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Revision 0

Results of Tritium Tracking and Groundwater Monitoring at the Hanford Site 200 Area State Approved Land Disposal Site, Fiscal Year 2014

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

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

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Richland, Washington 99352

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Executive Summary

The 200 Area Effluent Treatment Facility (ETF) at the Hanford Site processes contaminated aqueous wastes derived from Hanford Site facilities. Treated wastewater discharge contains tritium because it is not cost effective to remove this constituent from the waste stream. The wastewater is discharged to the soil column at the 200 Area State-Approved Land Disposal Site (SALDS), which is authorized to receive the discharge by *State Waste Discharge Permit Number ST 4500*[1] (Ecology, 2000) (hereafter referred to as the "Permit"). During the period from August 2013 through July 2014, 14.4 million L (3.8 million gal) of water were discharged to SALDS, which is a 31 percent reduction from the previous reporting period (August 2012 through July 2013). The discharged water contained 4.84 Ci of tritium. ETF has not operated since January 2014 due to a major failure of the evaporator heat exchanger. Replacement of the heat exchanger is expected to keep the facility shut down until late 2015.

Groundwater monitoring for tritium and other constituents, as well as water-level measurements, are conducted consistent with provisions in the Permit.
The U.S. Department of Energy (DOE) has taken the position that its groundwater monitoring and provision of data to the Washington State Department of Ecology is a matter of intergovernmental comity and cooperation, and that the Permit has no jurisdiction over radionuclides, which are regulated by DOE under *Atomic Energy Act of 1954*[2] (AEA) authority, in the same way that permits for wastewater discharge to surface waters issued by the Environmental Protection Agency under Section 402 of the Clean Water Act are preempted by the AEA from regulating radionuclides.[3]

The current monitoring network consists of three proximal (compliance) monitoring wells (699-48-77A, 699-48-77C, and 699-48-77D) and eight tritium-tracking wells. Two of the proximal wells (699-48-77C and 699-48-77D) are sampled quarterly; well 699-48-77A can no longer be sampled because it is nearly dry, but it is still in use for water-level monitoring. Most of the tritium-tracking wells are sampled annually, although two are sampled semiannually (twice per year).

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[1] Ecology, 2000, *State Waste Discharge Permit Number ST 4500*, Washington State Department of Ecology, Kennewick, Washington. Available at: http://www.ecy.wa.gov/programs/nwp/pdf/4500dp.pdf.
[2] *Atomic Energy Act of 1954*, as amended, 42 USC 2011, Pub. L. 83-703, 68 Stat. 919. Available at: http://epw.senate.gov/atomic54.pdf.
[3] 40 CFR 122.2 and *Train v. Colorado Public Interest Research Group, Inc.* 426 U.S. 1 (1976).

Water-level measurements taken in the three proximal SALDS wells indicate that a small groundwater mound, resulting from operational effluent discharges, continues to be present beneath the facility. The mound has been relatively small since 2013 because of reduced effluent discharges to SALDS over the past 2 years. Measurements also indicate that the water table is being affected by the nearby groundwater pump-and-treat (P&T) system for the 200-ZP-1 Operable Unit, which remediates groundwater contamination beneath the northern 200 West Area. Water levels increased in eight of the SALDS network wells due to operation of several P&T system injection wells located to the south of SALDS. This has offset the long-term declining trend caused by reduced effluent discharges to the soil column at Hanford that began during the mid-1980s. The water level increased enough in tritium-tracking well 299-W8-1 to allow this formerly dry well to be sampled during 2014 for the first time since 2010. The water table increase will extend the useful life of some of the SALDS network wells for a few years. Even so, several wells are expected to become dry between 2015 and 2017, including the remaining shallow-screened proximal well 699-48-77D.

There were no exceedances of a groundwater concentration limit in the proximal wells during fiscal year (FY) 2014. Maximum tritium concentrations in the proximal wells were 83,000 pCi/L in 699-48-77C and 60,500 pCi/L in 699-48-77D. The tritium concentration is declining at 699-48-77C after peaking in 2012. The peak represented an attenuated, time-lagged response to increased SALDS discharges in 2006 and 2007. The tritium concentration increased at 699-48-77D during FY 2014 in response to recent SALDS discharges. Tritium continues to be detected in tritium-tracking well 299-W6-6; the concentration was 2,430 pCi/L during 2014, a decrease from 3,770 pCi/L during 2013. The source is injection into the aquifer of water containing tritium in a P&T system injection well located only 9.8 m (32 ft) from well 299-W6-6. To date, tritium from the SALDS facility has not been detected in any of the tritium-tracking wells.

The numerical groundwater flow and contaminant transport model of the SALDS tritium plume was last updated in FY 2011. The modeling results showed that some locations along the northern margin of the 200 West Area are expected to exhibit measurable concentrations of SALDS-derived tritium by the year 2030, although the model indicates that concentrations would be below the drinking water standard of 20,000 pCi/L. The eastern end of the tritium plume is also predicted to migrate to the south toward the 200-ZP-1 P&T system extraction wells by 2030.

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Terms

CCU	Cold Creek unit
CP	Central Plateau
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
ETF	Effluent Treatment Facility
FY	fiscal year
gpm	gallons per minute
OU	operable unit
P&T	pump-and-treat
SALDS	State-Approved Land Disposal Site
TASL	TestAmerica St. Louis
WSCF	Waste Sampling and Characterization Facility

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1 Introduction

The 200 Area Effluent Treatment Facility (ETF), on the Hanford Site, processes contaminated aqueous wastes derived from Hanford Site facilities. Treated water from ETF is discharged to the 600-211 State-Approved Land Disposal Site (SALDS), which is authorized to receive the discharge by *State Waste Discharge Permit Number ST 4500* (Ecology, 2000) (hereafter referred to as the "Permit"). The Permit allows disposal of ETF effluents to the SALDS drain field, located 360 m (1,200 ft) north of the 200 West Area (Figure 1-1). The Permit requires that groundwater samples be collected quarterly from the point of compliance monitoring wells 699-48-77A, 699-48-77C, and 699-48-77D (i.e., the proximal wells) located at the SALDS facility. Samples are being collected from only two of these wells because well 699-48-77A became dry during fiscal year (FY) 2012.[4] It is required that the samples be analyzed for 17 constituents, 11 of which have groundwater limitations (i.e., concentration limits) specified in the Permit. Collection of water-level measurements is also required.

