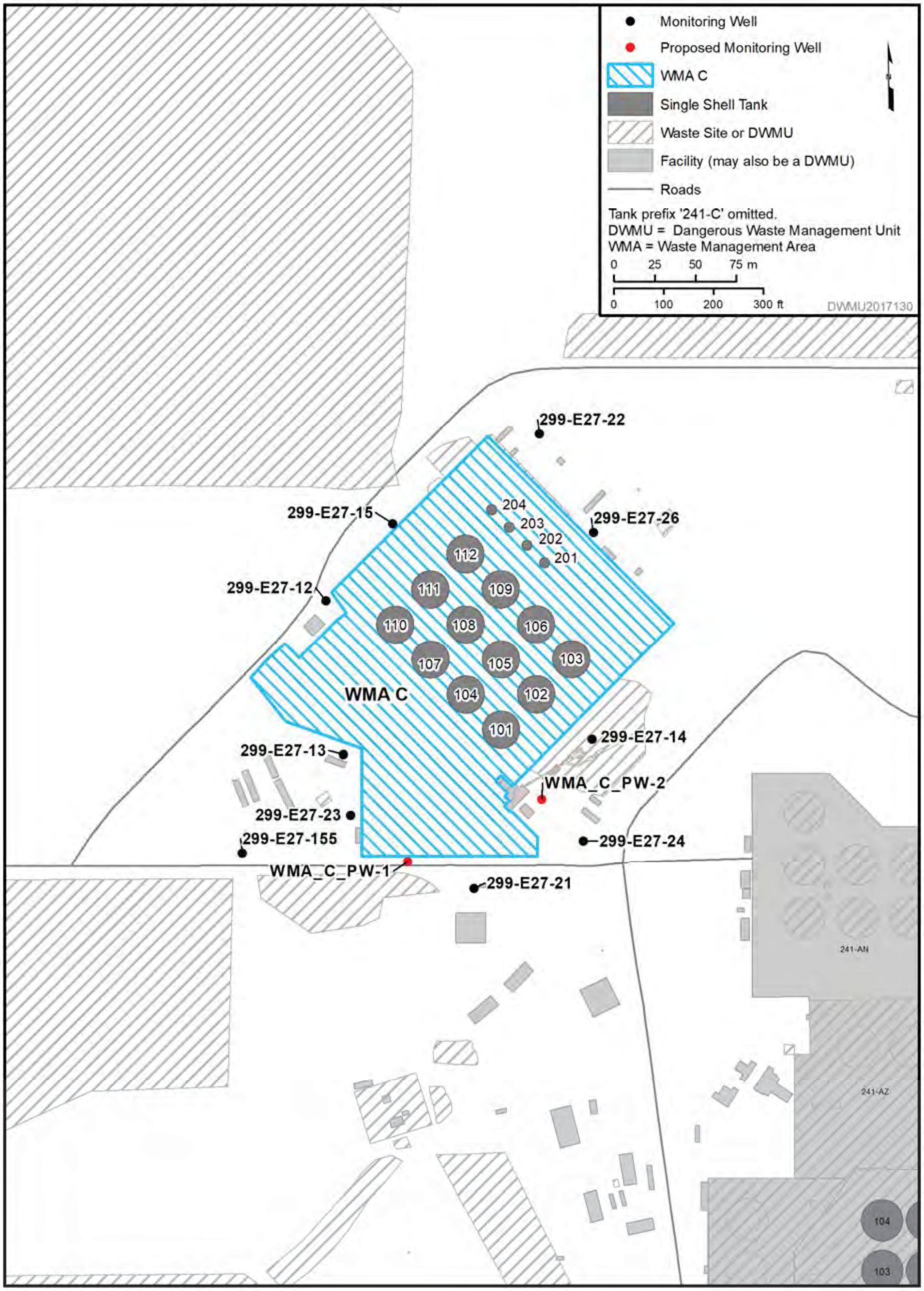


Figure 2-2. WMA C Monitoring Well Network

Table 2-11. Attributes for Wells in the WMA C Groundwater Monitoring Network

Well Name	Completion Date	Easting* (m)	Northing* (m)	Top of Casing Elevation (m [ft]) (NAVD88)	Water Table Elevation (m [ft]) (NAVD88)	Depth to Water (m [ft] bgs)	Depth of Water in Screen (m [ft])	Water-Level Date
299-E27-12	10/9/1989	575054.14	136583.53	202.55 (664.52)	121.61 (398.99)	79.9 (262.2)	1.6 (5.4)	9/30/2019
299-E27-13	10/12/1989	575064.92	136489.23	204.92 (672.30)	121.58 (398.87)	82.5 (270.7)	1.2 (4.0)	9/20/2019
299-E27-14	10/17/1989	575217.34	136498.24	201.75 (661.92)	121.60 (398.96)	79.2 (260.0)	2.1 (6.8)	9/30/2019
299-E27-15	10/3/1989	575095.26	136630.36	200.02 (656.25)	121.61 (398.97)	77.6 (254.4)	1.4 (4.6)	9/30/2019
299-E27-21	7/25/2003	575145.03	136407.21	205.72 (674.95)	121.60 (398.94)	83.4 (273.6)	10.0 (32.8)	9/30/2019
299-E27-22	9/12/2003	575185.10	136685.33	193.38 (634.45)	121.63 (399.06)	71.0 (232.8)	10.7 (35.2)	9/30/2019
299-E27-23	9/2/2003	575069.46	136452.23	206.56 (677.69)	121.61 (398.99)	84.0 (275.7)	10.0 (32.8)	9/30/2019
299-E27-24 (Deep)	6/7/2010	575212.03	136436.28	203.55 (667.83)	121.55 (398.80)	81.3 (266.7)	6.1 (20.0)	9/17/2019
299-E27-26	3/1/2016	575218.04	136624.88	195.25 (640.58)	121.05 (397.13)	73.5 (241.0)	10.3 (34.0)	9/18/2019
299-E27-155 (Deep)	11/13/2007	575003.11	136429.08	208.52 (684.11)	121.49 (398.59)	86.2 (282.8)	10.7 (35.0)	9/17/2019
WMA_C_PW-1 (D0044)	TBD	575104.50	136423.70	TBD	TBD	TBD	TBD	TBD
WMA_C_PW-2 (D0045)	TBD	575186.34	136461.91	TBD	TBD	TBD	TBD	TBD

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

Note: Proposed well coordinates are estimates and are subject to modification based on final well location survey.

*Coordinates are in Washington State Plane (south zone), NAD83, *North American Datum of 1983*; 1991 adjustment.

bgs = below ground surface

TBD = to be determined. Information will be obtained after well construction.

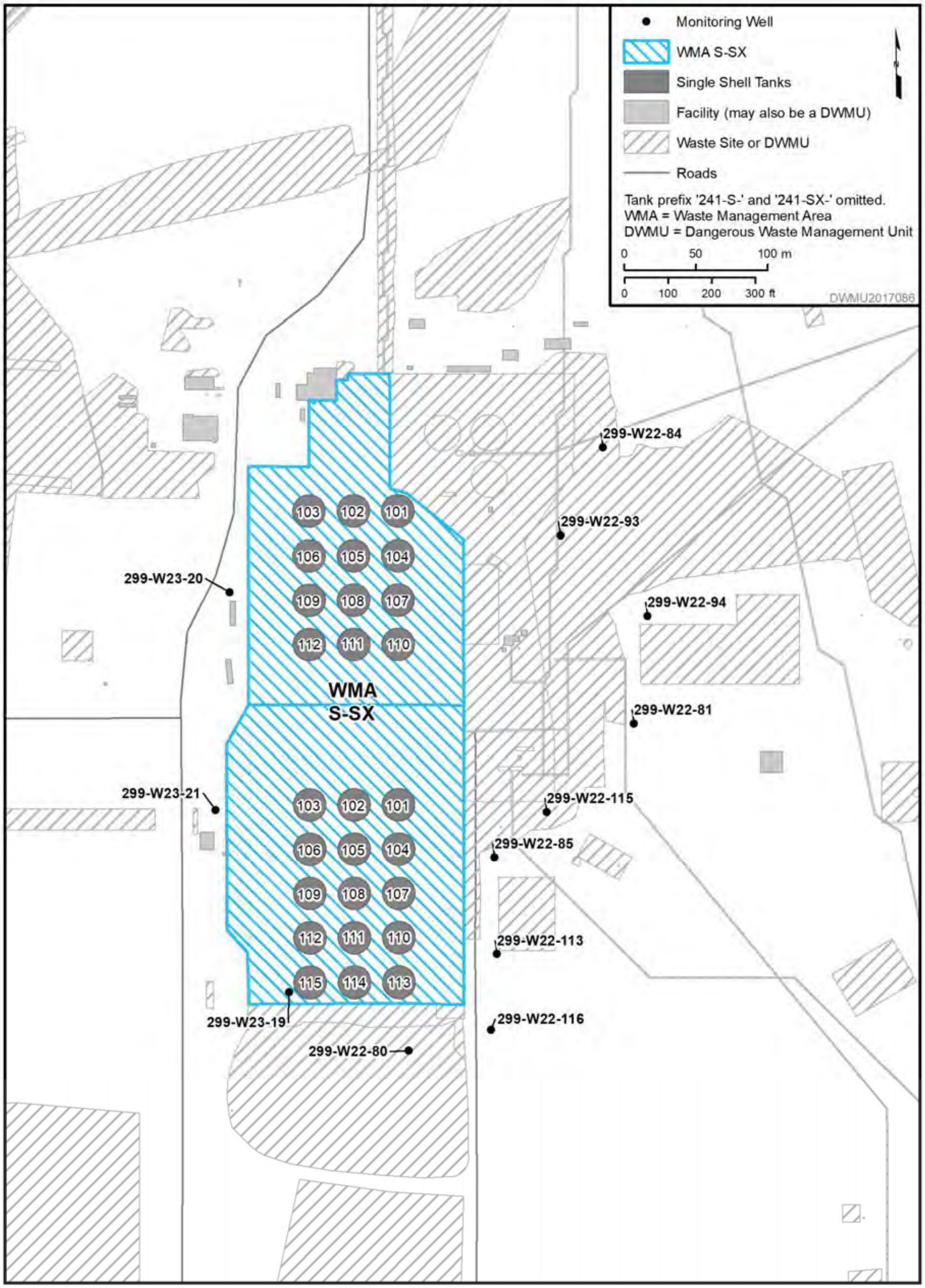


Figure 2-3. WMA S-SX Monitoring Well Network

Table 2-12. Attributes for Wells in the WMA S-SX Groundwater Monitoring Network

Well Name	Completion Date	Easting* (m)	Northing* (m)	Top of Casing Elevation (m [ft]) (NAVD88)	Water Table Elevation (m [ft]) (NAVD88)	Depth to Water (m [ft] bgs)	Depth of Water in Screen (m [ft])	Water-Level Date
299-W22-80	9/11/2000	566842.85	134125.65	200.85 (658.97)	132.10 (433.39)	67.9 (222.7)	5.3 (17.4)	9/30/2019
299-W22-81	1/31/2001	567000.26	134354.19	206.64 (677.97)	131.54 (431.55)	74.4 (244.0)	5.4 (17.7)	9/30/2019
299-W22-84	11/1/2001	566978.76	134547.62	208.51 (684.09)	131.51 (431.45)	76.3 (250.3)	5.1 (16.7)	9/30/2019
299-W22-85	10/26/2001	566902.90	134260.58	204.41 (670.63)	131.99 (433.03)	71.7 (235.2)	5.1 (16.8)	9/30/2019
299-W22-93	5/14/2015	566949.07	134485.98	207.63 (681.20)	131.41 (431.14)	75.5 (247.6)	9.8 (32.1)	9/11/2019
299-W22-94	9/30/2013	567009.82	134429.75	208.04 (682.54)	131.40 (431.11)	75.9 (249.0)	8.9 (29.2)	9/30/2019
299-W22-113	10/8/2014	566904.52	134192.75	204.75 (671.75)	131.88 (432.67)	72.2 (236.8)	8.3 (27.2)	9/30/2019
299-W22-115	6/4/2015	566939.39	134292.43	204.37 (670.49)	131.80 (432.43)	71.8 (235.6)	9.2 (30.3)	9/30/2019
299-W22-116	4/22/2015	566900.50	134139.92	204.91 (672.27)	131.87 (432.65)	72.3 (237.2)	10.0 (32.8)	9/30/2019
299-W23-20	8/21/2000	566717.67	134446.19	203.80 (668.64)	132.64 (435.17)	70.5 (231.2)	5.9 (19.3)	9/30/2019
299-W23-21	11/7/2000	566707.74	134293.99	203.36 (667.18)	132.78 (435.62)	69.8 (229.0)	6.3 (20.7)	9/30/2019

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

*Coordinates are in Washington State Plane (south zone), NAD83, North American Datum of 1983; 1991 adjustment.

bgs = below ground surface

The groundwater flow direction at WMA T is to the east-southeast (Section 9.3 in SGW-60575). Specific details regarding the selection of each of the well locations are presented in Sections 9.3.1 through 9.3.9 of SGW-60575. Figure 2-4 presents the groundwater monitoring network to be used in this plan. Information on the wells comprising the WMA T network is summarized in Table 2-13.

2.3.5 Waste Management Area TX-TY

The groundwater well network identified for interim status monitoring of WMA TX-TY is the same as that proposed for final status monitoring in SGW-60576 and consists of two upgradient wells (proposed wells WMA_TX-TY_PW1 and WMA_TX-TY_PW2 [D0020 and D0021]) and seven downgradient wells (299-W10-26, 299-W10-27, 299-W14-13, 299-W14-14, 299-W14-15, 299-W14-18, and 299-W14-19) (Section 9.3 in SGW-60576). The network wells were selected through the methodology presented in Chapters 5 through 7 of SGW-60576, based on known groundwater conditions.

As provided in the previous monitoring plan, the upgradient wells identified for the WMA TX-TY network are not yet installed; therefore, existing wells were identified for upgradient monitoring until the new wells are installed and ready for sampling (Section 2.2 in DOE/RL-2009-67, Rev. 2). The results of groundwater simulations in SGW-60576 indicated that wells 299-W15-44 and 299-W15-765 were upgradient of WMA TX-TY (Section 7.3 in SGW-60576). However, wells 299-W15-44 and 299-W15-765 are in close proximity to the 200 West Area P&T system extraction wells. Because of groundwater flow to the extraction wells, wells 299-W15-44 and 299-W15-765 were not considered appropriate upgradient monitoring locations, and two proposed upgradient wells (WMA_TX-TY_PW1 and WMA_TX-TY_PW2 [D0020 and D0021]) were identified for the WMA TX-TY monitoring network (Section 7.4 in SGW-60576). Since the proposed upgradient wells are not yet installed, the existing wells identified as upgradient in SGW-60576 (299-W15-44 and 299-W15-765) will continue to be used as upgradient wells until the new upgradient wells are ready for sampling. After WMA_TX-TY_PW1 and WMA_TX-TY_PW2 (D0020 and D0021) are ready for sampling, wells 299-W15-44 and 299-W15-765 will be removed from the network and no longer monitored under this plan.

The groundwater flow direction at WMA TX-TY is to the east (Section 9.3 in SGW-60576). Specific details regarding the selection of each of the well locations are presented in Sections 9.3.1 through 9.3.9 of SGW-60576. Figure 2-5 presents the groundwater monitoring network to be used in this plan. Information on the wells comprising the WMA TX-TY network is summarized in Table 2-14.

2.3.6 Waste Management Area U

The groundwater well network identified for interim status monitoring of WMA U is the same as that proposed for final status monitoring in SGW-60578 and consists of two upgradient wells (existing well 299-W18-40 and proposed well WMA-U_PW1 [D0016]) and six downgradient wells (299-W18-260, 299-W19-41, 299-W19-42, 299-W19-44, 299-W19-45, and 299-W19-47) (Section 9.3 in SGW-60578). The network wells were selected through the methodology presented in Chapters 5 through 7 of SGW-60578, based on known groundwater conditions.

The groundwater flow direction at WMA U is to the east (Section 9.3 in SGW-60578). Specific details regarding the selection of each of the well locations are presented in Sections 9.3.1 through 9.3.8 of SGW-60578. Figure 2-6 presents the groundwater monitoring network to be used in this plan. Information on the wells comprising the WMA U network is summarized in Table 2-15.

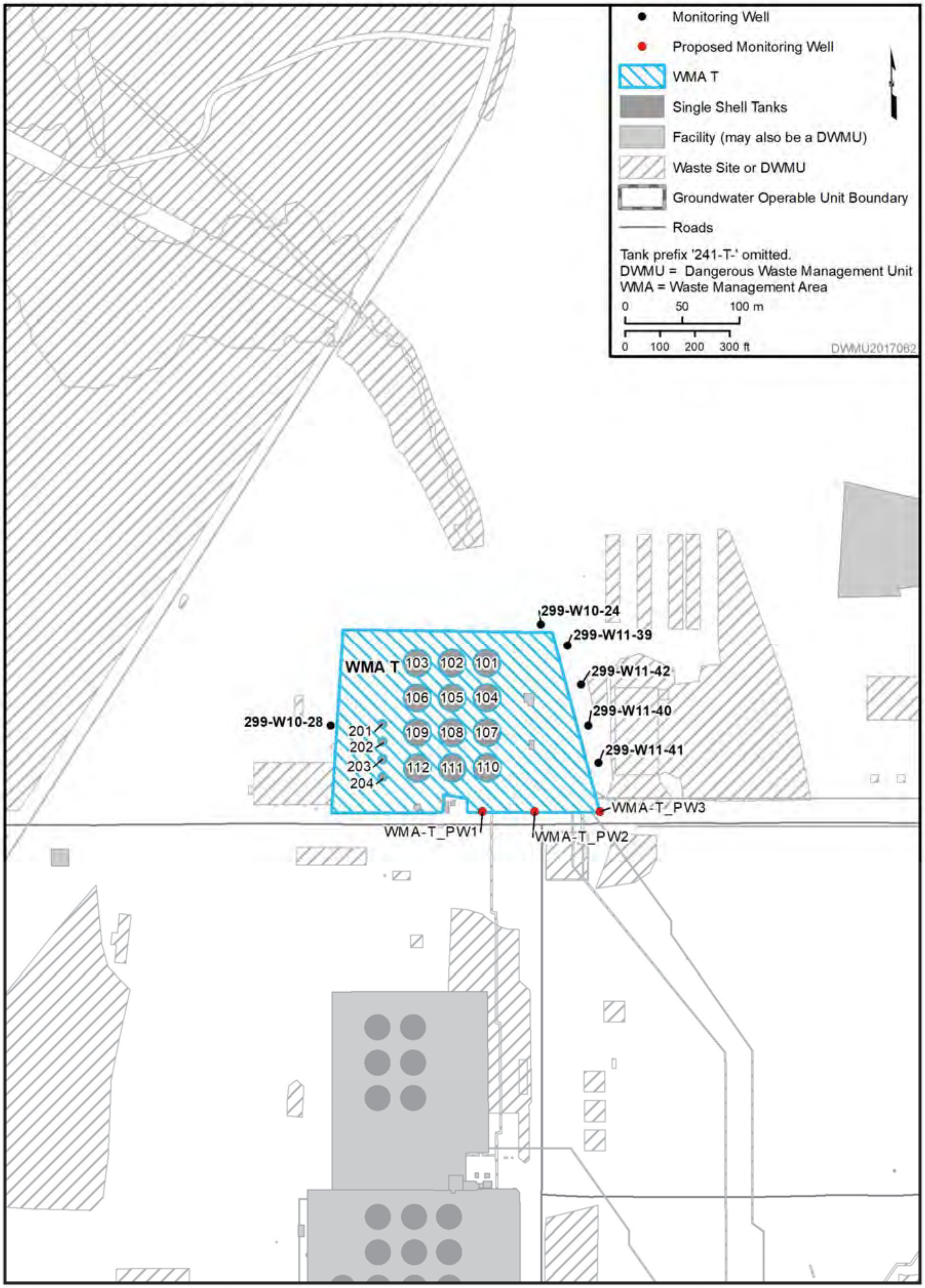


Figure 2-4. WMA T Monitoring Well Network

Table 2-13. Attributes for Wells in the WMA T Groundwater Monitoring Network

Well Name	Completion Date	Easting* (m)	Northing* (m)	Top of Casing Elevation (m [ft]) (NAVD88)	Water Table Elevation (m [ft]) (NAVD88)	Depth to Water (m [ft] bgs)	Depth of Water in Screen (m [ft])	Water-Level Date
299-W10-24	10/21/1998	566885.4	136798.8	209.73 (688.07)	131.71 (428.83)	78.3 (256.8)	3.4 (11.2)	8/15/2019
299-W10-28	10/17/2001	566701.6	136709.9	206.83 (678.56)	132.61 (435.07)	73.5 (241.1)	5.8 (19.1)	8/15/2019
299-W11-39	12/19/2000	566908.4	136779.9	210.55 (690.78)	130.495 (428.10)	79.4 (260.5)	4.0 (13.2)	8/13/2019
299-W11-40	10/09/2000	566926.8	136709.7	210.43 (690.38)	130.23 (427.26)	79.5 (260.7)	3.8 (12.4)	8/12/2019
299-W11-41	8/22/2000	566935.5	136677.8	210.64 (691.08)	130.09 (426.79)	79.6 (261.1)	3.2 (10.6)	8/12/2019
299-W11-42	9/13/2000	566920.4	136745.7	211.07 (692.47)	130.50 (428.16)	79.7 (261.4)	3.2 (10.4)	8/13/2019
WMA-T_PW1 (D0017)	TBD	566834.0	136634.7	TBD	TBD	TBD	TBD	TBD
WMA-T_PW2 (D0018)	TBD	566879.8	136634.7	TBD	TBD	TBD	TBD	TBD
WMA-T_PW3 (D0019)	TBD	566936.7	136634.9	TBD	TBD	TBD	TBD	TBD

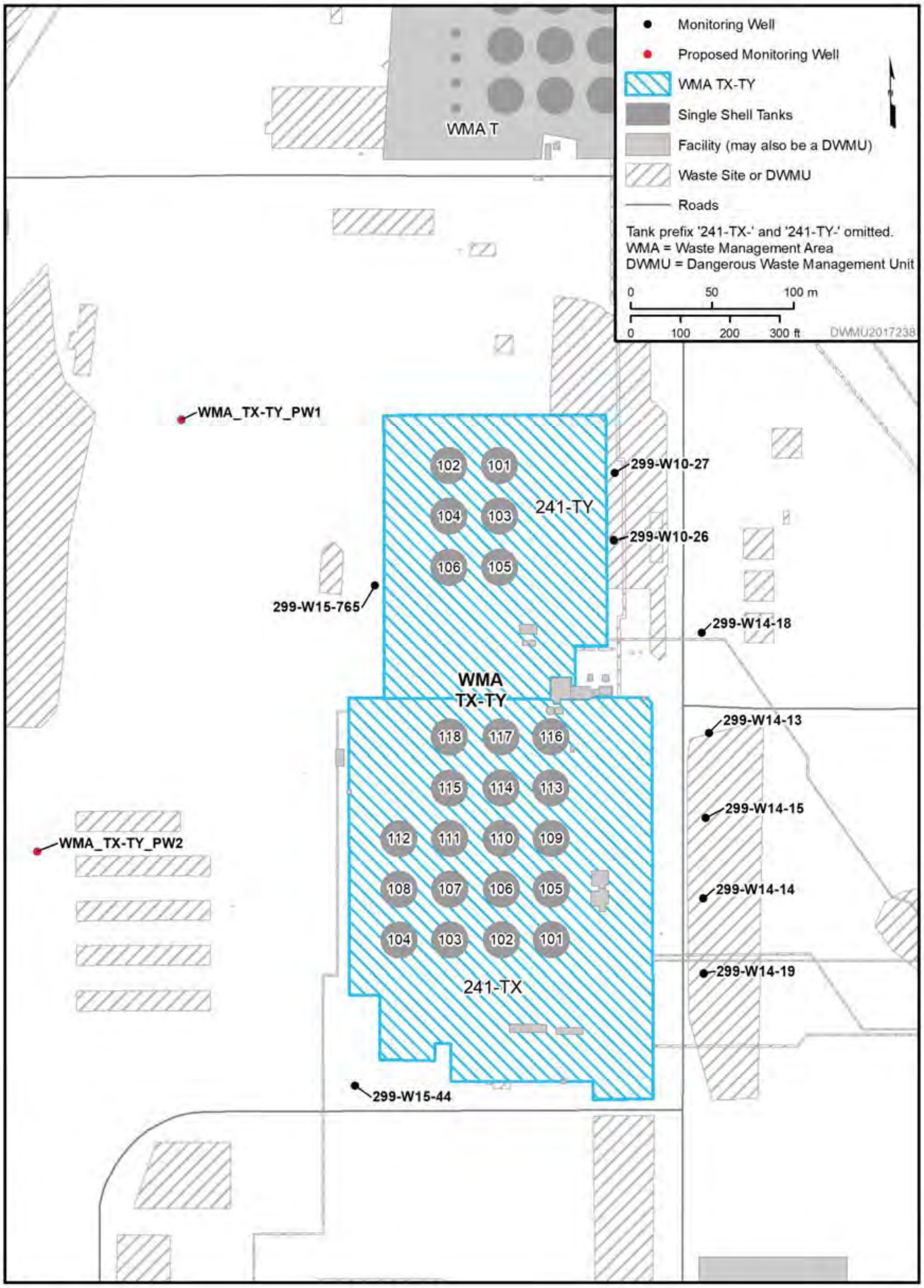
Reference: NAVD88, *North American Vertical Datum of 1988.*

Note: Proposed well coordinates are estimates and are subject to modification based on final well location survey.

*Coordinates are in Washington State Plane (south zone), NAD83, *North American Datum of 1983*; 1991 adjustment.

bgs = below ground surface

TBD = to be determined. Information will be obtained after well construction.



Note: Once WMA TX TY_PW1 and WMA_TX TY_PW2 (D0020 and D0021) are ready for sampling, wells 299-W15-44 and 299-W15-765 be removed from the network.

Figure 2-5. WMA TX-TY Monitoring Well Network

Table 2-14. Attributes for Wells in the WMA TX-TY Groundwater Monitoring Network

Well Name	Completion Date	Easting[a] (m)	Northing[a] (m)	Top of Casing Elevation (m [ft]) (NAVD88)	Water Table Elevation (m [ft]) (NAVD88)	Depth to Water (m [ft] bgs)	Depth of Water in Screen (m [ft])	Water-Level Date
299-W10-26	8/25/1998	566843.40	136400.59	205.45 (674.06)	129.66 (425.39)	75.0 (246.1)	1.8 (6.0)	9/27/2019
299-W10-27	3/23/2001	566843.97	136441.78	205.62 (674.62)	129.89 (426.15)	75.0 (246.1)	3.0 (9.9)	8/23/2019
299-W14-13	8/31/1998	566901.72	136282.38	205.11 (672.92)	128.31 (420.96)	76.0 (249.5)	0.7 (2.3)	8/26/2019
299-W14-14	11/12/1998	566898.39	136181.05	205.43 (673.99)	129.62 (425.28)	75.0 (246.1)	1.8 (5.9)	8/27/2019
299-W14-15	11/8/2000	566899.69	136230.65	205.35 (673.73)	129.24 (424.01)	75.3 (247.2)	2.3 (7.4)	8/27/2019
299-W14-18	11/1/2001	566897.47	136344.15	205.02 (672.63)	128.86 (422.77)	75.4 (247.4)	1.7 (5.7)	9/27/2019
299-W14-19	11/13/2002	566898.60	136135.06	205.61 (674.58)	129.62 (425.27)	75.3 (247.0)	3.5 (11.5)	8/27/2019
299-W15-44[b]	10/23/2002	566685.02	136066.47	204.89 (672.21)	131.44 (431.22)	72.7 (238.6)	3.8 (12.6)	8/26/2019
299-W15-765[b]	10/4/2001	566697.02	136373.06	205.30 (673.55)	130.55 (428.33)	74.0 (242.6)	3.8 (12.4)	8/26/2019
WMA_TX-TY_PW1 (D0020)	TBD	566578.6	136474.8	TBD	TBD	TBD	TBD	TBD
WMA_TX-TY_PW2 (D0021)	TBD	566490.1	136210.0	TBD	TBD	TBD	TBD	TBD

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

Note: Proposed well coordinates are subject to modification based on final well location survey.

a. Coordinates are in Washington State Plane (south zone), NAD83, *North American Datum of 1983*; 1991 adjustment.

b. Proposed wells WMA_TX-TY_PW1 and WMA_TX-TY_PW2 (D0020 and D0021) are the only upgradient wells planned for the network. Because the proposed upgradient wells are not yet installed, upgradient wells 299-W15-44 and 299-W15-765 will be used in this monitoring plan until the new upgradient wells are ready for sampling. After WMA-TX-TY_PW1 and WMA_TX-TY_PW2 (D0020 and D0021) are ready for sampling, wells 299-W15-44 and 299-W15-765 will be removed from the network and no longer sampled under this plan.

bgs = below ground surface

TBD = to be determined. Information will be obtained after well construction.

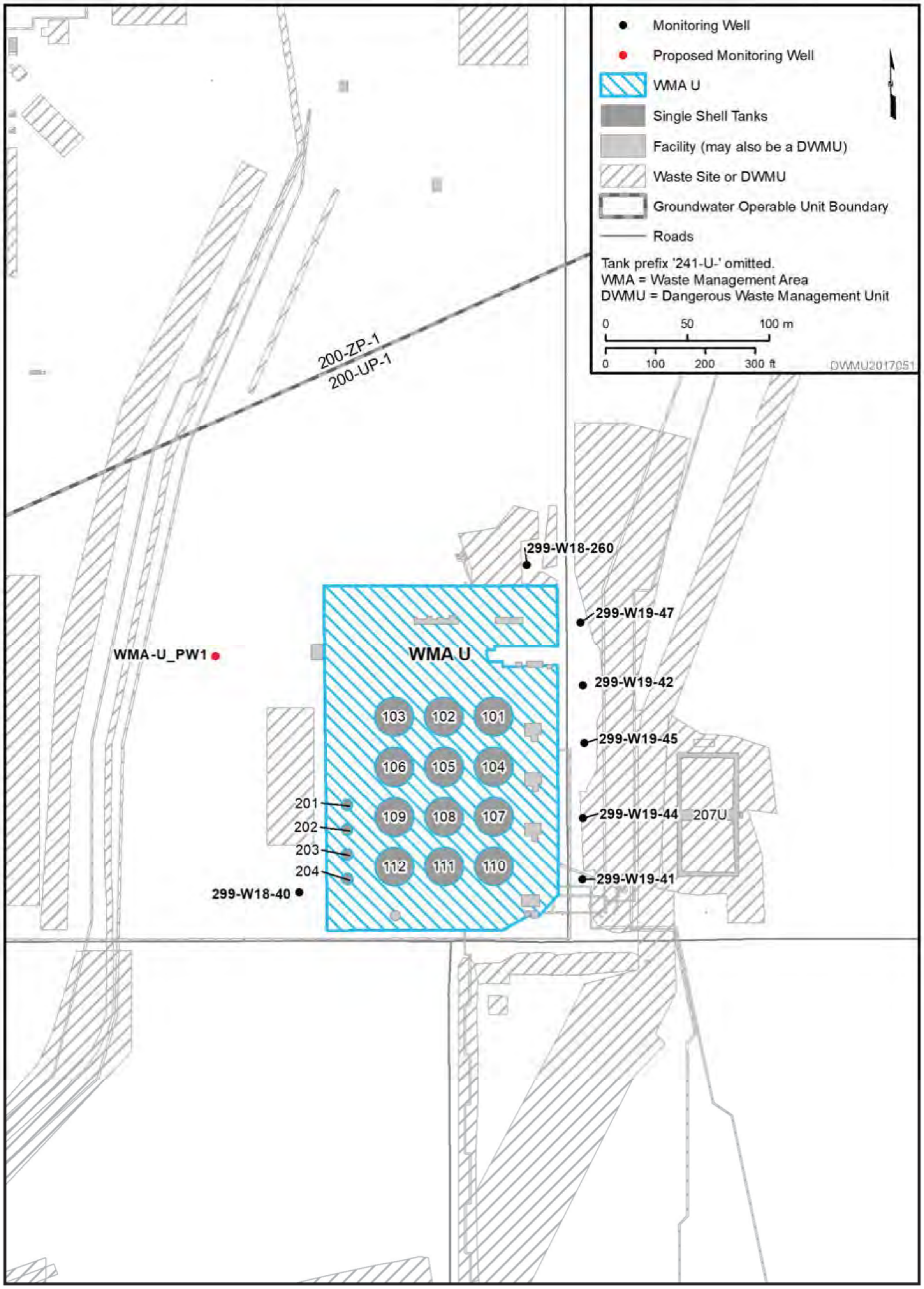


Figure 2-6. WMA U Monitoring Well Network

Table 2-15. Attributes for Wells in the WMA U Groundwater Monitoring Network

Well Name	Completion Date	Easting* (m)	Northing* (m)	Top of Casing Elevation (m [ft]) (NAVD88)	Water Table Elevation (m [ft]) (NAVD88)	Depth to Water (m [ft] bgs)	Depth of Water in Screen (m [ft])	Water-Level Date
299-W18-40	9/28/2001	566723.29	134996.41	203.41 (667.37)	132.84 (435.84)	69.9 (229.3)	7.3 (24.0)	10/10/2019
299-W18-260	11/25/2014	566862.54	135196.89	205.78 (675.12)	131.73 (432.19)	73.3 (240.6)	8.9 (29.2)	10/10/2019
299-W19-41	9/23/1998	566896.53	135004.51	206.53 (677.60)	131.80 (432.42)	74.0 (242.7)	3.8 (12.4)	10/9/2019
299-W19-42	9/16/1998	566896.81	135122.90	206.24 (676.65)	131.77 (432.31)	73.7 (241.9)	4.1 (13.5)	10/9/2019
299-W19-44	9/13/2001	566896.95	135041.97	207.28 (680.04)	131.73 (432.17)	74.8 (245.4)	5.9 (19.5)	10/9/2019
299-W19-45	8/23/2001	566897.65	135087.65	206.41 (677.21)	131.74 (432.21)	73.9 (242.5)	5.0 (16.2)	10/9/2019
299-W19-47	8/25/2004	566895.31	135161.86	206.28 (676.76)	131.75 (432.26)	73.8 (242.1)	6.1 (19.9)	10/10/2019
WMA_U_PW1 (D0016)	TBD	566656.54	135140.85	TBD	TBD	TBD	TBD	TBD

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

Note: Proposed well coordinates are estimates and are subject to modification based on final well location survey.

*Coordinates are in Washington State Plane (south zone), NAD83, *North American Datum of 1983*; 1991 adjustment.

bgs = below ground surface

TBD = to be determined. Information will be obtained after well construction.

2.4 Differences Between This Plan and the Previous Plans

Table 2-16 identifies the main differences between this plan and the previous groundwater monitoring plans.

Table 2-16. Main Differences Between this Monitoring Plan and the Previous Monitoring Plans

Type of Change	Previous Plan[a]	Current Plan	Justification Summary
Monitoring constituents	Dangerous waste constituent: – Cyanide (WMA B-BX-BY and WMA C) – Chromium (WMA S-SX, WMA T, WMA TX-TY, and WMA U)	SST System-specific waste constituents for assessment: Table 2-1 (includes cyanide and chromium)	Waste constituents associated with the SST System unit were identified for ongoing monitoring and evaluation.
	Supporting constituents: – Alkalinity, anions, and metals (all WMAs) – Hexavalent chromium (WMA S-SX, WMA T, WMA TX-TY, and WMA U)	Supporting constituents: – Alkalinity, anions, and metals (nitrite removed from WMA C, fluoride removed from WMA T and WMA TX-TY, and aluminum removed from WMA TX-TY) – Hexavalent chromium included as a supporting constituent for each WMA (added to WMA B-BX-BY and WMA C)	Supporting constituents: a standard set of supporting constituents provides additional information at each WMA. Nitrite, fluoride, and aluminum were carried over from previous plans but are no longer needed. Hexavalent chromium included to provide supporting information on chromium results.
	Stainless steel corrosion: chromium, iron, manganese, nickel (all WMAs)	Stainless steel corrosion: added molybdenum (all WMAs)	Stainless steel corrosion: molybdenum is added because it is a component of certain types of stainless steel.
	Field measurements: – pH, specific conductance, and water level (all WMAs) – Dissolved oxygen (WMA T and WMA TX-TY) – Temperature and turbidity (WMA S-SX, WMA T, WMA TX-TY, and WMA U)	Field measurements: dissolved oxygen, pH, specific conductance, temperature, turbidity, and water level (all WMAs)	Field measurements: dissolved oxygen, temperature, and turbidity included for all WMAs to provide groundwater quality information.
	Sampling at new or replacement wells added to the network: constituents identified in Appendix 5 of Ecology Publication 97-407	Sampling at new or replacement wells added to the network: Same	No change.
Sampling frequency	Dangerous waste constituents: quarterly	SST System waste constituents: quarterly	No change.
	Supporting constituents, corrosion constituents, field measurements: quarterly	Supporting constituents, corrosion constituents, field measurements: same	No change.

Table 2-16. Main Differences Between this Monitoring Plan and the Previous Monitoring Plans

Type of Change	Previous Plan[a]	Current Plan	Justification Summary
	Sampling at new or replacement wells added to the network: quarterly for 1 year	Sampling at new or replacement wells added to the network: same	No change.
Well network[b]	WMA B-BX-BY Upgradient: 299-E33-31 299-E33-32 299-E33-38 299-E33-42 299-E33-334 Downgradient: 299-E33-20 299-E33-41 299-E33-44 299-E33-47 299-E33-48 299-E33-49 299-E33-335 299-E33-337 299-E33-338 299-E33-339 WMA_B-BX-BY_PW-1 (D0062)	Same	No change.
	WMA C Upgradient: 299-E27-12 299-E27-15 299-E27-22 299-E27-26 Downgradient: 299-E27-13 299-E27-14 299-E27-21 299-E27-23 299-E27-24 299-E27-155 WMA_C_PW-1 (D0044) WMA_C_PW-2 (D0045)	Same	No change.
	WMA S-SX Upgradient: 299-W23-20 299-W23-21 Downgradient: 299-W22-80 299-W22-81 299-W22-84 299-W22-85 299-W22-93 299-W22-94 299-W22-113 299-W22-115 299-W22-116 299-W23-19	WMA S-SX Upgradient: 299-W23-20 299-W23-21 Downgradient: 299-W22-80 299-W22-81 299-W22-84 299-W22-85 299-W22-93 299-W22-94 299-W22-113 299-W22-115 299-W22-116	Well 299-W23-19 is removed from the network because it is not accessible for water-level measurements.

Table 2-16. Main Differences Between this Monitoring Plan and the Previous Monitoring Plans

Type of Change	Previous Plan[a]	Current Plan	Justification Summary
	WMA T Upgradient: 299-W10-28 Downgradient: 299-W10-24 299-W11-39 299-W11-40 299-W11-41 299-W11-42 WMA-T_PW1 (D0017) WMA-T_PW2 (D0018) WMA-T_PW3 (D0019)	Same	No change.
	WMA TX-TY Upgradient: WMA_TX-TY_PW1 (D0020) WMA_TX-TY_PW2 (D0021) Until the two new upgradient wells are ready for sampling, the wells identified as upgradient in SGW-60576 (299-W15-44 and 299-W15-765) will continue to be used for upgradient monitoring. Downgradient: 299-W10-26 299-W10-27 299-W14-13 299-W14-14 299-W14-15 299-W14-18 299-W14-19	Same	No change.
	WMA U Upgradient: 299-W18-40 WMA_U_PW1 (D0016) Downgradient: 299-W18-260 299-W19-41 299-W19-42 299-W19-44 299-W19-45 299-W19-47	Same	No change.
Groundwater flow direction	WMA B-BX-BY: Southeast WMA C: South-southeast WMA S-SX: East WMA T: East-southeast WMA TX-TY: East WMA U: East	Same	No change.

Table 2-16. Main Differences Between this Monitoring Plan and the Previous Monitoring Plans

Type of Change	Previous Plan[a]	Current Plan	Justification Summary
Type of groundwater monitoring program	Groundwater quality assessment program	Same	No change.

Complete references are provided in Chapter 5.

a. The previous plans applicable to the respective SST WMAs are as follows:

DOE/RL-2012-53, Rev. 1, *Interim Status Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area B-BX-BY*
DOE/RL-2009-77, Rev. 1, *Interim Status Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area C*
DOE/RL-2009-73, Rev. 1, *Interim Status Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area S-SX*
DOE/RL-2009-66, Rev. 2, *Interim Status Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area T*
DOE/RL-2009-67, Rev. 2, *Interim Status Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area TX-TY*
DOE/RL-2009-74, Rev. 2, *Interim Status Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area U*

b. Once proposed wells are drilled and ready for sampling, this plan will be modified to reflect the updated monitoring network.

SST = single-shell tank

WMA = waste management area

2.5 Sampling and Analysis Protocol

The groundwater protection regulations of WAC 173-303-400 dictate the groundwater sampling and analysis requirements applicable to interim status DWMUs. 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 Data Evaluation and Reporting

This chapter discusses the evaluation and interpretation of data.

3.1 Data Review

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

3.2 Data Evaluation

The quarterly sample results of the groundwater quality assessment constituents (Table 2-1) from the network wells at each WMA will be evaluated on an ongoing quarterly basis and are subject to reporting requirements discussed in Section 3.5.

Supporting constituents, corrosion constituents, and field measurements (Table 2-2) provide additional information for interpretation of groundwater quality assessment waste constituent results. The evaluations required for the groundwater quality assessment constituents are not applicable to supporting constituents, corrosion constituents, and field measurements[5]. Similarly, the sampling results of the constituents in Appendix 5 of Ecology Publication No. 97-407 (Table 2-3) at new wells are not subject to the evaluations required for the groundwater quality assessment constituents.

3.2.1 Dangerous Wastes Attributed to Single-Shell Tank Waste Management Areas

At each of the WMAs within this plan, dangerous waste has been previously identified in groundwater and attributed to the respective WMA as presented in Table 3-1. Each of the dangerous wastes in Table 3-1 will continue to be sampled quarterly as part of the groundwater quality assessment constituents (Table 2-1) under this groundwater quality assessment plan. Further quarterly determinations of the dangerous waste sample results associated with the respective WMA will identify the most recent concentration of the associated dangerous wastes in Table 3-1 and the rate and extent of contamination.

Determination of the concentration and rate and extent of contamination of dangerous wastes in groundwater under a groundwater quality assessment plan is required under 40 CFR 265.93(d)(4)(i) and (ii). In accordance with 40 CFR 265.93(d)(7)(i), such determinations will continue on a quarterly basis until final closure of the facility. Quarterly reporting of the dangerous wastes in Table 3-1 will be performed as described in Section 3.5.

For reporting purposes, a sample result is considered "detected" when its concentration exceeds its respective practical quantitation limit (PQL) (Table A-3 in Appendix A); reported concentrations that are less than or equal to the PQL are not considered detected. Evaluation of sample results to determine the rate and extent of contamination will also be performed.

Table 3-1. Dangerous Wastes in Groundwater and Attributed to SST WMAs

WMA	Associated Dangerous Waste
WMA B-BX-BY	Cyanide
WMA C	Cyanide
WMA S-SX	Chromium

[5] Some groundwater quality assessment constituents (Table 2-1) are also included as the casing corrosion constituents (Table 2-2) and/or for 1 year of monitoring at new wells (Table 2-3). In these cases, the constituents will be evaluated as required for either groundwater quality assessment constituents (Section 3.2.2) or dangerous waste previously associated with SST WMAs (Section 3.2.1), whichever is appropriate.

Table 3-1. Dangerous Wastes in Groundwater and Attributed to SST WMAs

WMA	Associated Dangerous Waste
WMA T	Chromium
WMA TX-TY	Chromium
WMA U	Chromium

3.2.2 Evaluation of Groundwater Quality Assessment Constituents

Determination of the concentration and rate and extent of contamination of dangerous wastes in groundwater under a groundwater quality assessment plan is required under 40 CFR 265.93(d)(4)(i) and (ii). Because it was determined that dangerous waste from the facility had entered the groundwater, such determinations will continue on a quarterly basis until final closure of the facility (40 CFR 265.93(d)(7)(i)).

Several steps are involved to evaluate sample results of the groundwater quality assessment constituents (Table 2-1) that have not been attributed to a given WMA (Table 3-1). Evaluations will be performed on sample results from upgradient and downgradient wells.

The initial steps that follow provide for determination of valid detections:

1. Sample data will be reviewed to determine which constituents are detected (Section 3.2.2.1).
2. Sample data identified as detected will be evaluated for analytical uncertainties associated with the results (Section 3.2.2.2).

The concentrations of valid detected sample results will be further evaluated. Particularly with inorganics that occur naturally in groundwater, statistical evaluation of sample results may be required to determine (1) the upgradient concentration for comparison to downgradient results, and/or (2) if a downgradient well concentration demonstrates a groundwater impact from the associated WMA. Such statistical evaluation of the results may be performed after a sufficient number of samples have been collected (typically a minimum of eight sample results). Data from samples collected under recent previous groundwater monitoring plans may be used for evaluation and/or statistical analysis of sample results collected under this plan.

Further evaluation of constituent concentrations may include the following, and may include other evaluations that are not specified herein:

- Comparison of downgradient concentrations to upgradient concentrations and/or Hanford Site background values (Section 3.2.2.3)
- Evaluation of stainless-steel well casing corrosion (as applicable) (Section 3.2.2.4)

The preceding evaluations provide instruction for determining if a sample result represents a valid detection and is indicative of contamination from a WMA. However, it is possible that a groundwater quality assessment constituent detection may be a false-positive result. To avoid the possibility of attributing groundwater contamination to a SST WMA based on a single false-positive sample result, the next quarterly sample result will also be evaluated prior to making a determination. Therefore, valid detections of a groundwater quality assessment constituent in two sequential sample results are needed prior to making a determination that a WMA has contaminated groundwater.

3.2.2.1 Constituent Detection

A groundwater quality assessment constituent (Table 2-1) is considered "detected" when its concentration exceeds its respective PQL (Table A-3 in Appendix A). Reported concentrations that are less than or equal to the PQL of a SST System groundwater quality assessment constituent are not considered detected and are not further evaluated. A detected constituent requires further evaluation before the constituent can be attributed to the WMA.

3.2.2.2 Analytical Uncertainties

For detected constituents, the analytical result will be evaluated for data qualifiers or other information that may indicate a potential data use issue. Laboratory qualifiers identify issues associated with the analysis of the sample at the laboratory. Review qualifiers identify results with high uncertainty or data quality issues. Definitions of laboratory and review qualifiers applicable to data generated under this plan are available in HNF-38155, *HEIS Sample, Result, and Sampling Site Data Dictionary*. Data qualifiers will be reviewed to determine if the results are of sufficient quality for decision-making purposes. Sample results that are not of sufficient quality for decision-making purposes are not further evaluated.

3.2.2.3 Comparison to Upgradient Concentrations and/or Hanford Site Background Values

The concentration of any detected groundwater quality assessment constituent in a downgradient well may be compared to the concentration in upgradient well(s), and for inorganics, the available Hanford Site groundwater background concentrations (90^{th} percentile background threshold values in DOE/RL-96-61, *Hanford Site Background: Part 3, Groundwater Background*). If the constituent concentration in a downgradient well is less than or equal to the upgradient concentration or less than or equal to the background value, the sample result is not further evaluated.

Further evaluation of detected groundwater quality assessment constituents may be performed to identify other sources of a detected constituent, including any known contaminant plumes in the area of the monitoring network. Additionally, injection and extraction wells from P&T operations in the area of the SST WMAs (as applicable) may affect the groundwater. If other sources of detected groundwater quality assessment constituents are identified, evaluation and discussion of other source(s), known contaminant plumes, and/or the impact from the P&T operation will be provided in the determination report (Section 3.5).

If the groundwater flow condition at a given WMA changes to the extent that the configuration of the well network no longer represents actual upgradient and downgradient locations, then this plan will be revised with an appropriate well network (see Section 3.4).

3.2.2.4 Evaluation for Stainless Steel Well Casing Corrosion

As presented in Section 2.1.4, groundwater is sampled for the products of stainless steel well casing corrosion, including chromium, iron, manganese, molybdenum, and nickel. Chromium and nickel are both groundwater quality assessment constituents in this plan. However, elevated concentrations of chromium and nickel will also be evaluated in the context of well corrosion.

3.2.2.5 Outcomes

If a groundwater quality assessment constituent is detected in two sequential sample results and cannot be eliminated based on the evaluations in Sections 3.2.2.3 and 3.2.2.4, it may be attributed to the SST WMA. Such constituents will be reported in the quarterly determination and added to Tables 3-1 and 3-2, after which future sample results of the dangerous waste will be evaluated as described in Section 3.2.1.

Groundwater quality assessment constituents that are not detected, or are detected but are not indicative of contamination from a SST WMA, will continue to be monitored and evaluated (as described in this section) on a quarterly basis.

3.2.3 Water-Level Measurements

Water-level measurements will be used to calculate groundwater direction and flow rate. The groundwater direction calculations will follow the processes described in ECF-200W-19-0082, *Groundwater Elevation Mapping for 200 West Area - Quarter 1 Calendar Year 2019*, (for the 200 West Area SST WMAs) or ECF-200E-19-0081, *Groundwater Elevation Mapping for 200 East Area – Quarter 1 Calendar Year 2019* (for the 200 East Area SST WMAs) for quarterly calculations. Annual calculations will follow the processes described in ECF-Hanford-19-0114, *Preparation of the March 2019 Hanford Site Water Table Map*. Groundwater flow rate calculations will follow the process described in ECF-Hanford-19-0091, *Hydraulic Gradient and Average Linear Velocity Calculations - Quarter 1 Calendar Year 2019.* The flow rate and direction will be evaluated in the context of groundwater in the surrounding area (e.g., plume maps in DOE/RL-2019-65). The flow rate and direction will be reported in the quarterly reports (Section 3.5).

3.3 Interpretation

Data are used to interpret groundwater conditions at each SST WMA. Interpretive techniques may include the following:

- **Hydrographs:** Graph water levels versus time to determine decreases, increases, seasonal, or manmade fluctuations in groundwater levels.
- **Water table maps:** Use water table elevations from multiple wells to construct contour maps and to estimate flow directions. Groundwater flow is assumed to be perpendicular to the 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.
- **Contaminant ratios:** Illustrate the relative abundances of contaminants from previously characterized Hanford Site-related processes and sources. Comparison of these ratios in groundwater can sometimes be used to distinguish among different sources of contamination (e.g., a specific process and its associated facility). Ratios may provide evidence of continuing source contamination, thereby linking contamination with a specific facility under monitoring. Evaluation of contaminant ratios in concentration trends may be used to demonstrate when facility-specific contamination no longer affects underlying groundwater.

3.4 Annual Determination of Monitoring Network

Groundwater monitoring requirements include determining the rate and extent of migration of dangerous waste contamination, if any, in the groundwater underlying the unit (40 CFR 265.93(d)(4)(i)), Preparation, Evaluation, and Response." An annual evaluation of the network is performed to determine if it remains adequate to monitor the facility's impact on the quality of the groundwater in the uppermost aquifer underlying the facility. The network must include at least one upgradient and at least three downgradient wells in the uppermost aquifer (40 CFR 265.91(a)(1) and (2)).

The groundwater monitoring network in this plan will continue to be reevaluated to ensure that it is adequate to monitor any changing hydrogeologic conditions beneath each of the SST WMAs. If flow changes are observed, the SST WMA contaminant migration conceptual model and geochemical trends will be reevaluated to determine the adequacy of the network and any necessary modifications required for the network. If a change in the groundwater flow direction occurs and the monitoring network is no longer aligned to the flow direction, the monitoring network will be modified and a revised monitoring plan will be prepared.

Water-level measurements will be collected during each sampling event and are reported in the annual Hanford Site RCRA groundwater monitoring reports (e.g., DOE/RL-2019-65). Additional water-level measurements from selected wells on the Hanford Site may be used as necessary for determining flow rate and direction at the SST WMAs.

3.5 Recordkeeping, Reporting, and Notification

This plan, the first determination report, and subsequent quarterly determination reports will be placed in the facility operating record and be maintained in accordance with the requirements of 40 CFR 265.93(d)(2) and (5), and (e). Records of the analyses and evaluations specified in this plan will be kept in accordance with the requirements of 40 CFR 265.94(b)(1).

The results of groundwater quality assessment monitoring are reported annually in accordance with the requirements of 40 CFR 265.94(b)(2). Reporting will be made in the annual Hanford Site RCRA groundwater monitoring reports (e.g., DOE/RL-2019-65) by March 1.

In accordance with 40 CFR 265.93(d)(7)(i), continued determinations of (1) the rate and extent of migration and (2) the concentrations of dangerous wastes/dangerous waste constituents that have entered the groundwater from the facility will be made quarterly. As discussed in Sections 1.1 and 3.2.1 of this plan, a dangerous waste in groundwater has been attributed to each of the SST WMAs. Continued quarterly determinations of these dangerous wastes at the associated SST WMA (Table 3-2) will be prepared.

Sample results of the SST System waste constituents (Table 2-1) will be evaluated on a quarterly basis at each of the SST WMAs. Any SST System waste constituent that is determined to be present in groundwater and attributable to a given SST WMA will be included in the quarterly determination and thereafter subject to continued quarterly determinations.

Quarterly determinations will be submitted informally (i.e., email) to Ecology within 15 days of issuance of the quarterly report and placed in the operating record.

Table 3-2. Dangerous Wastes Subject to Continued Quarterly Determinations

WMA	Associated Dangerous Waste
WMA B-BX-BY	Cyanide
WMA C	Cyanide
WMA S-SX	Chromium
WMA T	Chromium
WMA TX-TY	Chromium
WMA U	Chromium

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4 Implementation Schedule

The schedule for sampling is provided in Chapter 2 of this document. This groundwater quality assessment plan is a continuation of an existing groundwater quality assessment program at WMA B-BX-BY, WMA C, WMA S-SX, WMA T, WMA TX-TY, and WMA U and will be implemented within 4 months of the document being placed in the operating record.

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Appendix A

Quality Assurance Project Plan

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Contents

Figure

Tables

Terms

DOE	U.S. Department of Energy
DQI	data quality indicator
DUP	duplicate (laboratory)
EB	equipment blank
ECO	Environmental Compliance Officer
EPA	U.S. Environmental Protection Agency
FSO	Field Sample Operations
FTB	full trip blank
FWS	Field Work Supervisor
FXR	field transfer blank
HEIS	Hanford Environmental Information System
LCS	laboratory control sample
MB	method blank
MS	matrix spike
MSD	matrix spike duplicate
QA	quality assurance
QAPjP	quality assurance project plan
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
SMR	Sample Management and Reporting
SPLIT	field split
SST	single-shell tank
SUR	surrogate
VOC	volatile organic compound
WMA	waste management area

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A1 Introduction

A quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection. This QAPjP includes planning, implementation, and assessment of sampling tasks, field measurements, laboratory analysis, and data review. This chapter describes the applicable environmental data collection quality assurance (QA) elements for this groundwater monitoring plan. This QAPjP is intended to supplement the contractor's environmental QA program plan.

This QAPjP is divided into the following four chapters that describe the quality requirements and controls applicable to groundwater monitoring activities at the Single-Shell Tank System (SST) unit waste management areas (WMAs):

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

A2 Project Management

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

A2.1 Project/Task Organization

Project organization (regarding groundwater monitoring) is described in the following sections and illustrated in Figure A-1. Titles used in the project organization are for the purposes of discussing the role of the individual in the performance of the work scope. Individuals with different titles but similar/equivalent positions may fulfill these roles.

A2.1.1 U.S. Department of Energy Manager

Hanford Site operation is the responsibility of the U.S. Department of Energy (DOE). The DOE 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., 1989, *Hanford Federal Facility Agreement and Consent Order*.

A2.1.2 U.S. Department of Energy Project Lead

The DOE 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 DOE management.

A2.1.3 U.S. Department of Energy Primary Contractor Management for Groundwater Science

The DOE Primary Contractor Management for Groundwater Science provides oversight and coordinates with DOE in support of sampling and reporting activities. The DOE Primary Contractor Management for Groundwater Science also provides support to the Project Delivery Manager for Groundwater Science to ensure that work is performed safely and cost effectively.

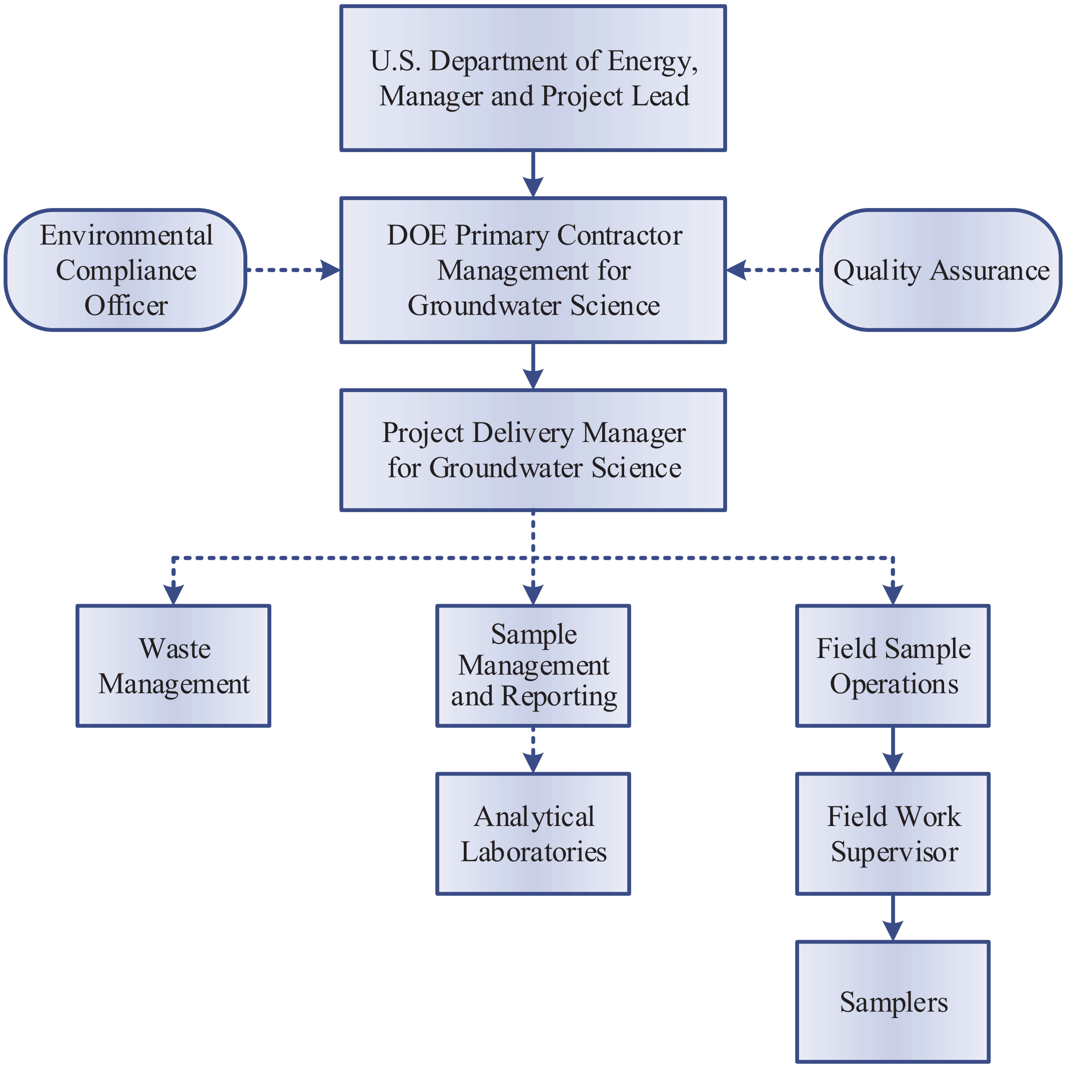

Figure A-1. Project Organization

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 dangerous waste management unit groundwater monitoring requirements. The Project Delivery Manager for Groundwater Science coordinates with, and reports to, DOE and DOE Primary Contractor Management for Groundwater Science regarding dangerous waste management unit groundwater monitoring requirements. The Project Delivery Manager for Groundwater Science (or designee) works closely with the Environmental Compliance Officer (ECO), QA, 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 staff to provide technical expertise.

A2.1.5 Sample Management and Reporting Group

The SMR group oversees offsite analytical laboratories, coordinates laboratory analytical work with this plan, and verifies that laboratories are qualified for performing Hanford Site analytical work. They generate field sampling documents, labels, and instructions for field sampling personnel and develop sample authorization forms, which provide information and instruction to the analytical laboratories.

The SMR group revises field sampling documents to reflect approved changes. This group's responsibilities include receiving analytical data from the laboratories, performing data entry into the Hanford Environmental Information System (HEIS) database, arranging 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. They are responsible for informing the Project Delivery Manager for Groundwater Science (or designee) 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 samplers who collect groundwater samples for this groundwater monitoring plan. Samplers collect samples, complete field logbooks, data forms, and chain-of-custody forms, including any shipping paperwork, and assist sample delivery to the analytical laboratory.

A2.1.7 Quality Assurance

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

A2.1.8 Environmental Compliance Officer

ECOs provide technical oversight, direction, and acceptance of project and subcontracted environmental work, with the goal of minimizing adverse environmental impacts.

A2.1.9 Waste Management

Waste Management identifies waste management sampling/characterization activities for regulatory compliance and is responsible for data interpretation to determine waste designations and profiles. Waste Management communicates policies and practices for project compliance for waste storage, transportation, disposal, and tracking in a safe and cost-effective manner.

A2.1.10 Analytical Laboratories

The laboratories maintain custody and analyze samples in accordance with established quality systems and provide data packages containing sample and quality control (QC) results. Laboratories provide explanations of results to support data review and resolve analytical issues.

A2.2 Problem Definition/Background

The purpose of this groundwater monitoring plan is to satisfy *Washington Administrative Code* and *Code of Federal Regulations* requirements (WAC 173-303-400, "Dangerous Waste Regulations," "Interim Status Facility Standards," and 40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Subpart F, "Ground-Water Monitoring") for groundwater quality assessment program monitoring. Additional information on the activities to satisfy these requirements and background information on monitoring is provided in the main text of this monitoring plan.

A2.3 Project/Task Description

The focus of this plan is to identify dangerous wastes or dangerous waste constituents from the SST WMAs that have entered the groundwater; determine the groundwater concentration and rate and extent of migration of any dangerous waste originating from the SST WMAs; evaluate the well network; interpret analytical results; and report findings; each in accordance with 40 CFR 265.93, "Preparation, Evaluation, and Response," as promulgated by WAC 173-303-400(3)(b) and modified by (3)(c)(v) when indicated. The constituents and parameters to be monitored, along with the monitoring wells and frequency of sampling, are provided in the main text of this monitoring plan. 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 the generation of analytical data of known and appropriate quality. In support of this objective, the process to assess data usability may include data verification, data validation, or a data quality indicator (DQI) evaluation. 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.

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. The process to assess data usability is further discussed in Section A4.

A2.5 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. 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 40 CFR 265 Subpart F cannot be changed.

Logbooks and data forms are used to document field activities. The logbooks are identified with a unique project name and number. Individuals responsible for the logbooks are identified in the front of the logbook, and only authorized individuals may make entries into the logbooks. Logbooks will be controlled documents. Data forms are also identified with a unique project name and number, may be used to record the same field information as logbooks, and are referenced in the logbooks.

The FWS, SMR group, and field crew supervisors are responsible for alignment of field instructions with the groundwater monitoring plan.

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 hardcopy format (e.g., DOE Records Holding Area). Records of analyses required by 40 CFR 265.94, "Recordkeeping and Reporting," are to be maintained throughout the active life of a facility and post-closure care period (if any).

By March 1, groundwater monitoring results are reported in the Hanford Site RCRA groundwater monitoring report (e.g., DOE/RL-2019-65, *Hanford Site RCRA Groundwater Monitoring Report for 2019*).

Table A-1. Data Quality Indicators

Data Quality Indicator (QC Element)[a]	Definition	Determination Methodologies	Possible 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 remeasurement. • 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 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 remeasurement. • Determine if follow-up evaluation is needed. • Evaluate instrumentation and re-calibrate, if necessary.
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. • Redefine sampling and measurement requirements and protocols. • Resample and reanalyze, as appropriate.

Table A-1. Data Quality Indicators

Data Quality Indicator (QC Element)[a]	Definition	Determination Methodologies	Possible Corrective Actions
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 usability assessment)	Completeness is a measure of the amount of valid data collected compared to the amount of data planned. Measurements are considered 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.

Table A-1. Data Quality Indicators

Data Quality Indicator (QC Element)[a]	Definition	Determination Methodologies	Possible Corrective Actions
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. Analytical bias refers to deviation in one direction (i.e., high, low, or unknown) of the measured value from a known spiked amount.	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 the recovery of a known amount of contaminant spiked into a sample (matrix spike).	For sampling bias: • Properly select and use sampling tools. • Institute correct sampling and subsampling processes to limit preferential selection or loss of sample media. • Use sample handling processes, 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 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 remeasurement using methods or analytical conditions that will meet required detection or limit of quantitation. • Qualify/reject the data before use.

Based on SW-846 Compendium (July 2014). Available at: https://www.epa.gov/hw-sw846/sw-846-compendium.

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

Table A-2. Change Control for Monitoring Plans

Type of Change	Action	Documentation
Unintentional impact to groundwater monitoring plan that impacts the requirements of 40 CFR 265 Subpart F, including one-time missed well sampling due to operational constraints, delayed sample collection, broken pump, lost bottle set, missed sampling of groundwater constituents or parameters, or loss of samples in transit.	Project Delivery Manager for Groundwater Science provides informal notification to DOE. DOE provides informal notification to Ecology as appropriate.	Copy of informal notification to Ecology is placed in facility operating record. Annual Hanford Site RCRA groundwater monitoring report.
Planned change to groundwater monitoring activities, including addition or deletion of constituents analyzed for, change of sampling frequency, or changes to well network.	Project Delivery Manager for Groundwater Science obtains DOE approval; revise monitoring plan as appropriate.	Annual Hanford Site RCRA groundwater monitoring report and revised groundwater monitoring plan as appropriate.

40 CFR 265, Subpart F, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Ground-Water Monitoring."

DOE = U.S. Department of Energy

Ecology = Washington State Department of Ecology

RCRA = *Resource Conservation and Recovery Act of 1976*

A3 Data Generation and Acquisition

This chapter addresses data generation and acquisition so that the project's methods for sampling, measurement and analysis, data collection or generation, data handling, and QC activities are appropriate and documented. Instrument calibration and maintenance, supply inspections, and data management are also discussed.

A3.1 Analytical Method Requirements

Sample analytical methods are presented in Table A-3. Equivalent (e.g., U.S. Environmental Protection Agency [EPA] Method 300 and SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods,* Method 9056) or updated (e.g., updates to SW-846 methods) Washington State Department of Ecology-accredited methods may be substituted for the methods identified in Table A-3. The updated methods will be able to achieve the practical quantitation limits identified in Table A-3.

Table A-3. Analytical Methods for the Single-Shell Tank System

CAS Number	Waste Constituent (Alternate Name)	Analytical Method[a]	Practical Quantitation Limit (µg/L)
General Chemistry			
ALKALINITY	Alkalinity, total as CaCO3	310.1, Standard Method 2320, Standard Method 4500	5250
57-12-5	Cyanide (total)	335.4, 9012, 9014, Standard Method 4500	10.5

Table A-3. Analytical Methods for the Single-Shell Tank System

CAS Number	Waste Constituent (Alternate Name)	Analytical Method[a]	Practical Quantitation Limit (µg/L)
--	Cyanide (free)	9014	4
18540-29-9	Hexavalent chromium	7196	10.5
18496-25-8	Sulfide (total)	376.1, Standard Method 4500S	2100
Anions[b]			
16887-00-6	Chloride	300, 9056	400
14797-55-8	Nitrate, as NO3	300, 9056	250
14808-79-8	Sulfate	300, 9056	1050
Field Measurements			
--	pH	150.1, 9040, Standard Method 4500 H+	N/A
--	Dissolved oxygen	360.1, Standard Method 4500 O	N/A
--	Specific conductance	120.1, 9050, Standard Method 2520 B -97	N/A
--	Temperature	170.1	N/A
--	Turbidity	180.1, Standard Method 2130 B	N/A
Metals			
7440-36-0	Antimony	6020	5.25
7440-38-2	Arsenic	6020	10.5
7440-39-3	Barium	6020	5.25
7440-41-7	Beryllium	6020	1.05
7440-43-9	Cadmium	6020	2.1
7440-70-2	Calcium	6010	1050
7440-47-3	Chromium	6020	10.5
7440-48-4	Cobalt	6020	5.25
7440-50-8	Copper	6020	12.6
7439-89-6	Iron	6010	105
7439-92-1	Lead	6020	3.15
7439-95-4	Magnesium	6010	1050
7439-96-5	Manganese	6020	5.25
7439-97-6	Mercury	7470	0.5
7439-98-7	Molybdenum	6020	5.25
7440-02-0	Nickel	6020	21

Table A-3. Analytical Methods for the Single-Shell Tank System

CAS Number	Waste Constituent (Alternate Name)	Analytical Method[a]	Practical Quantitation Limit (µg/L)
7440-09-7	Potassium	6010	5250
7782-49-2	Selenium	6020	10.5
7440-22-4	Silver	6020	5.25
7440-23-5	Sodium	6010	1050
7440-28-0	Thallium	6020	2.1
7440-31-5	Tin	6020	10.5
7440-62-2	Vanadium	6010	52.5
7440-66-6	Zinc	6010	21
Alcohols			
67-56-1	Methanol	8015	5250
Volatile Organic Compounds			
75-34-3	1,1-Dichloroethane	8260	10
75-35-4	1,1-Dichloroethene (1,1-Dichloroethylene)	8260	10
71-55-6	1,1,1-Trichloroethane	8260	5
630-20-6	1,1,1,2-Tetrachloroethane	8260	2.1
79-00-5	1,1,2-Trichloroethane	8260	5
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane (Trichlorotrifluoroethane)	8260	10
79-34-5	1,1,2,2-Tetrachloroethane	8260	5
96-12-8	1,2-Dibromo-3-Chloropropane	8260	5.25
106-93-4	1,2-Dibromoethane (Ethylene dibromide [EDB])	8260	5
107-06-2	1,2-Dichloroethane	8260	5
78-87-5	1,2-Dichloropropane	8260	5
156-60-5	trans-1,2-Dichloroethylene	8260	5
96-18-4	1,2,3-Trichloropropane	8260	5
10061-01-5	cis-1,3-Dichloropropene	8260	5
10061-02-6	trans-1,3-Dichloropropene	8260	5
110-57-6	trans-1,4-Dichloro-2-butene	8260	50
71-36-3	1-Butanol (n-Butyl alcohol)	8260	262.5
78-93-3	2-Butanone (Methyl ethyl ketone [MEK])	8260	10.5

Table A-3. Analytical Methods for the Single-Shell Tank System

CAS Number	Waste Constituent (Alternate Name)	Analytical Method[a]	Practical Quantitation Limit (µg/L)
67-64-1	2-Propanone (Acetone)	8260	20
591-78-6	2-Hexanone (Methyl butyl ketone [MBK])	8260	20
108-10-1	4-Methyl-2-Pentanone (Methyl isobutyl ketone [MIBK])	8260	10.5
75-05-8	Acetonitrile (Methyl cyanide)	8260	100
107-02-8	Acrolein	8260	100
107-13-1	Acrylonitrile	8260	100
107-05-1	Allyl chloride	8260	10.5
71-43-2	Benzene	8260	5
75-27-4	Bromodichloromethane	8260	5
75-25-2	Bromoform	8260	5
75-15-0	Carbon disulfide	8260	10.5
56-23-5	Carbon tetrachloride	8260	3
108-90-7	Chlorobenzene	8260	5
75-00-3	Chloroethane	8260	10
67-66-3	Chloroform	8260	5
126-99-8	Chloroprene (Chloro-1,3-butadiene;2-)	8260	10
124-48-1	Dibromochloromethane	8260	5
106-46-7	P-Dichlorobenzene (1,4-Dichlorobenzene)	8260	4
75-71-8	Dichlorodifluoromethane	8260	10
141-78-6	Ethyl acetate	8260	5000
100-41-4	Ethylbenzene	8260	4
60-29-7	Ethyl ether (Diethyl ether)	8260	5
97-63-2	Ethyl methacrylate	8260	10.5
78-83-1	Isobutanol (Isobutyl Alcohol)	8260	500
126-98-7	Methacrylonitrile (2-propenenitrile, 2-methyl-)	8260	10.5
74-83-9	Methyl bromide (Bromomethane)	8260	10
74-87-3	Methyl chloride (Chloromethane)	8260	10

Table A-3. Analytical Methods for the Single-Shell Tank System

CAS Number	Waste Constituent (Alternate Name)	Analytical Method[a]	Practical Quantitation Limit (µg/L)
74-88-4	Methyl iodide (Iodomethane)	8260	10.5
80-62-6	Methyl methacrylate (2-Propenoic acid, 2-methyl-, methyl ester)	8260	10.5
74-95-3	Methylene bromide (Dibromomethane)	8260	10
75-09-2	Methylene chloride (Dichloromethane)	8260	5.25
107-12-0	Propionitrile (Ethyl cyanide)	8260	21
100-42-5	Styrene	8260	5
127-18-4	Tetrachloroethene (Tetrachloroethylene, perchloroethylene)	8260	5
108-88-3	Toluene	8260	5
79-01-6	Trichloroethylene (Trichloroethene [TCE])	8260	2.1
75-69-4	Trichlorofluoromethane	8260	10
108-05-4	Vinyl acetate	8260	50
75-01-4	Vinyl chloride (Chloroethene, chloroethylene)	8260	2.1
1330-20-7	Xylene (Total)(Mixed isomers)	8260	10
Semivolatile Organic Compounds			
134-32-7	1-Naphthylamine	8270	25
95-50-1	1,2-Dichlorobenzene (o-Dichlorobenzene)	8270	10.5
120-82-1	1,2,4-Trichlorobenzene	8270	13
95-94-3	1,2,4,5-Tetrachlorobenzene	8270	20
123-91-1	1,4-Dioxane (1,4-Diethylene dioxide)	8270	21
130-15-4	1,4-Naphthoquinone	8270	52.5
53-96-3	2-Acetylaminofluorene	8270	100
91-58-7	2-Chloronaphthalene (Beta-chloronaphthalene)	8270	10.5
95-57-8	2-Chlorophenol	8270	10.5
95-48-7	2-Methylphenol (o-Cresol)	8270	10.5
91-57-6	2-Methylnaphthalene	8270	10.5

Table A-3. Analytical Methods for the Single-Shell Tank System

CAS Number	Waste Constituent (Alternate Name)	Analytical Method[a]	Practical Quantitation Limit (μg/L)
91-59-8	2-Naphthylamine	8270	10.5
88-75-5	2-Nitrophenol (o-Nitrophenol)	8270	10.5
109-06-8	2-Picoline	8270	21
58-90-2	2,3,4,6-Tetrachlorophenol	8270	52.5
120-83-2	2,4-Dichlorophenol	8270	10.5
105-67-9	2,4-Dimethylphenol (2,4-Xylenol)	8270	10.5
51-28-5	2,4-Dinitrophenol	8270	50
121-14-2	2,4-Dinitrotoluene	8270	10.5
95-95-4	2,4,5-Trichlorophenol	8270	10.5
88-06-2	2,4,6-Trichlorophenol	8270	10.5
87-65-0	2,6-Dichlorophenol	8270	10.5
606-20-2	2,6-Dinitrotoluene	8270	10.5
56-49-5	3-Methylcholanthrene	8270	21
108-39-4[c]	3-Methylphenol (m-Cresol)	8270	--
106-44-5[c]	4-Methylphenol (p-Cresol)	8270	--
91-94-1	3,3′-Dichlorobenzidine	8270	52.5
119-93-7	3,3′-Dimethylbenzidine	8270	50
92-67-1	4-Aminobiphenyl	8270	52.5
101-55-3	4-Bromophenyl phenyl ether	8270	10.5
59-50-7	4-Chloro-3-methylphenol (p-Chloro-m-cresol)	8270	10.5
7005-72-3	4-Chlorophenyl phenyl ether	8270	10.5
56-57-5	4-Nitroquinoline 1-oxide	8270	105
534-52-1	4,6-Dinitro-O-cresol (4,6-Dinitro-2-methyl phenol)	8270	52.5
99-55-8	5-Nitro-o-toluidine (Methyl-5-nitroaniline;2-)	8270	21
57-97-6	7,12-Dimethylbenz[a]anthracene	8270	21
83-32-9	Acenaphthene	8270	10.5
208-96-8	Acenaphthylene	8270	10.5
98-86-2	Acetophenone	8270	10.5

Table A-3. Analytical Methods for the Single-Shell Tank System

CAS Number	Waste Constituent (Alternate Name)	Analytical Method[a]	Practical Quantitation Limit (µg/L)
62-53-3	Aniline	8270	10.5
120-12-7	Anthracene	8270	10.5
140-57-8	Aramite	8270	20
56-55-3	Benz[a]anthracene (Benzo[a]anthracene)	8270	10.5
205-99-2	Benz[e]acephenanthrylene (Benzo[b]fluoranthene)	8270	10.5
207-08-9	Benzo[k]fluoranthene	8270	10.5
191-24-2	Benzo[ghi]perylene	8270	10.5
50-32-8	Benzo[a]pyrene	8270	10.5
100-51-6	Benzyl alcohol	8270	10.5
111-91-1	Bis(2-chloroethoxy)methane	8270	10.5
111-44-4	Bis(2-chloroethyl)ether	8270	10.5
108-60-1	Bis(2-chloro-1-methylethyl)ether (2,2'-Oxybis[1-chloropropane])	8270	10.5
117-81-7	Bis(2-ethylhexyl) Phthalate	8270	10.5
85-68-7	Butyl benzyl phthalate (Benzyl butyl phthalate)	8270	10.5
106-47-8	p-Chloroaniline (4-Chloroaniline)	8270	10.5
218-01-9	Chrysene	8270	10.5
53-70-3	Dibenz[a,h]anthracene (Dibeznanthracene, 1,2,5,6-)	8270	10.5
132-64-9	Dibenzofuran	8270	10.5
541-73-1	m-Dichlorobenzene (1,3-Dichlorobenzene)	8270	10.5
84-66-2	Diethyl phthalate	8270	10.5
297-97-2	O,O-Diethyl O-2-pyrazinyl phosphorothioate (Thionazin)	8270	52.5
60-11-7	p-(Dimethylamino)azobenzene	8270	21
122-09-8	alpha, alpha-Dimethylphenethylamine	8270	52.5
131-11-3	Dimethyl phthalate	8270	10.5
84-74-2	Di-n-butylphthalate (Dibutyl phthalate)	8270	10.5
99-65-0	m-Dinitrobenzene (1,3-Dinitrobenzene)	8270	10.5

Table A-3. Analytical Methods for the Single-Shell Tank System

CAS Number	Waste Constituent (Alternate Name)	Analytical Method[a]	Practical Quantitation Limit (µg/L)
117-84-0	Di-n-octylphthalate	8270	10.5
122-39-4	Diphenylamine	8270	10.5
62-50-0	Ethyl methanesulfonate	8270	10.5
206-44-0	Fluoranthene	8270	10.5
86-73-7	9H-Fluorene (Fluorene)	8270	10.5
118-74-1	Hexachlorobenzene	8270	10.5
87-68-3	Hexachlorobutadiene	8270	10.5
77-47-4	Hexachlorocyclopentadiene	8270	10.5
67-72-1	Hexachloroethane	8270	10.5
70-30-4	Hexachlorophene	8270	525
1888-71-7	Hexachloropropene	8270	105
193-39-5	Indeno(1,2,3-Cd)Pyrene	8270	10.5
78-59-1	Isophorone	8270	10.5
120-58-1	Isosafrole	8270	21
91-80-5	Methapyrilene	8270	52.5
66-27-3	Methyl methanesulfonate	8270	10.5
91-20-3	Naphthalene	8270	10.5
98-95-3	Nitrobenzene	8270	10.5
88-74-4	o-Nitroaniline (2-Nitroaniline)	8270	21
99-09-2	m-Nitroaniline (3-Nitroaniline)	8270	21
100-01-6	p-Nitroaniline (4-Nitroaniline)	8270	21
100-02-7	p-Nitrophenol (4-Nitrophenol)	8270	21
924-16-3	N-Nitrosodi-n-butylamine	8270	10.5
55-18-5	N-Nitrosodiethylamine	8270	10.5
62-75-9	N-Nitrosodimethylamine (Dimethyl nitrosamine)	8270	10.5
86-30-6[d]	N-Nitrosodiphenylamine	8270	--
621-64-7	n-Nitroso-di-n-dipropylamine (N-Nitrosodipropylamine; Di-n-propylnitrosamine)	8270	10.5

Table A-3. Analytical Methods for the Single-Shell Tank System

CAS Number	Waste Constituent (Alternate Name)	Analytical Method[a]	Practical Quantitation Limit (µg/L)
10595-95-6	N-Nitrosomethylethalamine (Ethanamine, N-methyl-N-nitroso-)	8270	10.5
59-89-2	n-Nitrosomorpholine	8270	10.5
100-75-4	N-Nitrosopiperidine	8270	10.5
930-55-2	N-Nitrosopyrrolidine	8270	10.5
608-93-5	Pentachlorobenzene	8270	10.5
76-01-7	Pentachloroethane	8270	52.5
82-68-8	Pentachloronitrobenzene	8270	52.5
87-86-5	Pentachlorophenol	8270	52.5
62-44-2	Phenacetin	8270	21
85-01-8	Phenanthrene	8270	10.5
108-95-2	Phenol	8270	10.5
106-50-3	p-Phenylenediamine	8270	525
129-00-0	Pyrene	8270	10.5
110-86-1	Pyridine	8270	21
94-59-7	Safrole	8270	21
3689-24-5	Tetraethyl dithiopyrophosphate (Sulfotep)	8270	50
95-53-4	o-Toluidine (Methylaniline;2-)	8270	20
126-68-1	O,O,O-Triethyl phosphorothioate	8270	52.5
99-35-4	sym-Trinitrobenzene (Trinitrobenzene;1,3,5-)	8270	52.5
Polychlorinated Biphenyls			
12674-11-2	Aroclor 1016	8082	1.05
11104-28-2	Aroclor 1221	8082	2.1
11141-16-5	Aroclor 1232	8082	1.05
53469-21-9	Aroclor 1242	8082	1.05
12672-29-6	Aroclor 1248	8082	1.05
11097-69-1	Aroclor 1254	8082	1.05
11096-82-5	Aroclor 1260	8082	1.05
Herbicides			
94-75-7	2,4-D (2,4-Dichlorophenoxy acetic acid)	8151	20

Table A-3. Analytical Methods for the Single-Shell Tank System

CAS Number	Waste Constituent (Alternate Name)	Analytical Method[a]	Practical Quantitation Limit (µg/L)
93-76-5	2,4,5-T (2,4,5-Trichlorophenoxyacetic acid)	8151	1.05
2303-16-4	Diallate	8270	21
88-85-7	Dinoseb (2-sec-Butyl-4,6-dinitrophenol)	8270	21
23950-58-5	Pronamide	8270	21
93-72-1	Silvex (2,4,5-TP)	8151	1.05
Pesticides			
72-54-8	4,4’-DDD	8081	0.1
72-55-9	4,4’-DDE	8081	0.1
50-29-3	4,4’-DDT	8081	0.1
309-00-2	Aldrin	8081	0.0525
319-84-6	alpha-BHC (hexachlorocyclohexane;alpha)	8081	0.0525
319-85-7	beta-BHC (hexachlorocyclohexane;beta-)	8081	0.0525
319-86-8	delta-BHC (hexachlorocyclohexane;delta-)	8081	0.0525
58-89-9	gamma-BHC (Lindane; hexachlorocyclohexane)	8081	0.0525
57-74-9	Chlordane	8081	0.525
510-15-6	Chlorobenzilate	8270	10.5
60-57-1	Dieldrin	8081	0.5
60-51-5	Dimethoate	8270	21
298-04-4	Disulfoton	8270	52.5
959-98-8	Endosulfan I	8081	0.0525
33213-65-9	Endosulfan II	8081	0.1
1031-07-8	Endosulfan sulfate	8081	0.1
72-20-8	Endrin	8081	0.1
7421-93-4	Endrin aldehyde	8081	0.1
52-85-7	Famphur	8270	105
76-44-8	Heptachlor	8081	0.0525
1024-57-3	Heptachlor epoxide	8081	0.0525
465-73-6	Isodrin	8270	10.5

Table A-3. Analytical Methods for the Single-Shell Tank System

CAS Number	Waste Constituent (Alternate Name)	Analytical Method[a]	Practical Quantitation Limit (µg/L)
143-50-0	Kepone	8270	100
72-43-5	Methoxychlor	8081	0.5
298-00-0	Methyl parathion (O,O-dimethyl O-P-nitrophenyl, phosphorothioate)	8270	10.5
56-38-2	Parathion	8270	52.5
298-02-2	Phorate (Phosphorodithioic acid, O,O-diethyl S-(ethylthio) methyl ester)	8270	52.5
8001-35-2	Toxaphene	8081	2.625
Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans (Totals and Congeners)			
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin	8290	1.05E-05
41903-57-5	Tetrachlorodibenzo-p-dioxins	8290	1.05E-05
36088-22-9	Pentachlorodibenzo-p-dioxins	8290	5.25E-05
34465-46-8	Hexachlorodibenzo-p-dioxin	8290	1.07E-04
55722-27-5	Tetrachlordibenzofurans	8290	1.05E-05
30402-15-4	Pentachlorodibenzofurans	8290	5.25E-05
55684-94-1	Hexachlorodibenzofurans	8290	1.05E-04

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

a. For EPA Methods 180.1, 300, and 335.4, see EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples.* For EPA Methods 120.1, 150.1, 170.1, 310.1, 360.1, and 376.1, EPA/600/4-79/020, *Methods for Chemical Analysis of Water and Wastes*. For four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods,Compendium*. For Standard Methods, see APHA/AWWA/WEF, 2017, *Standard Methods for the Examination of Water and Wastewater*.

b. Dilutions for certain ion chromatography constituents may be necessary, potentially raising the PQL above the limits provided.

c. Analyzed and reported as 3 & 4 Methylphenol (CAS number 65794-96-9). PQL for 3 & 4 Methylphenol is 20 µg/L.

d. Analyzed and reported as Diphenylamine+N-Nitrosodiphenylamine. PQL for Diphenylamine+N-Nitrosodiphenylamine is 10.5 µg/L.

CAS	=	Chemical Abstracts Service
Ecology	=	Washington State Department of Ecology
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 applicable work practices. Field analytical methods may also be performed in accordance with manufacturer manuals. Appendix B provides further discussion on field measurements.

A3.3 Quality Control

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 on the analytical data. Field and laboratory QC samples, and their typical frequencies, 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 the HEIS database, as appropriate.

Table A-4. QC Samples

Sample Type	Frequency	Characteristics Evaluated
Field QC		
Equipment blanks	1 in 20 samples when nondedicated equipment is used [a]	Contamination from nondedicated sampling equipment
Field duplicates	1 in 20 well trips[b]	Reproducibility/sampling precision
Field splits	As needed	Interlaboratory comparability
Field transfer blanks	One each day VOCs are sampled; additional field transfer blanks are collected if VOC samples are acquired on the same day for multiple laboratories	Contamination from sampling site
Full trip blanks	1 in 20 well trips[b]	Contamination from containers preservative reagents, storage, or transportation
Analytical QC[c]		
Laboratory control samples	One per analytical batch[d]	Method accuracy
Laboratory sample duplicates	One per analytical batch[d]	Laboratory reproducibility and precision
Matrix spikes	One per analytical batch[d]	Matrix effect/laboratory accuracy
Matrix spike duplicates	One per analytical batch[d]	Laboratory reproducibility, and method accuracy and precision
Method blanks	One per analytical batch[d]	Laboratory contamination
Surrogates	Added to each sample and QC sample	Recovery/yield for organic compounds

Note: The information in this table does not create U.S. Environmental Protection Agency or Washington State Department of Ecology requirements; it is intended solely as guidance.

a. For portable pumps, equipment blanks are collected (1 for every 20 well trips). Whenever a new type of nondedicated equipment is used, an equipment blank will be collected each 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.

Table A-4. QC Samples

Sample Type	Frequency	Characteristics Evaluated

b. For groundwater a sample is collected any time a well is accessed for sampling; this is also know as a well trip. Field duplicates and full trip blanks are run at a frequency of 1 in 20 well trips (i.e., 5% of the well trips) for all groundwater monitoring wells sampled within any given month and drilling campaign (for all groundwater monitoring programs).

c. A batch is a group of up to 20 samples that behave similarly with respect to the sampling or testing procedures being employed and which are processed as a unit. Batching across projects is allowed for similar matrices (e.g., Hanford Site groundwater).

d. Unless not required by, or different frequency is called out, in laboratory analysis method.

QC = quality control

VOC = volatile organic compound

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

Analyte[a]	QC Element	Acceptance Criteria	Corrective Action
General Chemistry			
Alkalinity	MB	<MDL <5% sample concentration	Flag with "C"
	LCS	80% to 120% recovery	Flag with "o"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD[d]	75% to 125% recovery	Flag with "N"
	EB, FTB	<MDL <5% sample concentration	Flag with "Q"
	Field duplicate[c]	≤20% RPD	Review data[e]
Cyanide (free and total)	MB	<MDL <5% sample concentration	Flag with "C"
	LCS	80% to 120% recovery	Flag with "o"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD[d]	75% to 125% recovery	Flag with "N"
	EB, FTB	<MDL <5% sample concentration	Flag with "Q"
	Field duplicate[c]	≤20% RPD	Review data[e]
Hexavalent chromium	MB	<MDL <5% sample concentration	Flag with "C"
	LCS	80% to 120% recovery	Flag with "o"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD[d]	75% to 125% recovery	Flag with "N"
	EB, FTB	<MDL <5% sample concentration	Flag with "Q"
	Field duplicate[c]	≤20% RPD	Review data[e]

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

Analyte[a]	QC Element	Acceptance Criteria	Corrective Action
Sulfide	MB	<MDL <5% sample concentration	Flag with "C"
	LCS	80% to 120% recovery	Flag with "o"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD[d]	75% to 125% recovery	Flag with "N"
	EB, FTB	<MDL <5% sample concentration	Flag with "Q"
	Field duplicate[c]	≤20% RPD	Review data[e]
Anions			
Anions by ion chromatography	MB	<MDL <5% sample concentration	Flag with "C"
	LCS	80% to 120% recovery	Flag with "o"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD[d]	75% to 125% recovery	Flag with "N"
	EB, FTB	<MDL <5% sample concentration	Flag with "Q"
	Field duplicate[c]	≤20% RPD	Review data[e]
Metals			
Metals by inductively coupled plasma/atomic emission spectrometry	MB	<MDL <5% sample concentration	Flag with "C"
	LCS	80% to 120% recovery	Flag with "o"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD[d]	75% to 125% recovery	Flag with "N"
	EB, FTB	<MDL <5% sample concentration	Flag with "Q"
	Field duplicate[c]	≤20% RPD	Review data[e]
Metals by inductively coupled plasma/mass spectrometry	MB	<MDL <5% sample concentration	Flag with "C"
	LCS	80% to 120% recovery	Flag with "o"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD[d]	75% to 125% recovery	Flag with "N"
	EB, FTB	<MDL <5% sample concentration	Flag with "Q"
	Field duplicate[c]	≤20% RPD	Review data[e]

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

Analyte[a]	QC Element	Acceptance Criteria	Corrective Action
Mercury by cold-vapor atomic absorption	MB	<MDL <5% sample concentration	Flag with "C"
	LCS	80% to 120% recovery	Flag with "o"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD[d]	75% to 125% recovery	Flag with "N"
	EB, FTB	<MDL <5% sample concentration	Flag with "Q"
	Field duplicate[c]	≤20% RPD	Review data[e]
Alcohols			
Methanol	MB	<MDL <5% sample concentration	Flag with "B"
	LCS	70%-130% recovery or % recovery statistically derived[f]	Flag with "o"[a]
	DUP[b] or MS/MSD[c]	≤20% RPD	Review data[d]
	MS/MSD[c]	% recovery statistically derived[f]	Flag with "N"
	SUR	% recovery statistically derived[f]	Review data[d]
	EB, FTB	<MDL <5% sample concentration	Flag with "Q"
	Field duplicate[c]	≤20% RPD	Review data[e]
Volatile Organic Compounds			
Volatile organics by gas chromatography/mass spectrometry	MB	<MDL[f] <5% sample concentration	Flag with "B"
	LCS	70% to 130% recovery or % recovery statistically derived[g]	Flag with "o"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD[d]	70% to 130% recovery	Flag with "T"
	SUR	70% to 130% recovery	Review data[e]
	EB, FTB, FXR	<MDL[f] <5% sample concentration	Flag with "Q"
	Field duplicate[c]	≤20% RPD	Review data[e]
Semivolatile Organic Compounds			
Phenols gas chromatography/mass spectrometry	MB	<MDL <5% sample concentration	Flag with "B"
	LCS	70% to 130% recovery or % recovery statistically derived[g]	Flag with "o"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]

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

Analyte[a]	QC Element	Acceptance Criteria	Corrective Action
	MS/MSD[d]	% recovery statistically derived[g]	Flag with "T"
	SUR	% recovery statistically derived[g]	Review data[e]
	EB, FTB	<MDL <5% sample concentration	Flag with "Q"
	Field duplicate[c]	≤20% RPD	Review data[e]
Semivolatiles by gas chromatography/mass spectrometry	MB	<MDL[f] <5% sample concentration	Flag with "B"
	LCS	70% to 130% recovery or % recovery statistically derived[g]	Flag with "o"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD[d]	% recovery statistically derived[g]	Flag with "T"
	SUR	% recovery statistically derived[g]	Review data[e]
	EB, FTB	<MDL[f] <5% sample concentration	Flag with "Q"
	Field duplicate[c]	≤20% RPD	Review data[e]
Polychlorinated Biphenyls			
Polychlorinated biphenyls by gas chromatography	MB	<MDL <5% sample concentration	Flag with "B"
	LCS	70% to 130% recovery or % recovery statistically derived[g]	Flag with "o"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD[d]	% recovery statistically derived[g]	Flag with "N"
	SUR	% recovery statistically derived[g]	Review data[e]
	EB, FTB	<MDL <5% sample concentration	Flag with "Q"
	Field duplicate[c]	≤20% RPD	Review data[e]
Herbicides			
Herbicides by gas chromatography	MB	<MDL <5% sample concentration	Flag with "B"
	LCS	70% to 130% recovery or % recovery statistically derived[g]	Flag with "o"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD[d]	% recovery statistically derived[g]	Flag with "N"
	SUR	% recovery statistically derived[g]	Review data[e]
	EB, FTB	<MDL <5% sample concentration	Flag with "Q"

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

Analyte[a]	QC Element	Acceptance Criteria	Corrective Action
	Field duplicate[c]	≤20% RPD	Review data[e]
Pesticides			
Pesticides by gas chromatography	MB	<MDL <5% sample concentration	Flag with "B"
	LCS	70% to 130% recovery or % recovery statistically derived[g]	Flag with "o"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD[d]	% recovery statistically derived[g]	Flag with "N"
	SUR	% recovery statistically derived[g]	Review data[e]
	EB, FTB	<MDL <5% sample concentration	Flag with "Q"
	Field duplicate[c]	≤20% RPD	Review data[e]
Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans (Totals and Congeners)			
Dioxins/furans by high-resolution gas chromatography/high-resolution mass spectrometry	MB	<PQL <5% sample concentration	Flag with "B"
	LCS	% recovery statistically derived[g]	Flag with "o"[b]
	DUP[c]	≤20% RPD	Review data[e]
	SUR	60%-140% recovery	Review data[e]
	EB, FTB	<PQL <5% sample concentration	Flag with "Q"
	Field duplicate[c]	<20% RPD	Review data[e]

Notes: The information in this table does not create U.S. Environmental Protection Agency or Washington State Department of Ecology requirements; it is intended solely as guidance.

This table applies only to laboratory analyses. Field measurements (e.g., specific conductance, pH, dissolved oxygen, temperature, and turbidity) are not listed because they are measured in the field.

a. See Table A-3 for constituent list and analytical methods.

b. The reporting laboratory will apply the "o" flag with SMR group concurrence.

c. Applies when at least one result is greater than the laboratory PQL.

d. Either a DUP or a MS/MSD is to be analyzed to determine measurement precision (if there is insufficient sample volume, a laboratory control sample duplicate is analyzed with the acceptance criteria defaulting to the ≤20% RPD criteria).

e.After review, corrective actions are determined on a case-by-case basis. Corrective actions may include a laboratory recheck or flagging the data.

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

g. Laboratory determined, statistically derived control limits based on historical data are used here. Control limits are reported with the data.

DUP	=	laboratory sample duplicate	MS	=	matrix spike
EB	=	equipment blank	MSD	=	matrix spike duplicate
FTB	=	full trip blank	PQL	=	practical quantitation limit
FXR	=	field transfer blank	QC	=	quality control
LCS	=	laboratory control sample	RPD	=	relative percent difference

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

Analyte[a]	QC Element	Acceptance Criteria	Corrective Action

MB = method blank

MDL = method detection limit

SMR = Sample Management and Reporting

SUR = surrogate

Data Flags

B, C = possible laboratory contamination: analyte was detected in the associated method blank – laboratory applied. The B flag is used for organic analytes. The C flag is used for general chemical and inorganic analytes.

N = result may be biased: associated matrix spike result was outside the acceptance limits (except gas chromatograph/mass spectrometry) – laboratory applied.

o = result may be biased: associated laboratory control sample result was outside the acceptance limits – laboratory applied.

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

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

A3.3.1 Field Quality Control Samples

Field QC samples are used to monitor the integrity of field samples during sample collection, transportation, storage, and laboratory analysis. Field QC samples are submitted to the analyzing laboratories as field samples. Field QC samples are analyzed for the same set of analytes as their corresponding field samples. Field QC samples include field duplicates, field split (SPLIT) samples, and field blanks (equipment blanks [EBs], field transfer blanks [FXRs], and full trip blanks [FTBs]). Field blanks are typically prepared to match the sample matrix as closely as possible using high-purity water[1]. The following describe the QC samples in more detail:

- **Equipment blanks:** EBs are used to monitor the effectiveness of the decontamination process for reusable sampling equipment. They are samples of high-purity water contacted with the sampling surfaces of equipment used to collect samples prior to using that equipment for field sampling. EBs are collected from each type of reusable sampling equipment to ensure that the decontamination procedures are effective for the specific equipment types. EBs will be analyzed for the same analytes as samples collected using that equipment. EB samples are not required for disposable sampling equipment.
- **Field duplicates:** Field duplicates provide information regarding the homogeneity of the sample matrix and the precision of the sampling and analysis processes. Field duplicates are two samples that are intended to be identical and are collected as close as possible in time and location. Each sample in the sample-duplicate pair receives its own unique sample number.
- **Field splits:** SPLITs are two samples that are intended to be identical and are collected as close as possible in time and location. 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.
- **Field transfer blanks:** FXRs are used to document possible contamination during field acquisition of volatile organic compound (VOC) samples. FXRs are sample bottles (already containing any required

[1] High-purity water 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.

sample preservative) filled at the sample collection site with high-purity water. The blank is sealed at the sampling site and becomes part of the sample set sent to the laboratory. FXRs are prepared daily for sites sampling for VOC analysis. Typically, one set of FXRs is prepared each day that VOC field samples are collected. If VOC samples are collected on the same day and shipped to multiple laboratories, a set of FXRs is collected for each analyzing laboratory.

- **Full trip blanks:** FTBs are used to monitor for potential sample contamination from the sampling container, preservation reagents, or storage conditions. FTBs are prepared high-purity water and sealed prior to traveling to the sampling site, transported to the sampling site (not opened in the field), and then shipped as part of the sample set to the laboratory. The bottle set is either for volatile organic analysis only or identical to the set that will be collected in the field. Collected FTBs are typically analyzed for the same constituents as the samples from the associated sampling event.

A3.3.2 Laboratory Quality Control Samples

Internal QA/QC programs are maintained by laboratories used by the project and include the use of laboratory control samples (LCSs), laboratory sample duplicates (DUPs), matrix spikes (MSs), matrix spike duplicates (MSDs), method blanks (MBs), and surrogates (SURs). These QC analyses follow EPA methods (e.g., those in the SW-846 Compendium). QC checks outside of control limits are documented in analytical laboratory reports and during a DQI evaluation. Descriptions of the various types of laboratory QC samples are as follows:

- **Laboratory control sample:** 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.

- **Laboratory sample duplicate:** A second aliquot of a sample that is taken through the entire sample preparation and analytical process. DUPs are used to evaluate the precision of a method in a given sample matrix.

- **Matrix spike:** An aliquot of a sample spiked with a known concentration of target analyte(s) that is then taken through the entire sample preparation and analytical process. An MS is used to assess the bias of a method in a given sample matrix. Thus, MS results are an indicator of the effect the sample matrix has on the accuracy of measurement of the target analytes.

- **Matrix spike duplicate:** 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.

- **Method blank:** 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 process. The MB is used to quantify contamination resulting from the sample preparation and analysis.

- **Surrogate:** Used only in organic analyses, 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 analytical process in a manner similar to the analytes of interest. Because SURs are added to every sample and QC sample, they are used to evaluate overall method performance in a given matrix.

Samples are analyzed within the holding time guidelines provided 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[a]	Preservation[b]	Holding Time
General Chemistry		
Alkalinity	Store ≤6°C	14 days
Cyanide (free and total)	Store ≤6°C, Adjust pH to >12 with 50% sodium hydroxide. If oxidizing agents present, add 5 mL 0.1 N sodium arsenite/L or 0.06 g ascorbic acid/L	14 days
Hexavalent chromium	Store ≤6°C	24 hours
Sulfide	Store ≤6ºC, adjust pH to > 9 with zinc acetate and sodium hydroxide	7 days
Anions		
Chloride, Sulfate	Store ≤6°C	28 days
Nitrate	Store ≤6°C	48 hours
Metals		
Metals by inductively coupled plasma-atomic emission spectrometry	Adjust pH to <2 with nitric acid	6 months
Metals by inductively coupled plasma/mass spectrometry	Adjust pH to <2 with nitric acid	6 months
Mercury by cold-vapor atomic absorption	Adjust pH to <2 with nitric acid	28 days
Alcohols		
Methanol	Cool ≤6ºC	14 days
Volatile Organic Compounds		
Volatile organics by gas chromatography/mass spectrometry	Store ≤6°C, Adjust pH to <2 with sulfuric acid or hydrochloric acid	7 days unpreserved 14 days maximum preserved
Semivolatile Organic Compounds		
Semivolatiles by gas chromatography/ mass spectrometry	Store ≤6°C	7 days before extraction 40 days after extraction
Polychlorinated Biphenyls		
Polychlorinated biphenyls	Store <6°C	1 year before extraction 40 days after extraction

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

Constituent[a]	Preservation[b]	Holding Time
Herbicides		
Herbicides	Store <6°C	7 days before extraction 40 days after extraction
Pesticides		
Pesticides	Store <6°C	7 days before extraction 40 days after extraction
Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans (Totals and Congeners)		
Dioxins/furans by high-resolution gas chromatography/high-resolution mass spectrometry	Store <6°C	30 days before extraction 45 days after extraction

Notes: Holding times and preservation methods are dependent on the constituent and are consistent with EPA guidance and approved analytical methods. Information in this table does not create EPA or Washington State Department of Ecology requirements but is intended solely as guidance.

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

This table applies only to laboratory analyses. Field measurements (e.g., specific conductance, pH, dissolved oxygen, temperature, and turbidity) are not listed because they are measured in the field.

a. See Table A-3 for constituent list and analytical methods.

b. 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.

EPA = U.S. Environmental Protection Agency

A3.4 Measurement Equipment

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

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

Collection, measurement, and testing equipment will meet applicable standards (e.g., ASTM International, formerly the American Society for Testing and Materials) or have been evaluated as acceptable and valid according to instrument-specific methods and specifications. Software applications will be acceptance tested prior to use in the field. Measurement and testing equipment used in the field will be subject to preventive maintenance measures to minimize downtime.

A3.6 Instrument/Equipment Calibration and Frequency

Field equipment calibration is discussed in Appendix B.

A3.7 Inspection/Acceptance of Supplies and Consumables

Consumables, supplies, and reagents will be reviewed per test methods in the SW-846 Compendium and EPA/600 Method series (e.g., EPA/600/4-79/020, *Methods for Chemical Analysis of Water and Wastes*) and will be appropriate for their use. Supplies and consumables used in sampling and analysis activities are procured under internal work processes. 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 records will be evaluated by staff assigned by the Project Delivery Manager for Groundwater Science. Data used in evaluations will be identified by source. Historical data obtained from the HEIS database are usable for comparison to data collected by this groundwater monitoring plan.

A3.9 Data Management

Records of data analyses and groundwater surface elevations are maintained as required by 40 CFR 265.94.

Electronic data access will be through a Hanford Site database (e.g., HEIS). Where electronic data are not available, hard copies will be provided.

A4 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.

A4.1 Data Review and Verification

Data review and verification are performed to confirm that field and field QC 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 determine if holding times were met.

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, and the correct application of conversion factors. Data verification is typically conducted on a portion of multi-media samples collected across projects.

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

A4.2 Data Validation

Data validation is performed at the discretion of the Project Delivery Manager for Groundwater Science, under the direction of the SMR group. The decision to perform validation is based on the results of QC samples for individual well networks and discussions with the staff member assigned by the Project Delivery Manager for Groundwater Science. If conducted, data validation (third-party) will be performed at a minimum frequency of 5% per method. Data validation evaluates the analytical quality of data from samples specifically collected for this plan.

A4.3 Reconciliation with User Requirements

The purpose of reconciliation with user requirements is to determine if quantitative data are of the correct type and are of adequate quality and quantity to meet the project data needs. For routine groundwater monitoring undertaken by projects, DQIs such as precision, accuracy, representativeness, comparability, completeness, bias, and sensitivity for the specific data sets (individual data packages) will typically be evaluated on an annual basis. A DQI evaluation specific to data quality requirements specified in this plan may be performed at the discretion of the Project Delivery Manager for Groundwater Science. Results of the DQI evaluation(s) will be used by the Project Delivery Manager for Groundwater Science to interpret the data and determine if the data quality objectives for this activity have been met.

A5 References

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SGW-846 Compendium, as amended, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://www.epa.gov/hw-sw846/sw-846-compendium.

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Appendix B

Sampling Protocol

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Contents

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Terms

DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
IATA	International Air Transport Association
QA	quality assurance
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*

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B1 Introduction

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

This appendix provides elements of the sampling protocols and techniques used for the groundwater monitoring plan. The main text 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 dangerous waste management units.

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 according 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 (0.36°F)
- **Conductivity** – two consecutive measurements agree within 10% of each other
- **Turbidity** – less than 5 nephelometric turbidity units prior to sampling (or the recommendation by staff assigned by the Project Delivery Manager for Groundwater Science's at the time of sample collection)

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

Unless special directions are provided by staff assigned by the Project Delivery Manager for Groundwater Science at the time of sample collection, wells are typically purged at a flow rate not to exceed 7.6 L/min (2 gal/min). Purging will continue until stable readings of selected field water quality parameters are achieved (as described above).

Field measurements (except for turbidity) are typically obtained using an instrumented flow-through cell located at the well head. 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, specific conductance, and dissolved oxygen. Turbidity is measured by collecting an aliquot of water from the purgewater valve and inserting the sample vial into a turbidimeter.

Purgewater, including the water passing through the flow-through cell, is then discharged to a tank on the purgewater truck.

Collection of the field measurement data will commence when a volume of water equal to the volume of the pump riser pipe has been extracted and 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 collection. The flow rate does not exceed 7.6 L/min (2 gal/min) during sampling to minimize loss of volatiles (if any) and prevent overfilling the bottles. Sample bottles are filled in a sequence designed to minimize loss of volatiles (if any). If both filtered and unfiltered samples are required (see Tables 2-4 through 2-9), filtered samples are collected after collection of the unfiltered samples.

If required, samples may be filtered in the field, using a 0.45 μm filter, as noted on the chain-of-custody form. Unfiltered samples are collected in conjunction with filtered samples to determine if metal constituents being monitored (excluding hexavalent chromium, if one of the monitored constituents) occur as both suspended and dissolved phases, or in only one state. The evaluation of suspended and dissolved metals provide supporting information for groundwater geochemical characteristics, as well as indication of well integrity such as the presence of dislodged well encrustation, well corrosion products, or failure of the well screen filter pack.

Environmental-grade electric submersible pumps will typically be used for well purging and sample collection. In the event a well exhibits insufficient productivity to support purging and sampling using the electric submersible pumps, adjustable-rate bladder pumps with typical flow rates of 0.1 to 0.5 L/min (0.26 to 0.13 gal/min) may be employed. The same purge protocol described above will be used for these pumps.

For certain types of samples, preservatives are required. Preservatives, based on the analytical methods used, are generally added to the collection bottles before their use in the field. Sample preservation and holding times for groundwater samples are provided in Appendix A (Table A-6) and are based on the analytical method identified in Appendix A (Table A-3). 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 holding times could result in changes in constituent concentrations due to volatilization, decomposition, or other chemical alterations. Holding times depend on the constituent and are listed in analytical method compilations such as APHA/AWWA/WEF, 2017, *Standard Methods for the Examination of Water and Wastewater*; SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*; and the EPA/600 Method series (e.g., EPA/600/4-79/020, *Methods for Chemical Analysis of Water and Wastes*).

B2.1 Decontamination of Drilling and Sampling Equipment

Drilling of wells is not addressed by this groundwater monitoring plan. Therefore, a discussion of the decontamination of drilling equipment is not included.

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:

- 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 typically performed using high-purity water[1] in each step. In general, three rinse cycles are performed to decontaminate sampling equipment: detergent rinse, acid rinse, and water rinse. During the detergent rinse, 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 1 M 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 approximately 50°C (122°F) for items that are not metal or glass or at approximately 100°C (212°F) for metal or glass. Once reaching temperature, equipment is baked for approximately 20 minutes and then cooled. Equipment is then removed from the oven and enclosed in clean unused aluminum foil using surgical gloves. The wrapped equipment is stored in a custody-locked, controlled access area. Water-level measurement tapes (portion that came in contact with groundwater) are decontaminated using a high-purity water rinse and dried with disposable towels.

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. Typically, 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. Cleaning is documented on a tag that is affixed to the pump with the following information:

- Date of pump cleaning
- Pump identification
- Comments (if any)
- 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 40 CFR 265.92(e), "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Sampling and Analysis." Using a calibrated depth measurement tape, the depth to water is recorded in each well prior to sampling. When two consecutive

[1] High-purity water 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.

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 for field activities are 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, 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 for field activities are also identified with a unique project name and number. Data forms may be used to collect field information; information recorded on data forms is the same as for logbooks. The data forms are referenced in the logbooks.

The following information is recorded in logbooks or on data forms:

- 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
- Details of field tests that were conducted, and references to forms that were used and methods followed in conducting the activity
- Details of field calibrations and surveys that were conducted, and references to forms that were used, other data records, and methods followed in conducting the calibrations and surveys
- Details of samples collected and the preparation (if any) of splits, duplicates, or blanks
- 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)
- Equipment failures or breakdowns that occurred, with a brief description of replacements

B4 Calibration of Field Equipment

Onsite environmental instruments are calibrated in accordance with the manufacturer's operating instructions, internal work processes, and/or field instructions that provide direction for equipment calibration or verification of accuracy by analytical methods. Calibration records will include the raw calibration data, identification of the standards used, associated reports, date of analysis, and analyst's name or initials. Results from instrument calibration activities are recorded.

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

- Prior to initial use of a field analytical measurement system
- At a minimum, 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 methods 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 will be collected, where and when appropriate, in break-resistant containers. The field sample collection record will indicate the lot number of the bottles used in sample collection. When commercially precleaned containers are used in the field, the name of the manufacturer, lot identification, and certification will be retained for documentation.

Containers will 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 will 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 will contain the sample identification number. The label will identify or provide reference to associate the sample with the date and time of collection, preservative used (if applicable), analysis requested, 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 protocols maintain sample integrity 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 following minimum information is provided on a completed chain-of-custody form:

- Project name
- Collectors' names
- Unique sample number
- Date, time, and location (or traceable reference thereto) of sample 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)

B5.4 Sample Transportation

Packaging and transportation instructions will comply with applicable transportation regulations and U.S. 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). Carrier-specific requirements, defined in the current edition of International Air Transport Association (IATA) *Dangerous Goods Regulations*, will also be considered when preparing sample shipments conveyed by air freight providers.

Samples containing hazardous constituents will be considered hazardous material in transportation and transferred 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.

B6 Management of Waste

Waste materials generated during sample activities, including purgewater and decontamination fluids, will be collected and managed in accordance with the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* as authorized under Ecology et al., 1989, *Hanford Federal Facility Agreement and Consent Order Action Plan*, Milestone M-024.

For waste designation purposes, wells listed 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 necessary.

Packaging and labeling during waste storage and transportation will meet WAC 173-303, DOE, and DOT requirements, as appropriate.

Offsite analytical laboratories are responsible for the disposal of unused sample quantities and wastes generated during analytical processes.

B7 References

40 CFR 265.92, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Sampling and Analysis," *Code of Federal Regulations*. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=2cd7465519114fb3472b4864a0e3c42b&node=pt40.26.265&rgn=div5.

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Appendix C

Well Construction for Waste Management Area B-BX-BY

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Contents

Figures

Tables

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C1 Introduction

This appendix provides the following information for the existing Waste Management Area (WMA) B-BX-BY groundwater monitoring wells:

- Well name
- Hydrogeologic unit monitored (the aquifer portion at the well screen perforation) (Table C-1)
- The following sampling interval information, as provided in Table C-2:
  - Elevation at the top of the screen or perforated interval
  - Elevation at the bottom of the screen or perforated interval
  - Open interval length (i.e., difference between the top and bottom screen perforation elevations)
  - Drilling method

For proposed wells, the following information is provided in Table C-3:

- Well location
- Surface elevation
- Estimated water elevation
- Estimated water depth

Figures C-1 through C-15 provide construction and completion summaries for the existing network wells.

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.
TB	**Top of Basalt.** Open to less than 9.1 m (30 ft) above and below the top of basalt.

Table C-2. Sampling Interval Information for Wells Within the WMA B-BX-BY 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])	Drilling Method
299-E33-20	TU, TB	123.3 (404.5)	118.7 (389.5)*	4.6 (15.0)	Cable tool
299-E33-31	TU, TB	125.8 (412.9)	119.4 (391.9)	6.4 (21.0)	Cable tool
299-E33-32	TU, TB	126.2 (413.9)	119.8 (392.9)	6.4 (21.0)	Cable tool
299-E33-38	TU, TB	126.4 (414.7)	120.0 (393.7)	6.4 (21.1)	Cable tool
299-E33-41	TU, TB	124.9 (409.9)	120.0 (393.8)	4.9 (16.1)	Cable tool
299-E33-42	TU	126.7 (415.7)	120.2 (394.4)	6.5 (21.3)	Cable tool
299-E33-44	TU, TB	123.5 (405.2)	118.9 (390.2)	4.6 (15.0)	Cable tool

Table C-2. Sampling Interval Information for Wells Within the WMA B-BX-BY 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])	Drilling Method
299-E33-47	TU, TB	123.3 (404.7)	117.3 (384.7)	6.1 (20.0)	Cable tool
299-E33-48	TU, TB	123.3 (404.5)	115.7 (379.5)	7.6 (25.0)	Cable tool
299-E33-49	TU, TB	122.9 (403.3)	116.8 (383.3)	6.1 (20.0)	Cable tool
299-E33-334	TU, TB	124.7 (409.3)	117.1 (384.2)	7.6 (25.0)	Cable tool
299-E33-335	TU, TB	124.2 (407.4)	118.1 (387.3)	6.1 (20.0)	Air rotary
299-E33-337	TU, TB	124.2 (407.3)	116.5 (382.3)	7.6 (25.0)	Air rotary
299-E33-338	TU, TB	123.8 (406.1)	117.7 (386.1)	6.1 (20.0)	Cable tool
299-E33-339	TU, TB	123.2 (404.3)	117.2 (384.4)	6.1 (19.9)	Cable tool, air rotary

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

Note: Due to rounding and conversion of metric units, the computed open interval length based on the top and bottom elevations may differ slightly from the actual open interval length reported in the associated well summary sheet.