The Permit also addresses the tritium plume from SALDS. Much of the effluent disposed to SALDS contains tritium because no cost effective treatment technology exists to remove tritium from wastewater (DOE/RL-2014-10, *2014 Evaluation of Tritium Removal and Mitigation Technologies for Wastewater Treatment*). The location of SALDS, north of the 200 West Area, was chosen because of the resulting long travel time for tritium to migrate from this location to the Columbia River. This allows for concentrations to be reduced to below the drinking water standard (20,000 pCi/L) by dispersion and radiological decay before the plume reaches the river.

The U.S. Department of Energy (DOE) has taken the position that its groundwater monitoring and provision of data to the Washington State Department of Ecology (Ecology) is a matter of intergovernmental comity and cooperation, and that the Permit has no jurisdiction over radionuclides, which are regulated by DOE under *Atomic Energy Act of 1954* (AEA) authority, in the same way that permits for wastewater discharge to surface waters issued by the Environmental Protection Agency under Section 402 of the Clean Water Act are preempted by the AEA from regulating radionuclides.[5] DOE shares its monitoring data with Ecology consistent with this policy of cooperation. The wells used to monitor the tritium plume and ensure it is migrating and dispersing as predicted are located farther from the facility than the proximal wells; they are referred to as the tritium-tracking wells. These wells are sampled either annually or semiannually. DOE also performs computer modeling of the tritium plume at last once every 5 years, and submits a groundwater monitoring and tritium-tracking report to Ecology annually.

In addition to this annual report, results of groundwater sampling and analysis of the proximal wells during FY 2014 were also reported in quarterly discharge monitoring reports submitted electronically to the Ecology.[6] Details of the SALDS groundwater monitoring program are described in the current groundwater monitoring plan (PNNL-13121, *Groundwater Monitoring and Tritium-Tracking Plan for the 200 Area State-Approved Land Disposal Site*).

---

[4] Well 699-48-77D is expected to become dry sometime between FYs 2015 and 2017. Approval to continue groundwater monitoring using only well 699-48-77C was granted by Ecology, because effluent from ETF is routinely monitored, and this will provide assurance that the facility is in compliance with permit discharge limits (12-NWP-035).

[5] 40 CFR 122.2 and *Train v. Colorado Public Interest Research Group, Inc.*, 426 U.S. 1 (1976).

[6] Quarterly discharge monitoring reports can be obtained by accessing the Water Quality Permitting and Reporting Information System (PARIS) at Ecology's website (www.ecy.wa.gov) and searching for the permit number, "ST0004500."

1.1 Objective and Scope

This report presents the results of groundwater monitoring of the proximal wells and tracking of the tritium plume from the SALDS facility during FY 2014. Because 30 days are required for the laboratory to analyze and report groundwater sampling results, this annual report addresses groundwater samples collected only through August 31 of the reporting period, so this report can be completed and submitted by the November 30 due date. For FY 2014, all required sampling had been completed before August 31.