*Top of well casing was extended in 1992. Screen elevations are calculated from the depth to bottom measured below top of casing and corrected for casing stickup (2008 well maintenance report).

TB = Top of Basalt, as described in Table C-1

TU = Top of Unconfined, as described in Table C-1

Table C-3. Planned Location, Depth, and Screen Interval for Proposed Well Within the WMA B-BX-BY Network

Well ID	Easting* (m)	Northing* (m)	Surface Elevation (m [ft] NAVD88)	Water Table Elevation (m [ft] NAVD88)	Depth to Water (m [ft] bgs)	Drill Depth (m [ft] bgs)	Final Well Diameter (cm [in.])	Screen Interval (m [ft] bgs)	Sump and End Cap Interval (m [ft] bgs)
WMA_ B-BX-BY_PW-1 (D0062)	573842.98	137240.21	TBD	TBD	TBD	TBD	TBD	TBD	TBD

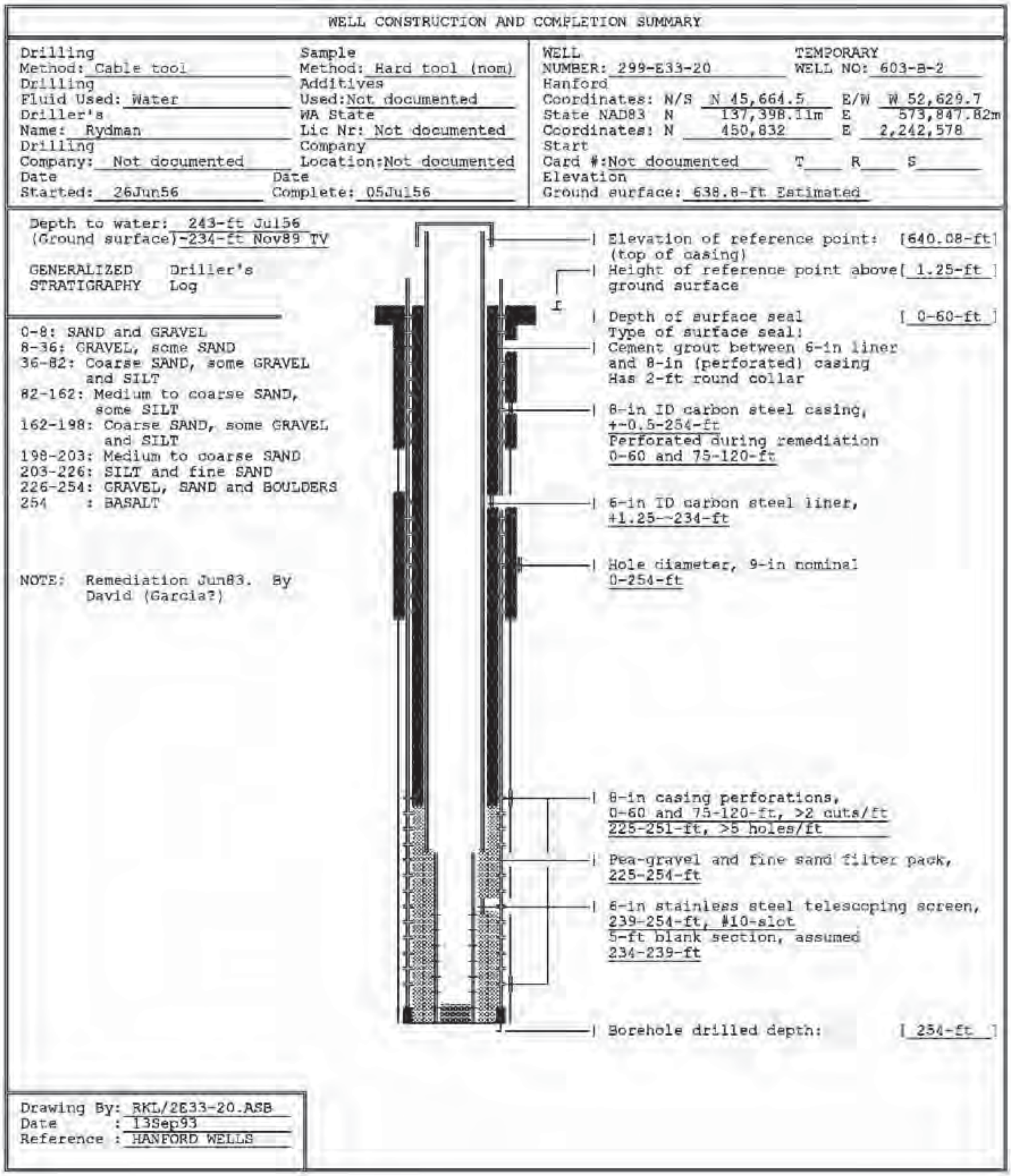
Reference: NAVD88, *North American Vertical Datum of 1988*.

Note: Well coordinates are estimates and subject to modification based on final well location survey.

*Coordinates are in Washington State Plane (south zone), NAD83, *North American Datum of 1983*; 1991 adjustment.

bgs = below ground surface

TBD = to be determined. Information will be obtained after well construction



WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: Water
Driller's Name: Rydman
Drilling Company: Not documented
Date Started: 26Jun56

Sample Method: Hard tool (nom)
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Not documented
Date Complete: 05Jul56

WELL NUMBER: 299-E33-20
TEMPORARY WELL NO: 603-B-2
Hanford Coordinates: N/S N 45,664.5 E/W W 52,629.7
State NAD83 N 137,398.11m E 573,847.82m
Coordinates: N 450,832 E 2,242,578
Start Card #: Not documented T___ R___ S___
Elevation Ground surface: 638.8-ft Estimated

Depth to water: 243-ft Jul56
(Ground surface) -234-ft Nov89 TV

GENERALIZED STRATIGRAPHY — Driller's Log

0-8: SAND and GRAVEL
8-36: GRAVEL, some SAND
36-82: Coarse SAND, some GRAVEL and SILT
82-162: Medium to coarse SAND, some SILT
162-198: Coarse SAND, some GRAVEL and SILT
198-203: Medium to coarse SAND
203-226: SILT and fine SAND
226-254: GRAVEL, SAND and BOULDERS
254 : BASALT

NOTE: Remediation Jun83. By David (Garcia?)

Elevation of reference point: (top of casing) [640.08-ft]
Height of reference point above ground surface [1.25-ft]
Depth of surface seal [0-60-ft]
Type of surface seal: Cement grout between 6-in liner and 8-in (perforated) casing
Has 2-ft round collar
8-in ID carbon steel casing, +-0.5-254-ft
Perforated during remediation 0-60 and 75-120-ft
6-in ID carbon steel liner, +1.25--234-ft
Hole diameter, 9-in nominal 0-254-ft
8-in casing perforations, 0-60 and 75-120-ft, >2 cuts/ft
225-251-ft, >5 holes/ft
Pea-gravel and fine sand filter pack, 225-254-ft
6-in stainless steel telescoping screen, 239-254-ft, #10-slot
5-ft blank section, assumed 234-239-ft
Borehole drilled depth: [254-ft]

Drawing By: RKL/2E33-20.ASB
Date : 13Sep93
Reference : HANFORD WELLS

Note: In 1992, the top of well casing at well 299-E33-20 was extended approximately 2.1 m (7 ft). The depths provided in this figure are no longer accurate.

Figure C-1. Well 299-E33-20 Construction and Completion Summary (1 of 2)

```
                    SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
                          RESOURCE PROTECTION WELL - 299-E33-20

WELL DESIGNATION     :   299-E33-20
RCRA FACILITY        :   SST-241-B-Farm
CERCLA UNIT          :   200 Aggregate Area Management Study (200-BP-1)
HANFORD COORDINATES  :   N  45,664.5    W    52,629.7   [17Sep90-200 East]
LAMBERT COORDINATES  :   N 450,832      E 2,242,578;     [HANCONV]
                         N 137,389.11m  E   573,847.82m [17Sep90-NAD83]
DATE DRILLED         :   Jul56/Remediation - Jun83
DEPTH DRILLED  (GS)  :   254-ft
MEASURED DEPTH (GS)  :   254-ft, Nov89 TV
DEPTH TO WATER (GS)  :   243-ft, Jul56;
                         234-ft, Nov89 TV
CASING DIAMETER      :   8-in, carbon steel, -0.5-254-ft;
                         6-in carbon steel, +1.2--234-ft
ELEV TOP OF CASING   :   640.87-ft
ELEV GROUND SURFACE  :   639.6-ft Estimated
PERFORATED INTERVAL  :   0-60, 75-120 and 225-251-ft
SCREENED INTERVAL    :   239-254-ft, 6-in telescoping,
                         stainless steel, 10-slot
COMMENTS             :   FIELD INSPECTION, 01Apr92,
                         Carbon steel casing (2). 2-ft round pad,
                         capped not locked, no posts.
                         No permanent identification.
                         Ground caving area and high radiation zone.
                         OTHER:
AVAILABLE LOGS       :   Driller
TV SCAN COMMENTS     :   Nov89, depths referenced to ground surface;
                         Depth to bottom: 254-ft
                         Bottom of casing: 254-ft
                         Depth to water: 234-ft
                         Screen started at 236-ft and ended at 254-ft.  Very little scale build-up
                         on casing or screen.  Sediment build-up on bottom.
                         Well can be used as is.
DATE EVALUATED       :   Not applicable
EVAL RECOMMENDATION  :   Not applicable
LISTED USE           :   Water levels measured 18Aug65-04Feb86
CURRENT USER         :   None documented
PUMP TYPE            :   None documented
MAINTENANCE          :   07Nov89; TV camera survey.
```

Figure C-1. Well 299-E33-20 Construction and Completion Summary (2 of 2)

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 E Water Supply
Driller's Name: Thoresen
Drilling Company: Kaiser Engineers
Date Started: 11Jul89

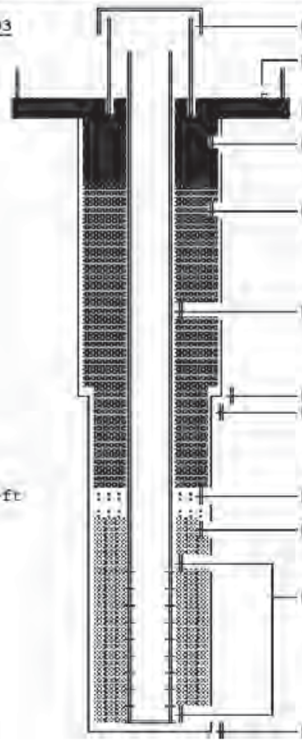
Sample Method: Drive barrel Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Hanford
Date Complete: 11Sep89

WELL NUMBER: 299-E33-31
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 45,974.7 E/W W 53,687.4
State NAD83 N 137,491.7m E 573,525.2m
Coordinates: N 451,139 E 2,241,520
Start Card #: Not documented T R S
Elevation Ground surface: 644.44-ft Brass cap

Depth to water: 239.2-ft Sep89
(Ground surface) 242.5-ft 23Jun93

GENERALIZED Geologist's STRATIGRAPHY Log

0-5: Muddy sandy GRAVEL
5-10: Sandy GRAVEL
10-20: Muddy sandy GRAVEL
20-25: Sandy GRAVEL
25-40: Gravelly SAND
40-50: Sandy GRAVEL
50-55: SAND
55-60: Sl. gravelly SAND
60-65: Gravelly SAND
65-70: Sl. gravelly SAND
70-80: SAND (FS-VFS)
80-85: Muddy SAND
85-90: SAND
90-100: Sl. gravelly SAND
100-120: SAND
120-130: Sl. gravelly SAND
130-140: SAND
140-150: Sl. gravelly SAND
150-155: Gravelly SAND
155-165: SAND
165-170: Gravelly SAND
170-175: Sandy GRAVEL
175-205: SAND, CLAY lens at 202-ft
205-210: Sandy GRAVEL
210-215: Muddy sandy GRAVEL
215-255.6: Sandy GRAVEL
255.6 : BASALT



Elevation of reference point: (top of 6-in casing) [647.50-ft]
Height of reference point above ground surface [3.06-ft]
Depth of surface seal [2-19.7-ft]
Type of surface seal: Cement grout to 19.7-ft, has 4-ft x 4-ft x 6-in concrete pad extending 2-ft into annulus
Bentonite crumbles, 19.7-226.0-ft, 8-20-mesh
4-in ID stainless steel casing, +0.7-234.9-ft
Hole diameter, 2-154.0-ft, 11-in nominal
154.0-255.9-ft, 9-in nominal
3-in Volclay pellets, 226.0-231.2-ft
Silica sand pack, 231.2-255.9-ft, 20-40-mesh
4-in stainless steel screen, 234.9-255.9-ft, #10-slot
Has channel pack and bottom cap
Borehole drilled depth: [255.9-ft]

Drawing By: RKL/2E33-31.ASB
Date : 13Sep93
Reference : WHC-MR-0209

Figure C-2. Well 299-E33-31 Construction and Completion Summary (1 of 2)

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-E33-31

WELL DESIGNATION	:	299-E33-31
RCRA FACILITY	:	Single Shell Tanks, 241-B-BX-BY Farms
CERCLA UNIT	:	200 Aggregate Area Management Study (200-BP-5)
HANFORD COORDINATES	:	N 45,974.7 W 53,687.4 [04Jan90-200E]
LAMBERT COORDINATES	:	N 451,139 E 2,241,520 [HANCONV] N 137,491.7m E 573,525,2m [04Jan90-NAD83]
DATE DRILLED	:	Sep89
DEPTH DRILLED (GS)	:	255.9-ft
MEASURED DEPTH (GS)	:	Not documented
DEPTH TO WATER (GS)	:	239.2-ft, Sep89, 242.5-ft, 23Jun93
CASING DIAMETER	:	4-in, stainless steel, +0.7-234.9-ft. 6-in, stainless steel, +3.06--0.5-ft
ELEV TOP CASING	:	647.50-ft, [26Feb92-NGVD'29]
ELEV GROUND SURFACE	:	644.44-ft, Brass cap [26Feb92-NGVD'29]
PERFORATED INTERVAL	:	Not applicable
SCREENED INTERVAL	:	4-in stainless steel with channel pack, 234.9-255.9-ft
COMMENTS	:	FIELD INSPECTION, OTHER:
AVAILABLE LOGS	:	Geologist, Driller
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	SST monthly water level measurement, 01Dec89-23Jun93;
CURRENT USER	:	WHC ES&M w/1 monitoring and RCRA sampling, WHC ER characterization
PUMP TYPE	:	Hydrostar
MAINTENANCE	:	

Figure C-2. Well 299-E33-31 Construction and Completion Summary (2 of 2)

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 E Water Supply
Driller's Name: Watkins
Drilling Company: Kaiser Engineers
Date Started: 11Jul89

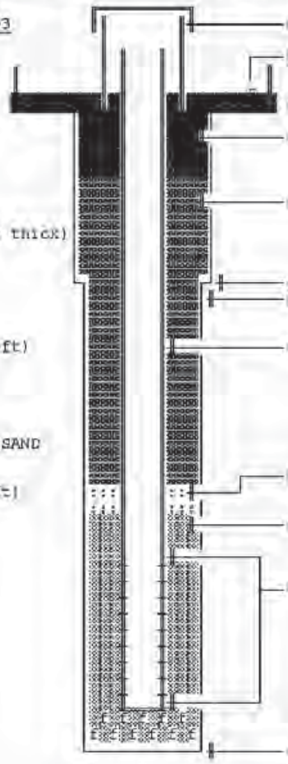
Sample Method: Drive barrel Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Hanford
Date Complete: 05Sep89

WELL NUMBER: 299-E33-32
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 45,523.7 E/W W 53,689.2
State NAD83 N 137,354.3m 573,525.0m
Coordinates: N 450,688 E 2,241,519
Start Card #: Not documented T R S
Elevation Ground surface: 656.96-ft Brass cap

Depth to water: 251.6-ft Aug89
(Ground surface) 255.0-ft 23Jun93

GENERALIZED STRATIGRAPHY
Geologist's Log

0-10: Muddy sandy GRAVEL
10-15: Sandy GRAVEL
15-20: Gravelly SAND
20-25: Sandy GRAVEL
25-30: GRAVEL
30-60: Gravelly SAND
60-65: Sl. gravelly SAND
65-70: SAND (MUD at 68-ft, ~9-in thick)
70-75: Sandy gravelly MUD
75-85: Sl. gravelly SAND
85-90: SAND
90-95: Sl. gravelly SAND
95-100: SAND
100-105: Sl. gravelly SAND
105-120: SAND (Sandy MUD at 118-ft)
120-125: Sl. muddy SAND
125-140: SAND
140-155: Sl. muddy SAND
155-170: SAND
170-175: Gravelly muddy SAND
175-180: Sl. gravelly sl. muddy SAND
180-190: Gravelly SAND
190-210: Sl. gravelly SAND
210-225: SAND (MUDSTONE at 223-ft)
225-240: Gravelly SAND
240-250: Sandy GRAVEL
250-255: Gravelly SAND
255-260: SAND
260-265: Sl. gravelly SAND
265-271: Gravelly SAND
271 : BASALT



Elevation of reference point: (top of 6-in casing) [660.05-ft]
Height of reference point above ground surface [3.09-ft]
Depth of surface seal [2-20.5-ft]
Type of surface seal:
Cement grout to 20.5-ft, has 4-ft x 4-ft x 6-in concrete pad extending 2-ft into annulus
Bentonite crumbles, 20.5-239.6-ft, 8-20-mesh
Hole diameter,
0-75.0-ft, 11-in nominal
75.0-270.3-ft, 9-in nominal
4-in ID stainless steel casing, +0.6-246.4-ft
¼- -in Volclay pellets, 239.6-243.2-ft
Silica sand pack, 243.2--267.4-ft, 20-40-mesh
4-in stainless steel screen, 246.4-267.4-ft, #10-slot W/channel pack and bottom cap
Borehole drilled depth: [270.3-ft]

Drawing By: RKL/2E33-32.ASB
Date : 13Sep93
Reference : WHC-MR-0209

Figure C-3. Well 299-E33-32 Construction and Completion Summary (1 of 2)

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-E33-32

WELL DESIGNATION :	299-E33-32
RCRA FACILITY :	Single Shell Tanks, 241-B-BX-BY Farms
CERCLA UNIT :	200 Aggregate Area Management Study (200-BP-5)
HANFORD COORDINATES :	N 45,523.7 W 53,689.2 [04Jan90-200E]
LAMBERT COORDINATES :	N 450,688 E 2,241,519 [HANCONV] N 137,354.3m E 573,525.0m [04Jan90-NAD83]
DATE DRILLED :	Sep89
DEPTH DRILLED (GS) :	270.3-ft
MEASURED DEPTH (GS) :	Not documented
DEPTH TO WATER (GS) :	251.6-ft, Aug89, 255.0-ft, 23Jun93
CASING DIAMETER :	4-in, stainless steel, +0.6-246.4-ft. 6-in, stainless steel, +3.09--0.5-ft
ELEV TOP CASING :	660.05-ft, [26Feb92-NGVD'29]
ELEV GROUND SURFACE :	656.96-ft, Brass cap [26Feb92-NGVD'29]
PERFORATED INTERVAL :	Not applicable
SCREENED INTERVAL :	4-in stainless steel with channel pack, 246.4-267.4-ft
COMMENTS :	FIELD INSPECTION, 05Feb90; 6-in stainless steel casing. 4-ft by 4-ft concrete pad, 4 posts, 1 removable capped and locked, brass cap in pad with well ID. Not in radiation zone. OTHER;
AVAILABLE LOGS :	Geologist, Driller
TV SCAN COMMENTS :	Not applicable
DATE EVALUATED :	Not applicable
EVAL RECOMMENDATION :	Not applicable
LISTED USE :	SST monthly water level measurement, 01Dec89-23Jun93;
CURRENT USER :	WHC ES&M w/l monitoring and RCRA sampling, WHC ER characterization
PUMP TYPE :	Hydrostar
MAINTENANCE :	

Figure C-3. Well 299-E33-32 Construction and Completion Summary (2 of 2)

299-E33-38 A4863 E008365

WELL SUMMARY SHEET 200-BP-1

Boring or Well No. 299-E33-38

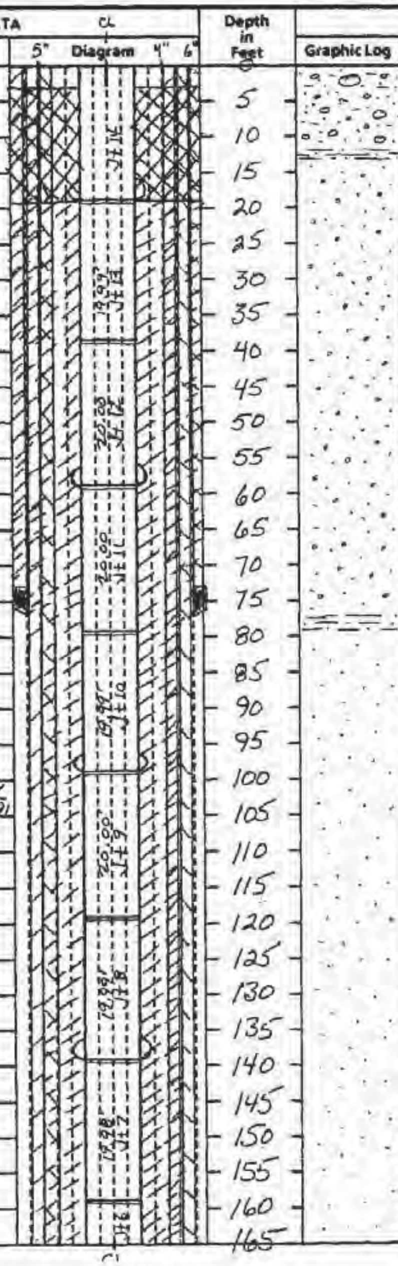
Sheet 1 of 2

Location ≈150' SOUTH OF THE 216BY CRIBS — Project 200-BP-1

Elevation 629.97' — Drilling Contractor KEH

Driller D. GARCIA — Drilling Method and Equipment CABLE TOOL-RIG#5301

Prepared By S.E. KOS S.E. Kos (Sign/Print Name) Date 1/10/90 — Reviewed By SJ TRENT (Sign/Print Name) Date 2/20/91



CONSTRUCTION DATA Description	Depth in Feet	GEOLOGIC/HYDROLOGIC DATA Lithologic Description
12" NOM DIA CS CASING	5	SILTY GRAVEL (MG); gmS 3.8'-6.2'
SET AT 76.5'	10	SILTY SANDY GRAVEL (gmS)
SHOE SIZE 14.0" OD	15	SILT LENSE 13.1'-13.9'
STICKUP +.8'	20	SLIGHTLY SILTY GRAVELLY
8 JTS-TOTAL 77.04'	25	SAND ((m)gS)
	30	
All 12" and 10" carbon	35	
Steel removed from	40	
Well on 2/1/91.	45	
	50	GRAVELLY SAND (gS)
	55	
	60	SLIGHTLY GRAVELLY SAND ((g)S)
	65	
	70	
	75	
	80	SILT LENSE 78.0'-79.0'
10" NOM DIA CS CASING	85	SLIGHTLY GRAVELLY SAND ((g)S)
SET AT 227.0'	90	SAND (S)
SHOE SIZE 11¾" OD	95	
STICKUP +1.3'	100	
19 JTS-TOTAL-~~233.14'~~ 228.3	105	
	110	
	115	
	120	
	125	
	130	
	135	CALCAREOUS ZONES
	140	
	145	
	150	CALCAREOUS AGGREGATES
	155	
	160	
	165	

A-6000-384 (04/90)

Figure C-4. Well 299-E33-38 Construction and Completion Summary (1 of 2)

WELL SUMMARY SHEET

Boring or Well No. 299-E33-38

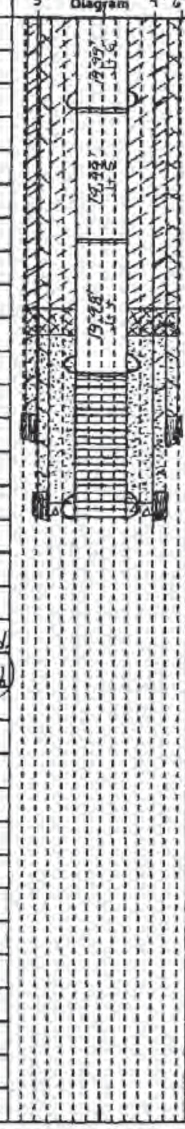
Sheet 2 of 2

Location ≈ 150' SOUTH OF THE 216BY CRIBS — Project 200-BP-1

Elevation 629.97' — Drilling Contractor KEH

Driller D. GARCIA — Drilling Method and Equipment CABLE TOOL - RIG # 5301

Prepared By S.E. KOS (Sign/Print Name) — Date 1/10/90 — Reviewed By S J TRENT/SJT (Sign/Print Name) — Date 2/20/91

CONSTRUCTION DATA: Description	Diagram	Depth in Feet	Graphic Log	GEOLOGIC/HYDROLOGIC DATA: Lithologic Description
		165		GRAVELLY SAND (gS)
		170		
		175		
		180		
		185		SAND @ 183.0'
		190		SILT ZONE 189.4'–190.0'
		195		SANDY GRAVEL (sG)
		200		
		205		
		210		
		215		SILTY SANDY GRAVEL
		220		
		225		H_2O LEVEL - 226.5' BELOW GRADE
		230		GRAVEL (G) - 228.6'
8" NOM DIA CS CASING		235		
SET AT 239.6'		240		SAND - 236.0
SHOE SIZE 9 5/16" OD		245	BASALT 238.0	DEPTH OF HOLE 239.6'
STICK UP +2.7'				
13 JTS - TOTAL 242.27'				
All 8" carbon steel removed				
Colorado Silica Sand (8-12 mesh)				
237.3'–212.5'				
Bentonite Pellets				
212.5'–208.1'				
Bentonite Crumbles				
208.1'–18.4'				
Portland cement				
18.4'–2.7'				
Screen set @				
~~228.45'~~ 218.55'–239.6'				
Screen is SS				
continuous wire				
wrap 20-slot				
~~10.69'~~ in length w/cap				
21.05'				

A-6000-384 (04/90)

Figure C-4. Well 299-E33-38 Construction and Completion Summary (2 of 2)

WELL CONSTRUCTION AND COMPLETION SUMMARY

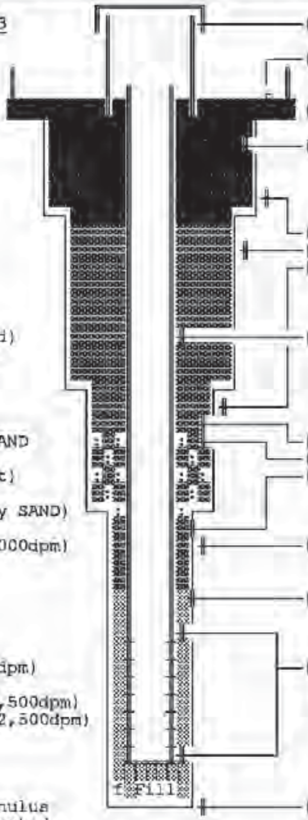
Drilling Method: Cable tool	Sample Method: Drive barrel Hard tool	WELL NUMBER: 299-E33-41
Drilling Fluid Used: Raw water	Additives Used: None	TEMPORARY WELL NO: None
Driller's Name: M Thorosen L Watkins/B Strode	WA State Lic Nr: Not documented	Hanford Coordinates: N/S N 45,573.4 E/W W 53,091.4
Drilling Company: Kaiser Engineers	Company Location: Hanford	State NAD83 Coordinates: N 137,369.94m 450,739 E 573,707.19m 2,242,117
Date Started: 31Jan91	Date Complete: 28Mar91	Start Card #: Not documented T R S
		Elevation Ground surface: 651.53-ft Brass cap

Depth to water: 252.4-ft Apr91
(Ground surface) 249.6-ft 23Jun93

GENERALIZED Geologist's
STRATIGRAPHY Log
Sl-slightly

0-5: GRAVEL and SAND
5-10: Sl silty gravelly SAND
10-15: Gravelly SAND
15-20: Sl silty sandy GRAVEL
20-25: Gravelly SAND
25-35: Sandy GRAVEL
35-45: SAND
45-50: Sl gravelly SAND
50-60: SAND
60-65: Sl gravelly SAND
65-70: Gravelly SAND
70-73: Sl gravelly SAND
(Contamination encountered)
73-74: Interbedded SAND and SILT
74-80: Gravelly SAND
(4,000dpm @ 78-ft)
80-95: Sl gravelly SAND
95-102.5: SAND
102.5-104.5: Interbedded silty SAND
and cse SAND (Wet)
104.5-110: SAND (PEBBLES @ 106-ft)
110-115: Sl gravelly SAND
115-125: SAND (Stringers of silty SAND)
125-140: Sl gravelly SAND
(SILT lens @ 137-ft; 4,000dpm)
140-164: SAND
(2,000dpm @ 160-ft)
164-164.5: Sandy SILT
164.5-170: SL gravelly SAND
170-217: Gravelly SAND
217-218: Sandy GRAVEL
218-220: Sl clayey SILT (25,000dpm)
220-230: Sl clayey sandy SILT
(Contamination 30,000>2,500dpm)
230-242: Sl clayey silt SAND (~2,500dpm)
242-262.7: Sandy GRAVEL
262.7-263: BASALT

DRILLING NOTE:
Well was completed with 1-in annulus
240.7-263.0-ft with variance granted
by Ecology



Elevation of reference point: [654.95-ft]
(top of casing)
Height of reference point above [3.42-ft]
ground surface

Depth of surface seal [2.5-20.4-ft]
Type of surface seal:
Cement grout to 20.4-ft, has
4x4-ft x 6-in concrete pad
extending 2.5-ft into annulus

Hole diameter,
0-20-ft, 13-in nominal
20-158.7-ft, 11-in nominal
158.7-263.0-ft, 9-in nominal

4-in ID stainless steel casing,
+0.5-244.9-ft

Bentonite,
20.4-172.6-ft, 8-20-mesh crumbles
172.6-239.9-ft, slurry
239.9-243.1-ft, 8-20-mesh crumbles

Hole diameter, 7-in nominal
240.7-263.0-ft

Silica sand pack,
243.1-262.0-ft, 10-20-mesh

4-in stainless steel screen,
244.9-261.0-ft, #10-slot
W/channel pack

Borehole drilled depth: [263.0-ft]

Drawing By: RKL/2E33-41.ASB
Date : 13Sep93
Reference : WHC-SD-EN-DP-041

Figure C-5. Well 299-E33-41 Construction and Completion Summary (1 of 2)

```
              SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
                    RESOURCE PROTECTION WELL - 299-E33-41

WELL DESIGNATION      :   299-E33-41
CERCLA UNIT           :   200 Aggregate Area Management Study
RCRA FACILITY         :   Single Shell Tanks
HANFORD COORDINATES   :   N  45,573.4     W    53,091.4    [200E-11Jul91]
LAMBERT COORDINATES   :   N 450,739       E 2,242,117      [HANCONV]
                      :   N 137,369.94m  E   573,707.19m [NAD83-11Jul91]
DATE DRILLED          :   Apr91
DEPTH DRILLED  (GS)   :   263.0-ft
MEASURED DEPTH (GS)   :   Not documented
DEPTH TO WATER (GS)   :   252.4-ft, 29Apr91;
                          249.6-ft, 23Jun93
CASING DIAMETER       :   4-in stainless steel, +0.5-279.2-ft;
                          6-in stainless steel, +3.4--0.5-ft
ELEV TOP CASING       :   654.95-ft,            [NGVD'29-11Jul91]
ELEV GROUND SURFACE   :   651.53-ft, Brass cap [NGVD'29-11Jul91]
PERFORATED INTERVAL   :   Not applicable
SCREENED INTERVAL     :   244.9-261.0-ft, 4-in #10-slot stainless steel, with channel pack
COMMENTS              :   FIELD INSPECTION,
                          OTHER:
AVAILABLE LOGS        :   Geologist, driller
TV SCAN COMMENTS      :   Not applicable
DATE EVALUATED        :   Not applicable
EVAL RECOMMENDATION   :   Not applicable
LISTED USE            :   SST monthly water level measurement, 01Jun91-23Jun93,
CURRENT USER          :   WHC ES&M w/1 monitoring and RCRA sampling,
PUMP TYPE             :   Hydrostar
MAINTENANCE           :
```

Figure C-5. Well 299-E33-41 Construction and Completion Summary (2 of 2)

3 of 5

WELL SUMMARY SHEET

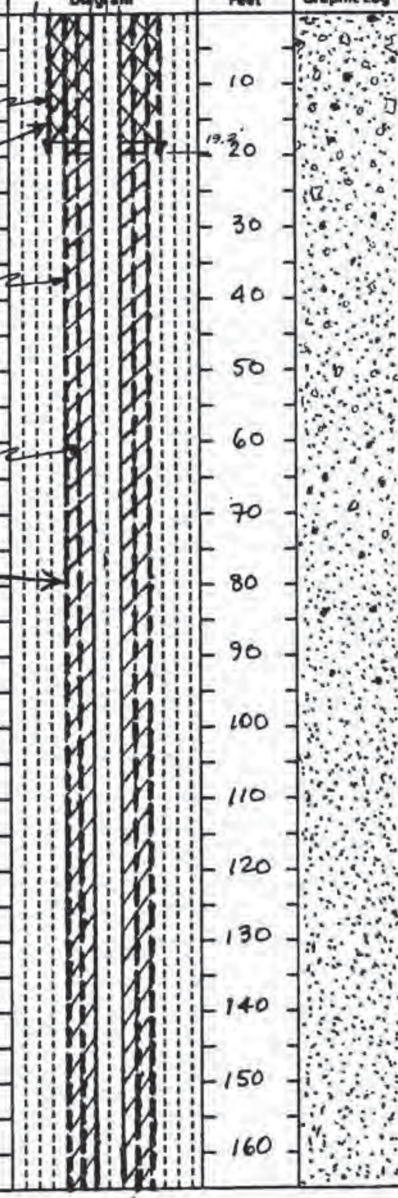
Boring or Well No. 299 - E 33 - 42

Sheet 1 of 2

Location 200 E BX - BY TANK FARM
Project WO 17 SST
Elevation 658.88 BRASS CAP
Drilling Contractor KESER ENGINEER
Driller J. McKNIGHT
Drilling Method and Equipment BE 22W CABLE TOOL
Prepared By ROBERT WIN... (Sign/Print Name) Date 10/5/81
Reviewed By Edward C. ... (Sign/Print Name) Date 1/3/92

CONSTRUCTION DATA – Description

Description
12" ϕ CS CSG @ 19.20'
CEMENT GROUT 20 - 180'
10" ϕ CS CSG @ 168.6'
8" ϕ CS CSG @ 259.9'
BENTONITE CRUMBLES 180' - 289.5'



GEOLOGIC/HYDROLOGIC DATA – Lithologic Description

Lithologic Description
SAND - GRAVEL - ANGULAR TO SUB - ROUNDED, BASALT PEBBLES
✓
✓
SAND - GRAVEL
✓
✓
✓
LIGHT MOISTURE IN SECTION
✓
✓
✓
✓
✓
SAND - 70% FELSIC, 30% MAFIC
✓
✓
✓
SAND - DIFFICULT TO KEEP IN CORE BARREL
✓
✓
✓
✓
✓
✓
✓
✓
✓
✓
✓
✓

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Figure C-6. Well 299-E33-42 Construction and Completion Summary (1 of 2)

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WELL SUMMARY SHEET

Boring or Well No. 299-E 33-42

Sheet 2 of 2

Location 200 E BX-BY TANK FARM
Project W017 SST
Elevation 650.88 BRASS CAP
Drilling Contractor KE
Driller J. McKNIGHT
Drilling Method and Equipment BE 22W CABLE TOOL
Prepared By (Sign/Print Name) Robert Winn — ROBERT WINN Date 10/5/91
Reviewed By (Sign/Print Name) Edward C. Ryker Date 1/2/92

CONSTRUCTION DATA: Description	Depth in Feet	GEOLOGIC/HYDROLOGIC DATA: Lithologic Description
10"ø CS CSG @ 168.6' BLS	170	SAND – TRACE GRAVEL, ANGULAR TO SUB-ROUNDED
BENTONITE CRUMBLES 180' – 229.5'	180	✓
	190	✓
	200	SAND – SILTY, DRY, HARD DRILLING; BASALT
	210	✓
	220	✓
BENTONITE PELLETS 229.5' – 233.0'	230	✓
TOP of SCREEN 238.5'	240	✓
WL @ 246.9' 10/10/91		✓
SAND 10-30 233.0' – 256.8'	250	GRAVEL/SAND – LARGE PEBBLES, ANGULAR, BASALT
8"ø CS CSG @ 259.9'	260	
BOTTOM of SCREEN 259.8'		
~~BOT BOTTOM~~ BOTTOM of WELL 259.5' (ECR 1/2/92)		
SWL AS OF 11/04/91 247' BLS		

A-6000-384 (04/90)

Figure C-6. Well 299-E33-42 Construction and Completion Summary (2 of 2)

0502377

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Cable Tool	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-E33-44 B8554 TEMPORARY WELL NO: Not Allowed
Drilling Fluid Used:	Water	Additives Used:	None	Coordinates: N	Not documented
Driller's Name:	M. Wrsapir	WA State Lic Nr:	Not Available	Coordinates: E	Not documented
Drilling Company:	Layne Christensen	Company Location:	Salt Lake City, Ut	Start Card #:	Not Available
Date Started:	12Sep98	Date Completed:	26Sep98	Elevation Ground Surface:	Brass Marker

Depth to Water: 239.6 ft 26Sep98
(Ground surface)

GENERALIZED STRATIGRAPHY Geologist's Log & Geophysical Logs

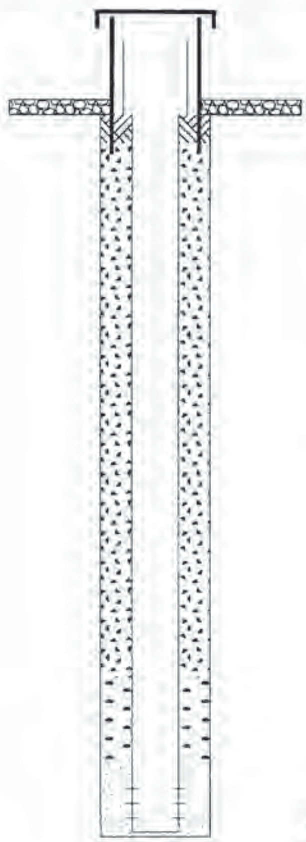
Elevation of Reference Point: m

Height of Reference Point Above Ground Surface:

Depth of Surface Seal: 9.8 ft

Type of Surface Seal: 4x4 Concrete Pad

0 - 9 ft : Silty Sandy Gravel
9 - 23 ft : Sandy Gravel
23 - 39 ft : Slightly Silty Gravel Sand
39 - 44 ft : Gravelly Sand
44 - 70 ft : Sand
70 - 74.5 ft : Silty Sand
74.5 - 124 ft : Sand
124 - 128 ft : Silty Sandy Gravel
128 - 134 ft : Slightly Silty Sand
134 - 154 ft : Sand
154 - 163.5 ft : Slightly silty Sand
163.5 - 165 ft : Silty Sand
165 - 167.5 ft : Sandy Silt
167.5 - 174.5 ft : Sand
174.5 - 207 ft : Gravelly Sand
207 - 208 ft : Silt
208 - 209.5 ft : Sand
209.5 - 212.5 ft : Silty Sandy Gravel
212.5 - 229 ft : Silty Sandy Gravel
229 - 231 ft : Gravelly Silty Sand
231 - 247.4 ft : Silty Sandy Gravel
247.4 - 255 ft : Basalt



Fill	Casing	Screen
0 - 9.8 ft : 9-inch hole Cement Seal	0 - 238 ft : 4 inch 4" Sch 5 SS Csg.	238 - 253 ft : 4 inch 4" Wire Wrap SS Screen .010 Slot
9.8 - 199 ft : 9-inch hole Med. Bentonite Chunks	253 - 253.3 ft : 4 inch 4" SS End Cap	
199 - 227.3 ft : 9-inch hole 1/4" Bentonite Pellets		
227.2 - 253.3 ft : 9-inch hole 20/40 Silica Sand		
253.3 - 255 ft : 9-inch hole 20/40 Silica Sand		

255 ft : Borehole drilled depth

0 - 255 ft : 9-in. 8-5/8" Temp. CS Csg.

Drawing By: JEA
Reference: Hanford Wells
Revision: 0
Revision Date: 29Sep98
Print Date: 28Dec98

BECHTEL

Figure C-7. Well 299-E33-44 Construction and Completion Summary (1 of 2)

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-E33-44

WELL DESIGNATION	:	299-E33-44
CERCLA UNIT	:	
RCRA FACILITY	:	
DEPTH DRILLED (GS)	:	255.0 ft
MEASURED DEPTH (GS)	:	
AVAILABLE LOGS	:	Geologist-Geophysical Logs
DATE EVALUATED	:	Data not available
EVAL RECOMMENDATION	:	Data not available
LISTED USE	:	Data not available
CURRENT USER	:	RCRA & Operations
PUMP TYPE	:	Hydrostar
MAINTENANCE	:	Data not available
COMMENTS	:	Cable Tool drilled - 8-5/8" csg. to 255 ft.
TV SCAN COMMENTS	:	

Report Form: WELLS Project File: WELLS.GPJ

Drawing By:	JEA
Reference:	Hanford Wells
Revision:	0
Revision Date:	29Sep98
Print Date:	28Dec98

BECHTEL

Figure C-7. Well 299-E33-44 Construction and Completion Summary (2 of 2)

WELL SUMMARY SHEET		Start Date 06/03/04 Finish Date: 8/5/04	Page 1 of 2
Well ID C4259		Well Name 299-E33-47	
Location: East side of WMA-B/200 East Area		Project: RCRA/CERCLA drilling/FY2004	
Prepared By: Jeffrey Weiss	Date: 8/5/04	Reviewed By: L.D. Walker	Date: 8/25/04
Signature Jeff Weiss		Signature: LD Walker	

CONSTRUCTION DATA

Description
10 3/4" OD carbon steel temp. casing used.
6" ID SS304 protective casing +1.01 → Above permanent cm
4" ID SS304, sch.5 riser: +2.0' → 244.11'
Portland cement Grout: 0' → 11'
Granular Bentonite: 11' → 209.4
Portland Cement Grout: 209.4' → 224.1'
Granular Bentonite: 224.1' → 226.8'
All depths in feet below ground surface
All temporary casing removed from ground.

Diagram

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet: 0, 40, 80, 120, 160, 200

Graphic Log

Lithologic Description
0'-3' SAND(S)
3'-13' silty sandy GRAVEL(msG)
13'-16' sandy GRAVEL(sG)
16'-18' gravelly SAND(gS)
18'-20' SAND(S)
20'-30' silty sandy GRAVEL(msG)
30'-48' sandy GRAVEL(sG)
48'-211' SAND(S)
211'-213' silty SAND(mS)
213'-223' SILT(m)
223'-251' silty sandy GRAVEL (msG)

A-6003-643 (03/03)

Figure C-8. Well 299-E33-47 Construction and Completion Summary (1 of 2)

WELL SUMMARY SHEET

Start Date 06/03/04
Finish Date 8/5/04
Page 2 of 2

Well ID: C4259	Well Name 299-E33-47
Location East side of WMA-B/200 East	Project RCRA/CERCLA drilling/FY2004
Prepared By Jeffrey Weiss — Date 8/5/04	Reviewed By: L.D. Walker — Date 8/25/04
Signature Jeff Weiss	Signature: LD Walker

CONSTRUCTION DATA / **GEOLOGIC/HYDROLOGIC DATA**

Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description
3/8" Bentonite Pellets: 226.8' → 233.6'		240		251' - 264' Sandy GRAVEL (sG)
10-20 mesh Colorado silica sand: 233.6' → 268.9'				264' - 268.9' BASALT
4" ID SS304, sch. 5, 0.020" slot well screen: 244.11' → 264.10'		280		TD = 268.9' bgs
4" ID SS304, sch 5 sump: 264.0' → 267.1'		320		Static water = 248.01' bgs (08/05/04)
All depths in feet below ground surface				
All temporary casing removed from ground.				

A-6003-643 (03/03)

Figure C-8. Well 299-E33-47 Construction and Completion Summary (2 of 2)

WELL SUMMARY SHEET

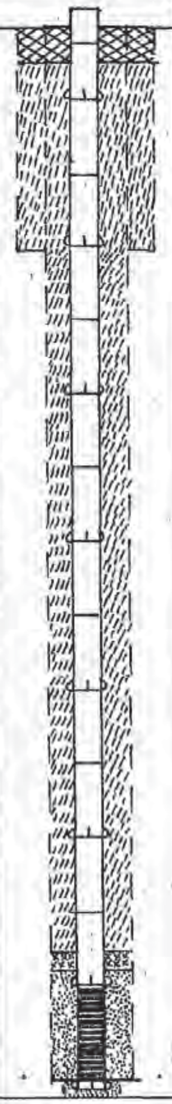
Start Date 08/5/04	Finish Date 9/3/04	Page 1 of 1

Well ID. C4260	Well Name 299-E33-48
Location S. of WMA-B / 200 EAST	Project RCRA / CERCLA DRILLING FY 2004
Prepared By Jess Hocking — Date. 8/30/04	Reviewed By: L.D. Walker — Date. 9/21/04
Signature. Jess Hocking	Signature. D Walker

CONSTRUCTION DATA

Description
4" TP-304/304L sch 05, Riser
+2.00' → 260.2'
4" TP-304/304L sch 05, 0.020" CONT. WIRE WRAP SCREEN
260.2' → 285.2'
4" TP-304/304L sch 05, Sump
285.2' → 288.2'
Type-I, II, V Portland Cement
0 → 10.3'
CETCO Granular Bentonite
10.3' → 250.2'
5/8" CETCO Bentonite Pellets
250.2' → 255.9'
Colorado 10-20 mesh Silica Sand
255.9' → 290.9'
Temporary Casing, 13 3/8"
0 → 60'
Temporary Casing, 10 3/4"
60 → 285'
NOTE: All Temporary casing has been removed from the ground
All depths reported in ft. below ground surface.

Diagram



Depth in Feet: 0, 50, 100, 150, 200, 250

GEOLOGIC/HYDROLOGIC DATA

Graphic Log

Lithologic Description
0-1' Fill Material
1-14' sandy Gravel (sG)
14-16' Sand (S)
16-22' Sand (S)
22-34' Sandy Gravel (sG)
34-40' gravelly Sand (gS)
40-44' Sand (S)
44-49' sandy Gravel (sG)
49-63' Sand (S)
63-67' sandy Gravel (sG)
67-128' Sand (S)
128-129' Sandy Silt (sM)
129-216.5' Sand (S)
216.5-217.5' Silt (M)
217.5-243' sandy Gravel (sG) to gravelly Sand (gS)
243-250' sl. silty gravelly Sand ((m)gS)
250-266' sandy Gravel (sG)
266-273' Gravel (G)
273-281' sl. silty gravelly Sand ((m)gS)
281-284' gravelly Sand (gS)
284-285.5' silty sandy gravel (msG)
285.5'-290' BASALT
TD=290.9' bgs
static water 265.23' bgs (08/31/04)

A-6003-643 (03/03)

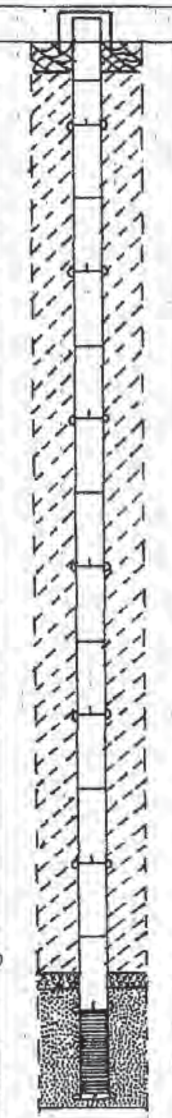
Figure C-9. Well 299-E33-48 Construction and Completion Summary (1 of 2)

WELL SUMMARY SHEET		Start Date 4/30/04 Finish Date 08/09/04	Page 1 of 1
Well ID C4261		Well Name 299-E33-49	
Location South of BX Tank Farm, 200 East		Project. 2004 RCRA Drilling	
Prepared By Charlene Martinez	Date 08/11/04	Reviewed By L.D. Walker	Date. 8/25/04
Signature. Charlene Martinez		Signature [signature]	

CONSTRUCTION DATA

Description
10-20 MESH SILICA SAND 288.4' → 258.6'
3/8" Sodium Bentonite Pellets 258.6' → 253.7'
Sodium Bentonite Crumbles 253.7' → 9.5'
Type I/II Portland Cement 9.5' → 0'
4" TP - 304/304L sch. 05s Riser +1.99' → 263.5'
4" TP- 304/304L sch. 05s 0.020" CONT WIRE WRAP SCREEN 263.5' → 283.5'
4" TP- 304/304L sch 05s Sump 283.5' → 286.5'
6" ID protective casing (ss 304, sch 5) set: +1.02' above permanent.
All depths in feet below ground surface.
All temporary casing (12") removed from ground

Diagram



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet: 0, 50, 100, 150, 200, 250

Graphic Log

Lithologic Description
0-5.5' Slightly Silty Gravelly SAND (m)gS
5.5'-13' Silty Sandy GRAVEL (msG)
13'-16' Gravelly SAND + Sandy GRAVEL
16'-17' SAND (S) 17'-45.5' Sandy GRAVEL
45.5'-48' Gravelly SAND (gS)
48'-51' Sandy GRAVEL (sG)
51'-93' SAND (S)
93'-98' Slightly Silty SAND (m)S
98'-163' SAND (S)
163'-171' Slightly Silty SAND (m)S
171'-217' SAND (S)
217'-217.3' Silty Sandy GRAVEL (msG)
217.3'-217.8' SAND (S)
217.8'-223' Sandy GRAVEL (sG)
223'-270' Silty Sandy GRAVEL (msG)
270'-273' Sandy Gravel (sG)
273'-283.5' Sandy Gravel (sG)
283.5'-288.8' Basalt
TD = 288.8' bgs
static water 265.44' bgs (08/10/04)

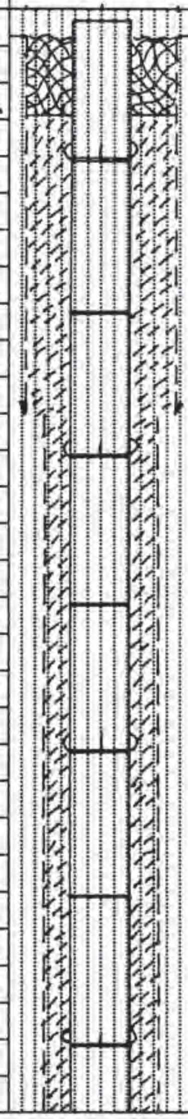
A-6003-643 (03/03)

Figure C-10. Well 299-E33-49 Construction and Completion Summary (2 of 2)

WELL SUMMARY SHEET 0515349

Page 1 of 2
Date: 12/27/99

Well ID: B8810	Well Name: 299-E33-334
Location: outside SW corner 241-BX Tank Farm/200E	Project: RCRA Drilling FY 2000
Prepared By: L.D. Walker Date: 12/27/99	Reviewed By: DCWeekes Date: 1/10/00
Signature: [signature]	Signature: [signature]

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
		0		0'→ 34': ~~Silty~~ Sandy GRAVEL
Portland Cement Type I, II 0'→ 10.5' below ground surface				
Temporary casing 11¾" OD 0'→ 51.5' bgs		25		
Stainless Steel casing, type 304, sched. 5, 4½" OD / 4" ID +2.5'→ 257.70' bgs				34'→ 44': Gravelly SAND
				44'→ 47.5': Sandy GRAVEL
		50		
Granular bentonite 10.5'→ 247.4'				47.5'→ 123.5': SAND
		75		
Temporary casing 8⅝" OD 51.5'→ 280'				
		100		
		125		123.5'→ 125': Silty SAND
				125'→ 151.5': SAND

BHI-EE-189 (12/97)

Figure C-11. Well 299-E33-334 Construction and Completion Summary (1 of 2)

WELL SUMMARY SHEET

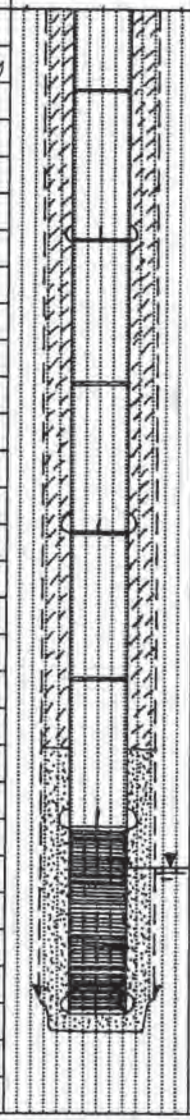
Page 2 of 2
Date: 12/27/99

Well ID: B8810
Well Name: 299- E33-334
Location: outside SW corner 241-BX Tank Farm/200E
Project: RCRA Drilling FY 2000
Prepared By: L.D. Walker
Date: 12/27/99
Reviewed By: DC Weekes
Date: 1/10/00
Signature: L.D. Walker
Signature: DC Weekes

CONSTRUCTION DATA

Description
All depths in Feet below ground
All temporary casing removed From ground.
Silica Sand 10-20 mesh 247.4' → 284.1'
crushed basalt/sluff 284.1' → 285'
Stainless Steel screen Cont. wire-wrap 0.020-in slot, type 304 SS 4½" OD/4" ID 257.70' → 282.72'
SS endcap 282.72' → 283.14'

Diagram



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet: 150, 175, 200, 225, 250, 275

Graphic Log

Lithologic Description
151.5' → 154': Silty SAND
154' → 208': SAND
208' → 222.5': SAND
222.5' → 229': ~~Silty~~ Sandy GRAVEL
229' → 233': Sandy GRAVEL
233' → 269': Silty Sandy GRAVEL
WL= 263.85' bgs (12/30/99)
269' → 280': Sandy GRAVEL
280' → 285': BASALT
TD= 285'

BHI-EE-189 (12/97)

Figure C-11. Well 299-E33-334 Construction and Completion Summary (2 of 2)

WELL SUMMARY SHEET

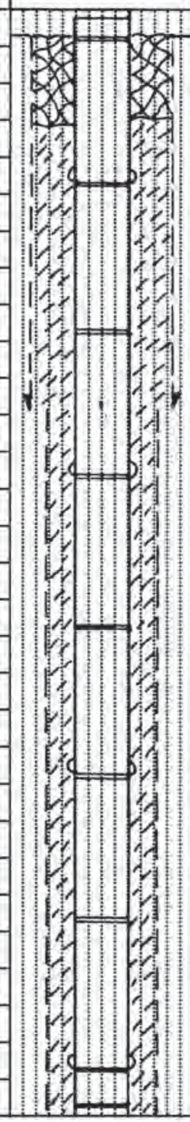
Page 1 of 2
Date: 2-9-00

Well ID: B8811		Well Name: 299-E33-335	
Location: South side BX-BY Tank Farm / 200 E		Project: FY 2000 RCRA Drilling	
Prepared By: L. D. Walker	Date: 2-9-00	Reviewed By: DG Weekes	Date: 2/10/00
Signature: LD Walker		Signature: DG Weekes	

CONSTRUCTION DATA

Description
Portland Cement 0 → 10.9' below ground surface
Temporary casing 11 3/4" OD 0 → 50.4'
Stainless steel casing type 304, sched. 5 4 1/2" OD / 4" ID +2.2' → 260.01'
Granular bentonite 10.9' → 250.5'
Temp casing 8 5/8" OD 50.4' → 280.8'

Diagram



Depth in Feet: 0, 25, 50, 75, 100, 125

GEOLOGIC/HYDROLOGIC DATA

Graphic Log

Lithologic Description
0'→7': Sandy GRAVEL
7'→12': Sandy GRAVEL
12'→14': SAND
14'→14.5': Sandy SILT
14.5'→20': Sandy GRAVEL
20'→22': Silty SAND
22'→45': Silty Sandy GRAVEL
45'→50': Silty Sandy GRAVEL
50'→58': Silty Sandy GRAVEL
58'→219': SAND

BHI-EE-189 (12/97)

Figure C-12. Well 299-E33-335 Construction and Completion Summary (1 of 2)

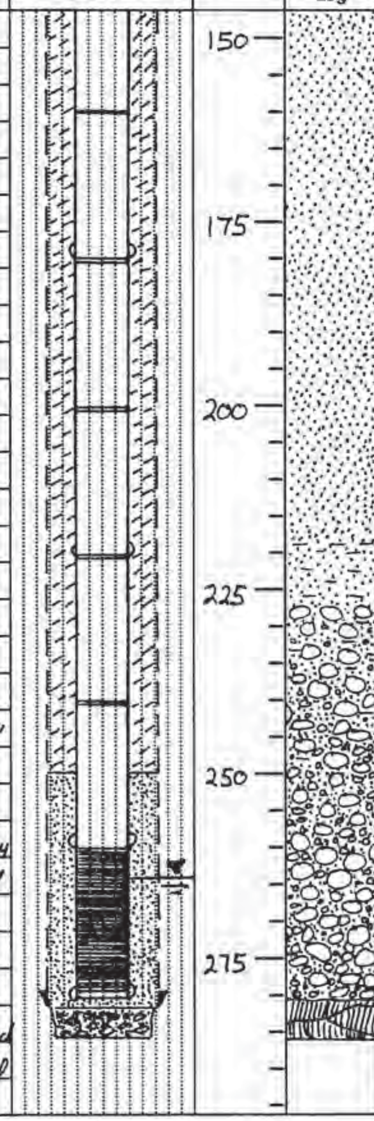
WELL SUMMARY SHEET

0515350

Page 2 of 2
Date: 2-9-00

Well ID: B 8811		Well Name: 299-E33-335	
Location: South side BX-BY Tank Farm/200E		Project: FY 2000 RCRA Drilling	
Prepared By: L. D. Walker	Date: 2-9-00	Reviewed By: DC Weekes	Date: 2/10/00
Signature:		Signature:	