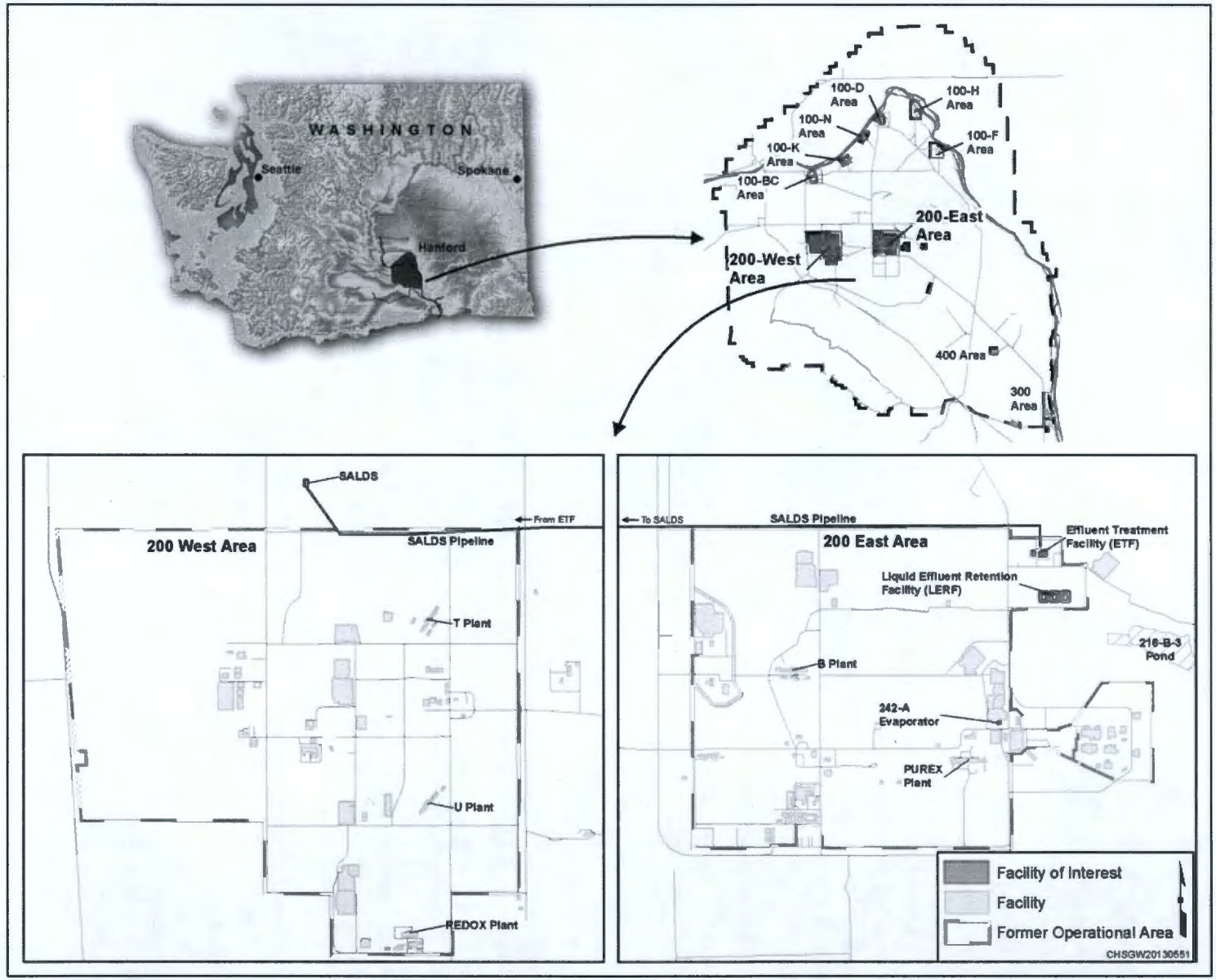

Figure 1-1. Location of SALDS and Related Infrastructure

This report also contains a summary of the most recent update to the numerical groundwater flow and contaminant transport model of the tritium plume, which was performed during FY 2011. DOE updates this model at least once every 5 years. The FY 2011 model update is fully described in Appendix B of SGW-51085, *Results of Tritium Tracking and Groundwater Monitoring at the Hanford Site 200 Area State-Approved Land Disposal Site, Fiscal Year 2011*.

1.2 Background

Background information presented in this section is based on PNNL-13121. It addresses the conceptual model, groundwater monitoring program, plume modeling, and SALDS discharges.

1.2.1 Hydrogeologic Setting and Conceptual Model

The hydrogeologic setting and conceptual model for SALDS have been described in previous documents (e.g., SGW-38802, *Results of Tritium Tracking and Groundwater Monitoring at the Hanford Site 200 Area State-Approved Land Disposal Site Fiscal Year 2008*) and are not repeated here. Figure 1-2 shows the conceptual model and depicts effluent migration through the sediment profile to groundwater. A key aspect of this conceptual model is the lateral migration of effluent in the vadose zone along the fine-grained Cold Creek unit (CCU), which dips toward the south. Thus, much of the effluent is interpreted to enter groundwater to the south of the drain field near monitoring well 699-48-77A.

1.2.2 Groundwater Monitoring Program

The primary objectives listed in the groundwater monitoring plan (PNNL-13121) are to compare groundwater sampling results for nonradionuclides in the proximal wells to the Permit concentration limits and track migration of the tritium plume from the SALDS facility. The following objectives are also listed in the monitoring plan:

- Track changes in groundwater quality associated with SALDS discharges.
- Determine why changes (if any) have occurred.
- Compare model predictions with observed results to refine predictive model capability.
- Correlate discharge events at SALDS with analytical results from groundwater monitoring.
- Assess the hydraulic response of the aquifer to SALDS discharges.

The groundwater monitoring well network (Figure 1-3) was designed to address these objectives using existing wells shared with other monitoring programs and dedicated wells drilled specifically to monitor SALDS (i.e., the proximal wells).

1.2.3 Groundwater Modeling

DOE provides an update to the tritium plume numerical model at least once every 5 years, to predict the distribution and movement of tritium in the aquifer as a result of SALDS discharges. The Permit asks that the model be updated "within 6 months of detection of [the] tritium plume in a new monitoring well," i.e., in a location not predicted by the most recent model run, or within a well not previously affected by SALDS-derived tritium. To date, no positive indications of SALDS-derived tritium have been detected in a new monitoring well.

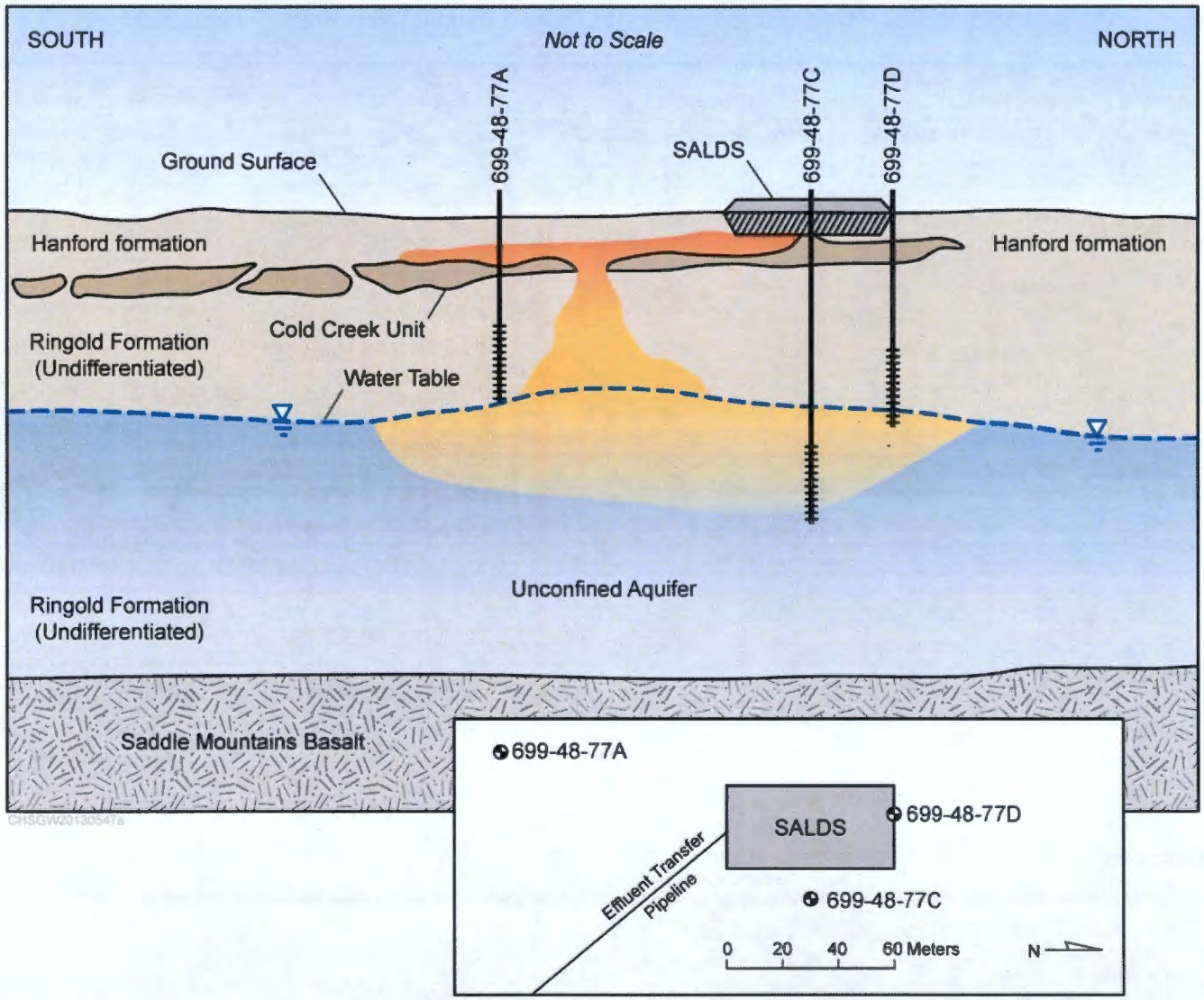

Figure 1-2. Conceptual Model Diagram of SALDS Operational Effects

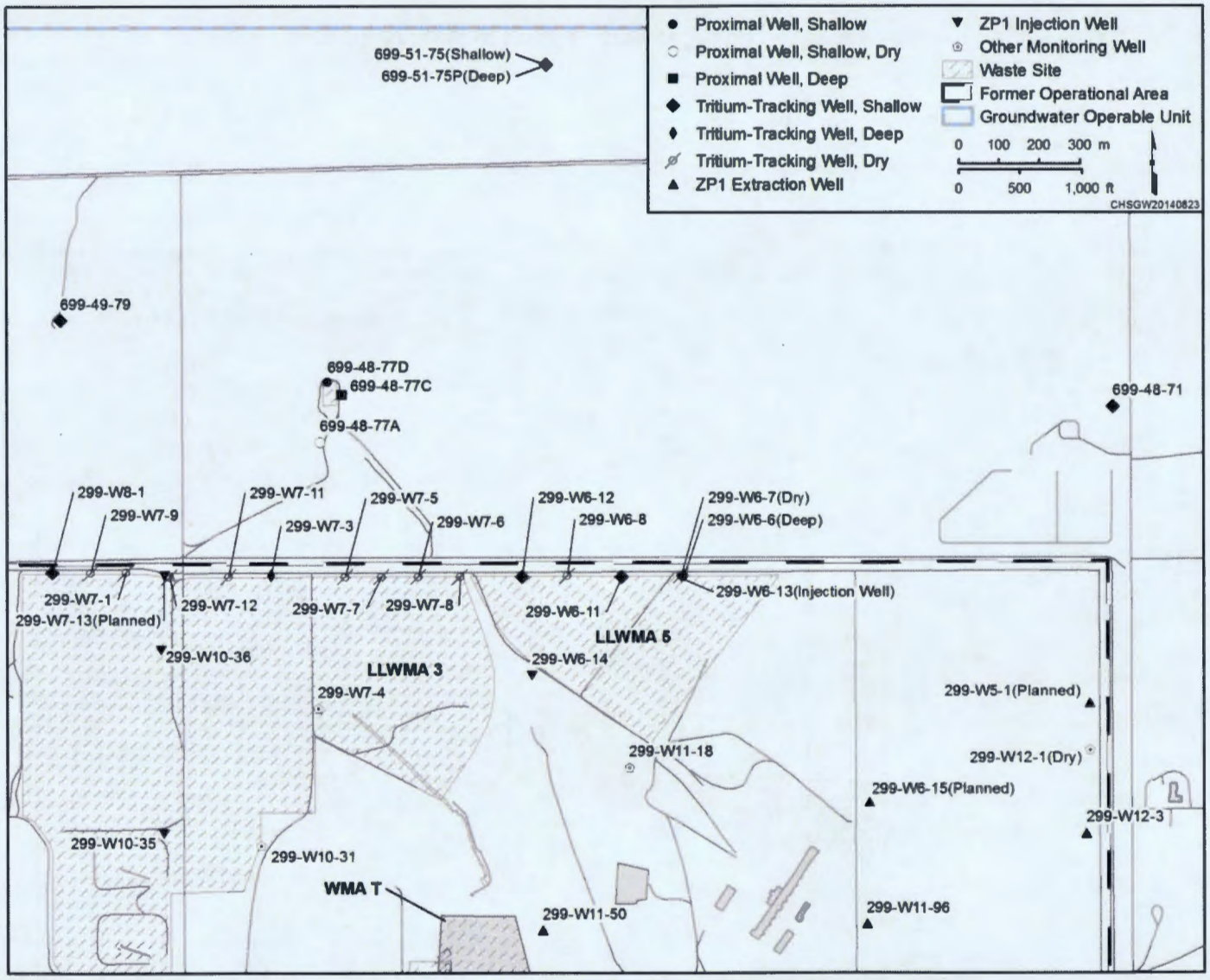

Figure 1-3. Locations of SALDS Groundwater Monitoring and Tritium-Tracking Network Wells

The groundwater model was last updated in 2011; Chapter 4 provides a summary of the results, including the predicted tritium concentrations in groundwater near SALDS for the year 2030. The model incorporated recent refinements to the Central Plateau (CP) groundwater model (DOE/RL-2009-38, *Description of Modeling Analyses in Support of the 200-ZP-1 Remedial Design/Remedial Action Work Plan*; CP-47631, *Model Package Report: Central Plateau Groundwater Model Version 3.3*) and included the SALDS discharge volume and tritium release information reported through June 2011. The model also included the latest information regarding the forecast operation of the 200-ZP-1 Operable Unit (OU) final remedy pump-and-treat (P&T) system located within the 200 West Area. The P&T system began operating during July 2012, and future model updates will include actual P&T system operational parameters at the time the model update is performed. Appendix B of SGW-51085 provides a more detailed description of the modeling performed during 2011.