CONSTRUCTION DATA / **GEOLOGIC/HYDROLOGIC DATA**



Description	Lithologic Description
Silica Sand 10-20 mesh 250.5' → 281.9'	219' → 226': Slightly Silty SAND
Sluff: 281.9' → 286'	226' → 250': Silty Sandy GRAVEL
Stainless Steel Wellscreen Cont. wire wrap 0.020-in slot, type 304-ss, 4½"/4" 260.01' → 280.03'	250' → 280.5': Sandy GRAVEL
Stainless Steel endcap, type 304 4½"/4" 280.03' → 280.43'	2-9-00 W.L. = 264.40'
All depths in feet below ground	280.5' → 286': BASALT
All temporary casing removed from the ground	TD = 286'

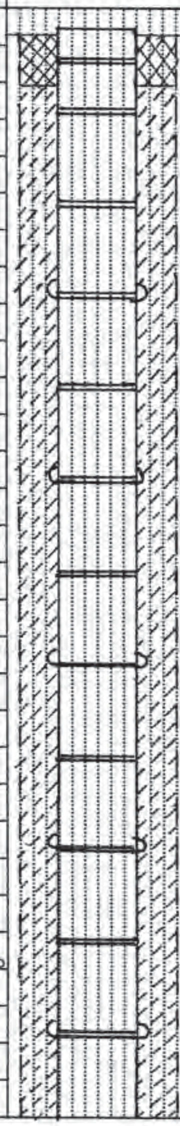
BHI-EE-189 (12/97)

Figure C-12. Well 299-E33-335 Construction and Completion Summary (2 of 2)

WELL SUMMARY SHEET

0538121

Page 1 of 2	Date: 07/16/01		
Well ID: C3390		Well Name: 299-E33-337	
Location: South of 241-B Tank Farm		Project: CY01 RCRA Drilling	
Prepared By: C martinez	Date: 07/16/01 08/03/01	Reviewed By: D C Weekes	Date: 8/13/01
Signature: Charlene Martinez		Signature: DC Weekes	

CONSTRUCTION DATA – Description	Diagram	Depth in Feet	Graphic Log	GEOLOGIC/HYDROLOGIC DATA – Lithologic Description
6"-dia protective casing set above stainless casing		0		0'-18' Sandy Gravel (sg)
4" ID SS 304L casing: +2.1' → 255.36'				18'-35' Sand (s)
Portland Cement grout: 0 → 10.1'		40		35'-37' Gravelly Sand (gs)
Bentonite Crumbles: 10.1' → 239.6'				37'-45' Sand (s)
1/4" + 3/8" Bentonite Pellets: 239.6' → 245.1'		80		45'-60' Sandy Gravel (sg)
4" ID SS 304L 0.020-in. Slot cont. wire-wrap well screen: 255.36' → 280.39'				60'-125' Sand (s)
10-20 mesh silica sand 245.1' ~~241.5'~~ (cm) → 283.6'		120		125'-138' Silty Sand (ms)
4" ID SS 304L Tailpipe: 280.39' → 282.4'				138'-178' Sand (s)
1/4" Bentonite Pellets (coated): 283.6' → 286.0'		160		178'-185' Slightly Silty Sand
All temp. casing removed:				185'-189' Silty Sand (ms)
All depths are in feet below ground surface.		200		189'-195' Gravelly Sand (GS)
				195'-205' Sand (S)
				205'-212' Silty Sand (ms)
				212'-215' Sand (S)
				215'-226' Gravelly Sand (gs)
				226'-228' Sandy Gravel (sg)

BHI-EE-189 (12/97)

J

Figure C-13. Well 299-E33-337 Construction and Completion Summary (1 of 2)

WELL SUMMARY SHEET

Page 2 of 2
Date: 07/16/01

Well ID: C3390		Well Name: 299-E33-337	
Location: South of 241-B Tank Farm		Project: CY01 RCRA Drilling	
Prepared By: C. Martinez	Date: 07/16/01 08/03/01	Reviewed By: DCWeekes	Date: 8/13/01
Signature: Charlene Martinez		Signature: DCWeekes	

CONSTRUCTION DATA

Description	Diagram
All temporary casing removed.	
All depths are in feet below ground surface.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Lithologic Description
240	228'-230' Gravel (g)
	230'-259.5' Sandy Gravel (sg)
	259.5'-265' Gravel (g) Trace sand
	265'-281' Sandy Gravel (sg)
280	281'-286' Basalt
	TD = 286' bgs
320	WL = 259.92' bgs 8/3/01

BHI-EE-189 (12/97)

Figure C-13. Well 299-E33-337 Construction and Completion Summary (2 of 2)

0540322

WELL SUMMARY SHEET

Page 1 of 2
Date: 09/19/01

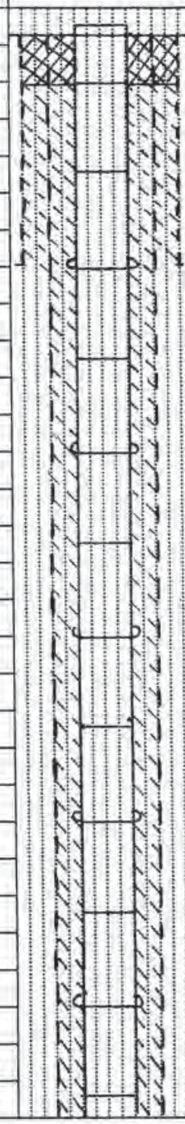
Well ID: C3391	Well Name: 299-E33-338
Location: SE corner of 241-B Tank Farm	Project: C401 RCRA Drilling
Prepared By: C. Martinez — Date: 09/19/01	Reviewed By: DC Weekes — Date: 9/20/01
Signature: Charlene Martinez	Signature: DC Weekes

CONSTRUCTION DATA

Description:

- 6" new Dia. protective casing set above stainless casing
- 4" ID SS304L casing: +2.0' → 250.9'
- Portland Cement Grout: 0' → 10.6'
- Granular Bentonite 10.6' → 236.0'
- 4" ID SS304L 0.020-in. slot cont. wire-wrap wellscreen: 250.9' → 270.9'
- Bentonite Pellets: 236.0' → 241.0'
- 10-20 mesh silica sand: 241.0' → 271.5'
- 4" ID SS304L Endcap: 270.9' → 271.32'
- 1/4" Bentonite Holeplug: 271.5' → 275.6'
- All temp. casing removed; All depths are in feet below ground surface

Diagram



Depth in Feet: 0, 40, 80, 120, 160, 200

GEOLOGIC/HYDROLOGIC DATA

Graphic Log

Lithologic Description:

- 0-12.5' silty Sandy GRAVEL (msG)
- 12.5'-14.5' silty gravelly SAND (mgS)
- 14.5'-15.0' SILT (S) (lens)
- 15.0'-16.5' silty sandy GRAVEL (msG)
- 16.5'-20.0' silty SAND (mS)
- 20.0'-31.0' silty sandy GRAVEL (msG)
- 31.0'-35.5' silty SAND (mS)
- 35.5'-51.5' silty sandy Gravel (msG)
- 51.5'-52.0' silt (m) lens
- 52.0'-57.7' silty SAND (mS)
- 57.7'-66.3' SAND (S)
- 66.3'-71.3' silty SAND (mS)
- 71.3'-72.3' SAND (S) lens
- 72.3'-94' silty SAND (mS)
- 94.0'-104.5' slightly silt gravelly SAND (mgS)
- 104.5'-114.0' silty SAND (mS)
- 114.0'-127.6' SAND (S)
- 127.6'-136.0' silty SAND (mS)
- 136.0'-143.2' SAND (S)
- 143.2'-167.0' silty SAND (mS)
- 167.0'-169.5' SAND (S)
- 169.5'-175.0' silty SAND (mS)
- 175.0'-203.5' SAND (S) w/silt lens (sporadic)
- 203.5'-212.5' sl. gravelly SAND (gS)
- 212.5'-216.0' SAND (S)
- 216.0'-218.0' silty SAND (mS)
- 218.0'-223.4' silt to Sandy silt (m)
- 223.4'-258.0' silty Sandy GRAVEL (msG)

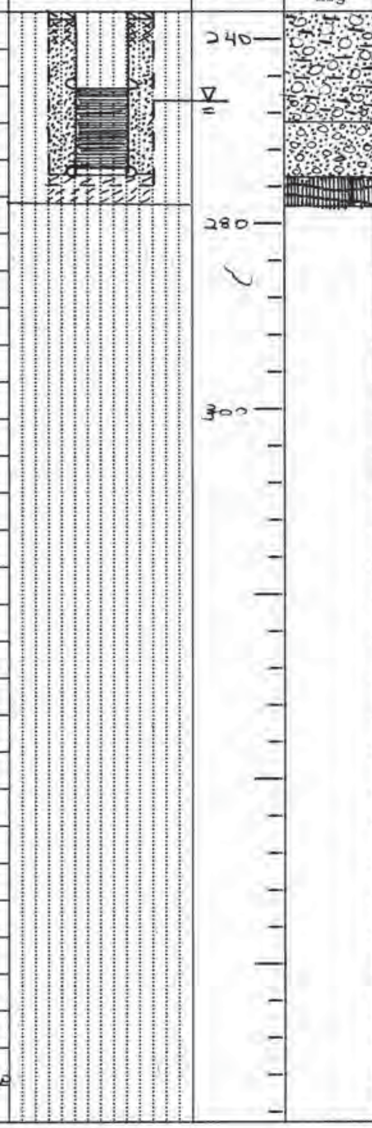
BHI-EE-189 (12/97)

Figure C-14. Well 299-E33-338 Construction and Completion Summary (1 of 2)

WELL SUMMARY SHEET		Page 2 of 2
		Date: 09/20/01
Well ID: C 3391	Well Name: 299-E33-338	
Location: SE Corner of 241-B Tank Farm	Project: C401 RCRA Drilling	
Prepared By: C. Martinez Date: 09/19/01	Reviewed By: DC Weekes	Date: 9/20/01
Signature: Charlene Martinez	Signature: DC Weekes	

CONSTRUCTION DATA | **GEOLOGIC/HYDROLOGIC DATA**

Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description
		240		
				258' - 271.0' sandy Gravel (sG)
				271' - 275.75' Basalt
		280		
		300		TD = 275.75' bgs. Static water level at 254.24' bgs (9/4/01). DCW
All temp. casing removed:				
All depths are in feet below ground surface				



BHI-EE-189 (12/97)

Figure C-14. Well 299-E33-338 Construction and Completion Summary (2 of 2)

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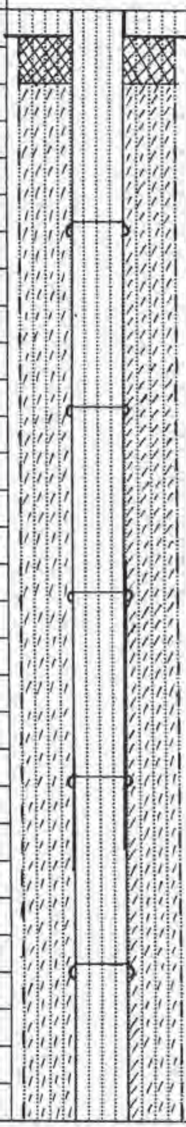
WELL SUMMARY SHEET

Page 1 of 2

Date: 07/18/01

Well ID: C3392	Well Name: 299-E33-339
Location: SE Corner of 241-BX Tank Farm	Project: C401 RCRA Drilling
Prepared By: Jess Hocking / Date:	Reviewed By: DCWeekes / Date: 9/19/01
Signature: Jess Hocking	Signature: DCWeekes

CONSTRUCTION DATA

Description	Diagram
6" - dia. protective casing set above stainless casing.	
4" ID SS 304L casing: +2.00 → 259.4'	
Portland cement grout: 0 → 10.4'	
Bentonite crumbles: 10.4' → 244.35'	
1/4" + 3/8" Bentonite pellets: 244.35' → 249.7'	
4" ID SS 304L 0.020 in. Slot cont. wire-wrap well screen: 259.4' → 279.3'	
10-20 mesh silica sand 249.7' → 283.1'	
4" ID SS304L Tailpipe: 279.3' , 281.4' , ~~281.4~~ → ~~283.1~~ DCW	
3/8 Bentonite Pellets (coated): 283.1' → 285.~~6~~44 DCW	
All temp. casing removed: All depths are in feet below ground surface.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
0		0'-6' Backfill material
		6'-15' Silty Sandy Gravel (msG)
		15'-18.5' Slightly Silty Sandy Gravel
		18.5'-20' Silt lens
		20'-23' Sand (S)
40		23'-25' Silty Sand (mS)
		25'-30' Slightly Silt Gravelly Sand
		28' Silt lens
		30'-34' Silty Sandy Gravel (msG)
		34'-37' Silty Sand (mS)
80		37'-37.5' (silt lens) M
		37.5'-55 silty sandy gravel (msG)
		55'-56' sandy Gravel (sG)
		56'-223' sand (S)
		223'-225' gravelly Sand (gS)
120		225'-235' Sandy Gravel (sG)
		235'-250' sl silty sandy Gravel (msG)
160		
200		

BHI-EE-189 (12/97)

Figure C-15. Well 299-E33-339 Construction and Completion Summary (1 of 2)

WELL SUMMARY SHEET

Page 2 of 2
Date: 7/18/01

Well ID: C3392	Well Name: 299-E33-339
Location: SE Corner of 241-BX Tank Farm	Project: RCRA FY-01
Prepared By: Jess Hocking — Date: 8/17/01	Reviewed By: DCWeekes — Date: 9/19/01
Signature: Jess Hocking	Signature: DCWeekes

CONSTRUCTION DATA | **GEOLOGIC/HYDROLOGIC DATA**

Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description
		240		250'-252' Gravel (G)
				252-253.5' Silt (m)
				253.5'-254 sl silty sandy gravel (msG)
				254'-260' Gravel (G)
				260'-275' Sandy Gravel (sG)
		280		275'-279' silty Gravel (mG)
				279'-~~284'~~ 285.44 ~~Gravel (G)~~ DCW BASALT
				TD = 285.44' bgs
				WL = 261.27' bgs 8/21/01
		320		
All temp. casing removed: All depths are in feet below ground surface.				

BHI-EE-189 (12/97)

Figure C-15. Well 299-E33-339 Construction and Completion Summary (2 of 2)

C2 References

NAD83, 1991, *North American Datum of 1983*, as revised, National Geodetic Survey, Federal Geodetic Control Committee, Silver Spring, Maryland. Available at: http://www.ngs.noaa.gov/.

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

Appendix D

Well Construction for Waste Management Area C

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Contents

Figures

Tables

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D1 Introduction

This appendix provides the following information for the existing Waste Management Area (WMA) C groundwater monitoring wells:

- Well name
- Hydrogeologic unit monitored (the aquifer portion at the well screen perforation) (Table D-1)
- The following sampling interval information, as provided in Table D-2:
  - Elevation at the top of the screen or perforated interval
  - Elevation at the bottom of the screen or perforated interval
  - Open interval length (i.e., difference between the top and bottom screen perforation elevations)
  - Drilling method

For proposed wells, the following design information is provided in Table D-3:

- Well location
- Drill depth
- Well diameter
- Screen interval depth
- Sump and end cap interval

Figures D-1 through D-10 provide construction and completion summaries for the existing network wells.

Table D-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.
TB	**Top of Basalt.** Open to less than 9.1 m (30 ft) above and below the top of basalt.
UU	**Upper Unconfined.** The top of the open interval is more than 1.5 m (5 ft) below the water table, and the bottom of the open interval is no more than 15.2 m (50 ft) below the water table.

Table D-2. Sampling Interval Information for Wells Within the WMA C 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])	Drilling Method
299-E27-12	TU	126.4 (414.7)	120.0 (393.6)	6.4 (21.1)	Cable tool
299-E27-13	TU	126.8 (416.0)	120.4 (394.9)	6.4 (21.1)	Cable tool
299-E27-14	TU	125.9 (413.1)	119.5 (392.1)	6.4 (21.0)	Cable tool
299-E27-15	TU	126.6 (415.4)	120.2 (394.4)	6.4 (21.0)	Cable tool
299-E27-21	TU	122.3 (401.2)	111.6 (366.1)	10.7 (35.1)	Becker hammer

Table D-2. Sampling Interval Information for Wells Within the WMA C 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])	Drilling Method
299-E27-22	TU	123.1 (403.8)	110.9 (363.9)	12.2 (40.0)	Becker hammer
299-E27-23	TU	122.3 (401.2)	111.6 (366.2)	10.7 (35.0)	Becker hammer
299-E27-24	TB, UU	113.1 (370.9)	107.0 (350.9)	6.1 (20.0)	Becker hammer
299-E27-26	TU	122.9 (403.2)	110.7 (363.2)	12.2 (40.0)	Cable tool, becker hammer
299-E27-155	TB, UU	116.1 (380.9)	105.4 (345.9)	10.7 (35.0)	Cable tool

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

Note: Due to rounding and conversion of metric units, the computed open interval length based on the top and bottom elevations may differ slightly from the actual open interval length reported in the associated well summary sheet.

TB = Top of Basalt, as described in Table D-1

TU = Top of Unconfined, as described in Table D-1

UU = Upper Unconfined, as described in Table D-1

Table D-3. Planned Locations, Depths, and Screen Intervals for Proposed Wells Within the WMA C Network

Proposed Well (Well ID)	Easting* (m)	Northing* (m)	Surface Elevation (m [ft] NAVD88)	Water Table Elevation (m [ft] NAVD88)	Depth to Water (m [ft] bgs)	Drill Depth (m [ft] bgs)	Final Well Diameter (cm [in.])	Screen Interval (m [ft] bgs)	Sump and End Cap Interval (m [ft] bgs)
WMA_C_PW1 (D0044)	575104.50	136423.70	TBD	TBD	TBD	TBD	TBD	TBD	TBD
WMA_C_PW2 (D0045)	575186.34	136461.91	TBD	TBD	TBD	TBD	TBD	TBD	TBD

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

Note: Well coordinates are estimates and subject to modification based on final well location survey.

*Coordinates are in Washington State Plane (south zone), NAD83, *North American Datum of 1983*; 1991 adjustment.

bgs = below ground surface

TBD = to be determined. Information will be obtained after well construction.

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AS-BUILT DIAGRAM

Well Number 299-E27-12 Geologist R Miller Page 1 of 3

Reviewed by [signature] Date 12-7-89

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Geologic/Hydrologic Data: Diagram Litho.	Geologic/Hydrologic Data: Lithologic Description
temporary 10"Ø carbon steel		5		Gravelly SAND
casing w/ drive shoe from		10		"
+1.0' to -127'2½"		15		Gravelly SAND to mud
		20		Gravelly SAND
temporary 8"Ø carbon steel		25		"
casing w/ drive shoe from		30		"
+3½" to 268'7"		35		Sand
		40		"
250.32' OF 4" DIA.		45		"
STAINLESS STEEL CASING		50		"
		55		"
		60		"
		65		"
		70		
		75		Gravelly SAND
FACTORY WELDED CASING		80		"
CENTRALIZER		85		"
		90		"
		95		"
		100		"
		105		"
		110		"
		115		"
		120		SAND
		125		Gravelly SAND (cobbles)
		130		SAND (cemented)

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PNL-MA 567, DO-1, Rev 0

Figure D-1. Well 299-E27-12 Construction and Completion Summary (1 of 3)

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AS-BUILT DIAGRAM

Well Number 299-E27-12 Geologist R. Miller Page 2 of 3

Reviewed by R. L. McGhan Date 12-7-89

Construction Data		Depth in Feet	Geologic/Hydrologic Data	
Description	Diagram		Diagram Litho.	Lithologic Description
temporary 8"ø carbon steel		135		SAND (sl. cemented)
casing w/ drive shoe from		140		sl. gravelly SAND
+3'6" to 268'7" (272'1")		145		"
		150		"
		155		"
		160		SANDY GRAVEL
		165		sl. gravelly SAND
250.32' of 4" DIA.		170		SAND
STAINLESS STEEL CASING		175		"
		180		"
		185		"
		190		"
		195		"
		200		"
		205		"
		210		"
		215		"
		220		"
		225		"
		230		~~Gravelly Sandy MUD @ 228 - 10" thick~~ Muddy Sandy GRAVEL
		235		Sandy GRAVEL
		240		"
		245		"
21.03' of 4" DIA CHANNEL	252.1' 9/18	250		Muddy Sandy GRAVEL
PACK SCREEN (10 SLOT)		255		" (wet)
		260		Sandy GRAVEL

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Figure D-1. Well 299-E27-12 Construction and Completion Summary (2 of 3)

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AS-BUILT DIAGRAM

Well Number 299-E27-12 Geologist R. Miller Page 3 of 3

Reviewed by V. L. McGhan Date 12-7-89

Construction Data		Depth in Feet	Geologic/Hydrologic Data	
Description	Diagram		Diagram Litho.	Lithologic Description
temporary 8" ø carbon steel from +3'6" to 268'7" (272'1")		265		Sandy GRAVEL
		270		"
				T.D. = 270.0'
21.03' OF 4" DIA. STAINLESS STEEL CHANNEL PACK SCREEN				COMPLETION DEPTH = 267.55'
COMPLETION SYMBOLS:				
CEMENT GROUT				
GRANULAR BENTONITE				
BENTONITE PELLETS				
SILICA SAND				
CASING CENTRALIZER				
CASING JOINT				

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PNL-MA-567 DO-1, REV. 0

Figure D-1. Well 299-E27-12 Construction and Completion Summary (3 of 3)

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AS-BUILT DIAGRAM

Well Number 299-E27-13 Geologist Ian Kennedy Page 1 of 3

Reviewed by [illegible signature] Date 12-6-89

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Geologic/Hydrologic Data: Diagram Litho.	Geologic/Hydrologic Data: Lithologic Description
10" diameter temporary carbon steel		5		Sandy Gravel
casing with drive shoe		10		"
from 0' to 138'-6½"		15		Slightly gravelly muddy sand
		20		gravelly sand
8" diameter temporary carbon		25		"
steel casing with drive		30		Sandy gravel
shoe from 1'-6¾" to 277'-1⅛"		35		"
		40		Sand
		45		"
255.45' of 4" DIA.		50		"
STAINLESS STEEL CASING		55		"
		60		"
		65		Slightly gravelly sand
		70		" " "
		75		" " "
		80		Sand
		85		Slightly gravelly sand
		90		" "
		95		" "
		100		gravelly sand
		105		" "
		110		" "
		115		Slightly gravelly sand
		120		Sand
		125		"
		130		

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Figure D-2. Well 299-E27-13 Construction and Completion Summary (1 of 3)

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AS-BUILT DIAGRAM

Well Number 299-E27-13 Geologist Ian Kennedy Page 2 of 5

Reviewed by V.L. McGhan Date 12-6-89

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Geologic/Hydrologic Data: Diagram Litho.	Geologic/Hydrologic Data: Lithologic Description
138' 6 1/8" of 10" CARBON		135'		Sand
STEEL CASING		140'		"
		145'		"
		150'		"
278' 8 1/8" of 8" CARBON		155'		Slightly gravelly sand
STEEL CASING		160'		Gravelly sand
		165'		Slightly gravelly sand
		170'		Sand
255.49' of 4" STAINLESS		175'		"
STEEL CASING		180'		"
		185'		Slightly gravelly Sand
		190'		[illegible]
		195'		
		200'		
		205'		Sand
		210'		Slightly gravelly Sand
		215'		Gravelly Sand
		220'		" "
		225'		Sand
		230'		Sand
		235'		Sand
		240'		Sandy Gravel
		245'		" "
		250'		" "
		255'		" "
		260'		" "

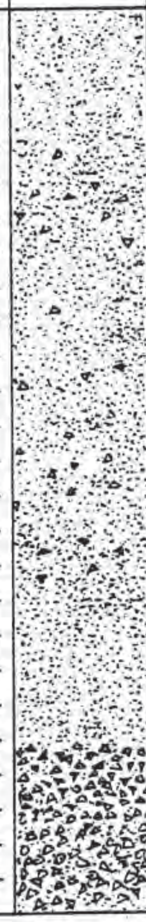

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Figure D-2. Well 299-E27-13 Construction and Completion Summary (2 of 3)

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AS-BUILT DIAGRAM

Well Number 299-E27-13 Geologist Ian Kennedy Page 3 of 3

Reviewed by V.L. McGhan Date 12-6-89

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Geologic/Hydrologic Data: Diagram Litho.	Geologic/Hydrologic Data: Lithologic Description
				D/W = 260.73' 10/12/89
273'8½" of 8" CARBON		265		Sandy Gravel
STEEL CASING		270		Gravel
		275		GRAVEL
21' of 4" DIA. STAINLESS				
STEEL CHANNEL PACK				D/B = 275.56 10/9/89
SCREEN (10 SLOT)				
COMPLETION SYMBOLS:				
CEMENT GROUT				
GRANULAR BENTONITE				
BENTONITE PELLETS				
SILICA SAND				
CASING JOINT				
CASING CENTRALIZER				

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Figure D-2. Well 299-E27-13 Construction and Completion Summary (3 of 3)

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AS-BUILT DIAGRAM

Well Number 299-E27-14 Geologist R Miller Page 1 of 3

Reviewed by V. T. Wuckhan Date 12-7-89

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Geologic/Hydrologic Data: Diagram Litho.	Geologic/Hydrologic Data: Lithologic Description
temporary 10" dia carbon		5		Muddy SAND
steel casing from		10		"
to 137'-7"		15		Gravelly SAND
		20		Sandy GRAVEL
		25		"
8" carbon steel temp		30		"
Casing installed to 267.1'		35		"
		40		"
		45		SAND 48-49' Slightly Muddy SAND - wet
		50		SAND
		55		"
		60		"
		65		"
		70		Sandy GRAVEL
		75		" "
		80		" "
		85		" "
		90		Gravelly SAND
		95		Sand (clay lense 94' to 94.5')
		100		Slightly Muddy SAND
		105		SAND
		110		SAND
		115		SAND
		120		SAND
		125		SAND
		130		SAND

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Figure D-3. Well 299-E27-14 Construction and Completion Summary (1 of 3)

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AS-BUILT DIAGRAM

Well Number 299-E27-14 Geologist M. Lubrecht Page 2 of 3

Reviewed by V.T. McClean Date 12-7-89

Construction Data		Depth in Feet	Geologic/Hydrologic Data	
Description	Diagram		Diagram Litho.	Lithologic Description
		135		SAND
End 10" @ 137'-7"		140		slightly gravelly SAND
		145		Gravelly SAND
		150		SAND
		155		"
		160		slightly gravelly SAND
		165		SAND
		170		gravelly SAND
		175		" "
		180		" "
8" carbon steel temp		185		" "
casing		190		" "
		195		" "
246.48' of 4" Type 304,		200		Sl. gravelly SAND
SCH.5 Stainless Steel		205		SAND
Casing		210		SAND
		215		SAND
		220		"
		225		"
		230		muddy sandy GRAVEL
		235		Sandy GRAVEL
		240		" "
		245		Muddy Sandy GRAVEL ▽ D/W = 249.81' ([illegible])
		250		Sandy GRAVEL
		255		" "
		260		Gravelly SAND

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Figure D-3. Well 299-E27-14 Construction and Completion Summary (2 of 3)

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AS-BUILT DIAGRAM

Well Number 299-E27-14 Geologist M.D. Lubrecht Page 3 of 3

Reviewed by [signature] Date 12-7-89

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Geologic/Hydrologic Data: Diagram Litho.	Geologic/Hydrologic Data: Lithologic Description
End 8" casing @ 267.1'		265'		Sand -
TD@ 266.05'				
				T.D. = 266.8'
21' of 4" dia. 10 slot				Completion Depth = 266.83'
Channel Pack Screen				
(Stainless Steel)				
Completion Symbols:				
Cement Grout				
Granular Bentonite				
Bentonite Pellets				
Silica Sand				
Casing Joint				
Casing Centralizer				

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PNL-MA-567 DO-1, REV. 0

Figure D-3. Well 299-E27-14 Construction and Completion Summary (3 of 3)

A4813

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AS-BUILT DIAGRAM

Well Number 299-E27-15 Geologist Jan Kennedy / Miller Page 1 of 2

Reviewed by D.L. McKeehan Date 12-7-89

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Geologic/Hydrologic Data: Diagram Litho.	Geologic/Hydrologic Data: Lithologic Description
temporary 10" carbon		5		SAND
steel temporary casing		10		"
w/drive shoe from +1'1" to		15		Sandy gravel
128'4½" (129'5½")		20		sand
		25		"
temporary 8" carbon steel		30		"
casing w/ drive shoe from		35		Gravelly sand
+2.25' to 261.87' bls (264.8')		40		Slightly gravelly sand
		45		Sand
240.48' of 4" stainless		50		Slightly gravelly sand
STEEL CASING		55		"
		60		Sand (to gravel)
		65		"
		70		"
		75		"
		80		"
		85		"
		90		"
		95		"
		100		"
		105		Gravelly SAND
		110		"
		115		"
		120		"
		125		"
		130		"

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PNL MA-567 DO-1, rev 0

Figure D-4. Well 299-E27-15 Construction and Completion Summary (1 of 2)

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AS-BUILT DIAGRAM

Well Number 299-E27-15 Geologist Kennedy / Miller Page 2 of 2

Reviewed by V. L. McClean Date 12-7-89

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Geologic/Hydrologic Data: Diagram Litho.	Geologic/Hydrologic Data: Lithologic Description
temporary 6" carbon steel casing		135		Sandy Gravel
with drive shoe		140		Sand
		145		Slightly Gravelly Sand
240.45' of 4"		150		"
STAINLESS STEEL CASING		155		Sand
		160		Slightly gravelly sand
		165		"
		170		Sandy GRAVEL
		175		Gravelly SAND
		180		SAND
		185		"
		190		"
		195		"
		200		"
Cement Grout		205		"
8-20 mesh Bentonite Crumbles		210		"
1/4" bentonite Pellets		215		"
16-30 mesh Silica Sand		220		"
		225		"
volclay pellets (1/4")		230		Sandy GRAVEL
		235		"
		240		"
Colorado Silica Sand		245		Muddy Sandy GRAVEL
4" stainless steel		250		"
10 slot channel pack		255		"
(21')		260		"

T.D. 262.54'

A-1800-188 (3/87)

PNL-MA-567-DC-1-rev-0

Figure D-4. Well 299-E27-15 Construction and Completion Summary (2 of 2)

WELL SUMMARY SHEET

Start Date: 07/21/03
Finish Date: 07/25/03
Page 1 of 2

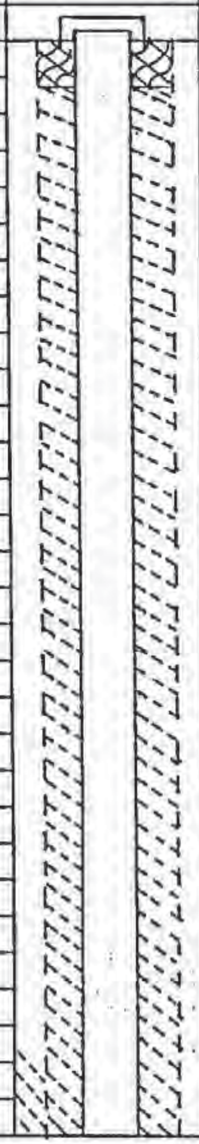
Well ID: C4127	Well Name: 299-E27-21
Location: South of CR-vault	Project: CY03 RCRA drilling
Prepared By: Charlene Martinez — Date: 08/07/03	Reviewed By: L.D. Walker — Date: 8/11/03
Signature: Charlene Martinez	Signature: LD Walker

CONSTRUCTION DATA

Description:

- 9" OD Dual-wall temporary casing used
- 6" ID SS protective casing set +1.0' above permanent
- 4" ID SS304 sched. 10 riser: + 2.0 ~~2.7137~~ → 271.37'
- Portland Cement Grout: 0' → 10.1'
- Granular Bentonite: 10.1' → 260.4'
- 1/4" Bentonite Pellets: 260.4' → 265.5'
- All temporary casing removed from ground;
- All depths are in feet below ground surface.

Diagram:



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet: 0, 40, 80, 120, 160, 200

Graphic Log:

Lithologic Description:

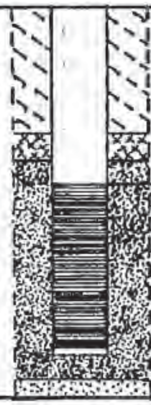
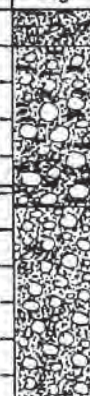
- 0-1' BackFill (crushed gravel)
- 1'-20' SAND(S)
- 20'-25' gravelly SAND(gS)
- 25'-40' SAND(S)
- 40'-65' gravelly SAND(gS)
- 65'-160' SAND(S)
- 160'-170' gravelly SAND(gS)
- 170'-185' SAND(S)
- 185'-200' silty sandy GRAVEL (msG)
- 200'-225' silty SAND(mS)
- 225'-235' silty sandy GRAVEL (msG)
- 235'-240' silty SAND(mS)

A-6003-643 (03/03)

Figure D-5. Well 299-E27-21 Construction and Completion Summary (1 of 2)

WELL SUMMARY SHEET	Start Date: 07/21/03 Finish Date: 07/25/03	Page 2 of 2

Well ID: C4127		Well Name: 299-E27-21	
Location: South of CR-Vault		Project: CY03 RCRA drilling	
Prepared By: Charlene Martinez	Date: 08/01/03	Reviewed By: L.D. Walker	Date: 8/11/03
Signature: Charlene Martinez		Signature: LD Walker	

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
10-20 mesh silica sand: 245.5' → 314.0'		240		240'-275' silty sandy GRAVEL (msG)
SS304 (4"ID) schedule 10 0.020-in. cont. wire-wrap wellscreen: 271.37' → 306.43'				275'-285' gravelly SAND (gS)
		280		285'-318' sandy GRAVEL (sG)
4"ID SS304 schedule 10 sump/endcap: 306.43' → 308.83'				
		320		TD = 318' bgs
4-8 mesh silica sand: 314.0' → 318.0'				Static water 271.38' bgs (07/25/03)
		360		
All temporary casing removed from ground.				
All depths are in feet below ground surface.				

A-6003-643 (03/03)

Figure D-5. Well 299-E27-21 Construction and Completion Summary (2 of 2)

WELL SUMMARY SHEET

Start Date: 08/21/03
Finish Date: 09/10/03
Page 1 of 2

Well ID: C4124	Well Name: 299-E27-22
Location: East of C-Tank Farm	Project: C4023 RCRA drilling
Prepared By: Charlene Martinez Date: 09/11/03	Reviewed By: L.D. Walker Date: 9/15/03
Signature: Charlene Martinez	Signature: LD Walker

CONSTRUCTION DATA

Description

9" OD dual-wall temporary casing used.

6" ID protective casing set +1.0' above permanent.

4" ID SS304 sch 10 riser: +2.2' → 228.05'

Portland Cement Grout: 0' → 10.0'

Granular Bentonite: 10.0' → 217.2'

1/4" Bentonite Pellets: 217.2' → 222.5'

10-20 mesh Silica sand: 222.5' → 268.0'

All depths in feet below ground surface.

All temporary casing removed from ground.

170' of 1/4" OD pipe remain in ground (bentonite seal) from 47'-217'

Diagram

Depth in Feet

0, 40, 80, 120, 160, 200

GEOLOGIC/HYDROLOGIC DATA

Graphic Log

Lithologic Description

0'-1' Backfill (crushed gravel)
1'-5' SAND (S)
5'-10' gravelly SAND (gS)
10'-29' SAND (S)
29'-36' sandy GRAVEL (sG)
36'-50' SAND (S)
50'-54' sandy GRAVEL (sG)
54'-56' SAND (S)
56'-60' sandy GRAVEL (sG)
60'-72' silty sandy GRAVEL (msG)
72'-81.5' silty gravelly SAND (mgS)
81.5'-89' SAND (S)
89'-98' silty SAND (mS)
98'-105' SAND (S)
105'-112' silty SAND (mS)
112'-116' SAND (S)
116'-122' silty SAND (mS)
122'-138' SAND (S)
138'-145' silty SAND (mS)
145'-153' gravelly silty SAND (gmS)
153'-157' silty sandy GRAVEL (msG)
157'-165' sandy GRAVEL (sG)
165'-185' SAND
185'-188' silty sandy GRAVEL (msG)
188'-192' silty SAND (mS)
192'-215' sandy GRAVEL (sG)
215'-219' gravelly SAND (gS)
219'-222' silty sandy GRAVEL (msG)
222'-227' SAND (S)
227'-233' silty sandy Gravel (msG)

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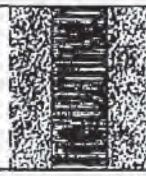
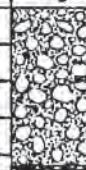
Figure D-6. Well 299-E27-22 Construction and Completion Summary (1 of 2)

WELL SUMMARY SHEET	Start Date: 09/21/03 Finish Date: 09/10/03	Page 2 of 2

Well ID: C4134	Well Name: 299-E27-22
Location: East of C-Tank Farm	Project: CY03 RCRA drilling
Prepared By: Charlene Martinez Date: 09/11/03	Reviewed By: L.D. Walker Date: 9/15/03
Signature: Charlene Martinez	Signature: LD Walker

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
4" ID SS304 sch.10, 0.020-in. slot, cont. wire-wrap wellscreen: 238.05' → 268.02'		240		233' - 268' Sandy GRAVEL (sG)
				268' BASALT
4" ID SS304 sch 10 endcap: 268.02' → 268.10'				TD = 268' bgs.
		280		static water ⇒ 230.46' bgs (09/10/03)
All depths are in feet below ground surface				
All temporary casing removed from ground.				

A-6003-643 (03/03)

Figure D-6. Well 299-E27-22 Construction and Completion Summary (2 of 2)

WELL SUMMARY SHEET	Start Date: 08/05/03 Finish Date: 08/12/03	Page 1 of 2

Well ID: C4190	Well Name: 299-E27-23
Location: West of C-Tank Farm	Project: CY03 RCRA drilling
Prepared By: Charlene Martinez — Date: 08/19/03	Reviewed By: L.D. Walker — Date: 9/5/03
Signature: Charlene Martinez	Signature: LD Walker

CONSTRUCTION DATA

Description:

9" OD dual-wall temporary casing used.

6" ID Protective casing set 1.0' above

4" ID SS304 schedule 10 casing:
+1.8' → 273.51'

Portland Cement Grout:
0' → 9.9'

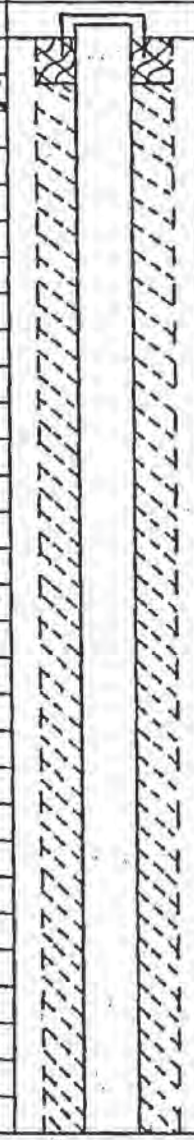
Granular Bentonite:
9.9' → 263.0'

1/4" Bentonite Pellets:
263.0' → 267.8'

All temporary casing removed from ground.

All depths in feet below ground surface.

Diagram:



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet: 0, 40, 80, 120, 160, 200

Graphic Log:

Lithologic Description:

0'–1.5' Backfill (Crushed GRAVEL)
1.5'–10' SAND(S)
10'–12' gravelly SAND(gS)
12'–15' sandy GRAVEL(sG)
15'–20' gravelly SAND(gS)
20'–103' SAND(S)
103'–107' gravelly SAND(gS)
107'–160' SAND(S)
160'–200' silty SAND(mS)
200'–210' silty sandy GRAVEL(msG)
210'–226' SAND(S)
226'–230' gravelly SAND(gS)
230'–245' SAND(S)

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Figure D-7. Well 299-E27-23 Construction and Completion Summary (1 of 2)

WELL SUMMARY SHEET

Start Date: 08/05/03
Finish Date: 08/12/03
Page 2 of 2

Well ID: C4190	Well Name: 299-E27-23
Location: West of C-Tank Farm	Project: CY03 RCRA drilling
Prepared By: Charlene Martinez Date: 08/19/03	Reviewed By: L.D. Walker Date: 9/5/03
Signature: Charlene Martinez	Signature: LD Walker

CONSTRUCTION DATA / **GEOLOGIC/HYDROLOGIC DATA**

Description	Depth in Feet	Lithologic Description
10-20 mesh silica sand: 267.8' → 318.0'	240	245'–255' silty sandy GRAVEL (msG)
4" ID SS 304 schedule 10, 0.020" cont. wire-wrap screen: 273.51' → 308.54'		255'–260' GRAVEL (G)
4" ID SS 304 schedule 10 sump/endcap: 308.64' → 310.97'	280	260'–318' sandy GRAVEL (sG)
		TD => 318' bgs
		static water => 273.1' bgs (08/12/03)
	320	
All temporary casing removed from ground;	360	
All depths are in feet below ground surface;		

Diagram:

Graphic Log:

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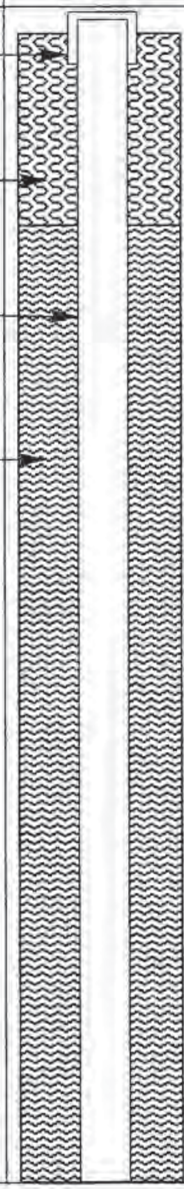
Figure D-7. Well 299-E27-23 Construction and Completion Summary (2 of 2)

WELL SUMMARY SHEET		Start Date: 5/4/10 Finish Date: 6/7/10	Page 1 of 2
Well ID: C7570		Well Name: 299-E27-24	
Location: SE corner of C Tank Farm		Project: 5 M-24 RCRA Monitoring Wells	
Prepared By: Ryan W. Brauchla	Date: 6/9/10	Reviewed By: L.D. Walker	Date: 8/9/10
Signature: Ryan W. Brauchla		Signature: L D Walker	

CONSTRUCTION DATA

Description	Diagram
Stainless Steel Protective Casing: +2.92 ft above ground surface Portland Cement Type I/II: 0 - 30 ft bgs LW 8-16-10 Sch. 10 4-in I.D. Stainless Steel Type 304, Permanent Blank Casing: +1.99 - 294.58 ft bgs Bentonite Slurry: 30 - ~~224.1~~ ft bgs 282.5' LW 8-4-10 All temporary drill casing was removed from the ground. All depths are in feet below ground surface. Borehole drilled with 9-inch O.D. casing: 0.0 - 317.8 ft bgs, re-drilled with 10 ¾-inch O.D. casing: 0.0 - 85.8 ft bgs, and re-drilled again with 9-inch O.D. casing: 0.0 - 317.7 bgs	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description/Groundwater Sample Depths (ft bgs)
0		0-1 Gravel (G)
		1-12 Gravelly Sand (gS)
		12-18 Slightly Gravelly Sand (mgS)
20		18-22 Gravelly Sand (gS)
		22-34 Sandy Gravel (sG)
		34-60 Sand (S)
40		
60		60-64 Sandy Gravel (sG)
		64-243 Sand (S)
80		
100		
120		
140		
160		

Figure D-8. Well 299-E27-24 Construction and Completion Summary (1 of 2)

WELL SUMMARY SHEET		Start Date: 5/4/10 Finish Date: 6/7/10	Page 2 of 2
Well ID: C7570		Well Name: 299-E27-24	
Location: SE corner of C Tank Farm		Project: 5 M-24 RCRA Monitoring Wells	
Prepared By: Ryan W. Brauchla	Date: 6/9/10	Reviewed By: L.D. Walker	Date: 8/9/10
Signature: Ryan W. Brauchla		Signature: L.D. Walker	

CONSTRUCTION DATA

Description

All temporary drill casing was removed from the ground.

All depths are in feet below ground surface.

Borehole drilled with 9-inch O.D. casing: 0.0 - 317.8 ft bgs, re-drilled with 10 ¾-inch O.D. casing: 0.0 - 85.8 ft bgs, and re-drilled again with 9-inch O.D. casing: 0.0 - 317.7 bgs

LW 8-16-10

Sched. 10
4-in I.D. Stainless Steel Type 304, Permanent Blank Casing: + 1.99 - 294.58 ft bgs

Bentonite Slurry: 30 - 282.5 ft bgs

Static Water Level 265.26 ft bgs (6/8/10)

¼-inch Coated Bentonite Pellets: 282.5 - 284.8 ft bgs

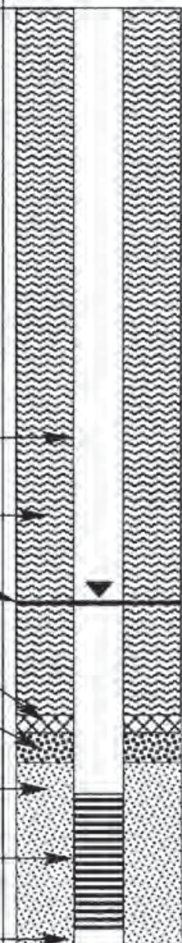
70 Mesh Transition Sand: 284.8 - 289.5 ft bgs

Primary Sand Pack 10-20 Mesh Colorado Silica Sand: 289.5 - 317.7 ft bgs

4-in I.D. Stainless Steel Type 316, 20 Slot (0.020-in) Screen: 294.58 - 314.59 ft bgs

4-in, I.D. Stainless Steel Type 304, Sump/End Cap: 314.59 - 317.59 ft bgs

Diagram



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet: 180, 200, 220, 240, 260, 280, 300, 320

Graphic Log

Lithologic Description/Groundwater Sample Depths (ft bgs)

64-243 Sand (S)
243-250 Silty Sand (mS)
250-265 Gravelly Sand (gS)
265-279 Sandy Gravel (sG)
279-283 Gravel (G)
283-297 Sandy Gravel (sG)
297-311 Gravel (G)
311-315 Sandy Gravel (sG)
315-317.8 Basalt
Total Depth Drilled: 317.8 ft bgs (5/14/10)

Figure D-8. Well 299-E27-24 Construction and Completion Summary (2 of 2)

WELL SUMMARY SHEET		Start Date: 2/16/16 Finish Date: 3/1/16	Page 1 of 4
Well ID: C9449		Well Name: 299-E27-26	
Location: 15 ft North of 241-C Tank Farm		Project: 8 M-24 TPA GW Monitoring Wells FY16	
Prepared By: Cameron Penner-Ash	Date: 3/2/16	Reviewed By: J.D. MEHRER	Date: 4-13-16
Signature: [signature]		Signature: [signature]	

CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description (ft bgs)

Concrete Pad: 0.5 ft above ground surface (ags)

Protective Permanent Monument: 3.00 ags - 2.00 bgs

Type I/II Portland Cement Grout: 0 - 12.2 ft bgs

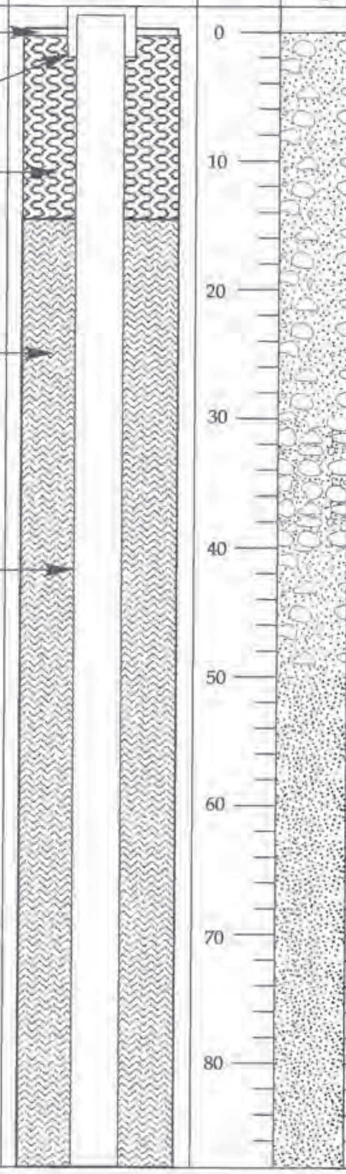
Cetco Medium Bentonite Chips / #8 Cetco Bentonite Crumbles (8-20 Mesh): 12.2 - 229.5 ft bgs

4-in ID Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.00 ft ags - 235.00 ft bgs

Depths are in ft below ground surface.

Borehole drilled with 10 3/4-in OD casing from 0.0 - 19.0 ft bgs and 8 5/8-in OD casing from 19.0 - 280.6 ft bgs

All temporary drill casing was removed from the ground.



0 - 30 Gravelly Sand (gS)

30 - 40 Sandy Gravel (sG)

40 - 50 Gravelly Sand (gS)

50 - 120 Sand (S)

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Figure D-9. Well 299-E27-26 Construction and Completion Summary (1 of 4)

WELL SUMMARY SHEET	Start Date: 2/16/16 Finish Date: 3/1/16	Page 2 of 4

Well ID: C9449	Well Name: 299-E27-26
Location: 15 ft North of 241-C Tank Farm	Project: 8 M-24 TPA GW Monitoring Wells FY16
Prepared By: Cameron Penner-Ash Date: 3/2/16	Reviewed By: J.D. MEHRER Date: 4-13-16
Signature:	Signature:

CONSTRUCTION DATA

Description

4-in ID Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.00 ft ags - 235.00 ft bgs

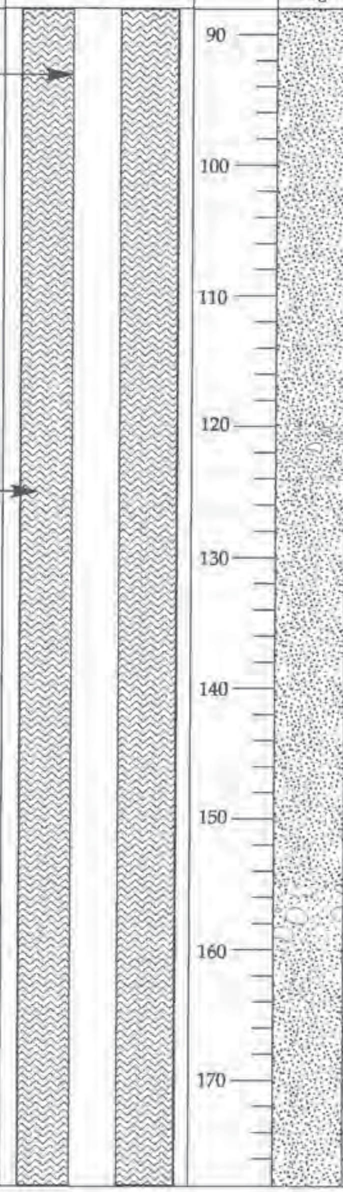
Cetco Medium Bentonite Chips / #8 Cetco Bentonite Crumbles (8-20 Mesh): 12.2 - 229.5 ft bgs

Depths are in ft below ground surface.

Borehole drilled with 10 3/4-in OD casing from 0.0 - 19.0 ft bgs and 8 5/8-in OD casing from 19.0 - 280.6 ft bgs

All temporary drill casing was removed from the ground.

Diagram



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
90		50 - 120 Sand (S)
100		
110		
120		120 - 122 Sandy Gravel (sG)
		122 - 155 Sand (S)
130		
140		
150		
		155 - 160 Gravelly Sand (gS)
160		160 - 200 Sand (S)
170		

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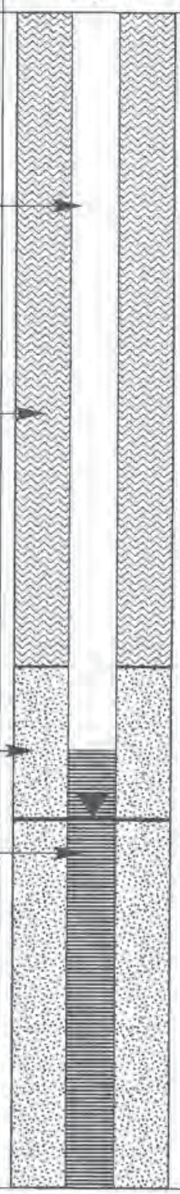
Figure D-9. Well 299-E27-26 Construction and Completion Summary (2 of 4)

WELL SUMMARY SHEET		Start Date: 2/16/16	Page 3 of 4
		Finish Date: 3/1/16	
Well ID: C9449		Well Name: 299-E27-26	
Location: 15 ft North of 241-C Tank Farm		Project: 8 M-24 TPA GW Monitoring Wells FY16	
Prepared By: Cameron Penner-Ash	Date: 3/2/16	Reviewed By: L.D. MEHRER	Date: 4-15-16
Signature:		Signature:	

CONSTRUCTION DATA

Description	Diagram
4-in ID Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.00 ft ags - 235.00 ft bgs	
Cetco Medium Bentonite Chips / #8 Cetco Bentonite Crumbles (8-20 Mesh): 12.2 - 229.5 ft bgs	
10-20 mesh Premier Colorado Silica Filter Pack Sand: 229.5 - 281.0 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, 20-Slot (0.020 in.) Stainless Steel Screen: 235.0 - 274.98 ft bgs	
Depths are in ft below ground surface.	
Borehole drilled with 10 3/4-in OD casing from 0.0 - 19.0 ft bgs and 8 5/8-in OD casing from 19.0 - 280.6 ft bgs	
All temporary drill casing was removed from the ground.	



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
180		160 - 200 Sand (S)
190		
200		200 - 225 Gravelly Sand (gS)
210		
220		225 - 270 Sandy Gravel (sG)
230		
240		Static Water Level: 240.3 ft bgs (2/26/16)
250		
260		

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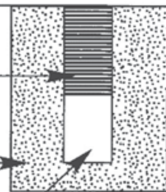
Figure D-9. Well 299-E27-26 Construction and Completion Summary (3 of 4)

WELL SUMMARY SHEET	Start Date: 2/16/16 Finish Date: 3/1/16	Page 4 of 4
Well ID: C9449	Well Name: 299-E27-26	
Location: 15 ft North of 241-C Tank Farm	Project: 8 M-24 TPA GW Monitoring Wells FY16	
Prepared By: Cameron Penner-Ash Date: 3/2/16	Reviewed By: J.D. MEHRER	Date: 4-13-16
Signature:	Signature:	

CONSTRUCTION DATA

Description	Diagram
4-in I.D. Schedule 10, Type 304/304L, 20-Slot (0.020 in.) Stainless Steel Screen: 235.0 - 274.98 ft bgs 10-20 mesh Premier Colorado Silica Filter Pack Sand: 229.5 - 281.0 ft bgs 4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Sump: 274.98 - 280.00 ft bgs	

Depths are in ft below ground surface.

Borehole drilled with 10 3/4-in OD casing from 0.0 - 19.0 ft bgs and 8 5/8-in OD casing from 19.0 - 280.6 ft bgs

All temporary drill casing was removed from the ground.

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
270		225 - 270 Sandy Gravel (sG) 270 - 280.8 Gravel (G)
280		280.8 - 280.9 Basalt
290		
300		
310		
320		
330		
340		
350		

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Figure D-9. Well 299-E27-26 Construction and Completion Summary (4 of 4)

WELL SUMMARY SHEET		Start Date: 09/26/06 Finish Date: 11/13/07	Page 1 of 4
Well ID: C5852		Well Name: 299-E27-155	
Location: N. of 7th St., S. of MO-527 near C-Tank Farm		Project: 200-BP-5 RI/FS	
Prepared By: Jeff Fetters	Date: 11/15/07	Reviewed By: L. D. Walker	Date: 12/10/07
Signature: Jeff Fetters		Signature: L D Walker	

CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description/Groundwater Sample Depths (ft bgs)

6-in Concrete Pad

6-in I.D. Type 304/304L Stainless Steel Protective Casing: +2.72 ft above Ground Surface

Portland Cement Type I/II: 0 - 10.01 ft

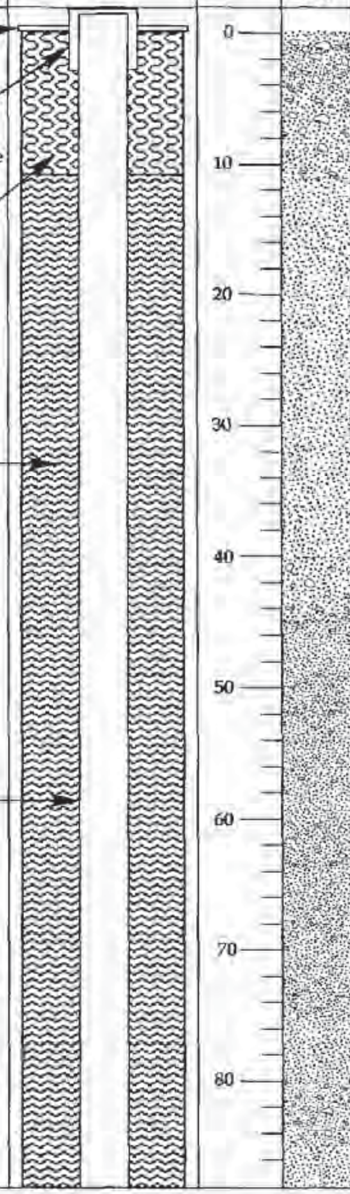
Granular Bentonite Crumbles: 10.01 - 279.0 ft

4-in I.D. Type Stainless Steel Type 304/304L, Schedule 10 Permanent Casing: +1.72 - 300.46 ft

All depths are in feet below ground surface.

Borehole drilled with 11 3/4-in threaded casing 0.0-130.0 ft and 8-in threaded casing 130.-340.0 ft

All temporary drill casing was removed from the ground.