1.2.4 State-Approved Land Disposal Site Discharge Information

The SALDS effluent infiltration gallery (i.e., 619-A Crib) is a 35 m by 61 m (116 ft by 200 ft) rectangular drain field with 10.2 cm (4 in.) diameter porous pipe laterals coming from a 20.3 cm (8 in.) diameter header at 1.8 m (6 ft) intervals. The drain field pipes are 15 cm (6 in.) below the surface of a 1.8 m (6 ft) deep gravel basin. The gravel basin is covered by at least 30 cm (12 in.) of natural, compacted cover soil.

Discharge of tritium-laden water to SALDS began in December 1995, with 220 Ci of tritium released in the first 7 months (which amounted to approximately 51 percent of the total activity released to date). Discharge volumes until FY 2004 were about 80 million L (21 million gal) each year. Discharges between March 2005 and August 2007 were sporadic and included intermittent campaigns to treat 242-A evaporator process condensate and K Basins project waste streams, both of which supplied much of the tritium recently discharged to SALDS. Discharge volumes increased in September 2007 when ETF began treating wastewater from the interim action P&T system at the T Tank Farm; however, the tritium activity in this stream was low. Because the final action P&T system for the 200-ZP-1 OU began operating during July 2012, the interim action P&T system was shut down on June 5, 2012. The final action system has its own treatment plant and returns water to the aquifer using injection wells, so ETF/SALDS does not receive wastewater from this system.

During the period from August 2013 through July 2014, 14.4 million L (3.8 million gal) of water were discharged to SALDS compared to 20.9 million L (5.5 million gal) during the previous reporting period (August 2012 to July 2013). ETF operated from August 2013 to September 2013 and from late December 2013 to January 2014. The facility has been shut down since February 2014 due to a major failure of the evaporator heat exchanger (reboiler). Replacement of the heat exchanger is expected to keep ETF shut down until late 2015. All of the ETF effluent discharged from August 2013 to January 2014 was from treating waste from the Liquid Effluent Retention Facility Basin 42, which contained process condensate from the 242-A Evaporator. This waste stream, which is distillate from evaporation of double-shell tank farm waste, has relatively high tritium concentrations, approximately equal to K Basins waste. The total discharge volume to SALDS, since startup in December 1995 through July 2014, is approximately 1,204 million L (318 million gal) (Figure 1-4).

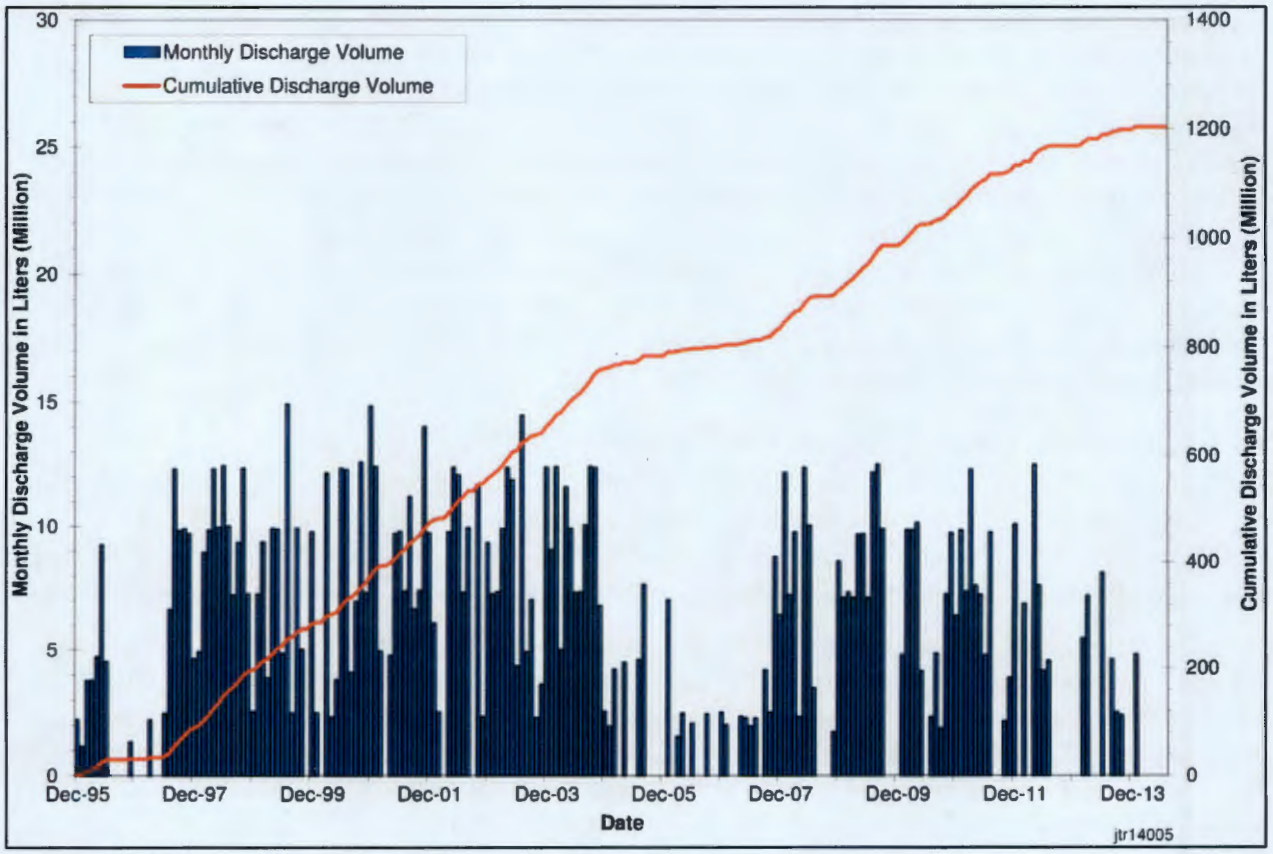

Figure 1-4. Monthly and Cumulative Discharge Volumes for SALDS from Inception through July 2014

Figure 1-5 shows the monthly and cumulative activity of tritium discharged to SALDS (not corrected for radioactive decay). The total quantity of tritium discharged from August 2013 through July 2014 was calculated to be 4.84 Ci based on sampling at ETF prior to discharge. The 4.84 Ci discharged was slightly more than one-half the 8.41 Ci reported to have been released during the previous one-year period (SGW-56060, *Results of Tritium Tracking and Groundwater Monitoring at the Hanford Site 200 Area State Approved Land Disposal Site, Fiscal Year 2013*). Recent release activities are relatively small compared to historical releases (Figure 1-5). This reflects the relatively low concentration of tritium in the waste streams currently being treated compared to historical discharges. The total amount of tritium discharged to SALDS from December 1995 through July 2014 was 430 Ci.

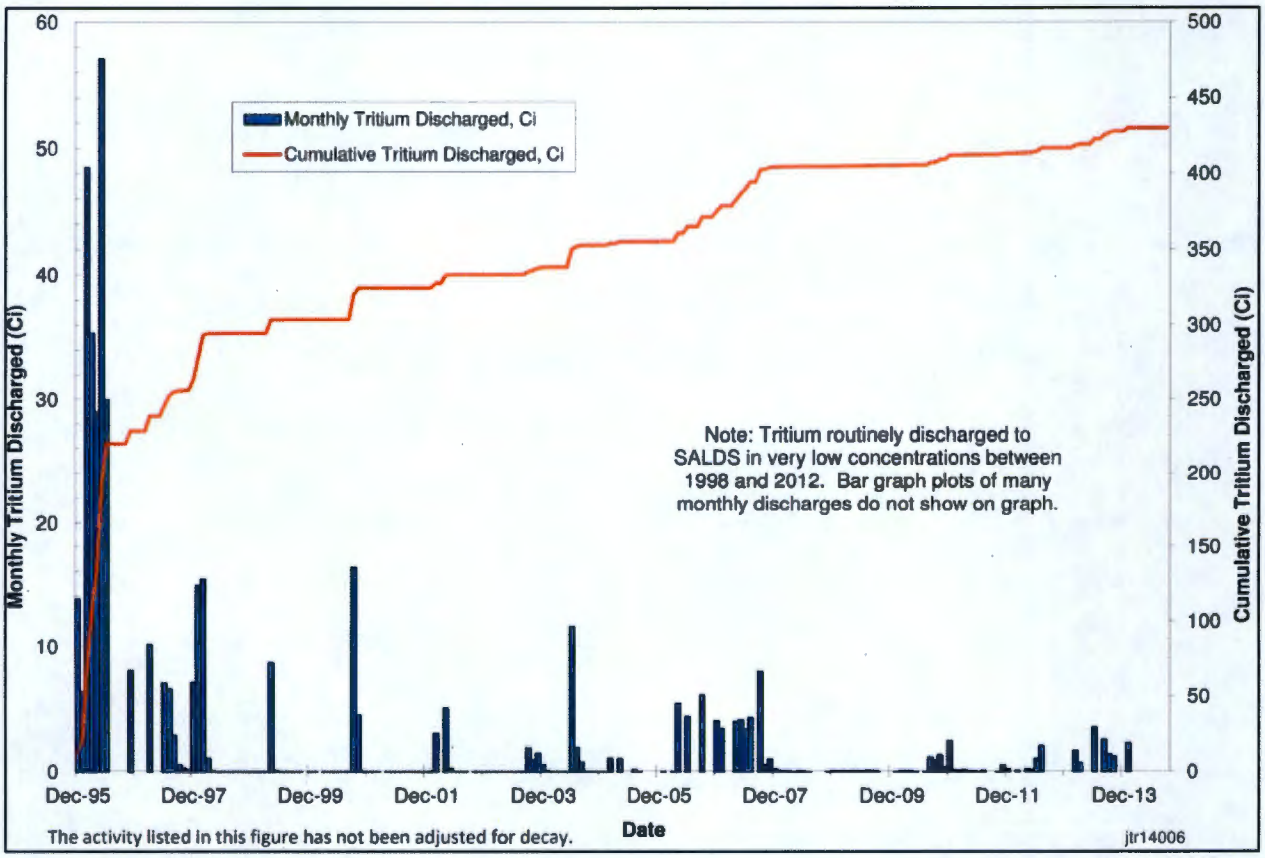

Figure 1-5. Monthly and Cumulative Tritium Activity Discharged to SALDS from Inception through July 2014

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2 Results of Fiscal Year 2014 Water-Level Monitoring

Measurements of water levels in wells surrounding SALDS are necessary to assess the hydraulic response of the aquifer to SALDS discharges, interpret local and regional water table elevation changes, and determine the groundwater flow direction. These measurements are used in combination with groundwater chemistry analyses to update conceptual and predictive models and forecast the movement of tritium from the SALDS facility.