0-3 Sandy Gravel sG (Fill)

3-11 Gravelly sand gS

11-40 sand S

40-45 Gravelly Sandy gS

45-69 Sand S

69-75 Gravelly Sandy gS

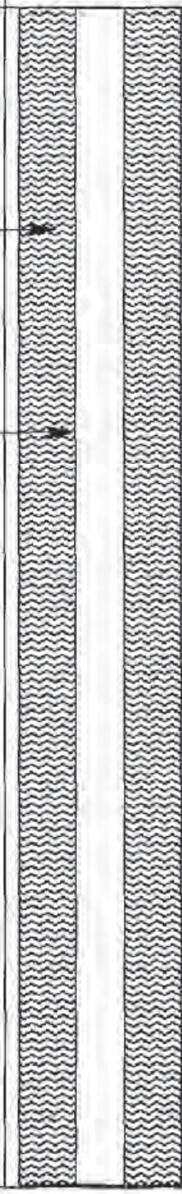
75-123 Sand S

Figure D-10. Well 299-E27-155 Construction and Completion Summary (1 of 4)

WELL SUMMARY SHEET		Start Date: 09/26/07 Finish Date: 11/13/07	Page 2 of 4
Well ID: C5852		Well Name: 299-E27-155	
Location: N. of 7th St. S. of MO-527 C-Tank Farm		Project: 200-BP-5 RI/FS	
Prepared By: Jeff Fetters	Date: 11/15/07	Reviewed By: L. D. Walker	Date: 12-10-07
Signature: Jeff Fetters		Signature: LD Walker	

CONSTRUCTION DATA

Description	Diagram
Granular Bentonite Crumbles: 10.01 - 279.0 ft	
4-in I.D. Type Stainless Steel Type 304/304L, Schedule 10 Permanent Casing: +1.72 - 300.46 ft	
All depths are in feet below ground surface.	
Borehole drilled with 11 3/4-in threaded casing 0.0-130.0 ft and 8-in threaded casing 130.-340.0 ft	
All temporary drill casing was removed from the ground.	



GEOLOGIC/HYDROLOGIC DATA

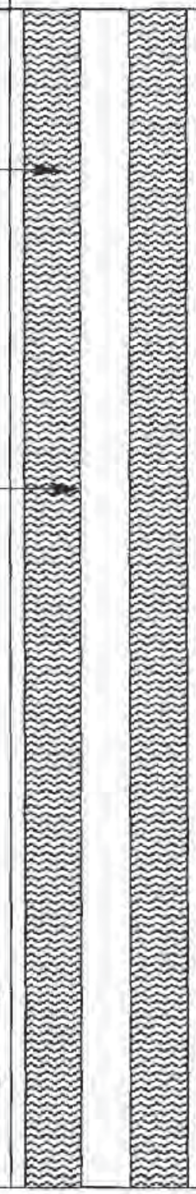
Depth in Feet	Lithologic Description/Groundwater Sample Depths (ft bgs)
90	75-123 Sand S
100	
110	
120	123-125 Gravelly Sandy gS
	125-129 Gravelly Silty Sandy gmS
130	129-144 Sandy S
140	144-153 Silty Sand mS
150	153-163 Sand S
160	163-164 Silty Sand mS
	164-185 Sand S
170	

Figure D-10. Well 299-E27-155 Construction and Completion Summary (2 of 4)

WELL SUMMARY SHEET		Start Date: 09/26/07 Finish Date: 11/13/07	Page 3 of 4
Well ID: C5852		Well Name: 299-E27-155	
Location: N. of 7th St., S. of Mo-527 near C-Tank Farm		Project: 200-BP-5 RI/FS	
Prepared By: Jeff Fetters	Date: 11/15/07	Reviewed By: L. D. Walker	Date: 12/10/07
Signature: Jeff Fetters		Signature: L D Walker	

CONSTRUCTION DATA

Description	Diagram
Granular Bentonite Crumbles: 10.01 - 279.0 ft	
4-in I.D. Type Stainless Steel Type 304/304L, Schedule 10 Permanent Casing: +1.72 - 300.46 ft	
All depths are in feet below ground surface.	
Borehole drilled with 11 3/4-in threaded casing 0.0-130.0 ft and 8-in threaded casing 130.-340.0 ft	
All temporary drill casing was removed from the ground.	



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description/Groundwater Sample Depths (ft bgs)
180		
		185-187 Gravelly Sandy gS
		187-190 Sand S
190		190-193 Gravelly Sand gS
		193-219 Sand S
200		
210		
220		219-223 Silty Sand mS
		223-230 Sand S
230		230-237 Gravelly Sand gS
		237-258 Sand S
240		
250		
		258-263 Gravelly Sand gS
260		
		263-270 Silty Gravel mG

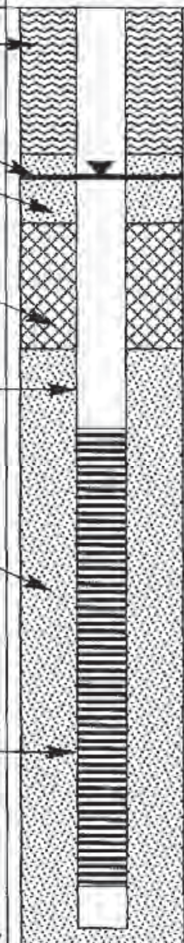
Figure D-10. Well 299-E27-155 Construction and Completion Summary (3 of 4)

WELL SUMMARY SHEET	Start Date: 09/26/07 Finish Date: 11/13/07	Page 4 of 4

Well ID: C5852	Well Name: 299-E27-155
Location: N. of 7th St., S. of Mo-527 near C-Tank Farm	Project: 200-BP-5 RI/FS
Prepared By: Jeff Fetters Date: 11/15/07	Reviewed By: L. D. Walker Date: 12/10/07
Signature:	Signature:

CONSTRUCTION DATA

Description	Diagram
Granular Bentonite Crumbles: 10.01 - 279.0 ft	
Static Water Level: 281.119 ft bgs (11-12-2007)	
10-20 Mesh Colorado Silica Sand: 279.00 - 284.45 ft	
3/8-in Bentonite Pellets: 284.45 - 294.25 ft	
4-in I.D. Type Stainless Steel Type 304/304L, Schedule 10 Permanent Casing: +1.72 - 300.46 ft	
Primary Filter pack 10-20 Mesh Colorado Silica Sand: 294.25 - 340.00 ft	
4-in I.D. Stainless Steel, Type 304, Slot 20 (.020-in) Screen: 300.46 - 335.46 ft bgs	
4-in I.D stainless steel 304/304L Sump with endcap 335.46' → 338.46'	



All depths are in feet below ground surface.

Borehole drilled with 11 3/4-in threaded casing 0.0-130.0 ft and 8-in threaded casing 130.-340.0 ft

All temporary drill casing was removed from the ground.

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description/Groundwater Sample Depths (ft bgs)
270		270-275 Gravelly Sand gS
		275-280 Silty Gravel mG
280		280-285 Sandy Gravel sG
		285-300 Gravel G
290		
300		300-302 Sandy Gravel sG
		302-305 Sand S
		305-325 Sandy Gravel sG
310		
320		
		325-332 Gravel G
330		332-335 Silty Gravel mG
		335-336 Gravelly Silt gM
		336-~~344~~ 340 Basalt LW 12-10-07
340		
		TD = 340 Ft.
350		

Figure D-10. Well 299-E27-155 Construction and Completion Summary (4 of 4)

D2 References

NAD83, 1991, *North American Datum of 1983*, as revised, National Geodetic Survey, Federal Geodetic Control Committee, Silver Spring, Maryland. Available at: http://www.ngs.noaa.gov/.

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

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Appendix E

Well Construction for Waste Management Area S-SX

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Contents

Figures

Tables

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E1 Introduction

This appendix provides the following information for the Waste Management Area (WMA) S-SX groundwater monitoring wells:

- Well name
- Hydrogeologic unit monitored (the aquifer portion at the well screen perforation) (Table E-1)
- The following sampling interval information, as provided in Table E-2:
  - Elevation at the top of the screen or perforated interval
  - Elevation at the bottom of the screen or perforated interval
  - Open interval length (i.e., difference between the top and bottom screen perforation elevations)
  - Drilling method

Figures E-1 through E-11 provide construction and completion summaries for the network wells.

Table E-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 E-2. Sampling Interval Information for Wells Within the WMA S-SX 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])	Drilling Method
299-W22-80	TU	137.5 (451.1)	126.8 (416.0)	10.7 (35.0)	Air rotary
299-W22-81	TU	136.8 (448.8)	126.1 (413.8)	10.7 (35.0)	Cable tool
299-W22-84	TU	137.1 (449.7)	126.4 (414.7)	10.7 (35.0)	Cable tool
299-W22-85	TU	137.5 (451.1)	126.9 (416.2)	10.6 (34.9)	Cable tool
299-W22-93	TU	132.3 (434.1)	121.6 (399.1)	10.7 (35.0)	Becker hammer
299-W22-94	TU	133.2 (436.9)	122.5 (401.9)	10.7 (35.0)	Cable tool/air rotary
299-W22-113	TU	132.7 (435.5)	123.6 (405.4)	9.2 (30.1)	Auger/cable tool
299-W22-115	TU	133.3 (437.2)	122.6 (402.2)	10.7 (35.0)	Auger
299-W22-116	TU	132.5 (434.9)	121.9 (399.8)	10.7 (35.0)	Auger
299-W23-20	TU	137.4 (450.8)	126.7 (415.8)	10.7 (35.0)	Air rotary

Table E-2. Sampling Interval Information for Wells Within the WMA S-SX 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])	Drilling Method
299-W23-21	TU	137.8 (452.1)	126.5 (415.0)	11.3 (37.1)	Cable tool

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

Note: Due to rounding and conversion of metric units, the computed open interval length based on the top and bottom elevations may differ slightly from the actual open interval length reported in the associated well summary sheet.

TU = Top of Unconfined, as described in Table E-1

WELL CONSTRUCTION AND COMPLETION SUMMARY

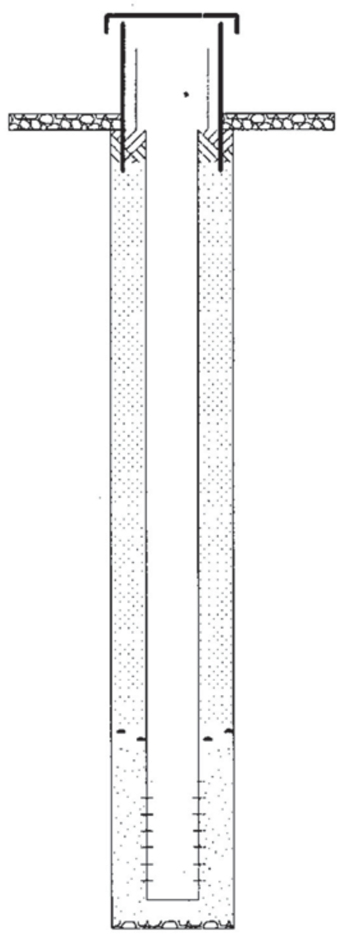
Drilling Method:	Air Rotary Csg. Hammer	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-W22-80 C3115
Drilling Fluid Used:	Air	Additives Used:	None	TEMPORARY WELL NO:	Not Allowed
Driller's Name:	M. Wraspir	WA State Lic Nr:	1909	Coordinates: N	Not documented
Drilling Company:	RSI	Company Location:	Woodland, Ca.	Coordinates: E	Not documented
Date Started:	01Sep00	Date Completed:	11Sep00	Start Card #:	R043398
				Elevation Ground Surface:	

Depth to Water: 205.29 ft. ft 11Sep00
(Ground surface)

GENERALIZED STRATIGRAPHY Geologist's Log

Elevation of Reference Point: m
Height of Reference Point Above Ground Surface:
Depth of Surface Seal: 10.2 ft.
Type of Surface Seal: 4x4 Concrete Pad

0 - 12 ft : Slightly Silty SAND
12 - 55 ft : Silty SAND
55 - 72 ft : SAND
72 - 133 ft : Silty SAND
133 - 138 ft : Silty Sandy GRAVEL
138 - 158 ft : SAND
158 - 177 ft : Sandy GRAVEL
177 - 185 ft : Gravelly SAND
185 - 212 ft : Sandy GRAVEL
212 - 237 ft : Silty Sandy GRAVEL
237 - 251 ft : Sandy GRAVEL



Fill	Casing	Screen
0 - 10.2 ft : 9-inch hole Cement Surface Seal	0 - 205.03 ft : 4 inch 4" 304 SS Sch 5 csg	205.03 - 240.05 ft : 4 inch 4" SS Wire Wrap .020 Slot Scrn.
10.2 - 187.1 ft : 9-inch hole Granular Bentonite	240.05 - 242.05 ft : 4 inch 4" 304 SS Sump	
187.1 - 194.8 ft : 9-inch hole 3/8" Bentonite Pellets		
194.8 - 248.4 ft : 9-inch hole 10/20 Silica Sand		
248.4 - 251 ft : 9-inch hole Slough		

251 ft : Borehole drilled depth

0 - 251 ft : 9-in. 8-5/8" CS Temp. Csg. set w/Air Rotary Casing Hammmer

Drawing By: JEA
Reference: Hanford Wells
Revision: 0
Revision Date: 25Sep00
Print Date: 25Sep00

Report Form: WELLS Project File: WELLS.GPJ

0526558

Figure E-1. Well 299-W22-80 Construction and Completion Summary (1 of 2)

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W22-80

WELL DESIGNATION	:	299-W22-80
CERCLA UNIT	:	
RCRA FACILITY	:	
DEPTH DRILLED (GS)	:	251.0 ft
MEASURED DEPTH (GS)	:	242.05 11Sep00
AVAILABLE LOGS	:	Geologist
DATE EVALUATED	:	Data not available
EVAL RECOMMENDATION	:	Data not available
LISTED USE	:	RCRA monitoring/sampling
CURRENT USER	:	RCRA & Operations
PUMP TYPE	:	Hydrostar
MAINTENANCE	:	Data not available
COMMENTS	:	Air Rortary Casing Hammer 8-5/8" CS csg to 251'
TV SCAN COMMENTS	:	

Report Form: WELLS Project File: WELLS.GPJ

Drawing By: JEA
Reference: Hanford Wells
Revision: 0
Revision Date: 25Sep00
Print Date: 25Sep00

BECHTEL

Figure E-1. Well 299-W22-80 Construction and Completion Summary (2 of 2)

0532885

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	**Cable Tool**	Sample Method:	**Grab/Split Spoon**	WELL NUMBER:	**299-W22-81 C3123** TEMPORARY WELL NO: **Not Allowed**
Drilling Fluid Used:	**none**	Additives Used:	**water**	Coordinates: N	**Not documented**
Driller's Name:	**Gary Howell**	WA State Lic Nr:	**Not Available**	Coordinates: E	**Not documented**
Drilling Company:	**RSI**	Company Location:	**Woodland, Ca.**	Start Card #:	**Not Available**
Date Started:	**09Jan01**	Date Completed:	**31Jan01**	Elevation Ground Surface:	

Depth to Water: **225.9 ft. ft 26Mar01**
(Ground surface)

GENERALIZED STRATIGRAPHY **Geologist's Log**

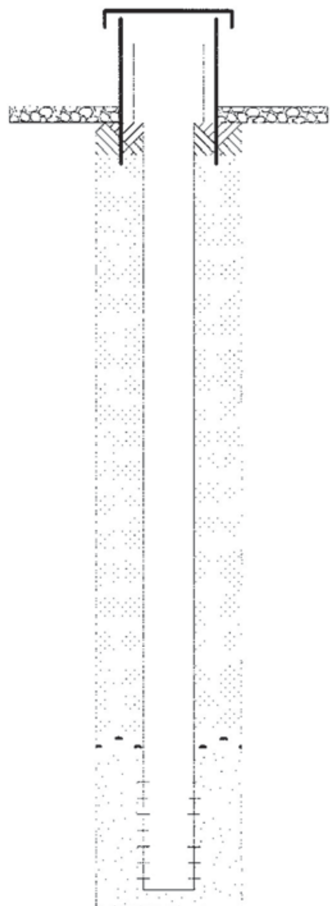
Elevation of Reference Point: **m**

Height of Reference Point Above Ground Surface:

Depth of Surface Seal: **11 ft.**

Type of Surface Seal: **4x4 Concrete Pad**

0 - 9.5 ft : Silty Sandy GRAVEL
9.5 - 19 ft : Slightly Silty SAND
19 - 34 ft : SAND
34 - 40 ft : Slightly Silty SAND
40 - 45 ft : Slightly Silt Gravelly SAND
45 - 48 ft : Silty Sandy GRAVEL
48 - 70 ft : Slightly Silty SAND
70 - 140 ft : SAND
140 - 163 ft : Silty SAND
163 - 174 ft : Silty Sandy GRAVELravel
174 - 178 ft : Silty SAND
178 - 259 ft : Silty Sandy GRAVEL
259 - 270 ft : Sandy GRAVEL



Fill	*Casing*	*Screen*
0 - 11 ft : 11-inch hole Cement Surface Seal	0 - 226.75 ft : 4 inch 4" 304L SS sch 5 csg.	
11 - 209.9 ft : 11-inch hole Granular Bentonite		
209.9 - 216.7 ft : 11-inch hole 3/8" Bentonite Pellets		226.75 - 261.72 ft : 4 inch 4" 304 SS .020 Slot Scrn.
216.7 - 263.72 ft : 11-inch hole 10/20 Silica Sand		
263.72 - 270 ft : 11-inch hole 10/20 Silica Sand	261.72 - 263.72 ft : 4 inch 4" 304L SS sump	

270 ft : Borehole drilled depth

0 - 270 ft : 11-in. 10-3/4" CS Temporary csg.

Drawing By: **JEA**
Reference: **Hanford Wells**
Revision: **0**
Revision Date: **16Apr01**
Print Date: **16Apr01**

BECHTEL

Report Form: WELLS Project File: WELLS.GPJ

Figure E-2. Well 299-W22-81 Construction and Completion Summary

0540440

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Cable Tool	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-W22-84 C3398	TEMPORARY WELL NO:	Not Allowed
Drilling Fluid Used:	None	Additives Used:	none	Coordinates: N	Not documented		
Driller's Name:	Gary Howell	WA State Lic Nr:	1930	Coordinates: E	Not documented		
Drilling Company:	RSI	Company Location:	Woodland, Ca.	Start Card #:	R037815		
Date Started:	01Oct01	Date Completed:	01Nov01	Elevation Ground Surface:			

Depth to Water: 232.36 ft 02Nov01
(Ground surface)

Elevation of Reference Point: m

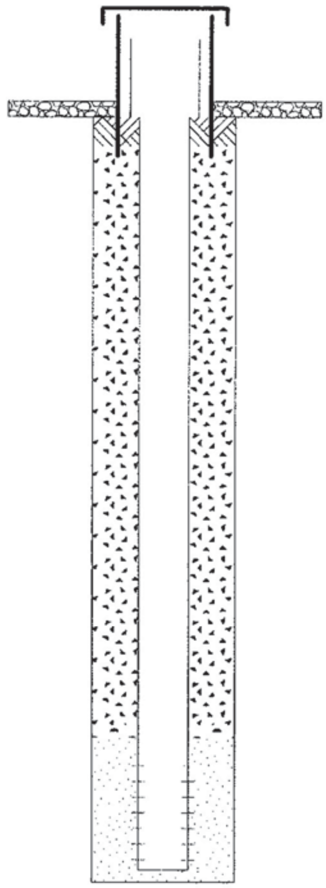
Height of Reference Point Above Ground Surface:

Depth of Surface Seal: 10.3 ft

Type of Surface Seal: 4x4 Concrete Pad

GENERALIZED STRATIGRAPHY — Geologist's Log

0 - 10 ft : Fill Material
10 - 25.3 ft : Gravelly Sand
25.3 - 39 ft : Sand
39 - 54.8 ft : Gravelly Sand
54.8 - 60 ft : Sand
60 - 70 ft : Slightly Silty Gravelly Sand
70 - 130 ft : Silty Sand w/clay lens 94 to 94.5 ft
130 - 148 ft : Sand
148 - 156 ft : Silt w/trace of sand
156 - 157 ft : Gravelly Sandy Silt
157 - 158 ft : Silty Sand
158 - 161 ft : Sand
161 - 180 ft : Silty Sand
180 - 250 ft : Silty Sandy Gravel
250 - 255 ft : Sandy Silt
255 - 265 ft : Silty Gravelly Sand
265 - 273.5 ft : Sandy Gravel



Fill	Casing	Screen
0 - 10.3 ft : 11-inch hole Cement Surface Seal	0 - 232 ft : 4 inch 304/304L SS sch 5 csg	232 - 267 ft : 4 inch 304/304L SS Wire Wrap .020 slot scrn
10.3 - 217.4 ft : 11-inch hole Bentonite Crumbles	267 - 269.1 ft : 4 inch 304/304L SS Sump	
217.4 - 222 ft : 11-inch hole 1/4" Bentonite Pellets		
222 - 269.1 ft : 11-inch hole 10/20 Silica Sand		
269.1 - 273.5 ft : 11-inch hole 10/20 Silica Sand		

273.5 ft : Borehole drilled depth

0 - 273.5 ft : 11-in. Cable Tool 10-3/4" CS Temp csg to 273.5 ft

Report Form: WELLS Project File: WELLS.GPJ

Drawing By:	JEA
Reference:	Hanford Wells
Revision:	0
Revision Date:	13Nov01
Print Date:	13Nov01

BECHTEL

Figure E-3. Well 299-W22-84 Construction and Completion Summary (1 of 2)

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W22-84

WELL DESIGNATION	:	299-W22-84
CERCLA UNIT	:	
RCRA FACILITY	:	
DEPTH DRILLED (GS)	:	273.5 ft
MEASURED DEPTH (GS)	:	269.1 02Nov01
AVAILABLE LOGS	:	Geologist & Geophysical
DATE EVALUATED	:	Data not available
EVAL RECOMMENDATION	:	Data not available
LISTED USE	:	RCRA Monitoring
CURRENT USER	:	RCRA & Operations
PUMP TYPE	:	Not Documented
MAINTENANCE	:	Data not available
COMMENTS	:	Cable Tool 10-3/4" CS csg to 273.5 ft
TV SCAN COMMENTS	:	

Report Form: WELLS Project File: WELLS.GPJ

Drawing By:	JEA
Reference:	Hanford Wells
Revision:	0
Revision Date:	13Nov01
Print Date:	13Nov01

BECHTEL

Figure E-3. Well 299-W22-84 Construction and Completion Summary (2 of 2)

0540438

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Cable Tool	Sample Method:	Grab/Split Spoon	WELL NUMBER:	2399-W22-85
Drilling Fluid Used:	None	Additives Used:	None Documented	TEMPORARY C3399WELL NO:	Not Allowed
Driller's Name:	K. Olson	WA State Lic Nr:	1217	Coordinates: N	Not documented
Drilling Company:	RSI	Company Location:	Woodland, Ca.	Coordinates: E	Not documented
Date Started:	21Sep01	Date Completed:	26Oct01	Start Card #:	R037815
				Elevation Ground Surface:	

Depth to Water: **218.42 ft ft 26Oct01**
(Ground surface)

Elevation of Reference Point: m

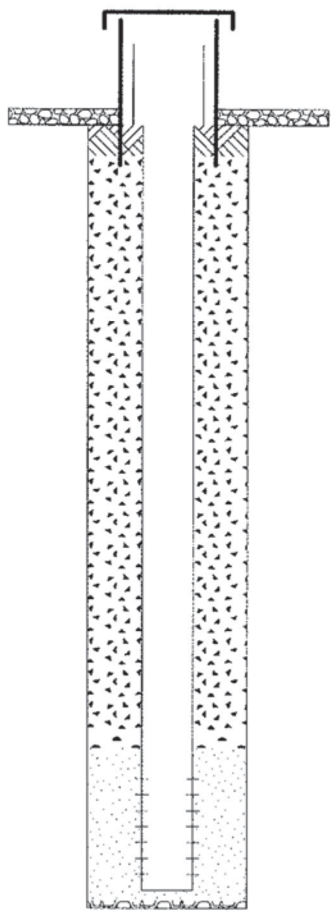
Height of Reference Point Above Ground Surface:

Depth of Surface Seal: **10.1 ft**

Type of Surface Seal: **4x4 Concrete Pad**

GENERALIZED STRATIGRAPHY **Geologist's Log**

0 - 5 ft : Backfill material
5 - 17 ft : Sand (silt lens @16 ft)
17 - 25 ft : Sandy Silt
25 - 32 ft : Sand
32 - 45 ft : Silty Sand w/silt lens @ 35 ft
45 - 47 ft : Sandy Gravel
47 - 54 ft : Silty Sandy Grvel
54 - 57 ft : Sand
57 - 65 ft : Silty Sand w/silt lens @ 60 ft
65 - 70 ft : Sand w/silt lens @ 66 ft.
70 - 100 ft : Silty Sand w/silt lenses @ 85 and 86 ft.
100 - 104 ft : Sand
104 - 130 ft : Silty Sand
130 - 140 ft : Silt
140 - 143 ft : Sandy Silt
143 - 149 ft : Silt
149 - 151 ft : Sandy Silt
151 - 153 ft : Silt
153 - 155 ft : Caliche
155 - 162 ft : Silty Sandy Gravel
162 - 168 ft : Silty Gravelly Sand
168 - 174 ft : Sand
174 - 180 ft : Sandy Gravel
180 - 235 ft : Silty Sandy Gravel
235 - 255 ft : Gravelly Silty Sand
255 - 260.1 ft : Silty Sandy Gravel



260.1 ft : Borehole drilled depth

0 - 260.1 ft : 12-in. Cable Tool 11-3/4" CS Temp csg

Fill	*Casing*	*Screen*
0 - 10.1 ft : 12-inch hole Cement Surface Seal	0 - 217.12 ft : 4 inch 304L SS sch 5 csg	217.12 - 252.03 ft : 4 inch 304L SS Wire Wrap .020 slot scrn
10.1 - 202.1 ft : 12-inch hole Bentonite crumbles	252.03 - 254.13 ft : 4 inch 304L SS Sump	
202.1 - 206.8 ft : 12-inch hole 1/4" Bentonite Pellets		
206.8 - 254.13 ft : 12-inch hole 10/20 Silica Sand		
254.13 - 257.5 ft : 12-inch hole 10/20 Silica Sand		
257.5 - 260.1 ft : 12-inch hole Slough		

Drawing By: **JEA**
Reference: **Hanford Wells**
Revision: **0**
Revision Date: **08Nov01**
Print Date: **08Nov01**

BECHTEL

Report Form: WELLS Project File: WELLS.GPJ

Figure E-4. Well 299-W22-85 Construction and Completion Summary (1 of 2)

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 2399-W22-85

WELL DESIGNATION	:	2399-W22-85
CERCLA UNIT	:	
RCRA FACILITY	:	
DEPTH DRILLED (GS)	:	260.1 ft
MEASURED DEPTH (GS)	:	254.13 26Oct01
AVAILABLE LOGS	:	Geologist & Geophysical
DATE EVALUATED	:	Data not available
EVAL RECOMMENDATION	:	Data not available
LISTED USE	:	RCRA Monitoring
CURRENT USER	:	RCRA & Operations
PUMP TYPE	:	Not Documented
MAINTENANCE	:	Data not available
COMMENTS	:	Cable Tool 11-3/4" CS Temp csg to 260.1 ft.
TV SCAN COMMENTS	:	

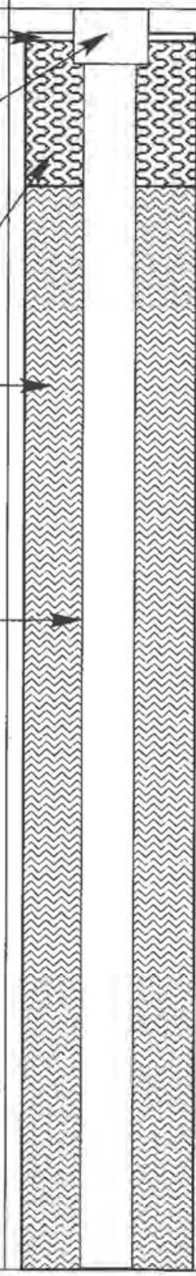
Report Form: WELLS Project File: WELLS.GPJ

Drawing By:	JEA
Reference:	Hanford Wells
Revision:	0
Revision Date:	08Nov01
Print Date:	08Nov01

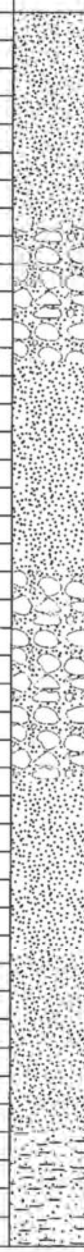
Figure E-4. Well 299-W22-85 Construction and Completion Summary (2 of 2)

WELL SUMMARY SHEET		Start Date: 5/06/2015 Finish Date: ~~5/13/2015~~ 5/18/15 MAG 7/16/15	Page 1 of 4
Well ID: C8202		Well Name: 299-W22-93	
Location: 10 m E of 241 S		Project: 8 M24 TPA GW Monitoring Wells FY2015	
Prepared By: Jessa Szecsody	Date: 5/27/15	Reviewed By: MEHRER	Date: 7-22-
Signature:		Signature:	

CONSTRUCTION DATA

Description	Diagram
Concrete Pad: 0.5 ft above ground surface (ags) 6-in Protective Casing: 2.94 ft ags - 2.06 ft below ground surface (bgs) Type I/II Portland Cement Grout: 0 - 10.0 ft bgs 3/8 in Cetco Medium Bentonite Chips: 10.0 - 240.8 ft bgs 4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.05 ft ags - 244.7 ft bgs Depths are in ft below ground surface. Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 288.1 ft bgs All temporary drill casing was removed from the ground.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
0		0 - 15 Sand (S)
10		
		15 - 25 Sandy Gravel (sG)
20		
		25 - 40 Sand (S)
30		
40		40 - 55 Sandy Gravel (sG)
50		
		55 - 80 Sand (S)
60		
70		
80		80 - 100 Silty Sand (mS)

A-6003-643 (REV 1)

Figure E-5. Well 299-W22-93 Construction and Completion Summary (1 of 4)

WELL SUMMARY SHEET

Start Date: 5/06/2015	Page 2 of 4
Finish Date: ~~5/13/2015~~ 5/18/15 ASG 7/16/15	
Well ID: C8202	Well Name: 299-W22-93
Location: 10 m E of 241 S	Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Jessa Szecsody Date: 5/27/15	Reviewed By: D. VEHRER Date: 7-22-1
Signature:	Signature:

CONSTRUCTION DATA | **GEOLOGIC/HYDROLOGIC DATA**

Description | Diagram | Depth in Feet | Graphic Log | Lithologic Description (ft bgs)

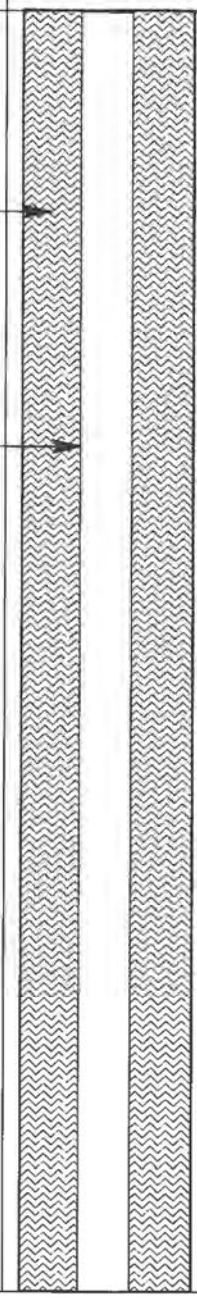
3/8 in Cetco Medium Bentonite Chips: 10.0 - 240.8 ft bgs

4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.05 ft ags - 244.7 ft bgs

Depths are in ft below ground surface.

Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 288.1 ft bgs

All temporary drill casing was removed from the ground.



Depth in Feet: 90, 100, 110, 120, 130, 140, 150, 160, 170

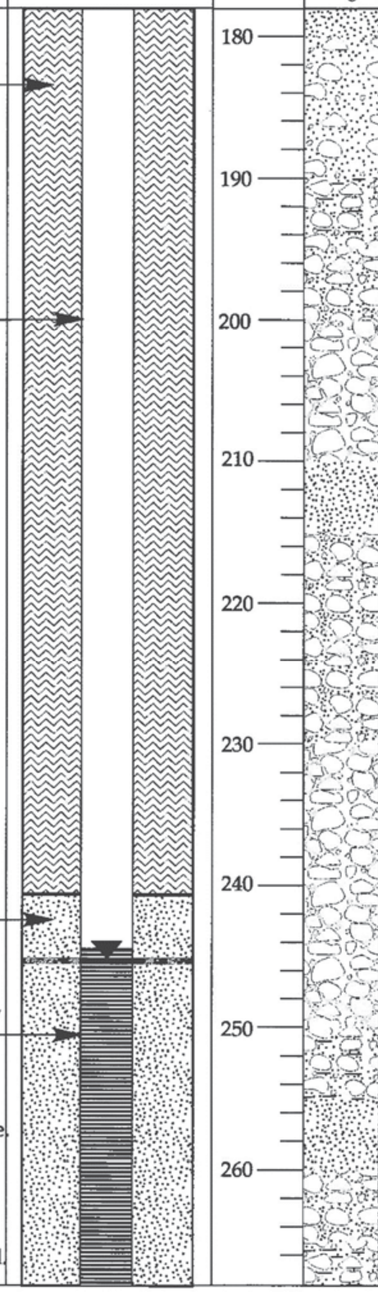
Depth (ft bgs)	Lithologic Description
80 - 100	Silty Sand (mS)
100 - 135	Sand (S)
135 - 155	Silt (M)
155 - 180	Sand (S)

A-6003-643 (REV 1)

Figure E-5. Well 299-W22-93 Construction and Completion Summary (2 of 4)

WELL SUMMARY SHEET	Start Date: 5/06/2015 Finish Date: ~~5/13/2015~~ 5/18/15 AGG 7/10/15	Page 3 of 4
Well ID: C8202	Well Name: 299-W22-93	
Location: 10 m E of 241 S	Project: 8 M24 TPA GW Monitoring Wells FY2015	
Prepared By: Jessa Szecsody Date: 5/27/15	Reviewed By: J.D. MEHRER	Date: 7-22-
Signature:	Signature:	

CONSTRUCTION DATA — Description / Diagram — Depth in Feet — **GEOLOGIC/HYDROLOGIC DATA** — Graphic Log / Lithologic Description (ft bgs)



Construction Data – Description

3/8 in Cetco Medium Bentonite Chips: 10.0 - 240.8 ft bgs

4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.05 ft ags - 244.7 ft bgs

10-20 mesh Premier Colorado Silica Filter Pack Sand: 240.8 - 288.1 ft bgs

4-in I.D. Schedule 10, Type 304/304L, 20-slot (0.020 in.) Stainless Steel Screen: 244.7 - 279.7 ft bgs

Depths are in ft below ground surface.

Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 288.1 ft bgs

All temporary drill casing was removed from the ground.

Lithologic Description (ft bgs)

155 - 180 Sand (S)
180 - 190 Gravelly Sand (gS)
190 - 195 Silty Sandy Gravel (msG)
195 - 200 Sandy Gravel (sG)
200 - 210 Gravel (G)
210 - 215 Sand (S)
215 - 230 Sandy Gravel (sG)
230 - 250 Gravel (G)
Static Water Level: 244.6 ft bgs (05/11/15)
250 - 255 Silty Sandy Gravel (msG)
255 - 260 Sand (S)
260 - 265 Sandy Gravel (sG)
265 - 288.1 Silty Sandy Gravel (msG)

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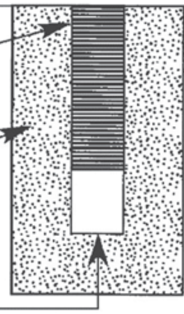
Figure E-5. Well 299-W22-93 Construction and Completion Summary (3 of 4)

WELL SUMMARY SHEET		Start Date: 5/06/2015 Finish Date: ~~5/13/2015~~	Page 4 of 4
Well ID: C8202		Well Name: 299-W22-93 5/18/15 ASG 7/16/15	
Location: 10 m E of 241 S		Project: 8 M24 TPA GW Monitoring Wells FY2015	
Prepared By: Jessa Szecsody	Date: 5/27/15	Reviewed By: J.D. MEHRER	Date: 7-22-1
Signature:		Signature:	

CONSTRUCTION DATA

Description	Diagram
4-in I.D. Schedule 10, Type 304/304L, 20-slot (0.020 in.) Stainless Steel Screen: 244.7 - 279.7 ft bgs 10-20 mesh Premier Colorado Silica Filter Pack Sand: 240.8 - 288.1 ft bgs 4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Sump: 279.7 - 284.7 ft bgs	

Depths are in ft below ground surface.

Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 288.1 ft bgs

All temporary drill casing was removed from the ground.

GEOLOGIC/HYDROLOGIC DATA

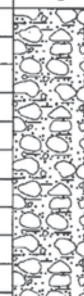
Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
270		265 - 288.1 Silty Sandy Gravel (msG)
280		
290		
		Total Depth: 288.1 ft bgs (5/6/2015)
		Straightness Test: 5/11/2015, Pass
300		
310		
320		
330		
340		
350		

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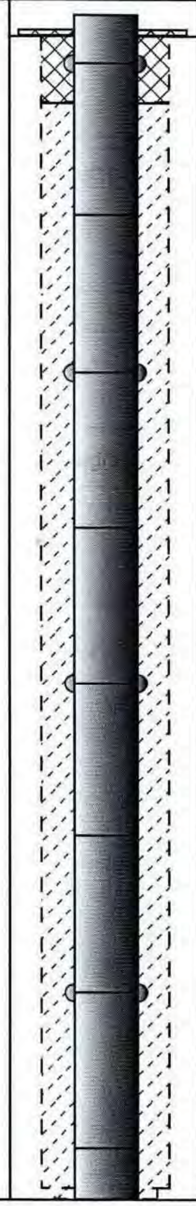
Figure E-5. Well 299-W22-93 Construction and Completion Summary (4 of 4)

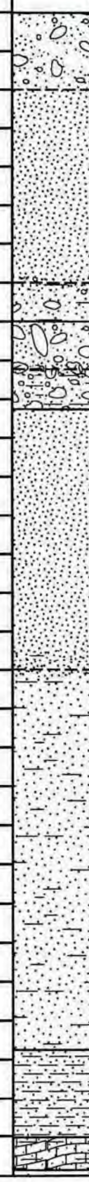
WELL SUMMARY SHEET	Start Date: 7/24/2013	Page 1 of 3
	Finish Date: 9/30/2013	

Well ID: C8203		Well Name: 299-W22-94	
Location: 200W Area, East of S-Tank Farm		Project: M-24 RCRA Compliance Wells	
Prepared by: Tessa Clark	Date: 11-1-13	Reviewed by: L. Craig Swanson	Date: 10/31/13
Signature:		Signature:	

CONSTRUCTION DATA

Description	Diagram
Surface Completion: 4'x4'x6" Concrete Pad w/brass survey marker and 6" protective monument (3 ft ags). Concrete Surface Seal: Type I/II Portland Cement 0.0' bgs - 8.7' bgs. Permanent Well: 4 1/2" OD Stainless Steel Blank 1.88' ags - 243.15' bgs 4 1/2" OD Stainless Steel 0.030 slot Screen 243.15' bgs - 278.18' bgs 4 1/2" Stainless Steel Sump w/end cap 278.18' bgs - 283.52' bgs 3/8" Granular Bentonite Chips: 8.7' bgs - 233.9' bgs 3/8" Coated Bentonite Pellets: 233.9' bgs - 238.2' bgs 10-20 Colorado Silica Sand Pack: 238.2' bgs - 284.4' bgs Natural Backfill: 284.4' bgs - 287.1' bgs 10-20 Colorado Silica Sand Pack: 287.1' bgs - 288.3' bgs 3/8" Granular Bentonite Chips: 288.3' bgs - 341.2' bgs Natural Backfill: 341.2' bgs - 342.8' bgs bgs = below ground surface ags = above ground surface	

GEOLOGIC/HYDROLOGIC DATA



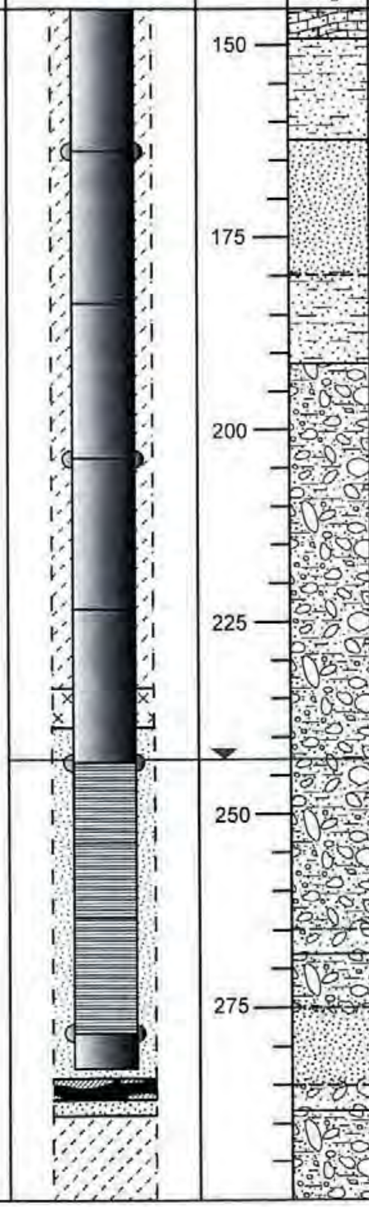
Depth in Feet	Lithologic Description
0	0 - 10: Gravelly Sand, gS
	10 - 35: Sand, S
25	
	35 - 40: Gravelly Silty Sand, gmS
	40 - 46: Sandy Gravel, sG
	46 - 51.5: Silty Sandy Gravel, msG
50	
	51.5 - 85: Sand, S
75	
	85 - 133.5: Slightly Silty Sand, (m)S
100	
125	
	133.5 - 145: Sandy Silt, sM
	145 - 149: Silty Sand, mS

Figure E-6. Well 299-W22-94 Construction and Completion Summary (1 of 3)

WELL SUMMARY SHEET		Start Date: 7/24/2013	Page 2 of 3
		Finish Date: 9/30/2013	
Well ID: C8203		Well Name: 299-W22-94	
Location: 200W Area, East of S-Tank Farm		Project: M-24 RCRA Compliance Wells	
Prepared by: Tessa Clark	Date: 11-1-13	Reviewed by: L. Craig Swanson	Date: 10/31/13
Signature: [signature]		Signature: [signature]	

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description

bgs = below ground surface
ags = above ground surface



- 145 - 149: Silty Sand, mS
- 149 - 162.5: Silty Sand, mS
- 162.5 - 180: Sand, S
- 180 - 191.5: Silty Sand, mS
- 191.5 - 265: Silty Sandy Gravel, msG
- DTW = 243.1bgs (8/22/2013)
- 265 - 268: Gravelly Sand, gS
- 268 - 275: Silty Sandy Gravel, msG
- 275 - 285: Sand, S
- 285 - 288: Sandy Gravel, sG
- 288 - 320: Silty Sandy Gravel, msG

Figure E-6. Well 299-W22-94 Construction and Completion Summary (2 of 3)

WELL SUMMARY SHEET	Start Date: 7/24/2013	Page 3 of 3
	Finish Date: 9/30/2013	

Well ID: C8203		Well Name: 299-W22-94	
Location: 200W Area, East of S-Tank Farm		Project: M-24 RCRA Compliance Wells	
Prepared by: Tessa Clark	Date: 11-1-13	Reviewed by: L. Craig Swanson	Date: 10/31/13
Signature:		Signature: Hydrogeologist	

CONSTRUCTION DATA

Description	Diagram
All temporary 8 5/8" OD casing completely removed from ground (9/27/2013). All temporary 10 3/4" OD casing completely removed from ground (9/27/2013). bgs = below ground surface ags = above ground surface	

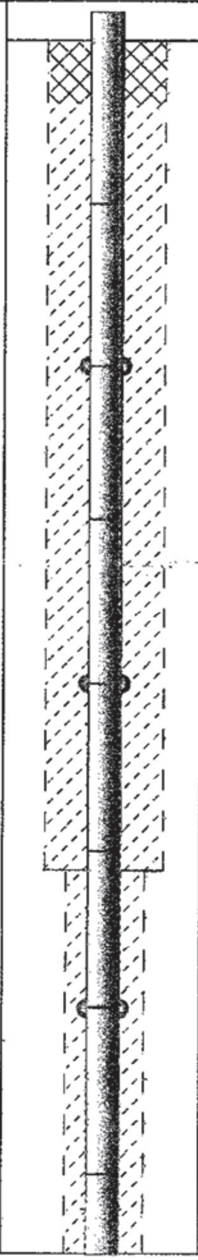
GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
300		288 - 320: Silty Sandy Gravel, msG
325		320 - 342.8: Silty Sandy Gravel, msG
		TD = 342.8' bgs (9/18/2013)
350		
375		
400		
425		

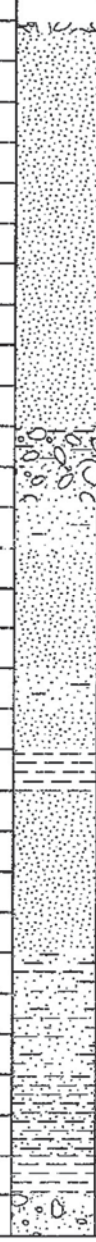
Figure E-6. Well 299-W22-94 Construction and Completion Summary (3 of 3)

WELL SUMMARY SHEET		Start Date: 7-23-2014 Finish Date: 10-8-2014	Page 1 of 2
Well ID: C8943		Well Name: 299-W22-113	
Location: SE corner of WMA SX		Project: TPA M-24 Monitoring Wells	
Prepared by: Abby Wicks	Date: 10-22-14	Reviewed by: D. MEHRER	Date: 1-21-15
Signature: Abby a. Wicks		Signature:	

CONSTRUCTION DATA

Description	Diagram
Temporary Casing Materials 12" Carbon Steel (11 3/4" OD, 11 5/16" ID) 0.0 ft -105 ft bgs 8" Carbon Steel (8 11/16" OD, 8 3/4" ID) 105 ft- 271ft bgs **Permanent Casing Materials** 4" Type 316 L sch 10s Riser 2.00 ft ags- 233.9 ft bgs 4" Type 316 L sch10s Continuous wire wrap screen 40-slot. 233.9 ft bgs- 264.0 ft bgs 4" Type 316 L sch 10s sump 264.0 ft-267.0 ft bgs **Construction Materials** Type I/II Portland Cement 0.0 ft bgs - 11.1ft bgs Medium Bentonite Chips 11.1 ft bgs- 104.2 ft bgs #8 Granular Bentonite 104.2 ft bgs- 227 ft bgs 3/8" Bentonite Pellets 227.1 ft bgs- 230.0 ft bgs Colorado Silica Sand 230.0 ft bgs -269.1 ft bgs Note: All temporary casing has been removed from the ground. All depths are reported in feet below ground surface (ft bgs) unless otherwise noted.	

GEOLOGIC/HYDROLOGIC DATA



Depth in Feet	Lithologic Description
0	0-1": Gravel Pad
	1"-50': Sand [S]
25	
50	50'-55': Silty Sandy Gravel [msG]
	55'-60': Sandy Gravel [sG]
	60'-65: Slt. Silty Sandy Gravel [(m)S]
	65'-80': Sand [S]
75	
	80'-85' Slt. Silty Sand [(m)S]
	85'-90' Sand [S]
	90'-95' Silt [M]
	95'-115' Sand [S]
100	
	115'-130' Silty Sand [mS]
125	
	130'-140' Sandy Silt [sM]
	140'-145' Silt [M]
	145'-155' Gravelly Sand [gS]

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Figure E-7. Well 299-W22-113 Construction and Completion Summary (1 of 2)

WELL SUMMARY SHEET		Start Date: 7-23-2014 Finish Date: 10-8-2014	Page 2 of 2
Well ID: C8943		Well Name: 299-W22-113	
Location: SE corner of WMA SX		Project: TPA M-24 Monitoring Wells	
Prepared by: Abby Wicks	Date: 10-22-14	Reviewed by: J.D. MEHRER	Date: 1-21-15
Signature: Abby a. Wicks		Signature:	

CONSTRUCTION DATA			GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description
		150		145'-155' Gravelly Sand [gS]
				155'-160' Sand [S]
				160'-165' Slt. Silty Grvly Sand [(m)gS]
				165'-170' Slt. Silty Sand [(m)S]
		175		170'-172' Sand [S]
				172'-177' Gravelly Sand [gS]
				177'-200 Sandy Gravel [sG]
		200		200'-205' Slt. Silty Sand [(m)S]
				205'-238' Sandy Gravel [sG]
		225		
				238'-240' Gravelly Sand [gS]
				240'-271' Sandy Gravel [sG]
		250		
		275		
				TD= 271.3 ft bgs
				DTW=232.5 ft bgs 10/8/2014

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Figure E-7. Well 299-W22-113 Construction and Completion Summary (2 of 2)

WELL SUMMARY SHEET		Start Date: 5/15/2015 Finish Date: 6/5/2015	Page 1 of 4
Well ID: C9430		Well Name: 299-W22-115	
Location: 50 m E of 241-SX		Project: 8 M24 TPA GW Monitoring Wells FY2015	
Prepared By: Jessa Szecsody	Date: 5/27/15	Reviewed By: D. MEHRER	Date: 7-22
Signature:		Signature:	

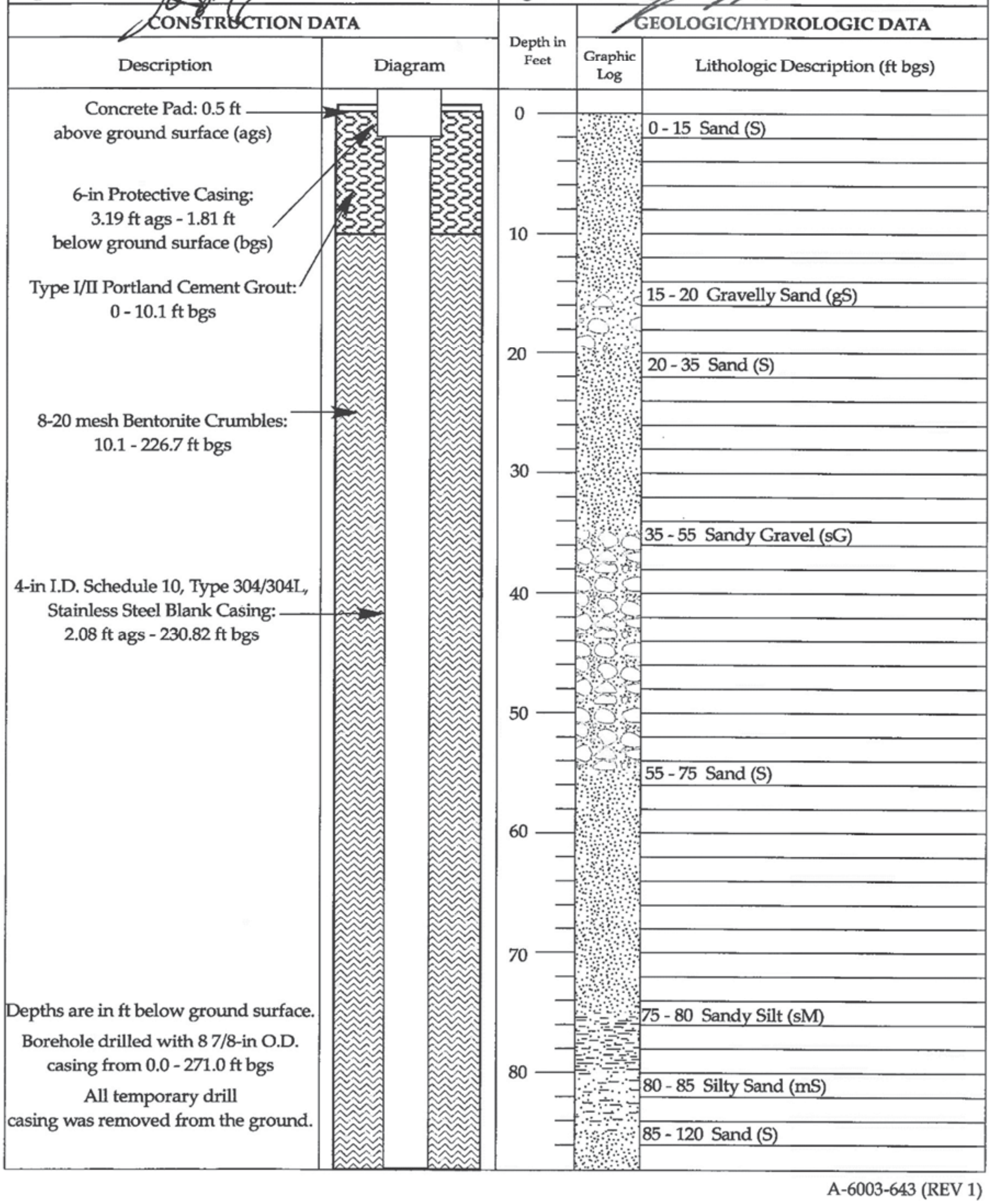


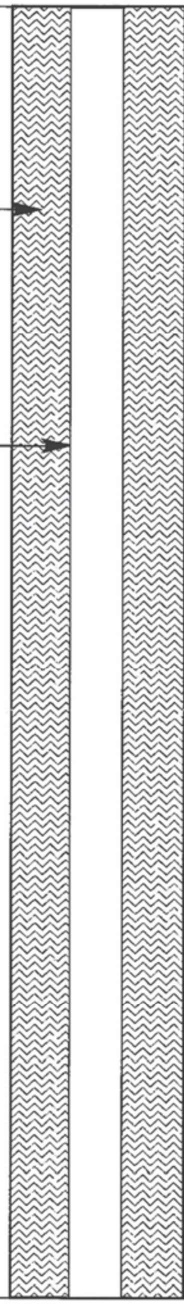
Figure E-8. Well 299-W22-115 Construction and Completion Summary (1 of 4)

WELL SUMMARY SHEET	Start Date: 5/15/2015 Finish Date: 6/5/2015	Page 2 of 4

Well ID: C9430	Well Name: 299-W22-115
Location: 50 m E of 241-SX	Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Jessa Szecsody Date: 5/27/15	Reviewed By: L.D. MEHRER Date: 7-22
Signature:	Signature:

CONSTRUCTION DATA

Description	Diagram
8-20 mesh Bentonite Crumbles: 10.1 - 226.7 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.08 ft ags - 230.82 ft bgs	



Depths are in ft below ground surface.

Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 271.0 ft bgs

All temporary drill casing was removed from the ground.

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
90		85 - 120 Sand (S)
100		
110		
120		120 - 125 Sandy Silt (sM)
		125 - 150 Silt (M)
130		
140		
150		150 - 155 Sandy Gravel (sG)
		155 - 170 Sand (S)
160		
170		170 - 175 Gravelly Sand (gS)
		175 - 185 Silty Sandy Gravel (msG)

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Figure E-8. Well 299-W22-115 Construction and Completion Summary (2 of 4)

WELL SUMMARY SHEET		Start Date: 5/15/2015 Finish Date: 6/5/2015	Page 3 of 4
Well ID: C9430		Well Name: 299-W22-115	
Location: 50 m E of 241-SX		Project: 8 M24 TPA GW Monitoring Wells FY2015	
Prepared By: Jessa Szecsody	Date: 5/27/15	Reviewed By: D. MEHRER	Date: 7-22
Signature:		Signature:	

CONSTRUCTION DATA | **GEOLOGIC/HYDROLOGIC DATA**

Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description (ft bgs)

8-20 mesh Bentonite Crumbles:
10.1 - 226.7 ft bgs

4-in I.D. Schedule 10, Type 304/304L,
Stainless Steel Blank Casing:
2.08 ft ags - 230.82 ft bgs

Depths are in ft below ground surface.

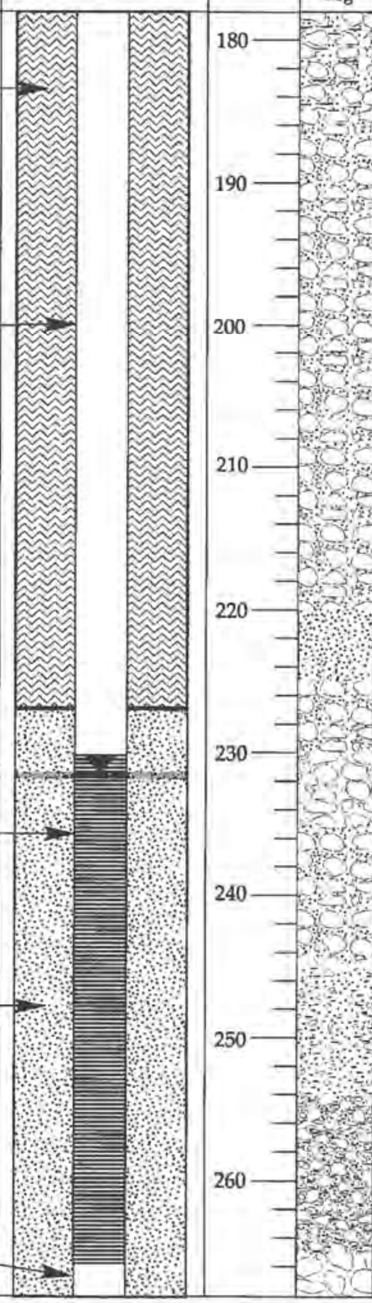
Borehole drilled with 8 7/8-in O.D.
casing from 0.0 - 271.0 ft bgs

All temporary drill
casing was removed from the ground.

4-in I.D. Schedule 10, Type 304/304L,
20-slot (0.020 in.) Stainless Steel
Screen: 230.82 - 265.85 ft bgs

10-20 mesh Premier Colorado
Silica Filter Pack Sand:
226.7 - 272.3 ft bgs

4-in I.D. Schedule 10, Type 304/304L,
Stainless Steel Sump:
265.85 - 270.86 ft bgs



175 - 185 Silty Sandy Gravel (msG)

185 - 220 Sandy Gravel (sG)

220 - 225 Sand (S)

225 - 230 Sandy Gravel (sG)

230 - 235 Gravel (G)

Static Water Level: 231.2 ft bgs (5/18/15)

235 - 245 Sandy Gravel (sG)

245 - 255 Slightly Silty Gravelly Sand ((m)gS)

255 - 265 Silty Sandy Gravel (msG)

265 - 272.3 Gravel (G)

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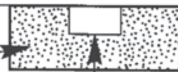
Figure E-8. Well 299-W22-115 Construction and Completion Summary (3 of 4)

WELL SUMMARY SHEET		Start Date: 5/15/2015 Finish Date: 6/5/2015	Page 4 of 4
Well ID: C9430		Well Name: 299-W22-115	
Location: 50 m E of 241-SX		Project: 8 M24 TPA GW Monitoring Wells FY2015	
Prepared By: Jessa Szecsody	Date: 5/27/15	Reviewed By: J.D. MEHRER	Date: 7-22-15
Signature:		Signature:	

CONSTRUCTION DATA

Description	Diagram
10-20 mesh Premier Colorado Silica Filter Pack Sand: 226.7 - 272.3 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Sump: 265.85 - 270.86 ft bgs	



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
270		265 - 272.3 Gravel (G)
		Static Water Level: 321.2 ft bgs (05/18/15)
		Total Depth: 272.3 ft bgs (05/18/15)
280		
290		
300		
310		
320		
330		
340		
350		

Depths are in ft below ground surface.

Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 271.0 ft bgs

All temporary drill casing was removed from the ground.

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Figure E-8. Well 299-W22-115 Construction and Completion Summary (4 of 4)

WELL SUMMARY SHEET		Start Date: ~~4/07/2015~~ 4/8/15 AJG 7/10/15 Finish Date: ~~5/12/2015~~ 5/11/15	Page 1 of 4
Well ID: C9431		Well Name: 299-W22-116	
Location: 25 m SE of 241 SX		Project: 8 M24 TPA GW Monitoring Wells FY2015	
Prepared By: Jessa Szecsody	Date: 5/26/15	Reviewed By: D. MEHRER	Date: 7-23-15
Signature:		Signature:	

CONSTRUCTION DATA | **GEOLOGIC/HYDROLOGIC DATA**

Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description (ft bgs)

Concrete Pad: 0.5 ft above ground surface (ags)

6-in Protective Casing: 2.92 ft ags - 2.08 ft below ground surface (bgs)

Type I/II Portland Cement Grout: 0 - 10.5 ft bgs

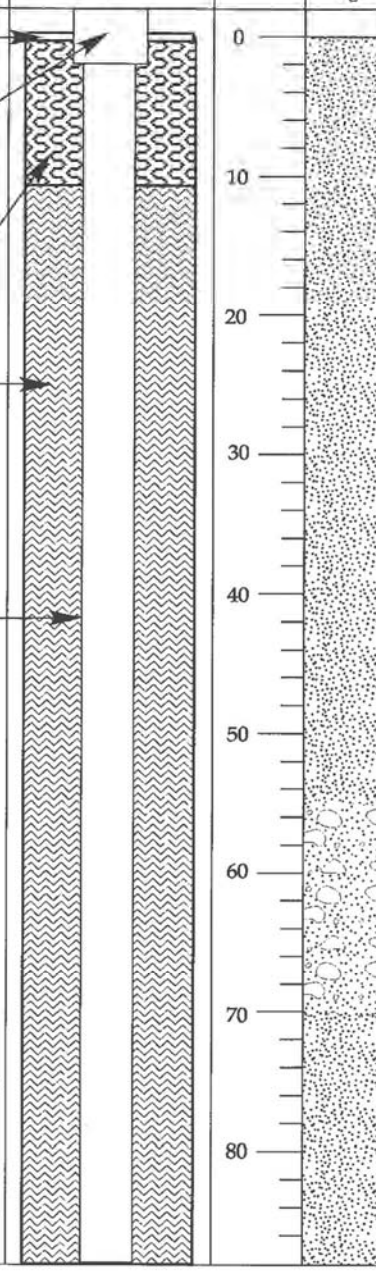
Cetco Bentonite Crumbles: 10.5 - 230.6 ft bgs

4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 1.99 ft ags - 234.99 ft bgs

Depths are in ft below ground surface.

Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 272.4 ft bgs

All temporary drill casing was removed from the ground.



0 - 55 Sand (S)

55 - 70 Gravelly Sand (gS)

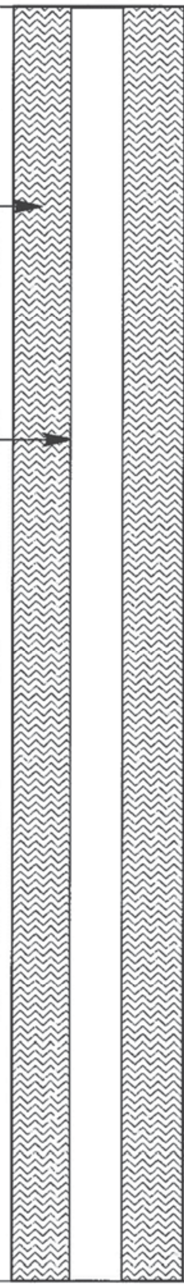
70 - 120 Sand (S)

A-6003-643 (REV 1)

Figure E-9. Well 299-W22-116 Construction and Completion Summary (1 of 4)

WELL SUMMARY SHEET		Start Date: ~~4/07/2015~~ 4/8/15 ~~5/11/15~~ 7/16/15 Finish Date: ~~5/12/2015~~	Page 2 of 4
Well ID: C9431		Well Name: 299-W22-116	
Location: 25 m SE of 241 SX		Project: 8 M24 TPA GW Monitoring Wells FY2015	
Prepared By: Jessa Szecsody	Date: 5/26/15	Reviewed By: D. MEHRER	Date: 7-23-15
Signature:		Signature:	

CONSTRUCTION DATA

Description	Diagram
Cetco Bentonite Crumbles: 10.5 - 230.6 ft bgs 4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 1.99 ft ags - 234.99 ft bgs Depths are in ft below ground surface. Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 272.4 ft bgs All temporary drill casing was removed from the ground.	

GEOLOGIC/HYDROLOGIC DATA

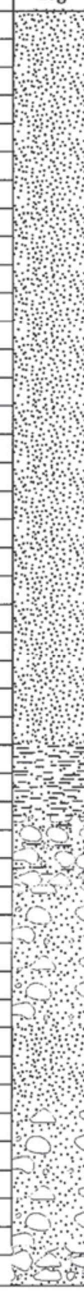
Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
90		70 - 140 Sand (S)
100		
110		
120		
130		
140		140 - 145 Sandy Silt (sM)
		145 - 150 Silty Sandy Gravel (msG)
150		150 - 160 Gravelly Sand (gS)
160		160 - 165 Sand (S)
		165 - 175 Gravelly Sand (gS)
170		
		175 - 185 Sandy Gravel (sG)

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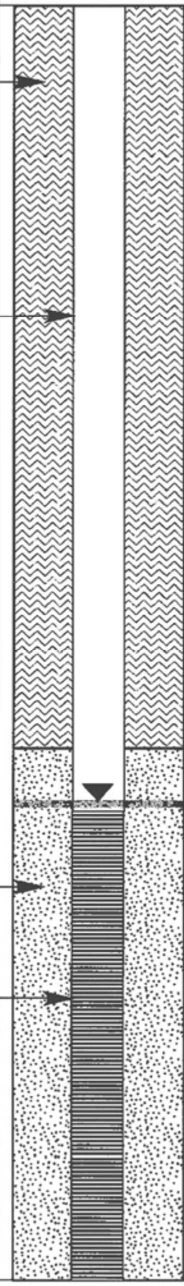
Figure E-9. Well 299-W22-116 Construction and Completion Summary (2 of 4)

WELL SUMMARY SHEET	Start Date: ~~4/07/2015~~ 4/8/15	Page 3 of 4
	Finish Date: ~~5/12/2015~~ 5/11/15	

Well ID: C9431	Well Name: 299-W22-116
Location: 25 m SE of 241 SX	Project: 8 M24 TPA GW Monitoring Wells FY2015
Prepared By: Jessa Szecsody — Date: 5/26/15	Reviewed By: J.D. MEHRER — Date: 7-23-15
Signature:	Signature:

CONSTRUCTION DATA

Description	Diagram
Cetco Bentonite Crumbles: 10.5 - 230.6 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 1.99 ft ags - 234.99 ft bgs	
10-20 mesh Premier Colorado Silica Filter Pack Sand: 230.6 - 275.3 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, 20-slot (0.020 in.) Stainless Steel Screen: 234.99 - 270.01 ft bgs	

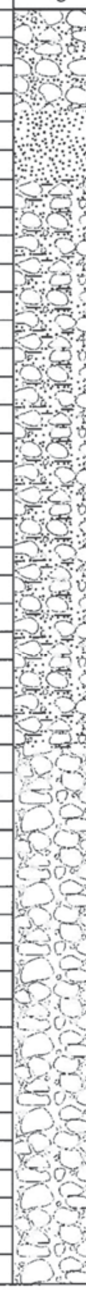


Depths are in ft below ground surface.

Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 272.4 ft bgs

All temporary drill casing was removed from the ground.

GEOLOGIC/HYDROLOGIC DATA



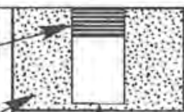
Depth in Feet	Lithologic Description (ft bgs)
180	175 - 185 Sandy Gravel (sG)
	185 - 190 Sand (S)
190	190 - 230 Sandy Gravel (sG)
200	
210	
220	
230	230 - 275.3 Gravel (G)
	Static Water Level: 234.6 ft bgs (04/20/15)
240	
250	
260	

A-6003-643 (REV 1)

Figure E-9. Well 299-W22-116 Construction and Completion Summary (3 of 4)

WELL SUMMARY SHEET		Start Date: ~~4/07/2015~~ 4/8/15 A36 7/16/15 Finish Date: ~~5/12/2015~~ 5/11/15	Page 4 of 4
Well ID: C9431		Well Name: 299-W22-116	
Location: 25 m SE of 241 SX		Project: 8 M24 TPA GW Monitoring Wells FY2015	
Prepared By: Jessa Szecsody	Date: 5/26/15	Reviewed By: D. MEHRER	Date: 7-28-15
Signature:		Signature:	

CONSTRUCTION DATA

Description	Diagram
4-in I.D. Schedule 10, Type 304/304L, 20-slot (0.020 in.) Stainless Steel Screen: 234.99 - 270.01 ft bgs 10-20 mesh Premier Colorado Silica Filter Pack Sand: 230.6 - 275.3 ft bgs 4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Sump: 270.01 - 275.01 ft bgs	
Depths are in ft below ground surface. Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 272.4 ft bgs All temporary drill casing was removed from the ground.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
270		230 - 275.3 Gravel (G)
280		
290		Straightness Test: 04/20/2015, Pass Total Depth: 275.3 ft bgs (4/9/2015)
300		
310		
320		
330		
340		
350		

A-6003-643 (REV 1)

Figure E-9. Well 299-W22-116 Construction and Completion Summary (4 of 4)

0526561

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Air Rotary Csg. Hamme	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-W23-20 C3112 TEMPORARY WELL NO: Not Allowed
Drilling Fluid Used:	Air	Additives Used:	None	Coordinates: N	Not documented
Driller's Name:	M. Wraspir	WA State Lic Nr:	1909	Coordinates: E	Not documented
Drilling Company:	RSI	Company Location:	Woodland, Ca.	Start Card #:	R043398
Date Started:	27Jul00	Date Completed:	21Aug00	Elevation Ground Surface:	

Depth to Water: 214.29 ft ft 15Aug00
(Ground surface)

GENERALIZED STRATIGRAPHY Geologist's Log

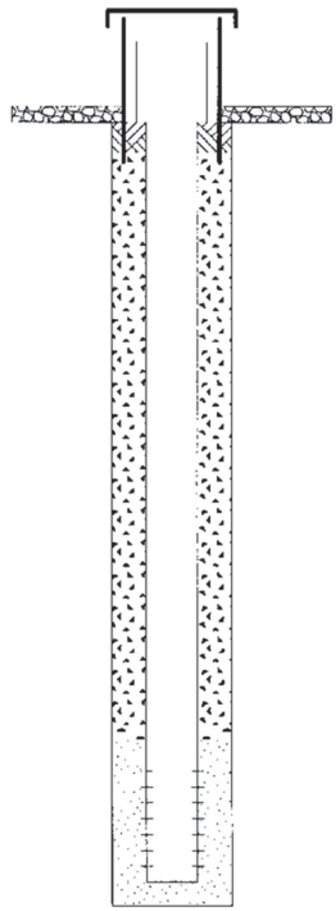
Elevation of Reference Point: m

Height of Reference Point Above Ground Surface:

Depth of Surface Seal:

Type of Surface Seal: **4x4 Concrete Pad**

0 - 6 ft : Silty Sandy GRAVEL
6 - 19 ft : Sandy GRAVEL
19 - 34 ft : Gravvelly SAND
34 - 36 ft : Sandy GRAVEL
36 - 55 ft : SAND
55 - 83 ft : SAND
83 - 87 ft : Gravelly SAND
87 - 94 ft : SAND
94 - 102 ft : Gravelly SAND
102 - 117 ft : SAND
117 - 139 ft : Slightly Silty SAND
139 - 148 ft : No Returns
148 - 153 ft : Silty SAND
153 - 157 ft : Silty Sandy GRAVEL (w/caliche)
157 - 169 ft : No Returns
169 - 184 ft : Silty Sandy GRAVEL
184 - 220 ft : Sandy GRAVEL
220 - 260.5 ft : Sandy GRAVEL



Fill	*Casing*	*Screen*
0 - 10 ft : 9-inch hole Cement Surface Seal	0 - 215.5 ft : 4 inch 4" 304L SS Sch 5 csg.	
10 - 200.1 ft : 9-inch hole Bentonite Crumbles		
200.1 - 205 ft : 9-inch hole Bentonite Pellets		215.5 - 250.5 ft : 4 inch 4" SS Wire Wrap .020 slot scrn.
205 - 252.5 ft : 9-inch hole 10/20 Silica Sand		
252.5 - 260.5 ft : 9-inch hole 10/20 Silica Sand	250.5 - 252.5 ft : 4 inch 4" SS Sump	

260 ft : Borehole drilled depth

0 - 206.5 ft : 9-in. 8-5/8" CS csg. set with Air Rotary csg hammer

Drawing By:	JEA
Reference:	Hanford Wells
Revision:	0
Revision Date:	22Sep00
Print Date:	22Sep00

BECHTEL

Report Form: WELLS Project File: WELLS.GPJ

Figure E-10. Well 299-W23-20 Construction and Completion Summary (1 of 2)

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W23-20

WELL DESIGNATION	:	299-W23-20
CERCLA UNIT	:	
RCRA FACILITY	:	
DEPTH DRILLED (GS)	:	260.0 ft
MEASURED DEPTH (GS)	:	260.5 15Aug00
AVAILABLE LOGS	:	Geologist
DATE EVALUATED	:	Data not available
EVAL RECOMMENDATION	:	Data not available
LISTED USE	:	RCRA monitoring/sampling
CURRENT USER	:	RCRA & Operations
PUMP TYPE	:	Hydrostar
MAINTENANCE	:	Data not available
COMMENTS	:	8-5/8" CS Temp. csg set w/Air Rotary Csg. Hammer
TV SCAN COMMENTS	:	

Report Form: WELLS Project File: WELLS.GPJ

Drawing By: JEA
Reference: Hanford Wells
Revision: 0
Revision Date: 22Sep00
Print Date: 22Sep00

BECHTEL

Figure E-10. Well 299-W23-20 Construction and Completion Summary (2 of 2)

0532877

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Cable Tool	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-W23-21 C3113 TEMPORARY WELL NO: Not Allowed
Drilling Fluid Used:	none	Additives Used:	None	Coordinates: N	Not documented
Driller's Name:	M. Wraspir	WA State Lic Nr:	1909	Coordinates: E	Not documented
Drilling Company:	RSI	Company Location:	Woodland, Ca.	Start Card #:	Not Available
Date Started:	26Sep00	Date Completed:	07Nov00	Elevation Ground Surface:	

Depth to Water: 212.88 ft 03Nov00
(Ground surface)

GENERALIZED STRATIGRAPHY Geologist's Log

Elevation of Reference Point: m

Height of Reference Point Above Ground Surface:

Depth of Surface Seal: 10.1 ft.

Type of Surface Seal: **4x4 Concrete Pad**

0 - 0.5 ft : Gravel
0.5 - 8.5 ft : Sand
8.5 - 20 ft : Sand to Slightly Silty Sand
20 - 36.8 ft : Sandy GRAVEL

36.8 - 38.5 ft : Silty SAND
38.5 - 40 ft : Slightly Gravelly SAND
40 - 80 ft : SAND

80 - 83 ft : Gravelly SAND
83 - 88 ft : Silty SAND
88 - 99 ft : Gravelly SAND
99 - 120.5 ft : SAND

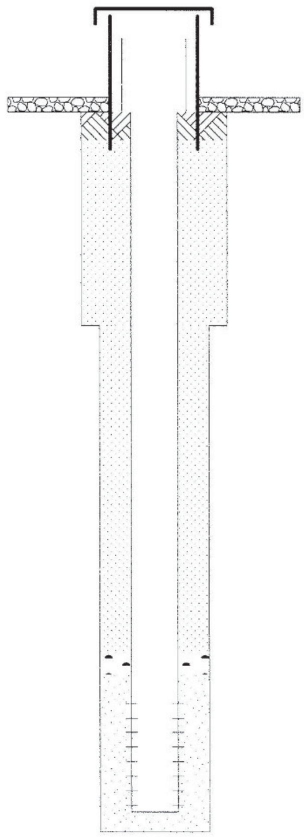
120.5 - 130.5 ft : Silty SAND

130.5 - 131.5 ft : Sandy SILT
131.5 - 139 ft : Silty SAND
139 - 141.5 ft : Slightly Silty SAND
141.5 - 143.5 ft : Silty SAND
143.5 - 147 ft : Slightly Silty SAND
147 - 153 ft : Sandy Silt
153 - 158 ft : Slightly Silty Gravelly SAND
158 - 168 ft : SAND
168 - 189 ft : Sandy GRAVEL

189 - 193 ft : Slightly Silty Gravelly SAND
193 - 197.5 ft : Gravelly Silty SAND
197.5 - 204 ft : Gravelly Sandy SILT
204 - 214 ft : Silty Sandy GRAVEL
214 - 219 ft : Gravelly Sandy SILT
219 - 240 ft : Silty Sandy GRAVEL

240 - 255 ft : Sandy GRAVEL

255 - 259 ft : Gravelly Silty SAND



Fill	*Casing*	*Screen*
0 - 10.1 ft : 12-inch hole Cement Surface Seal	0 - 212.58 ft : 4 inch 4" 304L SS csg	
10.1 - 76.41 ft : 12-inch hole Granular Bentonite		
76.41 - 193.7 ft : 9-inch hole Granular Bentonite		
193.7 - 202 ft : 9-inch hole Bentonite pellets		212.58 - 249.69 ft : 4 inch 4" 304 SS Wire Wrap .020 slot scrn.
202 - 251.87 ft : 9-inch hole 10/20 Silica Sand		
251.87 - 259 ft : 9-inch hole 10/20 Silica Sand	249.69 - 251.87 ft : 4 inch 4" SS Sump	

259 ft : Borehole drilled depth

0 - 76.41 ft : 12-in. 11-3/4" CS Temp csg set w/Cable Tool
76.41 - 2529 ft : 9-in. 8-5/8" CS Temp csg set w/Cable Tool

Drawing By: JEA
Reference: Hanford Wells
Revision: 0
Revision Date: 20Mar01
Print Date: 20Mar01

Report Form: WELLS Project File: WELLS.GPJ

Figure E-11. Well 299-W23-21 Construction and Completion Summary

E2 Reference

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

Appendix F

Well Construction for Waste Management Area T

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Contents

Figures

Tables

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F1 Introduction

This appendix provides the following information for the existing Waste Management Area (WMA) T groundwater monitoring wells:

- Well name
- Hydrogeologic unit monitored (the aquifer portion at the well screen perforation) (Table F-1)
- The following sampling interval information, as provided in Table F-2:
  - Elevation at the top of the screen or perforated interval
  - Elevation at the bottom of the screen or perforated interval
  - Open interval length (i.e., difference between the top and bottom screen perforation elevations)
  - Drilling method

For proposed wells, the following design information is provided in Table F-3:

- Well location
- Drill depth
- Well diameter
- Screen interval depth
- Sump and end cap interval

Figures F-1 through F-6 provide construction and completion summaries for the existing network wells.

Table F-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 F-2. Sampling Interval Information for Wells Within the WMA T 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])	Drilling Method
299-W10-24	TU	138.0 (452.7)	127.3 (417.6)	10.7 (35.1)	Cable tool/air rotary
299-W10-28	TU	137.5 (451.0)	126.8 (416.0)	10.7 (35.0)	Cable tool
299-W11-39	TU	137.2 (450.0)	126.5 (414.9)	10.7 (35.1)	Cable tool
299-W11-40	TU	137.1 (449.9)	126.4 (414.8)	10.7 (35.0)	Cable tool/air rotary
299-W11-41	TU	137.5 (451.2)	126.9 (416.2)	10.7 (35.0)	Cable tool/air rotary

Table F-2. Sampling Interval Information for Wells Within the WMA T 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])	Drilling Method
299-W11-42	TU	138.0 (452.8)	127.3 (417.8)	10.7 (35.0)	Air rotary

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

Note: Due to rounding and conversion of metric units, the computed open interval length based on the top and bottom elevations may differ slightly from the actual open interval length reported in the associated well summary sheet.

TU = Top of Unconfined, as described in Table F-1

Table F-3. Planned Locations, Depths, and Screen Intervals for Proposed Wells Within the WMA T Network

Proposed Well (Well ID)	Northing* (m)	Easting* (m)	Surface Elevation (m [ft] NAVD88)	Water Table Elevation (m [ft] NAVD88)	Depth to Water (m [ft] bgs)	Drill Depth (m [ft] bgs)	Final Well Diameter (cm [in.])	Screen Interval (m [ft] bgs)	Sump and End Cap Interval (m [ft] bgs)
WMA-T_PW1 (D0017)	136634.7	566834.0	TBD	TBD	TBD	TBD	TBD	TBD	TBD
WMA-T_PW2 (D0018)	136634.7	566879.8	TBD	TBD	TBD	TBD	TBD	TBD	TBD
WMA-T_PW3 (D0019)	136634.9	566936.7	TBD	TBD	TBD	TBD	TBD	TBD	TBD

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

Note: Well coordinates are estimates and subject to modification based on final well location survey.

*Coordinates are in Washington State Plane (south zone), NAD83, *North American Datum of 1983*; 1991 adjustment.

bgs = below ground surface

TBD = to be determined. Information will be obtained after well construction.

0502369

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Air Rotary - TUBEX	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-W10-24 B8546 TEMPORARY WELL NO: Not Allowed
Drilling Fluid Used:	Reverse Air	Additives Used:	None	Coordinates: N	Not documented
Driller's Name:	Randy Wrasplr	WA State Lic Nr:	Not Available	Coordinates: E	Not documented
Drilling Company:	Layne Christensen	Company Location:	Salt Lake City, Ut	Start Card #:	Not Available
Date Started:	07Oct98	Date Completed:	21Oct98	Elevation Ground Surface:	Brass Marker

Depth to Water: 231.41 ft 21Oct98
(Ground surface)

Elevation of Reference Point: m

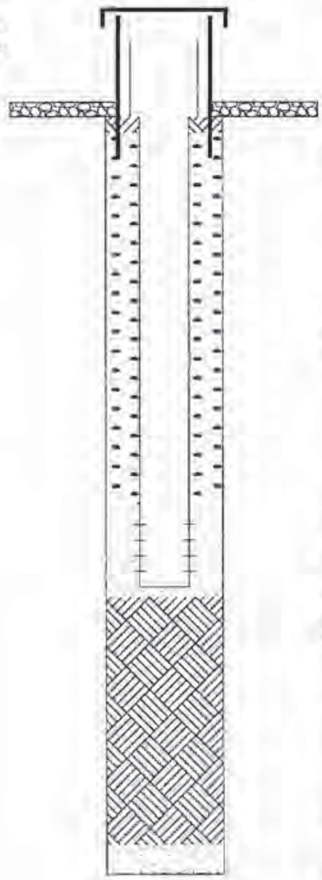
Height of Reference Point Above Ground Surface:

Depth of Surface Seal: 9.1 ft

Type of Surface Seal: 4x4 Concrete Pad

GENERALIZED STRATIGRAPHY — Geologist's Log & Geophysical Logs

0 - 2 ft : Backfill - cobbles, sand, & silt
2 - 5 ft : Silty Sandy Gravel (msG)
5 - 7 ft : Sasnd (s)
7 - 36 ft : Silty Sandy Gravel
36 - 39 ft : Gravelly Sand (gS)
39 - 42 ft : Sandy Gravel (sG)
42 - 59 ft : Sand
59 - 83.2 ft : Sandy Gravel
83.2 - 84 ft : Silty Sand (mS)
84 - 86 ft : Sand
86 - 98 ft : Silty Sand
98 - 108 ft : Caliche (calc. sand)
108 - 119 ft : Sand
119 - 128 ft : Sand
128 - 148 ft : Sandy Gravel
148 - 190 ft : Silty Sandy Gravel
190 - 228 ft : Silty Sandy Gravel
228 - 305 ft : Sandy Gravel
305 - 355 ft : Gravel (G)
355 - 409 ft : Sandy Gravel
409 - 413 ft : SIL. (M)
413 - 432.5 ft : Gravel (G)



Fill

0 - 9.1 ft : 9.125-inch hole Cement Surface Seal

9.1 - 218.5 ft : 9.125-inch hole Med. Bentonite Chunks

218.5 - 221 ft : 9.125-inch hole 3/8" Bentonite Pellets (Pel Plug)

221 - 260.2 ft : 9.125-inch hole 20/40 Silica Sand

260.2 - 268.35 ft : 9.125-inch hole 10/20 and 8/16 Silica Sand

268.35 - 274 ft : 9.125-inch hole 10/20 and 8/16 Silica Sand

274 - 415.6 ft : 9.125-inch hole Cement Grout Seal

415.6 - 431.5 ft : 9.125-inch hole 10/20 Silica Sand

431.5 - 432.5 ft : 9.125-inch hole Slough

Casing

0 - 232.94 ft : 4 inch 4" Sch. 5 SS Csg.

268.03 - 268.35 ft : 4 inch 4" SS End Cap

Screen

232.94 - 268.03 ft : 4 inch 4" SS Wire Wrap .010 Slot Screen

432.5 ft : Borehole drilled depth

0 - 432.5 ft : 9.125-in. TUBEX w/8-5/8" Temp. carbon steel csg.

Drawing By: JEA
Reference: Hanford Wells
Revision: 0
Revision Date: 22Oct98
Print Date: 28Dec98

BECHTEL

Report Form: WELLS Project File: WELLS.GPJ

Figure F-1. Well 299-W10-24 Construction and Completion Summary (1 of 2)

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W10-24

WELL DESIGNATION	:	299-W10-24
CERCLA UNIT	:	
RCRA FACILITY	:	
DEPTH DRILLED (GS)	:	432.5 ft
MEASURED DEPTH (GS)	:	268.35 21Oct98
AVAILABLE LOGS	:	Geologist & Geophysical Logs
DATE EVALUATED	:	Data not available
EVAL RECOMMENDATION	:	Data not available
LISTED USE	:	RCRA Groundwater Monitoring
CURRENT USER	:	RCRA & Operations
PUMP TYPE	:	Hydrostar
MAINTENANCE	:	Data not available
COMMENTS	:	Air Rotary TUBEX w/Reverse Air drilled - 8-5/8" csg. to 432.5 ft.
TV SCAN COMMENTS	:	

Report Form: WELLS Project File: WELLS.GPJ

Drawing By: JEA
Reference: Hanford Wells
Revision: 0
Revision Date: 22Oct98
Print Date: 28Dec98

Figure F-1. Well 299-W10-24 Construction and Completion Summary (2 of 2)

0540437

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Cable Tool	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-W10-28 C3400 TEMPORARY WELL NO: Not Allowed
Drilling Fluid Used:	none	Additives Used:	none reported	Coordinates: N	Not documented
Driller's Name:	G. Howell	WA State Lic Nr:	1930	Coordinates: E	Not documented
Drilling Company:	RSI	Company Location:	Woodland, Ca.	Start Card #:	R037816
Date Started:	10Sep01	Date Completed:	17Oct01	Elevation Ground Surface:	

Depth to Water: 225.51 ft. ft 17Oct01
(Ground surface)

Elevation of Reference Point: m

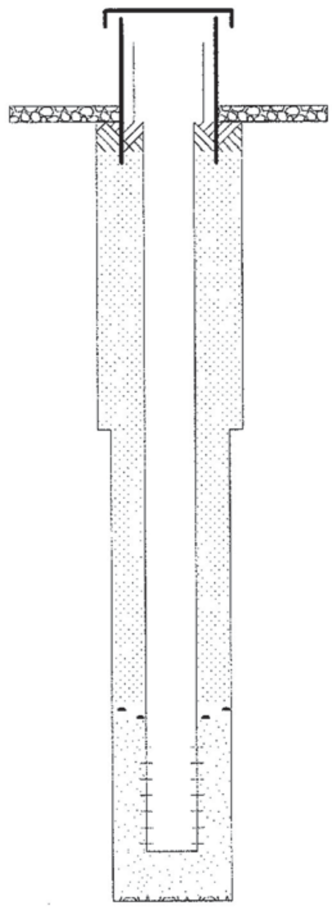
Height of Reference Point Above Ground Surface:

Depth of Surface Seal: 10.3 ft.

Type of Surface Seal: 4x4 Concrete Pad

GENERALIZED STRATIGRAPHY **Geologist's Log**

0 - 3 ft : Silty Sandy Gravel
3 - 14 ft : Sand
14 - 24 ft : Sandy Gravel
24 - 27.5 ft : Sand
27.5 - 50 ft : Sandy Gravel
50 - 79.9 ft : Sand
79.9 - 84.5 ft : Silt & Sand
84.5 - 87 ft : Sand
87 - 96.5 ft : Sandy Silt
96.5 - 101 ft : Caliche
112 - 114 ft : Sandy Silt
114 - 121 ft : Sand w/occasioal silt lenses
121 - 129 ft : Sandy Silt
129 - 131 ft : Silty Sandy Gravel
131 - 142 ft : Gravelly Sandy Silt
142 - 173 ft : Silty Sandy Gravel
173 - 274 ft : Silty Sandy Gravel more cemented than from 142-173 ft
274 - 274.5 ft : Silty Sand
274.5 - 280 ft : Gravelly Sand



280 ft : Borehole drilled depth

0 - 111 ft : 11-in. Cable Tool 10-5/8" CS Temp csg
111 - 280 ft : 9-in. Cable Tool 8-5/8" CS Temp csg

Fill	*Casing*	*Screen*
0 - 10.3 ft : 11-inch hole Cement Surface Seal	0 - 225.19 ft : 4 inch 304L SS sch 5 csg	
10.3 - 111 ft : 11-inch hole Granular Bentonite		
111 - 209.4 ft : 9-inch hole Granular Bentonite		
209.4 - 215.3 ft : 9-inch hole 3/8" Bentonite pELLETS		225.19 - 260.19 ft : 4 inch 304L SS Wire Wrap .020 slot scrn
215.3 - 262.19 ft : 9-inch hole 10/20 Silica Sand		
262.19 - 271.6 ft : 9-inch hole 10/20 Silica Sand	260.19 - 262.19 ft : 4 inch 304L SS Sump	
271.6 - 273.9 ft : 9-inch hole 3/8" Bentonite Hole Plug		
273.9 - 278.3 ft : 9-inch hole 10/20 Silica Sand		
278.3 - 280 ft : 9-inch hole Slough		

Drawing By: JEA
Reference: Hanford Wells
Revision: 0
Revision Date: 08Nov01
Print Date: 08Nov01

BECHTEL

Report Form: WELLS Project File: WELLS.GPJ

Figure F-2. Well 299-W10-28 Construction and Completion Summary (1 of 2)

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W10-28

WELL DESIGNATION	:	299-W10-28
CERCLA UNIT	:	
RCRA FACILITY	:	
DEPTH DRILLED (GS)	:	280.0 ft
MEASURED DEPTH (GS)	:	262.19 17Oct01
AVAILABLE LOGS	:	Geologist & Geophysical
DATE EVALUATED	:	Data not available
EVAL RECOMMENDATION	:	Data not available
LISTED USE	:	RCRA Monitoring
CURRENT USER	:	RCRA & Operations
PUMP TYPE	:	Not Documented
MAINTENANCE	:	Data not available
COMMENTS	:	Cable Tool 11-3/4" CS Temp csg to 111 ft. - 8-5/8" CS Temp csg to 280 ft.
TV SCAN COMMENTS	:	

Report Form: WELLS Project File: WELLS.GPJ

Drawing By:	JEA
Reference:	Hanford Wells
Revision:	0
Revision Date:	08Nov01
Print Date:	08Nov01

BECHTEL

Figure F-2. Well 299-W10-28 Construction and Completion Summary (2 of 2)

0532876

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Cable Tool	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-W11-39 C3117 TEMPORARY WELL NO: Not Allowed
Drilling Fluid Used:	none	Additives Used:	None	Coordinates: N	Not documented
Driller's Name:	M. Wraspir	WA State Lic Nr:	1909	Coordinates: E	Not documented
Drilling Company:	RSI	Company Location:	Woodland, Ca.	Start Card #:	Not Available
Date Started:	09Nov00	Date Completed:	18Dec00	Elevation Ground Surface:	

Depth to Water: **237.31 ft 18Dec00**
(Ground surface)

Elevation of Reference Point: m

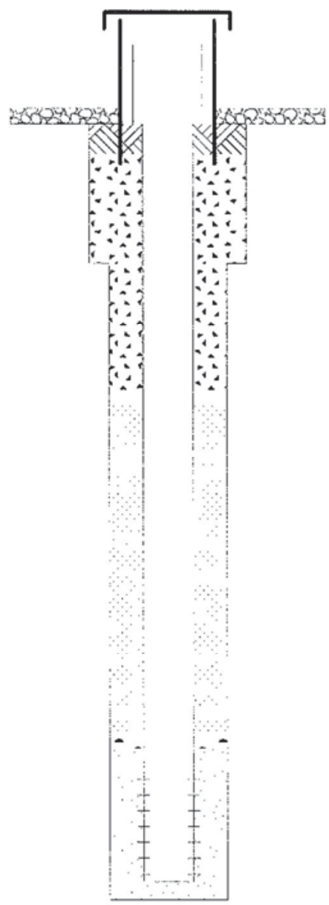
Height of Reference Point Above Ground Surface:

Depth of Surface Seal: **10.9 ft.**

Type of Surface Seal: **4x4 Concrete Pad**

GENERALIZED STRATIGRAPHY **Geologist's Log**

0 - 5.5 ft : Backfill
5.5 - 33.5 ft : Sandy GRAVEL
33.5 - 57 ft : Gravelly SAND
57 - 63 ft : SAND
63 - 82.5 ft : Gravelly SAND
82.5 - 90 ft : SAND
90 - 112 ft : Silty SAND
112 - 127 ft : Slightly Silty SAND
127 - 131 ft : Slightly Silty Gravelly SAND
131 - 145 ft : Silty Sandy GRAVEL
145 - 150 ft : Sandy GRAVEL
150 - 265 ft : Silty Sandy GRAVEL (Sandy GRAVEL at 265)
265 - 282.31 ft : Silty Sandy GRAVEL



Fill	*Casing*	*Screen*
0 - 10.9 ft : 12-inch hole Cement Surface Seal	0 - 238.6 ft : 4 inch 4" 304 SS sch 5 csg.	
10.9 - 50.94 ft : 12-inch hole Bentonite Chips		
50.94 - 96.5 ft : 9-inch hole Bentonite Chips		
96.5 - 222.47 ft : 9-inch hole Granular Bentonite		
222.47 - 227.15 ft : 9-inch hole 1/4" & 1/2" Bentonite pellets		238.6 - 273.66 ft : 4 inch 4" SS Wire Wrap .020 Slot scrn.
227.15 - 275.66 ft : 9-inch hole 10/20 Silica Sand	273.66 - 275.66 ft : 4 inch 4" SS Sump	
275.66 - 282.31 ft : 9-inch hole 10/20 Silica Sand		

282.31 ft : Borehole drilled depth

0 - 50.94 ft : 12-in. Cable Tool 11-3/4 CS Temp. csg.
50.94 - 282.31 ft : 9-in. Cable Tool 8-5/8 CS Temp. csg.

Drawing By: **JEA**
Reference: **Hanford Wells**
Revision: **0**
Revision Date: **20Mar01**
Print Date: **20Mar01**

Report Form: WELLS Project File: WELLS.GPJ

BECHTEL

Figure F-3. Well 299-W11-39 Construction and Completion Summary

0532874

WELL CONSTRUCTION AND COMPLETION SUMMARY

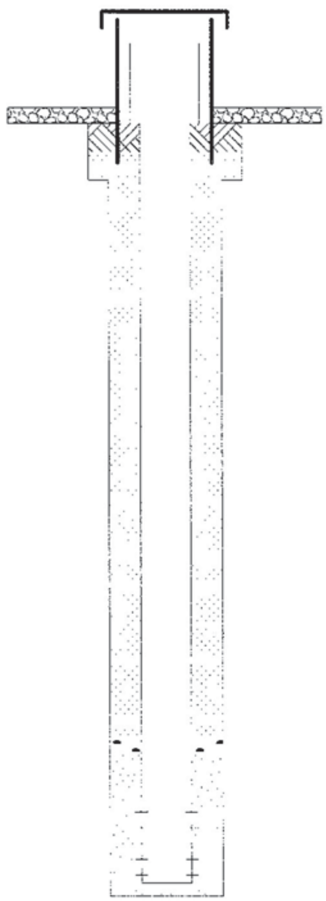
Drilling Method:	Cable Tool & A. R. Drl & Drive	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-W11-40 C3118 TEMPORARY WELL NO: Not Allowed
Drilling Fluid Used:	Air	Additives Used:	None	Coordinates: N	Not documented
Driller's Name:	K. Cowden	WA State Lic Nr:	Not Available	Coordinates: E	Not documented
Drilling Company:	RSI	Company Location:	Woodland, Ca.	Start Card #:	Not Available
Date Started:	26Sep00	Date Completed:	09Oct00	Elevation Ground Surface:	

Depth to Water: 237.05 ft 06Oct00
(Ground surface)

GENERALIZED STRATIGRAPHY Geologist's Log

Elevation of Reference Point: m
Height of Reference Point Above Ground Surface:
Depth of Surface Seal: 10.2 ft
Type of Surface Seal: 4x4 Concrete Pad

0 - 2 ft : Silty Sandy GRAVEL
2 - 6.5 ft : Slightly Silty SAND
6.5 - 32 ft : Sandy GRAVEL
32 - 43 ft : SAND
43 - 46 ft : Gravelly SAND
46 - 64 ft : SAND
64 - 70 ft : Gravelly SAND
70 - 88 ft : SAND
88 - 92 ft : Slightly Silty SAND
92 - 103 ft : Sandy SILT
103 - 117 ft : Gravelly Silty SAND
117 - 122 ft : Gravelly SAND
122 - 133 ft : Silty SAND
133 - 142 ft : Silty Sandy GRAVEL
142 - 163 ft : Sandy GRAVEL
163 - 170 ft : Silty Sandy GRAVEL
170 - 198 ft : Sandy GRAVEL
198 - 222 ft : Silty Sandy GRAVEL
222 - 280 ft : Sandy GRAVEL



Fill

0 - 10.2 ft : 11.75-inch hole Cement Surface Seal

10.2 - 20.5 ft : 11.75-inch hole Granular Bentonite

20.5 - 222.2 ft : 8.625-inch hole Granular Bentonite

222.2 - 228.6 ft : 8.625-inch hole 3/8" Bentonite pellets

228.6 - 275.18 ft : 8.625-inch hole 10/20 Silica Sand

275.18 - 280 ft : 8.625-inch hole 10/20 Silica Sand

Casing

0 - 238.08 ft : 4 inch 4" 304L SS csg.

273.12 - 275.18 ft : 4 inch 4" 304L SS csg.

Screen

238.08 - 273.13 ft : 4 inch 4" 304 SS Wire wrap .020 slot scrn

280 ft : Borehole drilled depth

0 - 20.5 ft : 11.75-in. 11-3/4" CS Temp. csg set w/Cable Tool
20.5 - 280 ft : 8.625-in. 8-5/8" CS Temp. csg. set w/A.R. Drl & Drive

Drawing By: JEA
Reference: Hanford Wells
Revision: 0
Revision Date: 19Mar01
Print Date: 19Mar01

BECHTEL

Report Form: WELLS Project File: WELLS.GPJ

Figure F-4. Well 299-W11-40 Construction and Completion Summary

0526560

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Cable Tool/Air Rotary	Sample Method:	Grab/Split Spoon	WELL NUMBER.	299-W11-41 C3119 TEMPORARY WELL NO: Not Allowed
Drilling Fluid Used:	NA/Air	Additives Used:	None	Coordinates: N	Not documented
Driller's Name:	M. Wraspir	WA State Lic Nr:	1909	Coordinates: E	Not documented
Drilling Company:	RSI	Company Location:	Woodland, Ca.	Start Card #:	R037802
Date Started:	04Aug00	Date Completed:	22Aug00	Elevation Ground Surface:	

Depth to Water: 236.6 ft. ft 22Aug00
(Ground surface)

Elevation of Reference Point: m

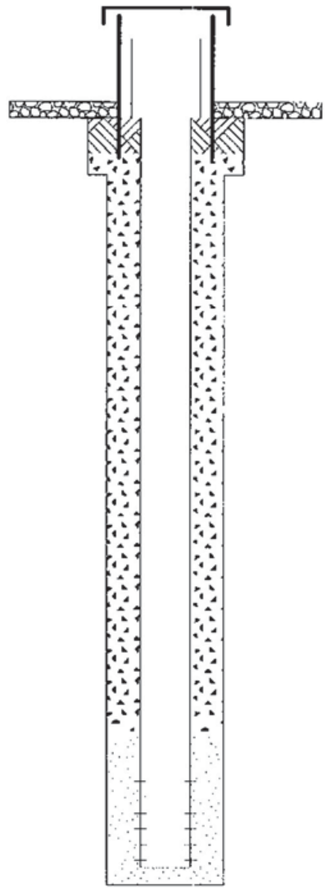
Height of Reference Point Above Ground Surface:

Depth of Surface Seal: 12.9 ft.

Type of Surface Seal: 4x4 Concrete Pad

GENERALIZED STRATIGRAPHY — Geologist's Log

0 - 4 ft : Silty Sandy GRAVEL
4 - 7 ft : Slightly Silty SAND
7 - 33 ft : Silty Sandy GRAVEL
33 - 37 ft : Gravelly SAND
37 - 39 ft : Sandy GRAVEL
39 - 44 ft : SAND
44 - 94 ft : Sand
94 - 98 ft : Silty SAND (calcareous)
98 - 118 ft : Slightly Silty SAND - trace of caliche 103-106 ft
118 - 122 ft : SAND
123 - 133 ft : Sandy SILT
133 - 144 ft : Gravelly Silty SAND
144 - 158 ft : Silty Sandy GRAVEL
158 - 169 ft : Sandy GRAVEL
169 - 173 ft : Gravelly SAND
173 - 198 ft : Sandy GRAVEL
198 - 208 ft : Silty Sandy GRAVEL
208 - 213 ft : Sandy GRAVEL
213 - 218 ft : Gravelly SAND
218 - 246 ft : Sandy GRAVEL
246 - 270 ft : Silty Sandy GRAVEL
270 - 280 ft : Sandy GRAVEL



Fill	*Casing*	*Screen*
0 - 12.9 ft : 12-inch hole Cement Surface Seal	0 - 236.7 ft : 4 inch 4" 304L SS Sch 5 csg	
12.9 - 20.6 ft : 12-inch hole Bentonite Crumbles		
20.6 - 218.8 ft : 9-inch hole Bentonite Crumbles		
218.8 - 226 ft : 9-inch hole Bentonite Pellets		236.7 - 271.7 ft : 4 inch 4" 304L SS Wire Wrap .020 slot scrn.
226 - 273.7 ft : 9-inch hole 10/20 Silica Sand		
273.7 - 280 ft : 9-inch hole 10/20 Silica Sand	271.7 - 273.7 ft : 4 inch 4" SS Sump	

280 ft : Borehole drilled depth

0 - 20.6 ft : 12-in. 11-3/4" CS Temp. csg set w/Cable Tool
20.6 - 280 ft : 9-in. 8-5/8" CS Temp. csg set w/Air Rotary csg hammer

Report Form: WELLS Project File: WELLS.GPJ

Drawing By: JEA
Reference: Hanford Wells
Revision: 0
Revision Date: 22Sep00
Print Date: 22Sep00

BECHTEL

Figure F-5. Well 299-W11-41 Construction and Completion Summary (1 of 2)

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W11-41

WELL DESIGNATION	:	299-W11-41
CERCLA UNIT	:	
RCRA FACILITY	:	
DEPTH DRILLED (GS)	:	280.0 ft
MEASURED DEPTH (GS)	:	280 22Aug00
AVAILABLE LOGS	:	Geologist
DATE EVALUATED	:	Data not available
EVAL RECOMMENDATION	:	Data not available
LISTED USE	:	RCRA monitoring/sampling
CURRENT USER	:	RCRA & Operations
PUMP TYPE	:	Hydrostar
MAINTENANCE	:	Data not available
COMMENTS	:	Cable tool to 20.6 ft w/11-3/4" CS csg Air Rotary from 20.6 to 280 ft w/8-5/8" CS csg.
TV SCAN COMMENTS	:	

Report Form: WELLS Project File: WELLS.GPJ

Drawing By:	JEA
Reference:	Hanford Wells
Revision:	0
Revision Date:	22Sep00
Print Date:	22Sep00

BECHTEL

Figure F-5. Well 299-W11-41 Construction and Completion Summary (2 of 2)

WELL CONSTRUCTION AND COMPLETION SUMMARY

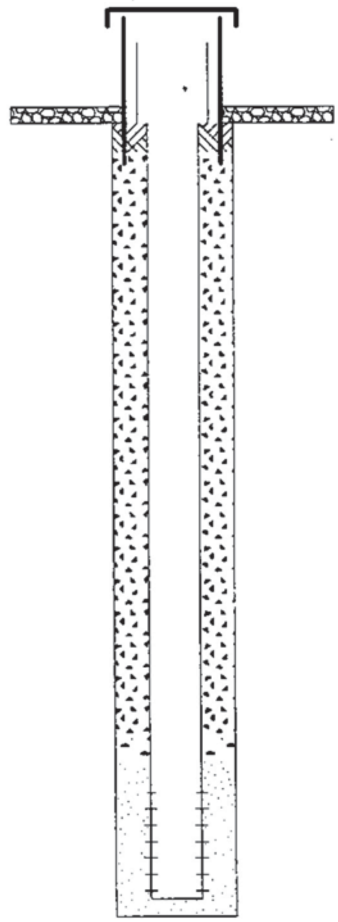
Drilling Method:	Air Rotary Csg. Hamme	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-W11-42 C3242 TEMPORARY WELL NO: Not Allowed
Drilling Fluid Used:	Air	Additives Used:	None	Coordinates: N	Not documented
Driller's Name:	M. Wraspir	WA State Lic Nr:	1909	Coordinates: E	Not documented
Drilling Company:	RSI	Company Location:	Woodland, Ca.	Start Card #:	Not Available
Date Started:	10Sep00	Date Completed:	13Sep00	Elevation Ground Surface:	

0527524

Depth to Water: **238.06 ft** **13Sep00**
(Ground surface)

GENERALIZED STRATIGRAPHY **Geologist's Log**

0 - 8 ft : Slightly Silt Gravel Sand (m)gS
8 - 39 ft : Sandy Gravel
39 - 62 ft : Slightly Silty Sand (m)S
62 - 69 ft : Sand S
69 - 74 ft : Gravelly Sand gS
74 - 91 ft : Slightly Silty Sand (m)S
91 - 100 ft : Silty Sand mS
100 - 117 ft : Slightly Silty Sand (m)S w/caliche
117 - 121 ft : Gravelly Sand gS
121 - 128 ft : Sandy Silt sM
128 - 134 ft : Slightly Silty Sand (m)S
134 - 140 ft : Silty Sandy Gravel msG
140 - 179 ft : Sandy Gravel sG
179 - 188 ft : Silty Sandy Gravel msG
188 - 200 ft : Sandy Gravel sG
200 - 223 ft : Silty Sandy Gravel msG
223 - 280 ft : Sandy Gravel sG



Elevation of Reference Point: **m**

Height of Reference Point Above Ground Surface:

Depth of Surface Seal: **10.2 ft.**

Type of Surface Seal: **4x4 Concrete Pad**

Fill	***Casing***	***Screen***
0 - 10.2 ft : 9-inch hole Cement Surface Seal	0 - 236.76 ft : 4 inch 4" 304L SS Sch 5 Csg	
10.2 - 217.8 ft : 9-inch hole Bentonite Crumbles		
217.8 - 225.5 ft : 9-inch hole Bentonite Pellets		236.76 - 271.77 ft : 4 inch 4" 304L SS Wire Wrap .020 slot scrn.
225.5 - 273.77 ft : 9-inch hole 10/20 Silica Sand		
273.77 - 280 ft : 9-inch hole 10/20 Silica Sand	271.77 - 273.77 ft : 4 inch 4" 304L SS Sump	

280 ft : Borehole drilled depth

0 - 280 ft : 9-in. 8-5/8" CS Temp. csg. set Air Rotary Casing Hammer

Drawing By: **JEA**
Reference: **Hanford Wells**
Revision: **0**
Revision Date: **26Sep00**
Print Date: **27Sep00**

BECHTEL

Report Form: WELLS Project File: WELLS.GPJ

Figure F-6. Well 299-W11-42 Construction and Completion Summary (1 of 2)

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W11-42

WELL DESIGNATION	:	299-W11-42
CERCLA UNIT	:	
RCRA FACILITY	:	
DEPTH DRILLED (GS)	:	280.0 ft
MEASURED DEPTH (GS)	:	273.77 13Sep00
AVAILABLE LOGS	:	Geologist
DATE EVALUATED	:	Data not available
EVAL RECOMMENDATION	:	Data not available
LISTED USE	:	RCRA monitoring/sampling
CURRENT USER	:	RCRA & Operations
PUMP TYPE	:	Hydrostar
MAINTENANCE	:	Data not available
COMMENTS	:	8-5/8" CS Temp. csg w/Air Rotary Casing Hammer. Replacement well for C3116.
TV SCAN COMMENTS	:	

Report Form: WELLS Project File: WELLS.GPJ

Drawing By: JEA
Reference: Hanford Wells
Revision: 0
Revision Date: 26Sep00
Print Date: 27Sep00

Figure F-6. Well 299-W11-42 Construction and Completion Summary (2 of 2)

F2 References

NAD83, 1991, *North American Datum of 1983*, as revised, National Geodetic Survey, Federal Geodetic Control Committee, Silver Spring, Maryland. Available at: http://www.ngs.noaa.gov/.

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

Appendix G

Well Construction for Waste Management Area TX-TY

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Contents

Figures

Tables

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Introduction

This appendix provides the following information for the existing Waste Management Area (WMA) TX-TY groundwater monitoring wells:

- Well name
- Hydrogeologic unit monitored (the aquifer portion at the well screen perforation) (Table G-1)
- The following sampling interval information, as provided in Table G-2:
  - Elevation at the top of the screen or perforated interval
  - Elevation at the bottom of the screen or perforated interval
  - Open interval length (i.e., difference between the top and bottom screen perforation elevations)
  - Drilling method

For proposed wells, the following design information is provided in Table G-3:

- Well location
- Drill depth
- Well diameter
- Screen interval depth
- Sump and end cap interval

Figures G-1 through G-9 provide construction and completion summaries for the existing network wells.

Table G-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 G-2. Sampling Interval Information for Wells Within the WMA TX-TY 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])	Drilling Method
299-W10-26	TU	138.5 (454.5)	127.8 (419.4)	10.7 (35.1)	Air rotary
299-W10-27	TU	137.5 (451.2)	126.9 (416.2)	10.7 (35.0)	Cable tool
299-W14-13	TU	138.3 (453.8)	127.6 (418.7)	10.7 (35.1)	Air rotary
299-W14-14	TU	138.5 (454.3)	127.8 (419.3)	10.7 (35.0)	Air rotary
299-W14-15	TU	137.6 (451.5)	127.0 (416.6)	10.6 (34.9)	Air rotary/ cable tool
299-W14-18	TU	137.8 (452.1)	127.1 (417.1)	10.7 (35.0)	Cable tool
299-W14-19	TU	136.8 (448.7)	126.0 (413.7)	10.7 (35.0)	Becker hammer

Table G-2. Sampling Interval Information for Wells Within the WMA TX-TY 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])	Drilling Method
299-W15-44	TU	138.3 (453.6)	127.6 (418.6)	10.7 (35.0)	Becker hammer
299-W15-765	TU	137.4 (450.9)	126.8 (415.9)	10.7 (35.0)	Air rotary

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

Note: Due to rounding and conversion of metric units, the computed open interval length based on the top and bottom elevations may differ slightly from the actual open interval length reported in the associated well summary sheet.

TU = Top of Unconfined, as described in Table G-1

Table G-3. Planned Locations, Depths, and Screen Intervals for Proposed Wells Within the WMA TX-TY Network

Proposed Well (Well ID)	Northing* (m)	Easting* (m)	Surface Elevation (m [ft] NAVD88)	Water Table Elevation (m [ft] NAVD88)	Depth to Water (m [ft] bgs)	Drill Depth (m [ft] bgs)	Final Well Diameter (cm [in.])	Screen Interval (m [ft] bgs)	Sump and End Cap Interval (m [ft] bgs)
WMA-TX-TY_PW1 (D0020)	136474.8	566578.6	TBD	TBD	TBD	TBD	TBD	TBD	TBD
WMA-TX-TY_PW2 (D0021)	136210.0	566490.1	TBD	TBD	TBD	TBD	TBD	TBD	TBD

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

Note: Well coordinates are estimates and subject to modification based on final well location survey.

*Coordinates are in Washington State Plane (south zone), NAD83, *North American Datum of 1983*; 1991 adjustment.

bgs = below ground surface

TBD = to be determined. Information will be obtained after well construction.

0502371

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Air Rotary - TUBEX	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-W10-26 B8548 TEMPORARY WELL NO: Not Allowed
Drilling Fluid Used:	Reverse Air	Additives Used:	None	Coordinates: N	Not documented
Driller's Name:	Willie Franklin	WA State Lic Nr:	Not Available	Coordinates: E	Not documented
Drilling Company:	Layne Christensen	Company Location:	Salt Lake City, Ut	Start Card #:	Not Available
Date Started:	20Aug98	Date Completed:	25Aug98	Elevation Ground Surface:	Brass Marker

Depth to Water: 216.8 ft 25Aug98
(Ground surface)

GENERALIZED STRATIGRAPHY Geologist's Log & Geophysical Logs

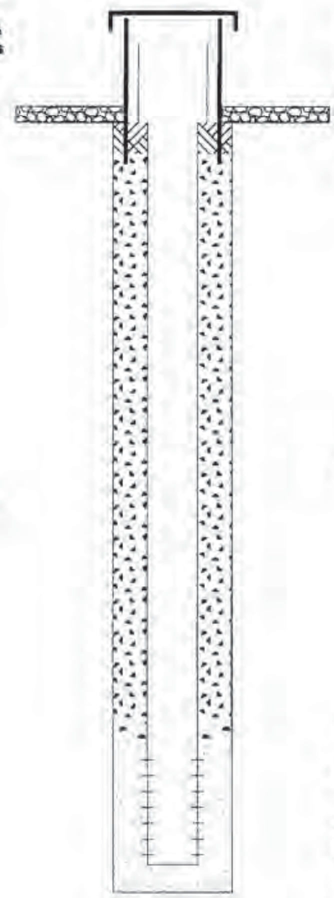
Elevation of Reference Point: m

Height of Reference Point Above Ground Surface:

Depth of Surface Seal: 10.5 ft.

Type of Surface Seal: 4x4 Concrete Pad

0 - 4 ft : Backfill
4 - 9 ft : Sand
9 - 22 ft : Gravel
22 - 42.5 ft : Sandy gravel
42.5 - 64 ft : Sand
64 - 89 ft : Gravelly sand
89 - 102 ft : Silty sand - calcareous (97-100 Caliche)
102 - 108 ft : Sand (108-110: caliche)
108 - 114 ft : Silty sand
114 - 116 ft : Sand
116 - 124 ft : Silty sand
124 - 127 ft : Sand
127 - 159 ft : Silty sandy gravel (152-156: large cobbles)
159 - 161 ft : Gravelly sand
161 - 205 ft : Sandy gravel
205 - 262 ft : Silty sandy gravel



Fill	Casing	Screen
0 - 10.5 ft : 9.125-inch hole Cement Seal		
10.5 - 204.5 ft : 9.125-inch hole Bentonite Chips		
204.5 - 211 ft : 9.125-inch hole Bentonite Pellets 211 - 217.04 ft : 9.125-inch hole 20-40 Silica Sand 217.04 - 252.13 ft : 9.125-inch hole 20-40 Silica Sand 252.13 - 262 ft : 9.125-inch hole 20-40 Silica Sand	217.04 - 0 ft : 4 inch 4" SS Sch. 5 Csg 252.13 - 252.45 ft : 4 inch 4" SS End Cap	217.04 - 252.13 ft : 4 inch 4" Wire Wrap SS .010 Slot Screen

262 ft : Borehole drilled depth

0 - 262 ft : 9.125-in. 8-5/8" Temp. carbon steel csg.