2.1 200-ZP-1 Operable Unit Pump-and-Treat System

The 200-ZP-1 OU final remedy P&T system is affecting the water table in the SALDS vicinity. The P&T system consists of extraction and injection wells, piping, transfer stations, and a treatment plant (200 West Groundwater Treatment Facility). The system began operating in July 2012 (DOE/RL-2014-26, *Calendar Year 2013 Annual Summary Report for the 200-ZP-1 and 200-UP-1 Operable Unit Pump-and-Treat Operations*) and has a capacity of 9,500 L/min (2,500 gallons per minute [gpm]). As of August 2014, 18 groundwater extraction wells and 15 injection wells were operating. The water is treated at the 200 West Groundwater Treatment Facility, located within the 200 West Area. This facility is designed to remove carbon tetrachloride, chromium, iodine-129, nitrate, technetium-99, and trichloroethene from the extracted groundwater. The plant is currently being upgraded to remove uranium from groundwater. Tritium is not removed, because just like for ETF, there is no cost effective treatment technology for tritium. Thus, the water injected into the aquifer contains tritium. The selected remedy for tritium in the 200-ZP-1 OU is monitored natural attenuation.

Several 200-ZP-1 extraction and injection wells are located along the north side of the 200 West Area, and it is these wells that are primarily affecting the water table in the SALDS vicinity. The P&T system wells nearest to SALDS are injection wells 299-W10-36, 299-W6-14, and 299-W6-13 (Figure 1-3). From September 2013 through July 2014, average flow rates to these wells were 461 L/min (122 gpm), 713 L/min (188 gpm), and 338 L/min (89 gpm), respectively. These wells are located between 750 and 950 m (2,460 and 3,120 ft) from SALDS, but they are closer to the tritium-tracking wells along the north side of the 200 West Area. In particular, injection well 299-W6-13 is located only 9.8 m (32 ft) from tritium-tracking well 299-W6-6. Numerical modeling indicated that a slight water table elevation increase would occur in the SALDS vicinity due to operation of these injection wells (SGW-50907, *Predicted Impact of Future Water-Level Declines on Groundwater Well Longevity within the 200 West Area, Hanford Site*), and this has been confirmed by water-level measurements (see Sections 2.3 and 2.4).

The nearest operating extraction wells to SALDS are 299-W11-50, 299-W11-96, and 299-W12-3, which are located 1.4 km (0.9 mi), 1.9 km (1.2 mi), and 2.2 km (1.4 mi) to the southeast, respectively. Two other nearby extraction wells (299-W6-15 and 299-W5-1) have been drilled and recently had pumps installed (Figure 1-3). These wells are planned to begin operating during late 2014. A substantial water table drawdown was expected in the area of the extraction wells. For example, the water table at the location of monitoring well 299-W12-1 (115 m [377 ft] south of 299-W5-1) was predicted to decline 6 m (19.7 ft) by the year 2020 (SGW-50907). This well actually became dry during 2014. Because of this substantial drawdown, the tritium plume from SALDS is predicted to migrate toward these extraction wells in the future (Section 4.2).

2.2 Groundwater Flow

A synoptic set of water-level measurements across the 200 West Area was collected during March 2014, and the water table map constructed from these measurements for the northern portion of the 200 West

Area is shown in Figure 2-1.[7] This map clearly shows the effect of the 200-ZP-1 P&T system. Groundwater mounds occur where injection wells are located, and a large area where the water table has been drawn down occurs along the east side of the 200 West Area in response to groundwater extraction. This has changed the groundwater flow direction in the northeastern 200 West Area to be southeast toward the extraction wells (Figure 2-1), whereas prior to operation of the P&T system, the flow direction was more toward the east-northeast. Because of the influence of the injection wells along the north side of the 200 West Area, the regional groundwater flow direction in the immediate vicinity of the SALDS continues toward the northeast.

Bends in the water table contours around the SALDS facility, shown in Figure 2-1, indicate that a small mound exists on the water table caused by SALDS discharges. The size of the mound correlates to effluent discharge volumes. The mound was relatively small during March 2014 and was about the same size during March 2013. The water-level elevation difference between wells 699-48-77A and 699-48-77D during March 2014 was 0.23 m (0.75 ft) compared to 0.20 m (0.66 ft) during March 2013. The mound has been much larger in the past. For example, in March 2011, the water-level elevation difference between these two wells was 0.67 m (2.2 ft). From January to March 2011, the volume of effluent discharged to SALDS was 30 million L (7.8 million gal) compared to only 13 million L (3.4 million gal) from January to March 2013 and 4.8 million L (1.3 million gal) during January to March 2014. The mound is typically centered near well 699-48-77A. Discharge water from SALDS is interpreted to move south along the CCU within the vadose zone and infiltrate to the aquifer near 699-48-77A (Figure 1-2).

The groundwater flow arrows shown in Figure 2-1 denote the interpreted groundwater flow paths from the SALDS facility. When the groundwater mound was higher, such as during 2011 (SGW-51085), these flow paths indicated that effluent from SALDS may approach wells located southeast of the facility and may actually reach these wells if dispersion is taken into account. However, the situation is different for 2014 because of the smaller groundwater mound. The current flow system indicates that groundwater flow paths from beneath SALDS will not approach as close to the tritium-tracking wells along the north side of the 200 West Area as when the mound was higher. Thus, whether the tritium plume actually reaches these wells depends on future discharge volumes to SALDS. Predictions from the latest modeling are that the tritium plume will turn south toward the 200-ZP-1 extraction wells prior to reaching tritium-tracking well 699-48-71 (Section 4.2).

2.3 Water-Level Trends

Water levels are measured in all of the SALDS wells prior to each sampling event, and additional measurements are collected monthly in the proximal wells (699-48-77A, 699-48-77C, and 699-48-77D) in accordance with the groundwater monitoring plan (PNNL-13121). The water table has declined in recent years to the point where a number of the SALDS monitoring wells have become dry (Figure 1-3). As this occurs, water-level measurements and sampling in these wells are discontinued. Proximal well 699-48-77A had too little water remaining to be sampled as of 2012, but water-level measurements continued to be collected from this well during 2014. Operation of the 200-ZP-1 P&T system injection wells along the north side of the 200 West Area caused water levels to increase in many of the SALDS network wells during 2014. The water level increased enough in tritium-tracking well 299-W8-1 to allow this well to be sampled during 2014 for the first time since 2010.