Drawing By: TGB
Reference: Hanford Wells
Revision: 0
Revision Date: 21Sep98
Print Date: 28Dec98

BECHTEL

Report Form: WELLS Project File: WELLS.GPJ

Figure G-1. Well 299-W10-26 Construction and Completion Summary (1 of 2)

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W10-26

WELL DESIGNATION	:	299-W10-26
CERCLA UNIT	:	
RCRA FACILITY	:	
DEPTH DRILLED (GS)	:	262.0 ft
MEASURED DEPTH (GS)	:	
AVAILABLE LOGS	:	Data not available
DATE EVALUATED	:	Data not available
EVAL RECOMMENDATION	:	Data not available
LISTED USE	:	Data not available
CURRENT USER	:	RCRA & Operations
PUMP TYPE	:	Data not available
MAINTENANCE	:	Data not available
COMMENTS	:	8-5/8" TUBEX Sys. 4-1/2" Reverse Cir. Drl. Pipe with Interchange
TV SCAN COMMENTS	:	

Report Form: WELLS Project File: WELLS.GPJ

Drawing By:	TGB
Reference:	Hanford Wells
Revision:	0
Revision Date:	21Sep98
Print Date:	28Dec98

BECHTEL

Figure G-1. Well 299-W10-26 Construction and Completion Summary (2 of 2)

0532883

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Cable Tool	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-W10-27 C3125 TEMPORARY WELL NO: Not Allowed
Drilling Fluid Used:	none	Additives Used:	water	Coordinates: N	Not documented
Driller's Name:	M. Wraspir	WA State Lic Nr:	1909	Coordinates: E	Not documented
Drilling Company:	RSI	Company Location:	Woodland, Ca.	Start Card #:	Not Available
Date Started:	22Jan01	Date Completed:	23Mar01	Elevation Ground Surface:	

Depth to Water: 220.63 ft ft 23Mar01
(Ground surface)

GENERALIZED STRATIGRAPHY Geologist's Log

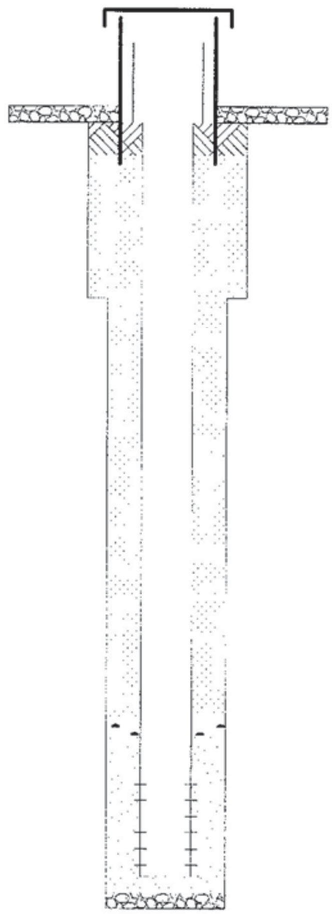
Elevation of Reference Point: m

Height of Reference Point Above Ground Surface:

Depth of Surface Seal: 10.9 ft

Type of Surface Seal: 4x4 Concrete Pad

0 - 1 ft : Construction gravel
1 - 4.5 ft : Silty SAND (mS)
4.5 - 8.5 ft : SAND (S)
8.5 - 24 ft : Sandy GRAVEL (sG)
24 - 38 ft : Silty Sandy GRAVEL (msG)
38 - 41.5 ft : Sandy GRAVEL (sG)
41.5 - 89 ft : SAND (S)
89 - 98.2 ft : Silt (M) Plio Pleistene top
98.2 - 102 ft : Caliche in Silty SAND (mS)
102 - 108 ft : Silty SAND (mS)
108 - 112 ft : Caliche in SAND(s)
112 - 117.5 ft : SAND (S)
117.5 - 120.5 ft : SILT (M(
120.5 - 124.5 ft : SAND (S)
124.5 - 220 ft : Silty Sandy GRAVEL (msG)- Ringold E top
220 - 225 ft : Slightly Silty Gravelly SAND
225 - 268.7 ft : Silty Sandy Gravel (msg)



Fill	*Casing*	*Screen*
0 - 10.9 ft : 12-inch hole Cement Surface Seal	0 - 256 ft : 4 inch 4" 304 SS sch 5 csg.	
10.9 - 60 ft : 12-inch hole Grannular Bentonite		
60 - 204.6 ft : 9-inch hole Grannular Bentonite		
204.6 - 210 ft : 9-inch hole 1/4" Bentonite Pellets		221 - 256 ft : 4 inch 4" 304 SS .020 Slot wirewrap scrn
210 - 257.76 ft : 9-inch hole 10/20 Silica Sand		
257.76 - 268.7 ft : 9-inch hole 10/20 Silica Sand	256 - 257.86 ft : 4 inch 4" 304L SS Sump	
263.3 - 268.7 ft : 9-inch hole Slough		

268.7 ft : Borehole drilled depth

0 - 60 ft : 12-in. 11-3/4" CS Temp. csg set w/cable tool
60 - 268.7 ft : 9-in. 8-5/8" CS Temp. csg set w/ cable tool

Drawing By: JEA
Reference: Hanford Wells
Revision: 0
Revision Date: 16Apr01
Print Date: 16Apr01

BECHTEL

Report Form: WELLS Project File: WELLS.GPJ

Figure G-2. Well 299-W10-27 Construction and Completion Summary

0502372

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Air Rotary - TUBEX	Sample Method:	Grab/Split Spoon	WELL NUMBER: 299-W14-13 B8549	TEMPORARY WELL NO: Not Allowed
Drilling Fluid Used:	Reverse Air	Additives Used:	None	Coordinates: N	Not documented
Driller's Name:	Willie Franklin	WA State Lic Nr:	Not Available	Coordinates: E	Not documented
Drilling Company:	Layne Christensen	Company Location:	Salt Lake City, Ut	Start Card #:	Not Available
Date Started:	26Aug98	Date Completed:	31Aug98	Elevation Ground Surface:	Brass Marker

Depth to Water: 215.8 ft 31Aug98
(Ground surface)

GENERALIZED STRATIGRAPHY Geologist's Log & Geophysical Logs

Elevation of Reference Point: m

Height of Reference Point Above Ground Surface:

Depth of Surface Seal: 9.6 ft.

Type of Surface Seal: 4x4 Concrete Pad

0 - 4 ft : Construction fill
4 - 14 ft : Sand
14 - 33 ft : Sandy gravel

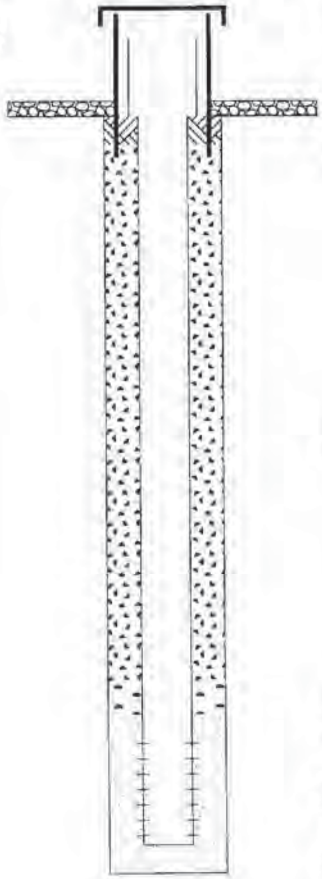
33 - 95 ft : Sand

95 - 98 ft : Sand, sl calcareous
98 - 101 ft : Caliche
101 - 112 ft : Sandy gravel sl calcareous
112 - 125 ft : Sand

125 - 163 ft : Silty sandy gravel

163 - 210 ft : Sandy gravel

210 - 262 ft : Sandy gravel



Fill	Casing	Screen
0 - 9.6 ft : 9.125-inch hole Cement Seal	0 - 216.62 ft : 4 inch 4" SS Sch. 5 Csg.	
9.6 - 195.1 ft : 9.125-inch hole Bentonite Chips		
195.1 - 206.4 ft : 9.125-inch hole Bentonite Pellets		216.62 - 251.73 ft : 4 inch 4" Wire Wrap SS .010 Slot Screen
206.4 - 252.05 ft : 9.125-inch hole 20-40 Silica Sand		
252.05 - 262 ft : 9.125-inch hole 20-40 Silica Sand	251.73 - 252.05 ft : 4 inch 4" SS End Cap	

262 ft : Borehole drilled depth

0 - 262 ft : 9.125-in. 8-5/8" CS Temp. Csg.

Drawing By: TGB
Reference: Hanford Wells
Revision: 0
Revision Date: 21Sep98
Print Date: 28Dec98

Report Form: WELLS Project File: WELLS.GPJ

BECHTEL

Figure G-3. Well 299-W14-13 Construction and Completion Summary (1 of 2)

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W14-13

WELL DESIGNATION	:	299-W14-13
CERCLA UNIT	:	
RCRA FACILITY	:	
DEPTH DRILLED (GS)	:	262.0 ft
MEASURED DEPTH (GS)	:	
AVAILABLE LOGS	:	Data not available
DATE EVALUATED	:	Data not available
EVAL RECOMMENDATION	:	Data not available
LISTED USE	:	Data not available
CURRENT USER	:	RCRA & Operations
PUMP TYPE	:	Data not available
MAINTENANCE	:	Data not available
COMMENTS	:	8-5/8" TUBEX Sys. 4-1/2" Reverse Cir. Drl. Pipe with Interchange
TV SCAN COMMENTS	:	

Report Form: WELLS Project File: WELLS.GPJ

Drawing By:	TGB
Reference:	Hanford Wells
Revision:	0
Revision Date:	21Sep98
Print Date:	28Dec98

Figure G-3. Well 299-W14-13 Construction and Completion Summary (2 of 2)

0502370

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Air Rotary - TUBEX	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-W14-14 B8547 TEMPORARY WELL NO: Not Allowed
Drilling Fluid Used:	Reverse Air	Additives Used:	None	Coordinates: N	Not documented
Driller's Name:	Randy Smith	WA State Lic Nr:	Not Available	Coordinates: E	Not documented
Drilling Company:	Layne Christensen	Company Location:	Salt Lake City, Ut	Start Card #:	Not Available
Date Started:	08Oct98	Date Completed:	12Nov98	Elevation Ground Surface:	Brass Marker

Depth to Water: (Ground surface) 216 ft 24Oct98; 217.42 ft 14Nov98

GENERALIZED STRATIGRAPHY: Geologist's Log & Geophysical Logs

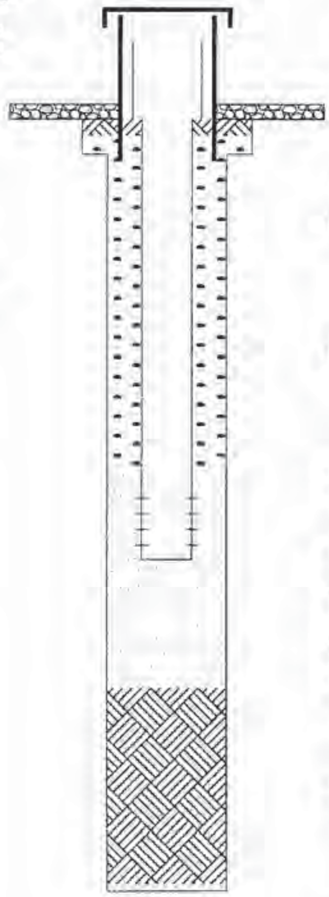
Elevation of Reference Point: m

Height of Reference Point Above Ground Surface:

Depth of Surface Seal: 9.3 ft.

Type of Surface Seal: 4x4 Concrete Pad

0 - 4.5 ft : Backfill - Sand and gravel
4.5 - 7 ft : Silty Gravelly SAND
7 - 14.5 ft : Silty SAND
14.5 - 16.5 ft : Silty Sandy GRAVEL
16.5 - 33 ft : Sandy GRAVEL
33 - 86.5 ft : SAND
86.5 - 93.5 ft : SAND (trace of caliche @ 86')
93.5 - 123 ft : Silty SAND (Caliche 108 to 110')
123 - 145 ft : Sandy GRAVEL
145 - 209 ft : Sandy GRAVEL
209 - 217 ft : Gravelly SAND
217 - 360 ft : Silty Sandy GRAVEL
360 - 402 ft : Sandy GRAVEL
402 - 412 ft : Silty CLAY
412 - 415.5 ft : SILT
415.5 - 424 ft : SILT (trace of gravel)
424 - 428 ft : GRAVEL
428 - 438 ft : SILT
438 - 443 ft : Sandy GRAVEL



Fill

0 - 9.3 ft : 13-inch hole Cement Seal
9.3 - 20 ft : 13-inch hole Medium Bentonite Chunks
20 - 202.3 ft : 9.125-inch hole Medium Bentonite Chunks
202.3 - 203.8 ft : 9.125-inch hole 3/8 Bentonite Pellets
203.8 - 252.3 ft : 9.125-inch hole 20-40 Silica Sand
252.3 - 257.3 ft : 9.125-inch hole 20-40 Silica Sand
257.3 - 326.6 ft : 9.125-inch hole 4-10, 6-9, 8-12, 8-16 & 10-20 Silica Sand
326.6 - 438.8 ft : 9.125-inch hole Cement Grout
438.8 - 443 ft : 9.125-inch hole 8-16 & 10-20 Silica Sand

Casing

0 - 216.98 ft : 9.125 inch 4" SS Sch. 5 Csg.
252 - 252.3 ft : 9.125 inch 4" SS End Cap

Screen

216.98 - 252 ft : 4 inch 4" SS Wire Wrap Screen - .010 Slot

443 ft : Borehole drilled depth

0 - 20 ft : 13-in. 12-3/4" Temp. Csg. set w/Cable Tool
20 - 443 ft : 9.125-in. 8-5/8" Temp. Csg. Set w/Tubex air rotary-rev. air 4-1/2" Drl. Pipe

Drawing By: JEA
Reference: Hanford Wells
Revision: 0
Revision Date: 16Oct98
Print Date: 28Dec98

Report Form: WELLS Project File: WELLS.GPJ

BECHTEL

Figure G-4. Well 299-W14-14 Construction and Completion Summary (1 of 2)

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W14-14

WELL DESIGNATION	:	299-W14-14
CERCLA UNIT	:	
RCRA FACILITY	:	
DEPTH DRILLED (GS)	:	443.0 ft
MEASURED DEPTH (GS)	:	252.30 06Nov98
AVAILABLE LOGS	:	Geologist & Geophysical Logs
DATE EVALUATED	:	Data not available
EVAL RECOMMENDATION	:	Data not available
LISTED USE	:	RCRA Monitoring
CURRENT USER	:	RCRA & Operations
PUMP TYPE	:	Hydrostar
MAINTENANCE	:	Data not available
COMMENTS	:	12" Temp. Csg. to 20 ft.- Cable Tool. 20 ft. to 443 ft. 8-5/8" Temp. Csg.- Tubex Rev. Air w/4-1/2" D.P.
TV SCAN COMMENTS	:	

Report Form: WELLS Project File: WELLS.GPJ

Drawing By: JEA
Reference: Hanford Wells
Revision: 0
Revision Date: 16Oct98
Print Date: 28Dec98

BECHTEL

Figure G-4. Well 299-W14-14 Construction and Completion Summary (2 of 2)

0526562

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Cable Tool/Air Rotary	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-W14-15 C3114 TEMPORARY WELL NO: Not Allowed
Drilling Fluid Used:	NA/Air	Additives Used:	None	Coordinates: N	Not documented
Driller's Name:	M. Wrasplr	WA State Lic Nr:	1909	Coordinates: E	Not documented
Drilling Company:	RSI	Company Location:	Woodland, Ca.	Start Card #:	Ro37802
Date Started:	17Aug00	Date Completed:	01Sep00	Elevation Ground Surface:	

Depth to Water: (Ground surface) 219.8 ft 05Sep00

Elevation of Reference Point: m

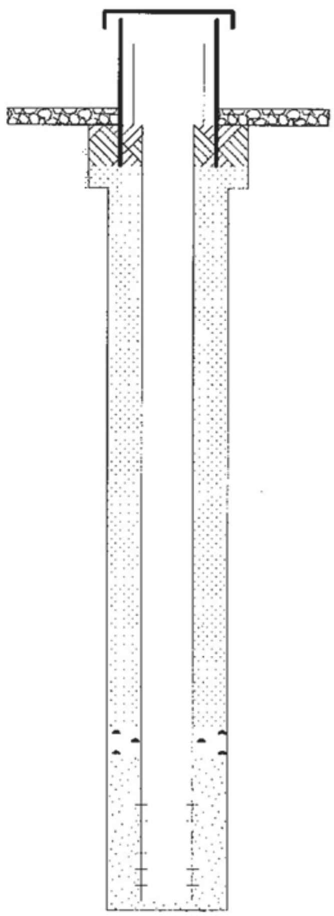
Height of Reference Point Above Ground Surface:

Depth of Surface Seal: 13.5 ft.

Type of Surface Seal: 4x4 Concrete Pad

GENERALIZED STRATIGRAPHY Geologist's Log

0 - 2 ft : Silty SAND
2 - 19 ft : Gravelly Silty SAND
19 - 37 ft : Silty Sandy GRAVEL
37 - 68 ft : SAND
68 - 74 ft : Silty SAND
74 - 88 ft : SAND
88 - 103 ft : Silty SAND
103 - 118 ft : Slightly Silty Gravelly SAND
118 - 123 ft : Slightly Silty SAND
123 - 142 ft : Silty Sandy GRAVEL
142 - 143 ft : SAND
143 - 175 ft : Sandy GRAVEL
175 - 221 ft : Sandy GRAVEL
221 - 260 ft : Silty Sandy GRAVEL



Fill	Casing	Screen
0 - 13.5 ft : 12-inch hole Cement Surface Seal	0 - 219.75 ft : 4 inch 4" 304 SS Sch 5 well csg.	
13.5 - 20.7 ft : 12-inch hole Granular Bentonite		
20.7 - 199.3 ft : 9-inch hole Granular Bentonite		
199.3 - 209.9 ft : 9-inch hole Bentonite Pellets		219.75 - 254.62 ft : 4 inch SS Wire Wrap .020 slot scrn.
256.7 - 209.9 ft : 9-inch hole 10/20 Silica Sand		
260 - 256.7 ft : 9-inch hole 10/20 Silica Sand	254.62 - 256.7 ft : 4 inch 4" SS Sump	

260 ft : Borehole drilled depth

0 - 20.7 ft : 12-in. 11-3/4" CS Temp. csg. drl w/cable tool
20.7 - 260 ft : 9-in. 8-5/8" CS Temp. csg. drl w/air rotary (csg hammer)

Drawing By: JEA
Reference: Hanford Wells
Revision: 0
Revision Date: 22Sep00
Print Date: 22Sep00

BECHTEL

Report Form: WELLS Project File: WELLS.GPJ

Figure G-5. Well 299-W14-15 Construction and Completion Summary (1 of 2)

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W14-15

WELL DESIGNATION	:	299-W14-15
CERCLA UNIT	:	
RCRA FACILITY	:	
DEPTH DRILLED (GS)	:	260.0 ft
MEASURED DEPTH (GS)	:	260.0 05Sep00
AVAILABLE LOGS	:	Geologist
DATE EVALUATED	:	Data not available
EVAL RECOMMENDATION	:	Data not available
LISTED USE	:	RCRA monitoring/sampling
CURRENT USER	:	RCRA & Operations
PUMP TYPE	:	Hydrostar
MAINTENANCE	:	Data not available
COMMENTS	:	Cable tool to 20.7 ft w/11-3/4" CS csg Air Rotary from 20.7 to 260 ft w/8-5/8" CS csg.
TV SCAN COMMENTS	:	

Report Form: WELLS Project File: WELLS.GPJ

Drawing By:	JEA
Reference:	Hanford Wells
Revision:	0
Revision Date:	22Sep00
Print Date:	22Sep00

Figure G-5. Well 299-W14-15 Construction and Completion Summary (2 of 2)

0540441

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Cable Tool	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-W14-18 C3396 TEMPORARY WELL NO: Not Allowed
Drilling Fluid Used:	None	Additives Used:	None	Coordinates: N	Not documented
Driller's Name:	M. Waspir	WA State Lic Nr:	1909	Coordinates: E	Not documented
Drilling Company:	RSI	Company Location:	Woodland, Ca.	Start Card #:	R037816
Date Started:	30Aug01	Date Completed:	01Nov01	Elevation Ground Surface:	

Depth to Water: 220.45 ft 07Nov01
(Ground surface)

GENERALIZED STRATIGRAPHY Geologist's Log

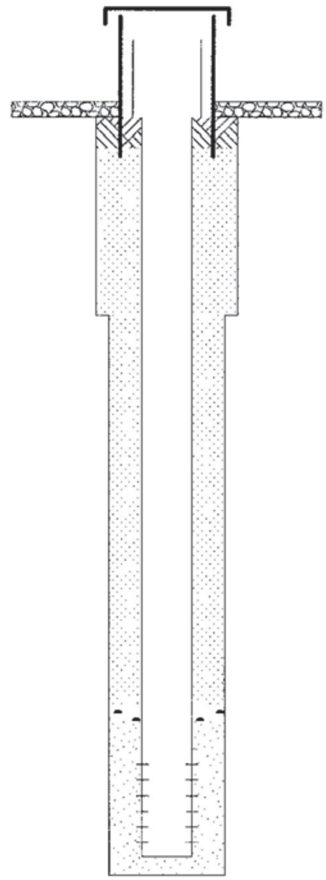
Elevation of Reference Point: m

Height of Reference Point Above Ground Surface:

Depth of Surface Seal: 10.5 ft

Type of Surface Seal: 4x4 Concrete Pad

0 - 0.5 ft : Drill Pad Material
0.5 - 8 ft : Silty Sand
8 - 13 ft : Sand
13 - 34 ft : Sandy Gravel
34 - 88.5 ft : Sand
88.5 - 114 ft : Sandy Silt
114 - 120 ft : Silty Sand
120 - 125 ft : Sandy Silt
125 - 145 ft : Gravelly Silt
145 - 155 ft : Silty Gravel
155 - 160 ft : Gravelly Silt
160 - 165 ft : Silty Gravel
165 - 190 ft : Gravelly Silt
190 - 200 ft : Sandy Silt
200 - 205 ft : Gravelly Sandy Silt
205 - 210 ft : Silty Gravel
210 - 215 ft : Sandy Silt
215 - 220 ft : Gravelly Silt
220 - 235 ft : Gravelly Sandy Silt
235 - 240 ft : Gravelly Silt
240 - 261.5 ft : Gravelly Sandy Silt



Fill	Casing	Screen
0 - 10.5 ft : 11-inch hole Cement Surface Seal	0 - 218.06 ft : 4 inch 304L SS sch 5 csg	
10.5 - 68.6 ft : 11-inch hole Granular Bentonite		
68.6 - 203.3 ft : 9-inch hole Granular Bentonite		
203.3 - 208.4 ft : 9-inch hole 1/4" Bentonite Pellets		218.06 - 253.05 ft : 4 inch 304L SS Wire Wrap .020 slot scrn
208.4 - 255.05 ft : 9-inch hole 10/20 Silica Sand		
255.05 - 261.5 ft : 9-inch hole 10/20 Silica Sand	253.05 - 255.05 ft : 4 inch 304L SS Sump	

261.5 ft : Borehole drilled depth

0 - 68.6 ft : 11-in. Cable Tool 10-3/4" CS Temp csg to 68.6 ft
68.6 - 261.5 ft : 9-in. Cable Tool 8-5/8" CS Temp csg to 261.5 ft

Report Form: WELLS Project File: WELLS.GPJ

Drawing By: JEA
Reference: Hanford Wells
Revision: 0
Revision Date: 13Nov01
Print Date: 13Nov01

BECHTEL

Figure G-6. Well 299-W14-18 Construction and Completion Summary (1 of 2)

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W14-18

WELL DESIGNATION	:	299-W14-18
CERCLA UNIT	:	
RCRA FACILITY	:	
DEPTH DRILLED (GS)	:	261.5 ft
MEASURED DEPTH (GS)	:	255.05 07Nov01
AVAILABLE LOGS	:	Geologist & Geophysical
DATE EVALUATED	:	Data not available
EVAL RECOMMENDATION	:	Data not available
LISTED USE	:	RCRA Monitoring
CURRENT USER	:	RCRA & Operations
PUMP TYPE	:	Not Documented
MAINTENANCE	:	Data not available
COMMENTS	:	Cable Tool 10-3/4" CS csg to 68.6 ft & 8-5/8" CS csg to 261.5 ft
TV SCAN COMMENTS	:	

Report Form: WELLS Project File: WELLS.GPJ

Drawing By: JEA
Reference: Hanford Wells
Revision: 0
Revision Date: 13Nov01
Print Date: 13Nov01

BECHTEL

Figure G-6. Well 299-W14-18 Construction and Completion Summary (2 of 2)

AS-BUILT WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Becker Hammer	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-W14-19 C3967
Drilling Fluid Used:	Air	Additives Used:	None	TEMPORARY WELL NO:	Not Allowed
Driller's Name:	Paul Lodder	WA State Lic Nr:	1628	Coordinates: N	Not documented
Drilling Company:	Layne Christensen	Company Location:	Salt Lake City, Ut	Coordinates: E	Not documented
Date Started:	24Oct02	Date Completed:	13Nov02	Start Card #:	Not Available
				Elevation Ground Surface:	

Depth to Water: (Ground surface) 223.55 ft ft 04Nov02

GENERALIZED STRATIGRAPHY Geologist's Log

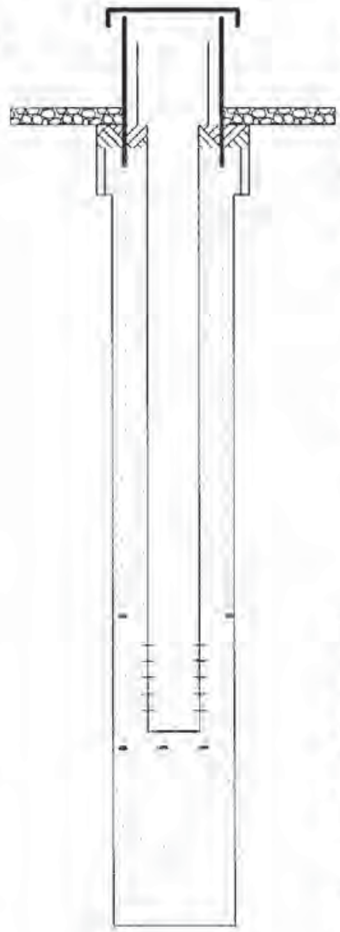
Elevation of Reference Point: m

Height of Reference Point Above Ground Surface:

Depth of Surface Seal: 0 ft

Type of Surface Seal: 4x4 Concrete Pad

0 - 3 ft : Backfill
3 - 41 ft : silty SAND (mS)
41 - 50 ft : sandy GRAVEL (sG)
50 - 95 ft : SAND (S)
95 - 100 ft : silty SAND (mS)
100 - 109 ft : SILT (m)
109 - 115 ft : CALICHE
115 - 125 ft : silty SAND (mS)
125 - 130 ft : silty sandy GRAVEL (msG)
130 - 135 ft : sandy GRAVEL (sG)
135 - 145 ft : GRAVEL (G)
145 - 150 ft : silty sandy GRAVEL (msG)
150 - 175 ft : sandy GRAVEL (sG)
175 - 185 ft : silty sandy GRAVEL (msG)
185 - 190 ft : sandy GRAVEL (sG)
190 - 200 ft : silty sandy GRAVEL (msG)
200 - 205 ft : SAND (S)
205 - 220 ft : sandy GRAVEL (sG)
220 - 225 ft : silty sandy GRAVEL (msG)
225 - 285 ft : sandy GRAVEL (sG)
285 - 295 ft : silty sandy GRAVEL (msG)
295 - 344 ft : sandy GRAVEL (sG)



Fill	Casing	Screen
0 - 10 ft : 11.25-inch hole Cement surface seal	0 - 223.5 ft : 4 inch	
10 - 30 ft : 11.25-inch hole Granular Bentonite	10 - 30 ft : 10.75 inch Left in hole	
30 - 208.3 ft : 9-inch hole Granular Bentonite		
208.3 - 213.5 ft : 9-inch hole 1/4" Bentonite Pellets		223.5 - 258.5 ft : 4 inch
213.5 - 260.5 ft : 9-inch hole 10/20 Silica sand		
260.5 - 264.9 ft : 9-inch hole 10/20 Silica sand	258.5 - 260.5 ft : 4 inch 304L SS csg and sump	
264.9 - 269.5 ft : 9-inch hole 1/4" Bentonite Pellets		
269.5 - 344.3 ft : 9-inch hole 4/8 Silica sand		

344.3 ft : Borehole drilled depth

0 - 30 ft : 11.5-in. Auger 10-3/4" Temp CS csg
30 - 344.3 ft : 9-in. Becker Hammer 9" x 7" Temp CS csg

Drawing By: JEA
Reference: Hanford Wells
Revision:
Revision Date: 16Dec02
Print Date: 16Dec02

Report Form: WELLS Project File: WELLS.GPJ

Figure G-7. Well 299-W14-19 Construction and Completion Summary

AS-BUILT WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Becker Hammer	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-W15-44 C3956 TEMPORARY WELL NO: Not Allowed
Drilling Fluid Used:	Air	Additives Used:	Not Documented	Coordinates: N	Not documented
Driller's Name:	Chris Dean	WA State Lic Nr:	2564	Coordinates: E	Not documented
Drilling Company:	Layne Christensen	Company Location:	Salt Lake City, Ut	Start Card #:	Not Documented
Date Started:	10Oct02	Date Completed:	23Oct02	Elevation Ground Surface:	

Depth to Water: 220.24 ft 17Oct02
(Ground surface)

Elevation of Reference Point: m

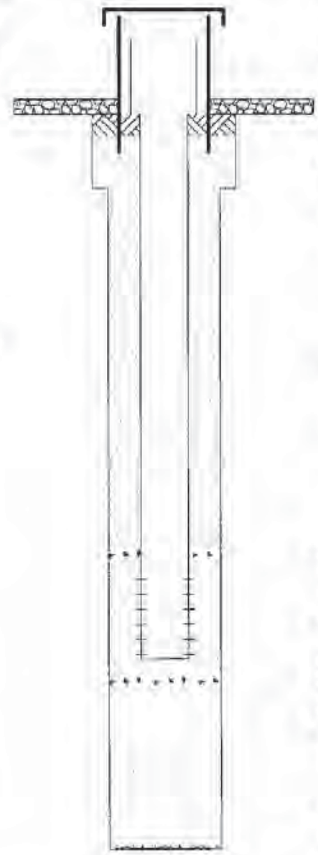
Height of Reference Point Above Ground Surface:

Depth of Surface Seal: 10.1 ft

Type of Surface Seal: 4x4 Concrete Pad

GENERALIZED STRATIGRAPHY Geologist's Log

0 - 15 ft : No Returns
15 - 27 ft : gravelly Sand (gS)
27 - 28.5 ft : Gravel (G)
28.5 - 35 ft : sandy Gravel (sG)
35 - 50 ft : silty Sand (mS)
50 - 105 ft : Sand (S)
105 - 125 ft : silty Sand (mS) - trace of caliche 113-114 ft
125 - 126.5 ft : gravelly Sand (gS)
126.5 - 141 ft : sandy Gravel (sG)
141 - 143 ft : Sand (S)
143 - 150 ft : sandy Gravel (sG)
150 - 165 ft : silty sandy Gravel (msG)
165 - 180 ft : sandy Gravel (sG)
180 - 185 ft : silty sandy Gravel (msG)
185 - 205 ft : sandy Gravel (sG)
205 - 210 ft : gravelly Sand (gS)
210 - 255 ft : sandy Gravel (sG)
255 - 285 ft : silty sandy Gravel (msG)
285 - 292 ft : SAND (S) - heaving
292 - 342 ft : sandy Gravel (sG)



Fill	Casing	Screen
0 - 10.1 ft : 11.5-inch hole Cement Surface Seal	0 - 216.25 ft : 4 inch 304L SS sch 5 csg	
10.1 - 34.5 ft : 11.5-inch hole Granular Bentonite		
34.5 - 201.4 ft : 9-inch hole Granular Bentonite		
201.4 - 206.3 ft : 9-inch hole 1/4" Bentonite pellets		216.25 - 251.25 ft : 4 inch 304L SS Wire Wrap .020 slot scrn
206.3 - 253.25 ft : 9-inch hole 10/20 Silica Sand	251.25 - 253.25 ft : 4 inch SS sump	
253.25 - 260.3 ft : 9-inch hole 10/20 Silica Sand		
260.3 - 265.6 ft : 9-inch hole 1/4" Bentonite pellets		
265.6 - 340.3 ft : 9-inch hole 4/8 Silica Sand		
340.3 - 342 ft : 9-inch hole Muddy slough		

342 ft : Borehole drilled depth

0 - 34.5 ft : 11.5-in. Auger 10-3/4" Temp CS csg
34.5 - 342 ft : 9-in. Becker Hammer 9" Dual Wall CS csg

Drawing By: JEA
Reference: Hanford Wells
Revision: 0
Revision Date: 06Nov02
Print Date: 06Nov02

Report Form: WELLS Project File: WELLS.GPJ

Figure G-8. Well 299-W15-44 Construction and Completion Summary

0540436

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Air Rotary Drl & Drive	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-W15-765 TEMPORARY C3397WELL NO: Not Allowed
Drilling Fluid Used:	Air	Additives Used:	None	Coordinates: N	Not documented
Driller's Name:	Mike Gomez	WA State Lic Nr:	Not Documented	Coordinates: E	Not documented
Drilling Company:	RSI	Company Location:	Woodland, Ca.	Start Card #:	R037816
Date Started:	19Sep01	Date Completed:	04Oct01	Elevation Ground Surface:	

Depth to Water: 219.8 ft 27Sep01
(Ground surface)

GENERALIZED STRATIGRAPHY Geologist's Log

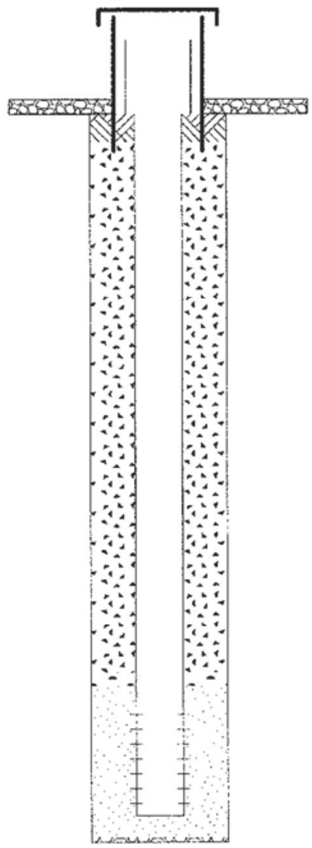
Elevation of Reference Point: m

Height of Reference Point Above Ground Surface:

Depth of Surface Seal: 10.2 ft.

Type of Surface Seal: 4x4 Concrete Pad

0 - 2 ft : Drill Pad
2 - 5 ft : Gravelly Sand
5 - 25 ft : Sandy Gravel
25 - 30 ft : Gravel
30 - 35 ft : Silty Gravel
35 - 40 ft : Slightly Silty Gravelly Sand
40 - 92 ft : Sand
92 - 93 ft : Silty Sand
93 - 105 ft : Silt
105 - 110 ft : Gravelly Silt
110 - 117 ft : Sandy Silt
117 - 120 ft : Sand
120 - 125 ft : Sandy Silt
125 - 130 ft : Silt
130 - 135 ft : Sand
135 - 136 ft : Silty Gravel
136 - 140 ft : Gravel
140 - 150 ft : Sandy Gravel
150 - 151 ft : Gravelly Silty Sand
151 - 155 ft : Gravel
155 - 157 ft : Gravelly Sandy Silt
157 - 160 ft : Gravel
160 - 170 ft : Sandy Gravel
170 - 175 ft : Gravel
175 - 180 ft : Silty gravel
180 - 195 ft : Gravelly Sand
195 - 200 ft : Sandy gravel
200 - 220 ft : Silty Gravel
220 - 230 ft : Silty Sandy Gravel
230 - 235 ft : Gravel
235 - 240 ft : Silty Gravel
240 - 250 ft : Silty Sandy Gravel
250 - 255 ft : Gravel
255 - 265 ft : Sandy Gravel



Fill	Casing	Screen
0 - 10.2 ft : 11-inch hole Cement Surface Seal	0 - 220 ft : 4 inch 304L SS sch 5 csg	
10.2 - 204.8 ft : 11-inch hole 8/20 Bentonite Crumbles		
204.8 - 209.5 ft : 11-inch hole 1/4" Bentonite Pellets		220 - 255 ft : 4 inch 304L SS Wire Wrap .020 slot scrn
209.5 - 257.1 ft : 11-inch hole 10/20 Silica Sand		
257.1 - 265 ft : 11-inch hole 10/20 Silica Sand	255 - 257.1 ft : 4 inch 304L SS Sump	
265 - 267 ft : 11-inch hole Slough		

267 ft : Borehole drilled depth

0 - 267 ft : 11-in. air Rotary Drl & Drive
10-5/8" CS Temp csg to 267 ft

Drawing By: JEA
Reference: Hanford Wells
Revision: 0
Revision Date: 08Nov01
Print Date: 08Nov01

Report Form: WELLS Project File: WELLS.GPJ

Figure G-9. Well 299-W15-765 Construction and Completion Summary (1 of 2)

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W15-765

WELL DESIGNATION	:	299-W15-765
CERCLA UNIT	:	
RCRA FACILITY	:	
DEPTH DRILLED (GS)	:	267.0 ft
MEASURED DEPTH (GS)	:	257.1 27Sep01
AVAILABLE LOGS	:	Geologist & Geophysical
DATE EVALUATED	:	Data not available
EVAL RECOMMENDATION	:	Data not available
LISTED USE	:	RCRA Monitoring
CURRENT USER	:	RCRA & Operations
PUMP TYPE	:	Not Documented
MAINTENANCE	:	Data not available
COMMENTS	:	Air Rotary Drg & Drive 10-5/8" CS Temp csg to 265 ft
TV SCAN COMMENTS	:	

Report Form: WELLS Project File: WELLS.GPJ

Drawing By: JEA
Reference: Hanford Wells
Revision: 0
Revision Date: 08Nov01
Print Date: 08Nov01

BECHTEL

Figure G-9. Well 299-W15-765 Construction and Completion Summary (2 of 2)

G2 References

NAD83, 1991, *North American Datum of 1983*, as revised, National Geodetic Survey, Federal Geodetic Control Committee, Silver Spring, Maryland. Available at: http://www.ngs.noaa.gov/.

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

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Appendix H

Well Construction for Waste Management Area U

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Contents

Figures

Tables

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H1 Introduction

This appendix provides the following information for the existing Waste Management Area (WMA) U groundwater monitoring wells:

- Well name
- Hydrogeologic unit monitored (the aquifer portion at the well screen perforation) (Table H-1)
- The following sampling interval information, as provided in Table H-2:
  - Elevation at the top of the screen or perforated interval
  - Elevation at the bottom of the screen or perforated interval
  - Open interval length (i.e., difference between the top and bottom screen perforation elevations)
  - Drilling method

For proposed wells, the following design information is provided in Table H-3:

- Well location
- Drill depth
- Well diameter
- Screen interval depth
- Sump and end cap interval

Figures H-1 through H-7 provide construction and completion summaries for the existing network wells.

Table H-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 H-2. Sampling Interval Information for Wells Within the WMA U 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])	Drilling Method
299-W18-40	TU	136.2 (446.9)	125.5 (411.9)	10.7 (35.0)	Cable tool
299-W18-260	TU	132.0 (433.0)	122.8 (403.0)	9.1 (30.0)	Cable tool
299-W19-41	TU	138.7 (455.1)	128.0 (420.0)	10.7 (35.1)	Air rotary
299-W19-42	TU	138.4 (454.0)	127.7 (418.9)	10.7 (35.1)	Air rotary
299-W19-44	TU	136.4 (447.7)	125.8 (412.7)	10.7 (35.0)	Cable tool
299-W19-45	TU	137.3 (450.6)	126.7 (415.7)	10.6 (34.9)	Cable tool/air rotary

Table H-2. Sampling Interval Information for Wells Within the WMA U 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])	Drilling Method
299-W19-47	TU	136.3 (447.3)	125.7 (412.3)	10.7 (35.0)	Cable tool

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

Note: Due to rounding and conversion of metric units, the computed open interval length based on the top and bottom elevations may differ slightly from the actual open interval length reported in the associated well summary sheet.

TU = Top of Unconfined, as described in Table H-1

Table H-3. Planned Location, Depth, and Screen Interval for Proposed Well Within the WMA U Network

Proposed Well (Well ID)	Northing* (m)	Easting* (m)	Surface Elevation (m [ft] NAVD88)	Water Table Elevation (m [ft] NAVD88)	Depth to Water (m [ft] bgs)	Drill Depth (m [ft] bgs)	Final Well Diameter (cm [in.])	Screen Interval (m [ft] bgs)	Sump and End Cap Interval (m [ft] bgs)
WMA-U_PW1 (D0016)	135140.85	566656.54	TBD	TBD	TBD	TBD	TBD	TBD	TBD

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

Note: Well coordinates are estimates and subject to modification based on final well location survey.

*Coordinates are in Washington State Plane (south zone), NAD83, *North American Datum of 1983*; 1991 adjustment.

bgs = below ground surface

TBD = to be determined

WELL SUMMARY SHEET

0540421

Page 1 of 2

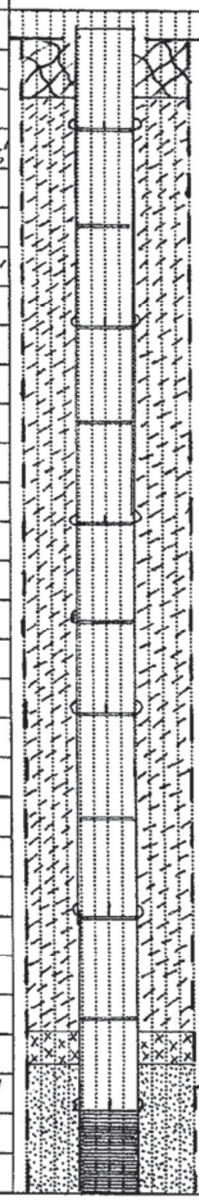
Date: 08/17/01

Well ID: C3395	Well Name: 299-W18-40
Location: SW corner of 241-U Tank Farm	Project: CY01 RCRA Drilling
Prepared By: C. Martinez | L.D. Walker Date: 04/19/01	Reviewed By: D.C. Weekes Date: 10/10/01
Signature: C. Martinez | L.D. Walker	Signature: D.C. Weekes

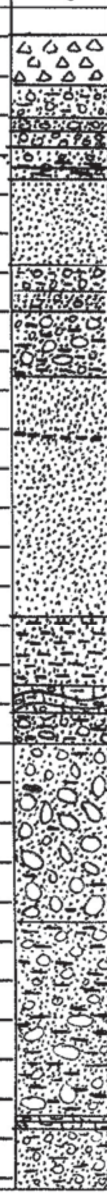
CONSTRUCTION DATA			GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description

Construction Data — Description:

- Portland cement Grout 0'-11.6'
- Casing: 4" sched 5 SS 304L ~~+1.9' → 218.27'~~ +1.9' → 218.27'
- Granular Bentonite: 11.6' → 202.0'
- Bentonite Pellets: 202.0' → 207.8'
- Wellscreen: SS 304L 0.020-in slot cont. wire-wrap 218.27' → 253.28'



Depth in Feet: 0, 40, 80, 120, 160, 200



Lithologic Description:

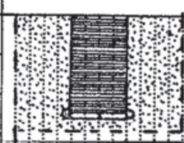
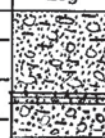
- 0'-10' Fill material
- 10'-17' Silty Sandy Gravel (msG)
- 17'-19' Gravelly Sand (gS)
- 19'-23' Sandy Gravel (sG)
- 23'-27' Slightly Silty Sandy Gravel
- 27'-30' Silty Sand (ms)
- 30'-47.0' Sand (s)
- 47'-53' Silty sandy GRAVEL (msG)
- 53'-56' Gravelly SAND (gS)
- 56'-69.5' silty sandy GRAVEL (msG)
- 69.5'-119' SAND (s)
- 119-132.5' Sandy SILT (sM) (81' silt layer)
- 132.5'-138.0' Silty Sandy Gravel w/ caliche
- 138'-144' silty sandy Gravel (msG)
- 144'-180' sandy GRAVEL (sG)
- 180'-220.5' silty sandy GRAVEL (msG)
- 220.5'-222.5' cemented silty sandy gravel
- 222.5'-250.0' silty sandy GRAVEL (msG)

BHI-EE-189 (12/97)

Figure H-1. Well 299-W18-40 Construction and Completion Summary (1 of 2)

WELL SUMMARY SHEET		Page 2 of 2
		Date: 09119101
Well ID: C3395	Well Name: 299-W18-40	
Location: SW Corner of 241-U Tank Farm	Project: CY01 RCRA Drilling	
Prepared By: C. Martinez \ LD Walker — Date: 09119101	Reviewed By: DC Weekes	Date: 10/10/01
Signature: C. Martinez \ DC Weekes for LD Walker	Signature: DC Weekes	

CONSTRUCTION DATA / **GEOLOGIC/HYDROLOGIC DATA**

Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description
Sandpack: 10-20 mesh silica 207.8' → 257.8'		240		250.0'-252.5' cemented silty sandy gravel
				252.5'-260' silty sandy gravel (msG)
Tailpipe with welded endcap: 253.28' → 255.28'		280		TD = 260' bgs
				WL = 214.6' 9/27/01
WHAT'S FROM 257.8 TO 260 SLOUGH? YES				
		300		
All temporary casing removed from ground				
All depths are in Feet below ground surface				

BHI-EE-189 (12/97)

Figure H-1. Well 299-W18-40 Construction and Completion Summary (2 of 2)

WELL SUMMARY SHEET		Start Date: 8-20-2014 Finish Date: 11-25-14	Page 1 of 3
Well ID: C8925		Well Name: 299-W18-260	
Location: N of WMA U Tank Farm		Project: TPA M-24 Monitoring Wells	
Prepared by: Abby Wicks	Date: 10-23-2014	Reviewed by: D. MEHRER	Date: 1-21-15
Signature: Abby a. Wicks		Signature:	

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description

CONSTRUCTION DATA – Description

Temporary Casing Materials

10 3/4" Carbon Steel
(9 3/4" OD, 10 3/4" ID)
0.0 ft -129.87' ft bgs
8" Carbon Steel
(8 11/16" OD, 8 3/4" ID)
129.87 ft bgs-232.12

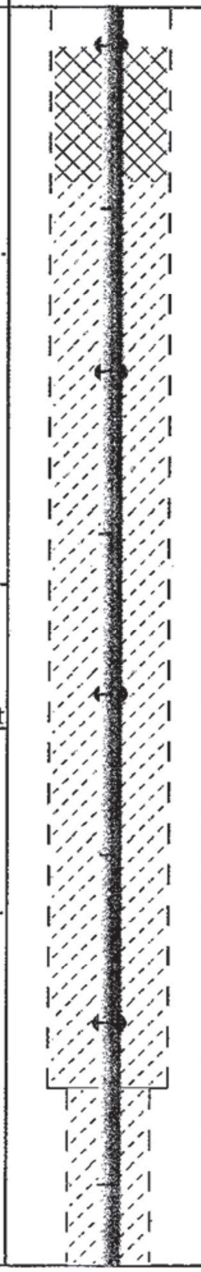
Permanent Casing Materials

4" Type 304 L sch 10s Riser
2.00 ft ags-239.77 ft bgs
4" Type 304 L sch 10s
Continuous wire wrap screen
20 Slot
239.77 ft bgs-269.77 ft bgs
4" Type 304 L sch 10s Sump
269.77 ft bgs-272.77 ft bgs

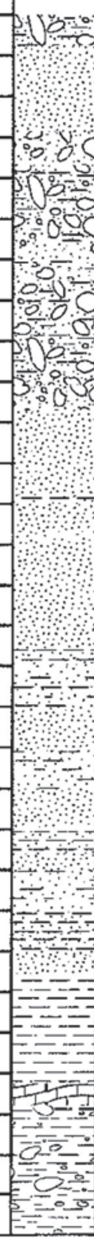
Construction Materials

Concrete
0 ft bgs-2.5 ft bgs
Type I-II Portland Cement Grout
2.5 ft bgs-14.10 ft bgs
Granular Bentonite Crumbles
14.10 ft bgs-233.4 ft bgs
3/8" Bentonite Pellets
233.4 ft bgs-235.8 ft bgs
16-30 Mesh Colorado Silica Sand
235.8 ft bgs- 274.4 ft bgs
3/4" Bentonite Hole Plug
274.4 ft bgs- 322.2 ft bgs
Natural Fill
322.2 ft bgs-326.3 ft bgs

Note: All temporary casing has been removed from the ground. All depths are reported in feet below ground surface (ft bgs) unless otherwise noted.



Depth in Feet: 0, 25, 50, 75, 100, 125



Lithologic Description

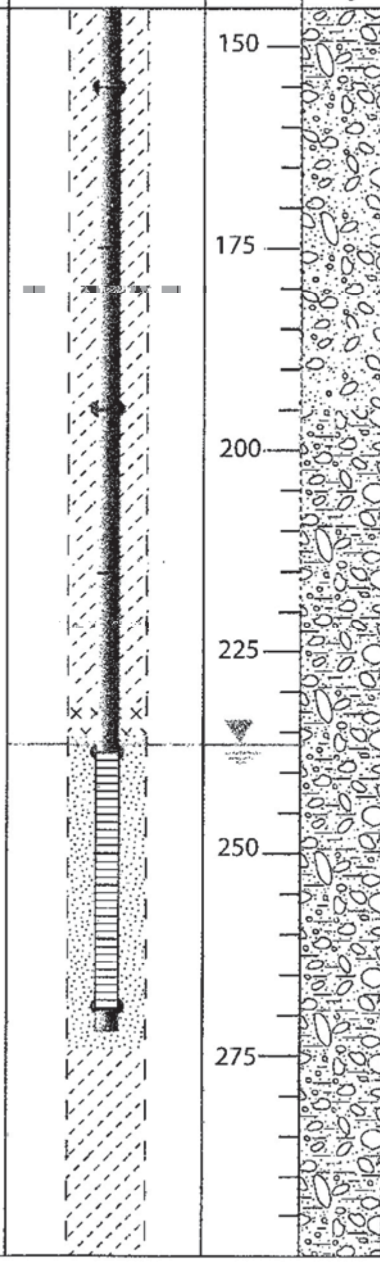
0'-4' Drill Pad, Sandy Gravel [sG]
4'-15' Sand [S]
15'-19' Sandy Gravel [sG]
19'-28' Gravel [G]
28'-33' Sandy Gravel [sG]
33'-45' Sandy Gravel [sG]
45'-48' Sandy Gravel [sG]
48'-58' Sand [S]
58'-60' Silty Sand [mS]
60'-78' Sand [S]
78'-80' Sandy Silt [sM]
80'-85' Slightly Silty Sand [(m)S]
85'-90' Sand [S]
90'-95' Silty Sand [mS]
95'-100' Sand [S]
100'-103' Sandy Silt [sM]
103'-105' Sand [S]
105'-110' Silty Sand [mS]
110'-115' Sandy Silt [sM]
115'-117' Sand [S]
117'-131.4' Silt [M]
131.4'-136' Caliche Silt [M]
136'-145' Gravelly Silt [gM]

A-6003-643 (03/03)

Figure H-2. Well 299-W18-260 Construction and Completion Summary (1 of 3)

WELL SUMMARY SHEET		Start Date: 8-20-2014 Finish Date: 11-25-14	Page 2 of 3
Well ID: C8925		Well Name: 299-W18-260	
Location: N WMA U Tank Farm		Project: TPA M-24 Monitoring Wells	
Prepared by: Abby Wicks	Date: 10-23-2014	Reviewed by: J.D. MEHRER	Date: 1-21-15
Signature: Abby a Wicks		Signature:	

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description



145'-155' Sandy Gravel [sG]

155'-185' Gravel [G]

185'-190' Sandy Gravel [sG]

190'-326.3' Sandy Gravel [sG]

Depth to water 236.6 ft bgs. 9/18/14

A-6003-643 (03/03)

Figure H-2. Well 299-W18-260 Construction and Completion Summary (2 of 3)

WELL SUMMARY SHEET		Start Date: 8-20-2014 Finish Date: 11-25-14	Page 3 of 3
Well ID: C8925		Well Name: 299-W18-260	
Location: N WMA U Tank Farm		Project: TPA M-24 Monitoring Wells	
Prepared by: Abby Wicks	Date: 10-23-2014	Reviewed by: J. D. MEHRER	Date: 1-21-15
Signature: Abby a. Wicks		Signature:	

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
		300		190'-326.3' Silty Sandy Gravel [msG]
		325		
				TD @ 326.3' bgs
				DTW 237.4' bgs 11/25/14

A-6003-643 (03/03)

Figure H-2. Well 299-W18-260 Construction and Completion Summary (3 of 3)

0502374

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Air Rotary - TUBEX	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-W19-41 B8551 TEMPORARY WELL NO: Not Allowed
Drilling Fluid Used:	Reverse Air	Additives Used:	None	Coordinates: N	Not documented
Driller's Name:	Willie Franklin	WA State Lic Nr:	Not Available	Coordinates: E	Not documented
Drilling Company:	Layne Christensen	Company Location:	Salt Lake City, Ut	Start Card #:	Not Available
Date Started:	17Sep98	Date Completed:	23Sep98	Elevation Ground Surface:	Brass Marker

Depth to Water: 220.35 ft 23Sep98
(Ground surface)

Elevation of Reference Point: m

Height of Reference Point Above Ground Surface:

Depth of Surface Seal: 10.5 ft

Type of Surface Seal: 4x4 Concrete Pad

GENERALIZED STRATIGRAPHY — Geologist's Log & Geophysical Logs

0 - 0.1 ft : Asphalt
0.1 - 14 ft : Silty sandy gravel
14 - 22 ft : Sand
22 - 39 ft : Sandy gravel

39 - 43 ft : Gravelly sand
43 - 47 ft : Sandy gravel
47 - 54 ft : Gravelly sand
54 - 81 ft : Sand

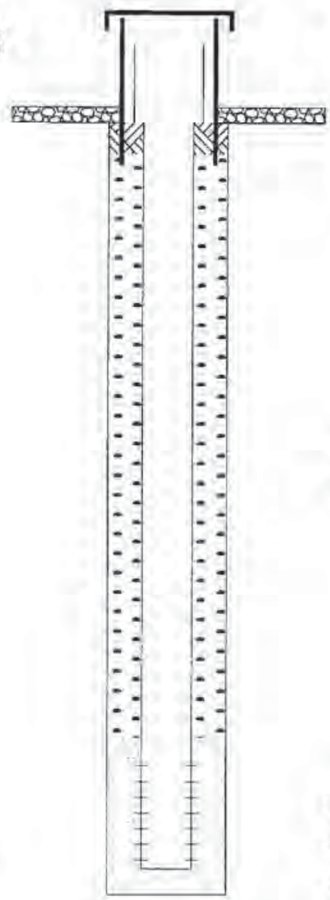
81 - 84 ft : Sand (Fn)
84 - 88 ft : Sand (Cse)
88 - 91 ft : Sand (Fu)
91 - 127 ft : Sand

127 - 136 ft : Silty sand
136 - 144 ft : Sandy silt - calcareous
144 - 168 ft : Silty sandy gravel

168 - 188 ft : Sandy gravel

188 - 249 ft : Silty sandy gravel
(Water Level = 220.35')

249 - 253 ft : Silty sandy gravel - Fe staining
253 - 264.5 ft : Silty sandy gravel



Fill	Casing	Screen
0 - 10.5 ft : 9.125-inch hole Cement Seal	0 - 220.05 ft : 4 inch 4" Sch.5 SS Csg.	
10.5 - 210.4 ft : 9.125-inch hole Bentonite Chips		
210.4 - 255.47 ft : 9.125-inch hole 20/40 Silica Sand		220.05 - 255.14 ft : 4 inch 4" Wire Wrap SS Screen .010 Slot
255.47 - 264.5 ft : 9.125-inch hole 20/40 Silica Sand	255.14 - 255.47 ft : 4 inch 4" SS End Cap	

264.5 ft : Borehole drilled depth

0 - 264.5 ft : 9.125-in. 8-5/8" CS Temp. Csg. set with TUBEX reverse air rotary

Drawing By: TGB
Reference: Hanford Wells
Revision: 0
Revision Date: 25Sep98
Print Date: 28Dec98

Report Form: WELLS Project File: WELLS.GPJ

Figure H-3. Well 299-W19-41 Construction and Completion Summary (1 of 2)

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W19-41

WELL DESIGNATION	:	299-W19-41
CERCLA UNIT	:	
RCRA FACILITY	:	
DEPTH DRILLED (GS)	:	264.5 ft
MEASURED DEPTH (GS)	:	255.47
AVAILABLE LOGS	:	Geologist & Geophysical Logs
DATE EVALUATED	:	Data not available
EVAL RECOMMENDATION	:	Data not available
LISTED USE	:	Data not available
CURRENT USER	:	RCRA & Operations
PUMP TYPE	:	Data not available
MAINTENANCE	:	Data not available
COMMENTS	:	8-5/8" TUBEX Sys. 4-1/2" Reverse Cir. Drl. Pipe with interchange
TV SCAN COMMENTS	:	

Report Form: WELLS Project File: WELLS.GPJ

Drawing By: TGB
Reference: Hanford Wells
Revision: 0
Revision Date: 25Sep98
Print Date: 28Dec98

BECHTEL

Figure H-3. Well 299-W19-41 Construction and Completion Summary (2 of 2)

0502376

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Air Rotary - TUBEX	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-W19-42 B8553
				TEMPORARY WELL NO:	Not Allowed
Drilling Fluid Used:	Reverse Air	Additives Used:	None	Coordinates: N	Not documented
Driller's Name:	Willie Franklin	WA State Lic Nr:	Not Available	Coordinates: E	Not documented
Drilling Company:	Layne Christensen	Company Location:	Salt Lake City, Ut	Start Card #:	Not Available
Date Started:	31Aug98	Date Completed:	16Sep98	Elevation Ground Surface:	Brass Marker

Depth to Water: 219.56 ft 16Sep98
(Ground surface)

GENERALIZED STRATIGRAPHY — Geologist's Log & Geophysical Logs

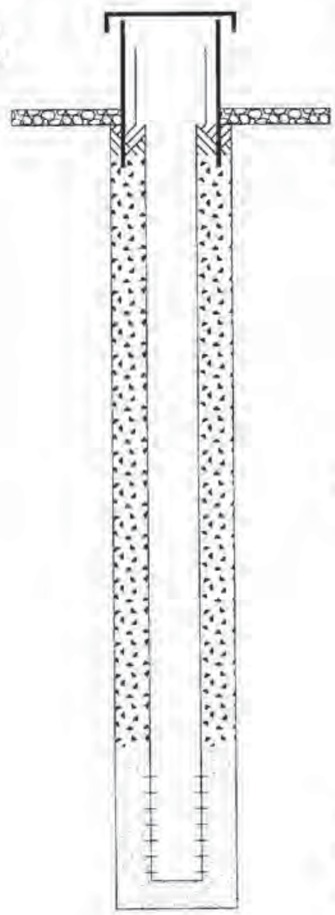
Elevation of Reference Point: m

Height of Reference Point Above Ground Surface:

Depth of Surface Seal: 10.2 ft

Type of Surface Seal: 4x4 Concrete Pad

0 - 0.7 ft : Backfill (gm 5)
0.7 - 7 ft : Sand
7 - 15 ft : Sandy gravel
15 - 119.5 ft : Silty sand
15 - 16 ft : Sand
16 - 32.5 ft : Sandy gravel
32.5 - 39 ft : Sandy gravel
39 - 43.5 ft : Sandy gravel
43.5 - 52 ft : Slightly silty gravelly sand
52 - 53 ft : Sandy gravel
53 - 71 ft : Sand
71 - 79 ft : Sand
79 - 84 ft : Slightly silty sand
84 - 89 ft : Sand
89 - 105 ft : Slightly silty sand
119.5 - 138.5 ft : Silt
138.5 - 141 ft : Caliche
141 - 170 ft : Silty sandy gravel
170 - 189 ft : Silty sandy gravel
189 - 196 ft : Gravelly sand
196 - 222 ft : Sandy gravel
222 - 265.2 ft : Silty sandy gravel



Fill	Casing	Screen
0 - 10.2 ft : 9.125-inch hole Cement Seal	0 - 220.28 ft : 4 inch 4" Sch 5 SS Csg.	
10.2 - 210.2 ft : 9.125-inch hole Bentonite Chips		
210.2 - 255.7 ft : 9.125-inch hole 20-40 Silica Sand		220.28 - 255.37 ft : 4 inch 4" Wire Wrap SS Screen .010 Slot
255.7 - 265.2 ft : 9.125-inch hole 20-40 Silica Sand	255.37 - 255.7 ft : 4 inch 4" SS End Cap	

265.2 ft : Borehole drilled depth

0 - 265.2 ft : 9.125-in. 8-5/8" CS Temp. Csg.

Drawing By: TGB
Reference: Hanford Wells
Revision: 0
Revision Date: 21Sep98
Print Date: 28Dec98

Report Form: WELLS Project File: WELLS.GPJ

BECHTEL

Figure H-4. Well 299-W19-42 Construction and Completion Summary (1 of 2)

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W19-42

WELL DESIGNATION	:	299-W19-42
CERCLA UNIT	:	
RCRA FACILITY	:	
DEPTH DRILLED (GS)	:	265.2 ft
MEASURED DEPTH (GS)	:	
AVAILABLE LOGS	:	Data not available
DATE EVALUATED	:	Data not available
EVAL RECOMMENDATION	:	Data not available
LISTED USE	:	Data not available
CURRENT USER	:	RCRA & Operations
PUMP TYPE	:	Data not available
MAINTENANCE	:	Data not available
COMMENTS	:	8-5/8" TUBEX Sys. 4-1/2" Reverse Cir. Drl. Pipe with Interchange
TV SCAN COMMENTS	:	

Report Form: WELLS Project File: WELLS.GPJ

Drawing By:	TGB
Reference:	Hanford Wells
Revision:	0
Revision Date:	21Sep98
Print Date:	28Dec98

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Figure H-4. Well 299-W19-42 Construction and Completion Summary (2 of 2)

0540340

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Cable Tool	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-W19-44 C3393 TEMPORARY WELL NO: Not Allowed
Drilling Fluid Used:	None	Additives Used:	raw water	Coordinates: N	Not documented
Driller's Name:	K. Olson	WA State Lic Nr:	Data not available	Coordinates: E	Not documented
Drilling Company:	RSI	Company Location:	Woodland, Ca.	Start Card #:	R
Date Started:	05Sep01	Date Completed:	13Sep01	Elevation Ground Surface:	

Depth to Water: **230.9 ft 05Sep01**
(Ground surface)

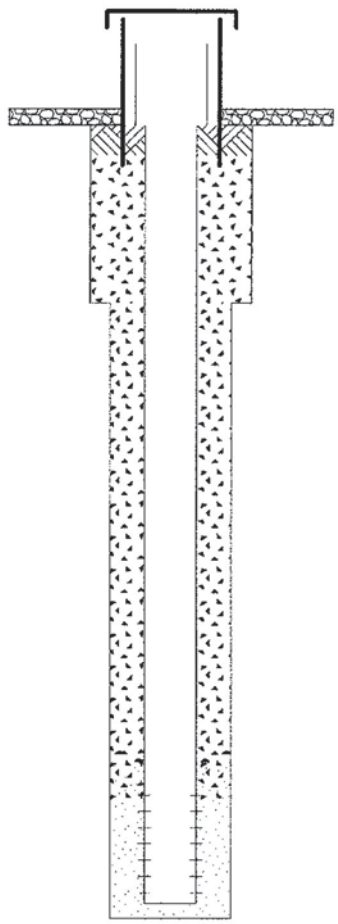
GENERALIZED STRATIGRAPHY **Geologist's Log**

Elevation of Reference Point: m

Height of Reference Point Above Ground Surface:

Depth of Surface Seal: **10.3 ft**

Type of Surface Seal: **4x4 Concrete Pad**



0 - 2.5 ft : Sandy Gravel (Sg)
2.5 - 7 ft : gravelly Sand (gS)
7 - 11 ft : sandy Gravel (sG)
11 - 19 ft : gravelly Sand (gS)
19 - 31 ft : silty sandy Gravel (MSG)
31 - 38.5 ft : sandy Gravel (sG)
38.5 - 44 ft : gravelly Sand (gS)
44 - 45.5 ft : sandy Gravel (sG)
45.5 - 50 ft : cemented silty Gravel
50 - 52 ft : gravelly Sand (gS)
52 - 58 ft : Sand (S)
58 - 59.2 ft : Silt (m)
59.2 - 67 ft : Sand (S)
67 - 67.5 ft : sandy Silt (sm)
67.5 - 68 ft : Silt (m)
68 - 69 ft : Sand (S)
69 - 70.5 ft : Silt (m)
70.5 - 81.5 ft : Sand (S)
81.5 - 88 ft : sandy Silt (sm)
88 - 97.5 ft : silty Sand (mS)
97.5 - 103 ft : Sand (S)
103 - 131.8 ft : silty Sand (mS)
131.8 - 144.5 ft : Silt (m)

144.5 - 150.5 ft : Caliche
150.5 - 155 ft : slightly silty gravelly sand
155 - 233 ft : silty sandy Gravel

233 - 234.45 ft : cemented silty sandy gravel
234.5 - 267.5 ft : silty sandy Gravel (msG)

267.5 - 269.5 ft : cemented silty sandy gravel
269.5 - 272 ft : silty sandy Gravel (msG)

Fill	*Casing*	*Screen*
0 - 10.3 ft : 12-inch hole Cement Surface Seal	0 - 229.9 ft : 4 inch 304L SS sch 5 csg	
10.3 - 61 ft : 12-inch hole Bentonite crumbles		
61 - 231.3 ft : 9-inch hole Bentonite crumbles		
213.3 - 218.9 ft : 9-inch hole 1/4" Bentonite Pellets		229.9 - 264.9 ft : 4 inch 304L SS Wire Wrap .020 slot scrn
218.9 - 266.9 ft : 9-inch hole 10/20 Silica Sand		
266.9 - 272 ft : 9-inch hole 10/20 Silica Sand	264.9 - 266.9 ft : 4 inch 304L SS Sump	

272 ft : Borehole drilled depth

0 - 61 ft : 12-in. Cable Tool 11-3/4" CS Temp csg
61 - 272 ft : 9-in. Cable Tool 8-5/8" CS Temp csg

Drawing By: **JEA**
Reference: **Hanford Wells**
Revision: **0**
Revision Date: **18Oct01**
Print Date: **24Oct01**

BECHTEL

Report Form: WELLS Project File: WELLS.GPJ

Figure H-5. Well 299-W19-44 Construction and Completion Summary (1 of 2)

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W19-44

WELL DESIGNATION	:	299-W19-44
CERCLA UNIT	:	
RCRA FACILITY	:	
DEPTH DRILLED (GS)	:	272.0 ft
MEASURED DEPTH (GS)	:	266.9 13Sep01
AVAILABLE LOGS	:	Geologist & Geophysical
DATE EVALUATED	:	Data not available
EVAL RECOMMENDATION	:	Data not available
LISTED USE	:	RCRA Monitoring
CURRENT USER	:	RCRA & Operations
PUMP TYPE	:	Not Documented
MAINTENANCE	:	Data not available
COMMENTS	:	Cable Tool 11-3/4" Temp CS csg to 61 ft, 8-5/8" temp Cs csg to 272 ft
TV SCAN COMMENTS	:	

Report Form: WELLS Project File: WELLS.GPJ

Drawing By:	JEA
Reference:	Hanford Wells
Revision:	0
Revision Date:	18Oct01
Print Date:	24Oct01

BECHTEL

Figure H-5. Well 299-W19-44 Construction and Completion Summary (2 of 2)

WELL SUMMARY SHEET

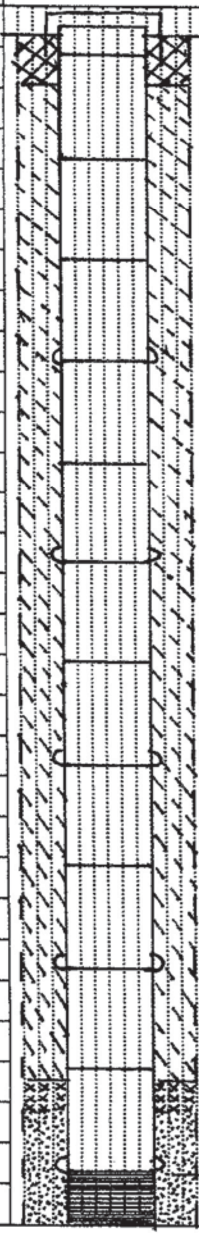
0540420

Page 1 of 2	Date: 08/15/01
Well ID: C3394	Well Name: 299-W19-45
Location: East side of 241-U	Project: C401 RCRA Drilling
Prepared By: Charlene Martinez Date: 08/21/01	Reviewed By: DC Weekes Date: 9/20/01
Signature: Charlene Martinez	Signature: DC Weekes

CONSTRUCTION DATA

Description
6"-dia. protective casing set 1.0' above 4" stainless casing
4" ID SS304L casing: +2.11' → 224.13'
Portland Cement Grout: 0' → 9.5'
Bentonite Crumbles: 9.5' → 207.3'
3/8" Bentonite Pellets: 207.3' → 213.4'
4" ID SS304L 0.020-in. slot cont. wire-wrap wellscreen: 224.13' → 259.03'
10-20 mesh silica sand: 213.4' → 266.1'
4" ID SS304L Tailpipe (sump): 259.03' → 261.13'
All temporary casing removed.
All depths are in feet below ground surface.

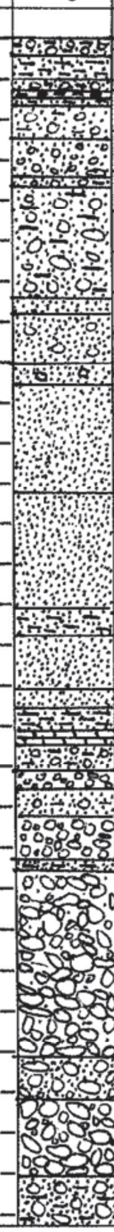
Diagram



Depth in Feet: 0, 40, 80, 120, 160, 200

GEOLOGIC/HYDROLOGIC DATA

Graphic Log



Lithologic Description
0-4.5' Silty Sandy Gravel (msG)
4.5'-8.0' Sandy Silt (sm)
8.0'-10.5' Silty Sandy Gravel (msG)
10.5'-11.0' Silt (m)
11.0'-13.0' Silty Sand (ms)
13.0'-20.0' Silty Sandy Gravel (msG)
20.0'-28.5' Sandy Gravel (sG)
28.5'-30.0' slightly Silty Sandy Gravel
30.0'-52.0' Silty Sandy Gravel (msG)
52.0'-55.0' Sand (S)
55.0'-64.0' Gravelly Sand (gS)
64.0'-69.0' Sand (S) to gravel
69.0'-90.0' Sand (S)
90.0'-113' Sand (S)
113.0'-118.0' Silty Sand (ms)
118.0'-129.0' Sand (S)
129.0'-133' Sand (S)
133.0'-137.0' Sandy Silt (sm)
137.0'-139.0' Calcrete
139.0'-145.0' Silty Sandy Gravel (msG)
145.0'-148.0' Gravel (G)
148.0'-154.0' Gravelly silty Sand (gms)
154.0'-163.0' Gravel (g)
163.0'-165.0' Silty Sand (ms)
166.0'-202.0' Gravel (g) to silt/sand
202.0'-210.0' Sandy Gravel (sg)
210.0'-225.0' Gravel (g)
225.0'-266.0' Silty Sandy Gravel (msg)

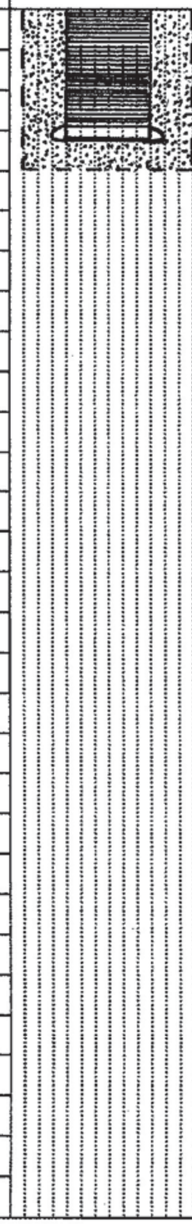
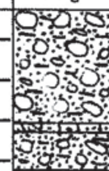
BHI-EE-189 (12/97)

Figure H-6. Well 299-W19-45 Construction and Completion Summary (1 of 2)

WELL SUMMARY SHEET

Page 2 of 2
Date: 08/15/01

Well ID: C3394	Well Name: 299-W19-45
Location: East of 241-U Tank Farm	Project: C401 RCRA Drilling
Prepared By: Charlene Martinez — Date: 08/21/01	Reviewed By: DC Weekes — Date: 9/20/01
Signature: Charlene Martinez	Signature: DC Weekes

CONSTRUCTION DATA			GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description
		240		
				cm 10/23/01
				~~257.0'-259.0 silty sandy gravel~~
				~~(msg) slightly cemented~~ cm 10/23/01
				(part of previous description)
		280		225'-266'
		300		
				TD = 266.1' bgs
				Static water level = 224.4'
				on 8/24/01 DCW
All temporary casing removed.				
All depths are in feet below ground surface				

BHI-EE-189 (12/97)

Figure H-6. Well 299-W19-45 Construction and Completion Summary (2 of 2)

WELL SUMMARY SHEET

Start Date 04/23/04	Finish Date. 08/09/04	Page 1 of 2	
Well ID: C4258	Well Name 299-W19-47		
Location East side of WMA-U/200 West	Project. RCRA/CERCLA drilling, FY2004		
Prepared By Charlene Martinez	Date 08/11/04	Reviewed By L.D. Walker	Date. 8-24-04
Signature Charlene Martinez	Signature. LD Walker		

CONSTRUCTION DATA

Description

11 7/8" / 10 7/8" temporary casing used.

6" ID SS304 protective casing set + 1.0' above permanent.

4" ID SS304, sch.5 riser: + 2.0' → 227.05'

Portland cement: 0' → 10.7'

Granular Bentonite: 10.7' → 215.8'

*Formation slough 62.3' → 66.3'

3/8" Bentonite Pellets: 215.8' → 220.7'

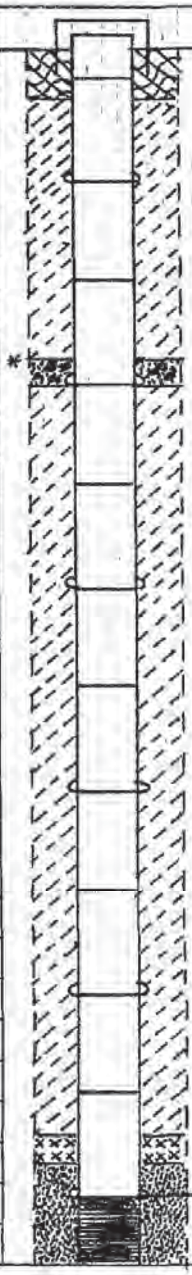
10-20 mesh Colorado Silica Sand: 220.7' → 269'

4" ID SS304, sch5, 0.020-inch slot wire-wrap wellscreen: 227.05' → 262.04'

All depths in feet below ground surface.

All temporary casing removed from ground.

Diagram



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet: 0, 40, 80, 120, 160, 200

Graphic Log

Lithologic Description

0'-1' Backfill material

1'-8' SAND(S) Hanford Fmtn

8'-15' sandy GRAVEL(sG)

15'-16.5' SAND(S)

16.5'-17.5' Sandy GRAVEL(sG)

17.5'-23' SAND(S)

23'-27' sandy GRAVEL(sG)

27'-36' silty sandy GRAVEL(msG)

36'-47' sandy GRAVEL(sG)

47'-53' gravelly SAND(gS)

53'-90' SAND(S)

90'-124' silty SAND(mS)

124'-138' SILT(m) (Cold Creek unit)

138'-145' CALICHE. Silty Sandy Gravel (msG)

145'-162' Silty Sandy GRAVEL (msG)

162'-165' Sandy GRAVEL(sG)

165'-185.5' Silty Sandy GRAVEL (msG)

185.5'-192' Sand (S)

192'-198.5' silty sandy gravel (msG)

198.5'-201' sand (S)

201'-204' sandy gravel (sG)

204'-227' silty sandy gravel (msG)

227'-229' sandy GRAVEL(sG)

A-6003-643 (03/03)

Figure H-7. Well 299-W19-47 Construction and Completion Summary (1 of 2)

WELL SUMMARY SHEET		Start Date 04/23/04 Finish Date 08/09/04	Page 2 of 2
Well ID: C4258		Well Name 299-W19-47	
Location East side of WMA-U/200 West		Project: RCRA/CERCLA drilling. FY 2004	
Prepared By: Charlene Martinez	Date 08/11/04	Reviewed By: L.D. Walker	Date 8-24-04
Signature: Charlene Martinez		Signature: [signature]	

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
4" ID SS304, sch. 5 sump: 262.04' → 265.02'	 TD => 269' bgs	240 280		229' - 238' silty sandy GRAVEL (msG) 238' - 244' sandy GRAVEL (sG) 244' - 260' silty sandy GRAVEL (msG) 260' - 266' sandy GRAVEL (sG) 266' - 269' silty sandy GRAVEL (msG) TD @ 269' bgs Static water => 226.84' bgs (08/09/04)
NCR-04-GRP-015 issued on the formation slough condition at 62.3' → 66.3'				
All depths in feet below ground surface:				
All temporary casing removed from ground.				

A-6003-643 (03/03)

Figure H-7. Well 299-W19-47 Construction and Completion Summary (2 of 2)

H2 References

NAD83, 1991, *North American Datum of 1983*, as revised, National Geodetic Survey, Federal Geodetic Control Committee, Silver Spring, Maryland. Available at: http://www.ngs.noaa.gov/.

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

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Appendix I

Waste Constituents for the Single-Shell Tank System Groundwater Quality Assessment

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Contents

Tables

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I1 Introduction

This appendix provides the source of the chemicals that are associated with the Single-Shell Tank (SST) System unit and the evaluation of those chemicals to identify waste constituents for monitoring and evaluation under the groundwater quality assessment plan at SST System waste management areas (WMAs) B-BX-BY, C, S-SX, T, TX-TY, and U (hereinafter referred to as SST WMAs).

The waste constituents for monitoring and evaluation were determined based on the chemical constituents identified in the data quality objectives for SST component closure at the SST farms (RPP-23403, *Single-Shell Tank Component Closure Data Quality Objectives*). Three types of data were identified for SST component closure: volume data, chemical constituent concentrations, and radiological constituent concentrations (Chapter 4 in RPP-23403). The chemical parameters needed to support SST component closures and associated risk assessments included major constituent categories that can be analyzed by specific analytical methods: inorganics, semivolatile organic compounds, and volatile organic compounds (Section 4.1 in RPP-23403). Specific or "primary" constituents were identified from the SST System Part A Form and underlying hazardous constituents (40 CFR 268.48, "Land Disposal Restrictions," "Universal Treatment Standards"). "Secondary" constituents (constituents that can be detected with the prescribed analytical methods but are not on the primary list) would be added to the primary list in the event it affected the risk assessment. Each of the primary and secondary chemical constituents in RPP-23403 were evaluated to identify waste constituents for the groundwater quality assessment at the SST WMAs.

I2 Evaluation of Chemical Constituents for Single-Shell Tank Closure

The objective of interim status groundwater quality assessment monitoring is to monitor for releases of dangerous waste(s) from a regulated unit. However, not every chemical prescribed as a data need for SST closure is a dangerous waste. Therefore, the primary and secondary chemical constituents identified in Tables 4-1, 4-2, 4-3, 4-5, and 4-6 in RPP-23403 were evaluated to identify dangerous wastes. Polychlorinated biphenyls were identified as primary constituents in Section 4.1.1.1 of RPP-23403 (p. 12) and were similarly evaluated. Those primary and secondary chemicals were then compared to the following:

- Dangerous wastes that were identified from the waste codes in the SST System Part A Form in WA7890008967, *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste* (11-NWP-054, 2011, "Approval of the Single-Shell Tank System Dangerous Waste Permit Application Part A Form, Revision 13")

- Constituents in Appendix 5 of Ecology Publication No. 97-407, *Chemical Test Methods For Designating Dangerous Waste WAC 173-303-090 & -100*

The primary and secondary SST closure chemicals that are also present in either the SST System Part A Form or Appendix 5 of Ecology Publication No. 97-407 were identified and evaluated for use in the groundwater quality assessment.

The dangerous waste codes from the SST System Part A Form are presented in Table I-1, and the specific dangerous wastes identified from the Part A Form waste codes are presented in Table I-2. The dangerous wastes in Table I-2 were used to identify primary and secondary chemicals for SST closure to be evaluated for use in the SST System groundwater quality assessment.

Table I-1. Dangerous Waste Codes from the SST System Part A Form

Dangerous Waste Code	Contaminant Description*	Dangerous Waste Code	Contaminant Description*
D001	Ignitable waste	D034	Hexachloroethane
D002	Corrosive waste	D035	Methyl ethyl ketone
D003	Reactive waste	D036	Nitrobenzene
D004	Arsenic	D038	Pyridine
D005	Barium	D039	Tetrachloroethylene
D006	Cadmium	D040	Trichloroethylene
D007	Chromium	D041	2,4,5-Trichlorophenol
D008	Lead	D043	Vinyl chloride
D009	Mercury	F001	Spent halogenated solvents
D010	Selenium	F002	Spent halogenated solvents
D011	Silver	F003	Spent nonhalogenated solvents
D018	Benzene	F004	Spent nonhalogenated solvents
D019	Carbon tetrachloride	F005	Spent nonhalogenated solvents
D022	Chloroform	WP01	Extremely hazardous waste/persistent dangerous waste
D028	1,2-Dichloroethane	WP02	Dangerous waste/persistent dangerous waste
D029	1,1-Dichloroethylene	WT01	Extremely hazardous waste/toxic dangerous waste
D030	2,4-Dinitrotoluene	WT02	Dangerous waste/toxic dangerous waste
D033	Hexachlorobutadiene	--	--

Source: 11-NWP-054, 2011, "Approval of the Single-Shell Tank System Dangerous Waste Permit Application Part A Form, Revision 13."

*Dangerous waste code contaminant descriptions are from WAC 173-303-090, "Dangerous Waste Regulations," "Dangerous Waste Characteristics"; WAC 173-303-104, "State-Specific Dangerous Waste Numbers"; and WAC 173-303-9904, "Dangerous Waste Sources List."

Table I-2. Dangerous Wastes Identified from Waste Codes in the SST System Part A Form

Dangerous Waste Code	Waste Constituent	CAS Number
D004	Arsenic	7440-38-2
D005	Barium	7440-39-3
D006	Cadmium	7440-43-9
D007	Chromium	7440-47-3
D008	Lead	7439-92-1
D009	Mercury	7439-97-6
D010	Selenium	7782-49-2
D011	Silver	7440-22-4

Table I-2. Dangerous Wastes Identified from Waste Codes in the SST System Part A Form

Dangerous Waste Code	Waste Constituent	CAS Number
D018	Benzene	71-43-2
D019	Carbon tetrachloride	56-23-5
D022	Chloroform	67-66-3
D028	1,2-Dichloroethane	107-06-2
D029	1,1-Dichloroethylene	75-35-4
D030	2,4-Dinitrotoluene	121-14-2
D033	Hexachlorobutadiene	87-68-3
D034	Hexachloroethane	67-72-1
D035	Methyl ethyl ketone	78-93-3
D036	Nitrobenzene	98-95-3
D038	Pyridine	110-86-1
D039	Tetrachloroethylene	127-18-4
D040	Trichloroethylene	79-01-6
D041	2,4,5-Trichlorophenol	95-95-4
D043	Vinyl chloride	75-01-4
F001	1,1,1-Trichloroethane	71-55-6
F001	Methylene chloride	75-09-2
F001	Carbon tetrachloride	56-23-5
F001	Tetrachloroethylene	127-18-4
F001	Trichloroethylene	79-01-6
F002	1,1,1-Trichloroethane	71-55-6
F002	1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1
F002	1,1,2-Trichloroethane	79-00-5
F002	Chlorobenzene	108-90-7
F002	Methylene chloride	75-09-2
F002	ortho-Dichlorobenzene	95-50-1
F002	Trichlorofluoromethane	75-69-4
F002	Tetrachloroethylene	127-18-4
F002	Trichloroethylene	79-01-6
F003	Acetone	67-64-1
F003	Cyclohexanone	108-94-1
F003	Ethyl acetate	141-78-6
F003	Ethyl benzene	100-41-4

Table I-2. Dangerous Wastes Identified from Waste Codes in the SST System Part A Form

Dangerous Waste Code	Waste Constituent	CAS Number
F003	Ethyl ether	60-29-7
F003	Methyl isobutyl ketone	108-10-1
F003	Methanol	67-56-1
F003	n-Butyl alcohol	71-36-3
F003	Xylene	1330-20-7
F004	Cresols	1319-77-3
F004	Cresylic acid	93-51-6
F004	Nitrobenzene	98-95-3
F005	2-Ethoxyethanol	110-80-5
F005	2-Nitropropane	79-46-9
F005	Benzene	71-43-2
F005	Carbon disulfide	75-15-0
F005	Isobutanol	78-83-1
F005	Methyl ethyl ketone	78-93-3
F005	Pyridine	110-86-1
F005	Toluene	108-88-3

Notes: The specific dangerous wastes associated with “F” code wastes were obtained from WAC 173-303-9904, “Dangerous Waste Regulations,” “Dangerous Waste Sources List.”

This table identifies specific dangerous wastes identified from the waste codes included in the SST System Part A Form. Characteristic wastes (D001, D002, and D003) and state-only wastes (WP01, WP02, WT01, and WT02) (waste codes assigned based on waste designation) are included in the SST System Part A Form but are not identified in this table.

CAS = Chemical Abstracts Service

SST = single-shell tank

The evaluation of primary and secondary SST System chemicals relative to the SST Part A Form dangerous wastes and Appendix 5 of Ecology Publication No. 97-407 constituents is presented in Table I-3.

The SST component primary and secondary constituents were checked for analytical availability at commercial laboratories. The constituents in Appendix 5 of Ecology Publication 97-407 are routinely analyzed at commercial laboratories; however, analysis for some of the dangerous wastes identified in the SST System Part A Form are either specialty analyses with availability at only a single laboratory, or are not available. It is necessary to have a backup laboratory available for constituents required in an interim status groundwater monitoring plan; therefore, constituents that were available at only one commercial laboratory (or at no commercial laboratory) were eliminated as waste constituents for the groundwater quality assessment (Table I-3).

The primary and secondary constituents associated with SST component closure that are included in either the SST System Part A Form or Appendix 5 of Ecology Publication 97-407, and are available for analysis at commercial laboratories, were identified as SST System waste constituents for the groundwater quality assessment (Table I-3).

Table I-3. Evaluation of Chemical Constituents Identified in SST Component Closure Data Quality Objectives

Chemical Name	CAS Number	Type of Chemical in RPP-23403[a]	Identified from SST System Part A Form?	Identified in Appendix 5 of Ecology Publication Number 97-407?	Analysis Available at Commercial Laboratories?	SST System Waste Constituent for Groundwater Quality Assessment?
1,1-Dichloroethane	75-34-3	Secondary	No	Yes	Yes	Yes
1,1,1-Trichloroethane	71-55-6	Primary	Yes (F code)[b]	Yes	Yes	Yes
1,1,2,2-Tetrachloroethane	79-34-5	Primary	No	Yes	Yes	Yes
1,1,2-Trichloro-1,2,2-trifluoroethane (Trichlorotrifluoroethane)	76-13-1	Primary	Yes (F code)[b]	No	Yes	Yes
1,1,2-Trichloroethane	79-00-5	Primary	Yes (F code)[b]	Yes	Yes	Yes
1,1'-Biphenyl	92-52-4	Secondary	No	No	No[c]	No
1,1-Dichloroethene (1,1-Dichloroethylene)	75-35-4	Primary	Yes	Yes	Yes	Yes
1,1-Dimethylhydrazine	57-14-7	Secondary	No	No	No	No
1,2,4-Trichlorobenzene	120-82-1	Primary	No	Yes	Yes	Yes
1,2-Dibromoethane	106-93-4	Secondary	No	Yes	Yes	Yes
1,2-Dichloro-1,1,2,2-tetrafluoroethane	76-14-2	Secondary	No	No	No	No
1,2-Dichlorobenzene (o-Dichlorobenzene)	95-50-1	Primary	Yes (F code)[b]	Yes	Yes	Yes
1,2-Dichloroethane	107-06-2	Primary	Yes	Yes	Yes	Yes
1,2-Dichloropropane	78-87-5	Secondary	No	Yes	Yes	Yes
1,3-Butadiene	106-99-0	Secondary	No	No	No	No
1,4-Dioxane (1,4-Diethylene dioxide)	123-91-1	Secondary	No	Yes	Yes	Yes
1-Butanol (n-Butyl alcohol)	71-36-3	Primary	Yes (F code)[b]	No	Yes	Yes
1-Methylpropyl alcohol	78-92-2	Secondary	No	No	No	No
2,4,5-Trichlorophenol	95-95-4	Primary	Yes	Yes	Yes	Yes
2,4,6-Trichlorophenol	88-06-2	Primary	No	Yes	Yes	Yes

Table I-3. Evaluation of Chemical Constituents Identified in SST Component Closure Data Quality Objectives

Chemical Name	CAS Number	Type of Chemical in RPP-23403[a]	Identified from SST System Part A Form?	Identified in Appendix 5 of Ecology Publication Number 97-407?	Analysis Available at Commercial Laboratories?	SST System Waste Constituent for Groundwater Quality Assessment?
2,4-Dinitrotoluene	121-14-2	Primary	Yes	Yes	Yes	Yes
2,6-Bis (tert-butyl)-4-methylphenol	128-37-0	Primary	No	No	No	No
2-Butanone (Methyl ethyl ketone [MEK])	78-93-3	Primary	Yes	Yes	Yes	Yes
2-Butenaldehyde (2-Butenal)	4170-30-3	Secondary	No	No	No	No
2-Chlorophenol	95-57-8	Primary	No	Yes	Yes	Yes
2-Ethoxyethanol	110-80-5	Primary	Yes (F code)[b]	No	No	No
2-Heptanone	110-43-0	Secondary	No	No	No	No
2-Hexanone (Methyl butyl ketone [MBK])	591-78-6	Secondary	No	Yes	Yes	Yes
2-Methyl-2-propanol	75-65-0	Secondary	No	No	Yes	No
2-Methylphenol (o-Cresol)	95-48-7	Primary	No	Yes	Yes	Yes
2-Nitrophenol (o-Nitrophenol)	88-75-5	Primary	No	Yes	Yes	Yes
2-Nitropropane	79-46-9	Primary	Yes (F code)[b]	No	No	No
2-Pentanone	107-87-9	Secondary	No	No	Yes	No
2-Propanone (Acetone)	67-64-1	Primary	Yes (F code)[b]	Yes	Yes	Yes
2-Propyl alcohol	67-63-0	Secondary	No	No	Yes	No
3-Heptanone	106-35-4	Secondary	No	No	No	No
3-Methy-2-butanone	563-80-4	Secondary	No	No	No	No
3-Methylphenol (m-Cresol)	108-39-4	Primary	No	Yes	Yes	Yes
3-Pentanone	96-22-0	Secondary	No	No	No	No
4-Chloro-3-methylphenol (p-Chloro-m-cresol)	59-50-7	Primary	No	Yes	Yes	Yes
4-Heptanone	123-19-3	Secondary	No	No	No	No

Table I-3. Evaluation of Chemical Constituents Identified in SST Component Closure Data Quality Objectives

Chemical Name	CAS Number	Type of Chemical in RPP-23403[a]	Identified from SST System Part A Form?	Identified in Appendix 5 of Ecology Publication Number 97-407?	Analysis Available at Commercial Laboratories?	SST System Waste Constituent for Groundwater Quality Assessment?
4-Methyl-2-pentanone (Methyl isobutyl ketone [MIBK])	108-10-1	Primary	Yes (F code)[b]	Yes	Yes	Yes
4-Methylphenol (p-Cresol)	106-44-5	Primary	No	Yes	Yes	Yes
5-Methyl-2-hexanone	110-12-3	Secondary	No	No	No	No
Acenaphthene	83-32-9	Primary	No	Yes	Yes	Yes
Acetate	71-50-1	Primary	No	No	No	No
Acetic acid, n-butyl ester (n-butyl acetate)	123-86-4	Secondary	No	No	No	No
Acetonitrile (Methyl cyanide)	75-05-8	Secondary	No	Yes	Yes	Yes
Acetophenone	98-86-2	Secondary	No	Yes	Yes	Yes
Acrolein	107-02-8	Secondary	No	Yes	Yes	Yes
Acrylonitrile	107-13-1	Secondary	No	Yes	Yes	Yes
Aldrin	309-00-2	Secondary	No	Yes	Yes	Yes
Allyl chloride	107-05-1	Secondary	No	Yes	Yes	Yes
alpha-BHC	319-84-6	Secondary	No	Yes	Yes	Yes
Aluminum	7429-90-5	Primary	No	No	Yes	No
Ammonium	14798-03-9	Primary	No	No	Yes, as ammonia	No
Antimony	7440-36-0	Primary	No	Yes	Yes	Yes
Aroclor 1016	12674-11-2	Primary	No	Yes	Yes	Yes
Aroclor 1221	11104-28-2	Primary	No	Yes	Yes	Yes
Aroclor 1232	11141-16-5	Primary	No	Yes	Yes	Yes
Aroclor 1242	53469-21-9	Primary	No	Yes	Yes	Yes
Aroclor 1248	12672-29-6	Primary	No	Yes	Yes	Yes
Aroclor 1254	11097-69-1	Primary	No	Yes	Yes	Yes

Table I-3. Evaluation of Chemical Constituents Identified in SST Component Closure Data Quality Objectives

Chemical Name	CAS Number	Type of Chemical in RPP-23403[a]	Identified from SST System Part A Form?	Identified in Appendix 5 of Ecology Publication Number 97-407?	Analysis Available at Commercial Laboratories?	SST System Waste Constituent for Groundwater Quality Assessment?
Aroclor 1260	11096-82-5	Primary	No	Yes	Yes	Yes
Arsenic	7440-38-2	Primary	Yes	Yes	Yes	Yes
Barium	7440-39-3	Primary	Yes	Yes	Yes	Yes
Benzene	71-43-2	Primary	Yes	Yes	Yes	Yes
Benzo[a]pyrene	50-32-8	Secondary	No	Yes	Yes	Yes
Beryllium	7440-41-7	Primary	No	Yes	Yes	Yes
beta-BHC	319-85-7	Secondary	No	Yes	Yes	Yes
Bismuth	7440-69-9	Secondary	No	No	Yes	No
Boron	7440-42-8	Secondary	No	No	Yes	No
Bromide	24959-67-9	Secondary	No	No	Yes	No
Butane	106-97-8	Secondary	No	No	No	No
Butyl benzyl phthalate (Benzyl butyl phthalate)	85-68-7	Primary	No	Yes	Yes	Yes
Cadmium	7440-43-9	Primary	Yes	Yes	Yes	Yes
Calcium	7440-70-2	Secondary	No	No	Yes	No
Carbon disulfide	75-15-0	Primary	Yes (F code)[b]	Yes	Yes	Yes
Carbon tetrachloride	56-23-5	Primary	Yes	Yes	Yes	Yes
Cerium	7440-45-1	Secondary	No	No	No	No
Chloride	16887-00-6	Secondary	No	No	Yes	No
Chlorobenzene	108-90-7	Primary	Yes (F code)[b]	Yes	Yes	Yes
Chlorodifluoromethane	75-45-6	Secondary	No	No	No	No
Chloroethane	75-00-3	Secondary	No	Yes	Yes	Yes
Chloroform	67-66-3	Primary	Yes	Yes	Yes	Yes

Table I-3. Evaluation of Chemical Constituents Identified in SST Component Closure Data Quality Objectives

Chemical Name	CAS Number	Type of Chemical in RPP-23403[a]	Identified from SST System Part A Form?	Identified in Appendix 5 of Ecology Publication Number 97-407?	Analysis Available at Commercial Laboratories?	SST System Waste Constituent for Groundwater Quality Assessment?
Chromium	7440-47-3	Primary	Yes	Yes	Yes	Yes
cis-1,3-Dichloropropene	10061-01-5	Secondary	No	Yes	Yes	Yes
Cobalt	7440-48-4	Primary	No	Yes	Yes	Yes
Copper	7440-50-8	Primary	No	Yes	Yes	Yes
Cresylic acid (Cresol, mixed isomers)	1319-77-3	Primary	Yes (F code)[b]	Yes (as isomers)	No[d]	No
Cyanide	57-12-5	Primary	No	Yes	Yes	Yes
Cyclohexane	110-82-7	Secondary	No	No	Yes	No
Cyclohexanone	108-94-1	Primary	Yes (F code)[b]	No	No	No
Cyclohexene	110-83-8	Secondary	No	No	Yes	No
Cyclopentane	287-92-3	Secondary	No	No	No	No
Dibenz[a,h]anthracene (Dibenzanthracene, 1,2,5,6-)	53-70-3	Secondary	No	Yes	Yes	Yes
Dichlorodifluoromethane	75-71-8	Secondary	No	Yes	Yes	Yes
Dichlorofluromethane	75-43-4	Secondary	No	No	No	No
Dieldrin	60-57-1	Secondary	No	Yes	Yes	Yes
Di-n-butyl phthalate (Dibutyl phthalate)	84-74-2	Primary	No	Yes	Yes	Yes
Di-n-octylphthalate	117-84-0	Primary	No	Yes	Yes	Yes
Dinoseb (2-sec-Butyl-4,6-dinitrophenol)	88-85-7	Secondary	No	Yes	Yes	Yes
Diphenylamine	122-39-4	Secondary	No	Yes	Yes	Yes
Endrin	72-20-8	Secondary	No	Yes	Yes	Yes
Ethyl acetate	141-78-6	Primary	Yes (F code)[b]	No	Yes	Yes
Ethyl alcohol	64-17-5	Secondary	No	No	Yes	No
Ethyl ether (Diethyl ether)	60-29-7	Primary	Yes (F code)[b]	No	Yes	Yes

Table I-3. Evaluation of Chemical Constituents Identified in SST Component Closure Data Quality Objectives

Chemical Name	CAS Number	Type of Chemical in RPP-23403[a]	Identified from SST System Part A Form?	Identified in Appendix 5 of Ecology Publication Number 97-407?	Analysis Available at Commercial Laboratories?	SST System Waste Constituent for Groundwater Quality Assessment?
Ethylbenzene	100-41-4	Primary	Yes (F code)[b]	Yes	Yes	Yes
Europium	7440-53-1	Secondary	No	No	No	No
Ferrocyanide	13601-19-9	Primary	No	No	No	No
Fluoranthene	206-44-0	Primary	No	Yes	Yes	Yes
Fluoride	16984-48-8	Primary	No	No	Yes	No
Formate	71-47-6	Primary	No	No	No	No
gamma-BHC (Lindane)	58-89-9	Secondary	No	Yes	Yes	Yes
Glycolate	666-14-8	Primary	No	No	No	No
Heptachlor	76-44-8	Secondary	No	Yes	Yes	Yes
Hexachlorobenzene	118-74-1	Secondary	No	Yes	Yes	Yes
Hexachlorobutadiene	87-68-3	Primary	Yes	Yes	Yes	Yes
Hexachloroethane	67-72-1	Primary	Yes	Yes	Yes	Yes
Hexachloronaphthalene	1335-87-1	Secondary	No	No	No	No
Hexafluoroacetone	684-16-2	Secondary	No	No	No	No
Iron	7439-89-6	Primary	No	No	Yes	No
Isobutanol (Isobutyl alcohol)	78-83-1	Primary	Yes (F code)[b]	Yes	Yes	Yes
Isodrin	465-73-6	Secondary	No	Yes	Yes	Yes
Lanthanum	7439-91-0	Secondary	No	No	Yes	No
Lead	7439-92-1	Primary	Yes	Yes	Yes	Yes
Lithium	7439-93-2	Secondary	No	No	Yes	No
Magnesium	7439-95-4	Secondary	No	No	Yes	No
Manganese	7439-96-5	Primary	No	No	Yes	No
m-Dichlorobenzene (1,3-Dichlorobenzene)	541-73-1	Secondary	No	Yes	Yes	Yes

Table I-3. Evaluation of Chemical Constituents Identified in SST Component Closure Data Quality Objectives

Chemical Name	CAS Number	Type of Chemical in RPP-23403[a]	Identified from SST System Part A Form?	Identified in Appendix 5 of Ecology Publication Number 97-407?	Analysis Available at Commercial Laboratories?	SST System Waste Constituent for Groundwater Quality Assessment?
Mercury	7439-97-6	Primary	Yes	Yes	Yes	Yes
Methacrylonitrile (2-propenenitrile, 2-Methyl-)	126-98-7	Secondary	No	Yes	Yes	Yes
Methanol	67-56-1	Primary	Yes (F code)[b]	No	Yes	Yes
Methyl bromide (Bromomethane)	74-83-9	Secondary	No	Yes	Yes	Yes
Methyl chloride (Chloromethane)	74-87-3	Secondary	No	Yes	Yes	Yes
Methyl isocyanate	624-83-9	Secondary	No	No	No	No
Methylcyclohexane	108-87-2	Secondary	No	No	Yes	No
Methylene chloride (Dichloromethane)	75-09-2	Primary	Yes (F code)[b]	Yes	Yes	Yes
Methylhydrazine	60-34-4	Secondary	No	No	No	No
Molybdenum	7439-98-7	Secondary	No	No	Yes	No
m-Xylene	108-38-3	Primary	Yes, as xylene (total)	Yes, as xylene (total)	No[e]	No
Naphthalene	91-20-3	Primary	No	Yes	Yes	Yes
Neodymium	7440-00-8	Secondary	No	No	No	No
n-Heptane	142-82-5	Secondary	No	No	No	No
n-Hexane	110-54-3	Secondary	No	No	Yes	No
Nickel	7440-02-0	Primary	No	Yes	Yes	Yes
Niobium	7440-03-1	Secondary	No	No	No	No
Nitrate	14797-55-8	Primary	No	No	Yes	No
Nitric acid, propyl ester (n-Propyl nitrate)	627-13-4	Secondary	No	No	No	No
Nitrite	14797-65-0	Primary	No	No	Yes	No
Nitrobenzene	98-95-3	Primary	Yes	Yes	Yes	Yes

Table I-3. Evaluation of Chemical Constituents Identified in SST Component Closure Data Quality Objectives

Chemical Name	CAS Number	Type of Chemical in RPP-23403[a]	Identified from SST System Part A Form?	Identified in Appendix 5 of Ecology Publication Number 97-407?	Analysis Available at Commercial Laboratories?	SST System Waste Constituent for Groundwater Quality Assessment?
n-Nitrosodimethylamine (Dimethyl nitrosamine)	62-75-9	Secondary	No	Yes	Yes	Yes
n-Nitrosodi-n-butylamine	924-16-3	Secondary	No	Yes	Yes	Yes
n-Nitroso-di-n-dipropylamine (n-Nitrosodipropylamine; Di-n-propylnitrosamine)	621-64-7	Primary	No	Yes	Yes	Yes
n-Nitrosomethylethalamine (Ethanamine, n-methyl-n-nitroso-)	10595-95-6	Secondary	No	Yes	Yes	Yes
n-Nitrosomorpholine	59-89-2	Primary	No	Yes	Yes	Yes
n-Nonane	111-84-2	Secondary	No	No	No	No
n-Octane	111-65-9	Secondary	No	No	No	No
n-Pentane	109-66-0	Secondary	No	No	No	No
n-Propionaldehyde	123-38-6	Secondary	No	No	No	No
n-Propyl alcohol (1-Propanol)	71-23-8	Secondary	No	No	Yes	No
Octachloronaphthalene	2234-13-1	Secondary	No	No	No	No
Oxalate	338-70-5	Primary	No	No	No	No
Oxirane (Ethylene oxide)	75-21-8	Secondary	No	No	No	No
o-Xylene	95-47-6	Primary	Yes, as xylene (total)	Yes, as xylene (total)	No[e]	No
Palladium	7440-05-3	Secondary	No	No	No	No
p-Chloronitrobenzene	100-00-5	Secondary	No	No	No	No
p-Dichlorobenzene (1,4-Dichlorobenzene)	106-46-7	Secondary	No	Yes	Yes	Yes
p-Dinitrobenzene	100-25-4	Secondary	No	No	Yes	No
Pentachloronaphthalene	1321-64-8	Secondary	No	No	No	No

Table I-3. Evaluation of Chemical Constituents Identified in SST Component Closure Data Quality Objectives

Chemical Name	CAS Number	Type of Chemical in RPP-23403[a]	Identified from SST System Part A Form?	Identified in Appendix 5 of Ecology Publication Number 97-407?	Analysis Available at Commercial Laboratories?	SST System Waste Constituent for Groundwater Quality Assessment?
Pentachloronitrobenzene	82-68-8	Secondary	No	Yes	Yes	Yes
Pentachlorophenol	87-86-5	Secondary	No	Yes	Yes	Yes
pH	N/A	Primary	No	No	Yes[f]	No
Phenol	108-95-2	Secondary	No	Yes	Yes	Yes
Phosphate	14265-44-2	Secondary	No	No	Yes	No
Phosphorous	7723-14-0	Secondary	No	No	Yes	No
Potassium	7440-09-7	Secondary	No	No	Yes	No
Praseodymium	7440-10-0	Secondary	No	No	No	No
Propionitrile (Ethyl cyanide)	107-12-0	Secondary	No	Yes	Yes	Yes
p-Xylene	106-42-3	Primary	Yes, as xylene (total)	Yes, as xylene (total)	No[e]	No
Pyrene	129-00-0	Primary	No	Yes	Yes	Yes
Pyridine	110-86-1	Primary	Yes	Yes	Yes	Yes
Rhodium	7440-16-6	Secondary	No	No	No	No
Rubidium	7440-17-7	Secondary	No	No	No	No
Ruthenium	7440-18-8	Secondary	No	No	No	No
Samarium	7440-19-9	Secondary	No	No	No	No
Selenium	7782-49-2	Primary	Yes	Yes	Yes	Yes
Silicon	7440-21-3	Secondary	No	No	Yes	No
Silver	7440-22-4	Primary	Yes	Yes	Yes	Yes
Sodium	7440-23-5	Secondary	No	No	Yes	No
Strontium	7440-24-6	Primary	No	No	Yes	No
Styrene	100-42-5	Secondary	No	Yes	Yes	Yes

Table I-3. Evaluation of Chemical Constituents Identified in SST Component Closure Data Quality Objectives

Chemical Name	CAS Number	Type of Chemical in RPP-23403[a]	Identified from SST System Part A Form?	Identified in Appendix 5 of Ecology Publication Number 97-407?	Analysis Available at Commercial Laboratories?	SST System Waste Constituent for Groundwater Quality Assessment?
Sulfate	14808-79-8	Secondary	No	No	Yes	No
Sulfur	7704-34-9	Secondary	No	No	Yes	No
Tantalum	7440-25-7	Secondary	No	No	No	No
Tellurium	13494-80-9	Secondary	No	No	No	No
Tetrachloroethene (Tetrachloroethylene, Perchloroethylene)	127-18-4	Primary	Yes	Yes	Yes	Yes
Tetrachloronaphthalene	1335-88-2	Secondary	No	No	No	No
Tetrahydrofuran	109-99-9	Secondary	No	No	Yes	No
Thallium	7440-28-0	Primary	No	Yes	Yes	Yes
Thorium	7440-29-1	Secondary	No	No	Yes	No
Tin	7440-31-5	Secondary	No	Yes	Yes	Yes
Titanium	7440-32-6	Secondary	No	No	Yes	No
Toluene	108-88-3	Primary	Yes (F code)[b]	Yes	Yes	Yes
Toxaphene	8001-35-2	Secondary	No	Yes	Yes	Yes
trans-1,3-Dichloropropene	10061-02-6	Primary	No	Yes	Yes	Yes
Tributyl phosphate	126-73-8	Primary	No	No	Yes	No
Trichloroethylene (Trichloroethene [TCE])	79-01-6	Primary	Yes	Yes	Yes	Yes
Trichlorofluoromethane	75-69-4	Primary	Yes (F code)[b]	Yes	Yes	Yes
Triethylamine	121-44-8	Secondary	No	No	No	No
Tungsten	7440-33-7	Secondary	No	No	Yes	No
Uranium	7440-61-1	Primary	No	No	Yes	No
Vanadium	7440-62-2	Primary	No	Yes	Yes	Yes

Table I-3. Evaluation of Chemical Constituents Identified in SST Component Closure Data Quality Objectives

Chemical Name	CAS Number	Type of Chemical in RPP-23403[a]	Identified from SST System Part A Form?	Identified in Appendix 5 of Ecology Publication Number 97-407?	Analysis Available at Commercial Laboratories?	SST System Waste Constituent for Groundwater Quality Assessment?
Vinyl chloride (Chloroethene, Chloroethylene)	75-01-4	Primary	Yes	Yes	Yes	Yes
Xylene (total) (mixed isomers)	1330-20-7	Primary	Yes (F code)[b]	Yes	Yes	Yes
Yttrium	7440-65-5	Secondary	No	No	No	No
Zinc	7440-66-6	Primary	No	Yes	Yes	Yes
Zirconium	7440-67-7	Secondary	No	No	Yes	No

Note: Complete reference citations are provided in Chapter I4.

a. The type of chemical identifier is obtained from the following listed tables or text from RPP-23403, *Single-Shell Tank Component Closure Data Quality Objectives*: Tables 4-1, 4-2, 4-3, 4-5, and 4-6, or in text on p. 12 of RPP-23403.

b. The dangerous wastes associated with "F" codes identified in the SST System Part A Form (11-NWP-054, 2011, "Approval of the Single-Shell Tank System Dangerous Waste Permit Application Part A Form, Revision 13," (F001 through F005) are spent solvents. Each of the "F" codes includes multiple solvents, as presented in Table I-2. The specific spent solvent(s) associated with the "F" codes in the SST System Part A Form are not identified; however, each of the organics associated with these codes is included for evaluation.

c. Two laboratories perform the analysis; however, one laboratory's analysis of extractable organics is unreliable.

d. Analysis for cresylic acid is not available, but isomers of cresol (m-, p-, and o-) will be analyzed.

e. Both the isomers of xylene (m-, p-, and o-) and xylene (total) are included in Table 4-1 of RPP-23404. Xylene (total) is included in the SST System Part A Form waste codes and Appendix 5 of Ecology Publication No. 97-407, *Chemical Test Methods For Designating Dangerous Waste WAC 173-303-090 & -100*, and is the form analyzed by laboratories (analysis for isomers of xylene is not available). Therefore, isomers of xylene are not included as groundwater quality assessment constituents.

f. pH is available at commercial laboratories but is performed as a field measurement.

CAS = Chemical Abstracts Service

N/A = not applicable

SST = single-shell tank

I3 Waste Constituents for Groundwater Quality Assessment

Based on the evaluation of the chemical constituents for SST closure (Table I-3), the waste constituents to be monitored and evaluated at the applicable SST WMAs under this groundwater quality assessment plan are presented in Table I-4.

Table I-4. Groundwater Quality Assessment Waste Constituents for the SST System

Waste Constituent	CAS Number
Inorganics	
Antimony	7440-36-0
Arsenic	7440-38-2
Barium	7440-39-3
Beryllium	7440-41-7
Cadmium	7440-43-9
Chromium	7440-47-3
Cobalt	7440-48-4
Copper	7440-50-8
Cyanide*	57-12-5
Lead	7439-92-1
Mercury	7439-97-6
Nickel	7440-02-0
Selenium	7782-49-2
Silver	7440-22-4
Thallium	7440-28-0
Tin	7440-31-5
Vanadium	7440-62-2
Zinc	7440-66-6
Semivolatile Organic Compounds	
1,2,4-Trichlorobenzene	120-82-1
1,2-Dichlorobenzene (o-Dichlorobenzene)	95-50-1
1,4-Dioxane (1,4-Diethylene dioxide)	123-91-1
2,4,5-Trichlorophenol	95-95-4
2,4,6-Trichlorophenol	88-06-2
2,4-Dinitrotoluene	121-14-2
2-Chlorophenol	95-57-8
2-Methylphenol (o-Cresol)	95-48-7
2-Nitrophenol (o-Nitrophenol)	88-75-5

Table I-4. Groundwater Quality Assessment Waste Constituents for the SST System

Waste Constituent	CAS Number
3-Methylphenol (m-Cresol)	108-39-4
4-Chloro-3-methylphenol (p-Chloro-m-cresol)	59-50-7
4-Methylphenol (p-Cresol)	106-44-5
Acenaphthene	83-32-9
Acetophenone	98-86-2
Benzo[a]pyrene	50-32-8
Butyl benzyl phthalate (Benzyl butyl phthalate)	85-68-7
Dibenz[a,h]anthracene (Dibenzanthracene, 1,2,5,6-)	53-70-3
Di-n-butyl phthalate	84-74-2
Di-n-octylphthalate	117-84-0
Diphenylamine	122-39-4
Fluoranthene	206-44-0
Hexachlorobenzene	118-74-1
Hexachlorobutadiene	87-68-3
Hexachloroethane	67-72-1
m-Dichlorobenzene (1,3-Dichlorobenzene)	541-73-1
Naphthalene	91-20-3
Nitrobenzene	98-95-3
n-Nitrosodimethylamine (Dimethyl nitrosamine)	62-75-9
n-Nitrosodi-n-butylamine	924-16-3
n-Nitroso-di-n-dipropylamine (n-Nitrosodipropylamine; Di-n-propylnitrosamine)	621-64-7
n-Nitrosomethylethalamine (Ethanamine, n-methyl-n-nitroso-)	10595-95-6
n-Nitrosomorpholine	59-89-2
Pentachloronitrobenzene	82-68-8
Pentachlorophenol	87-86-5
Phenol	108-95-2
Pyrene	129-00-0
Pyridine	110-86-1
Volatile Organic Compounds	
1,1 Dichloroethane	75-34-3
1,1,1-Trichloroethane	71-55-6
1,1,2,2-Tetrachloroethane	79-34-5

Table I-4. Groundwater Quality Assessment Waste Constituents for the SST System

Waste Constituent	CAS Number
1,1,2-Trichloro-1,2,2-trifluoroethane (Trichlorotrifluoroethane)	76-13-1
1,1,2-Trichloroethane	79-00-5
1,1-Dichloroethene (1,1-Dichloroethylene)	75-35-4
1,2-Dibromoethane	106-93-4
1,2-Dichloroethane	107-06-2
1,2-Dichloropropane	78-87-5
1-Butanol (n-Butyl alcohol)	71-36-3
2-Butanone (Methyl ethyl ketone; MEK)	78-93-3
2-Hexanone (Methyl butyl ketone [MBK])	591-78-6
2-Propanone (Acetone)	67-64-1
4-Methyl-2-pentanone (Methyl isobutyl ketone [MIBK])	108-10-1
Acetonitrile (Methyl cyanide)	75-05-8
Acrolein	107-02-8
Acrylonitrile	107-13-1
Allyl chloride	107-05-1
Benzene	71-43-2
Carbon disulfide	75-15-0
Carbon tetrachloride	56-23-5
Chlorobenzene	108-90-7
Chloroethane	75-00-3
Chloroform	67-66-3
cis-1,3-Dichloropropene	10061-01-5
Dichlorodifluoromethane	75-71-8
Ethyl acetate	141-78-6
Ethyl ether (Diethyl ether)	60-29-7
Ethylbenzene	100-41-4
Isobutanol (Isobutyl alcohol)	78-83-1
Methacrylonitrile (2-propenenitrile, 2-Methyl-)	126-98-7
Methyl bromide (Bromomethane)	74-83-9
Methyl chloride (Chloromethane)	74-87-3
Methylene chloride	75-09-2
p-Dichlorobenzene (1,4-Dichlorobenzene)	106-46-7

Table I-4. Groundwater Quality Assessment Waste Constituents for the SST System

Waste Constituent	CAS Number
Propionitrile (Ethyl cyanide)	107-12-0
Styrene	100-42-5
Tetrachloroethene (Tetrachloroethylene, Perchloroethylene)	127-18-4
Toluene	108-88-3
trans-1,3-Dichloropropene	10061-02-6
Trichloroethylene (Trichloroethene [TCE])	79-01-6
Trichlorofluoromethane	75-69-4
Vinyl chloride (Chloroethene, Chloroethylene)	75-01-4
Xylenes (total)	1330-20-7
Alcohols	
Methanol	67-56-1
Herbicides	
Dinoseb (2-sec-Butyl-4,6-dinitrophenol)	88-85-7
Pesticides	
Aldrin	309-00-2
alpha-BHC	319-84-6
beta-BHC	319-85-7
Dieldrin	60-57-1
Endrin	72-20-8
gamma-BHC (Lindane)	58-89-9
Heptachlor	76-44-8
Isodrin	465-73-6
Toxaphene	8001-35-2
Polychlorinated Biphenyls	
Aroclor 1016	12674-11-2
Aroclor 1221	11104-28-2
Aroclor 1232	11141-16-5
Aroclor 1242	53469-21-9
Aroclor 1248	12672-29-6
Aroclor 1254	11097-69-1
Aroclor 1260	11096-82-5

*Cyanide will be analyzed as both free and total cyanide.

CAS = Chemical Abstracts Service

I4 References

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40 CFR 268.48, "Land Disposal Restrictions," "Universal Treatment Standards," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol26/xml/CFR-2010-title40-vol26-sec268-48.xml.

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303-090, "Dangerous Waste Characteristics."

303-104, "State-Specific Dangerous Waste Numbers."

303-9904, "Dangerous Waste Sources List."