[7] All elevations in this document are in NAVD88, *North American Vertical Datum of 1988.*

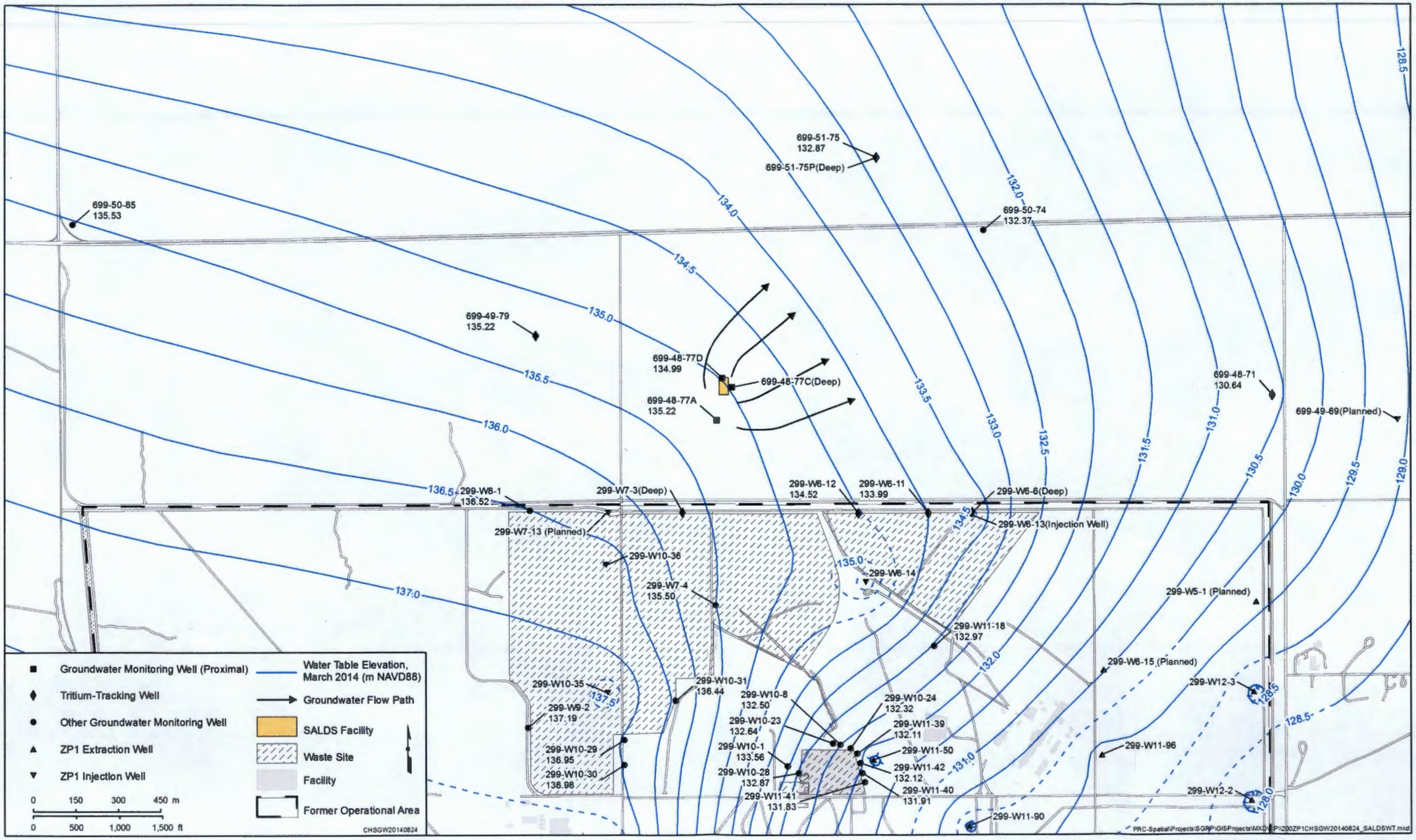

Figure 2-1. Water Table Map and Interpreted Groundwater Flow Directions in the SALDS Area, March 2014

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Figures 2-2 through 2-7 present hydrographs for the SALDS proximal and tritium-tracking wells. Wells depicted on these hydrographs are grouped by relative position to SALDS. Water levels in all wells in the 200 West Area have generally exhibited declining trends since effluent discharges associated with process operations were terminated at U Pond in 1985 and later at all nonpermitted facilities in 1995. However, many of the SALDS network wells now have increasing water-level trends due to the nearby 200-ZP-1 P&T injection wells which began operating during July 2012. This is particularly evident in the tritium-tracking wells along the north side of the 200 West Area closest to the injection wells, such as 299-W7-3 (Figure 2-4); 299-W8-1 (Figure 2-5); and 299-W6-6, 299-W6-11, and 299-W6-12 (Figure 2-6). Well 299-W6-6 has exhibited the largest water-level changes because it is located only 9.8 m (32 ft) from injection well 299-W6-13 and is, therefore, sensitive to changes in injection rates.

In the proximal wells, water levels have increased more in 699-48-77C and 699-48-77D than in 699-48-77A (Figure 2-2). Between July 2012 and August 2014, the water level increased by 0.43 m (1.4 ft) in 699-48-77C and by 0.30 m (1.0 ft) in 699-48-77D, but the water level increased by only 0.06 m (0.2 ft) in 699-48-77A during the same time. The water level at 699-48-77A is affected to a greater extent by SALDS discharges than the other proximal wells (Figure 2-2). At this well, the increase in the water table has been offset by the decline in the groundwater mound caused by recent low discharge volumes. The net effect is that the water table elevation has been relatively constant at 699-48-77A.

Groundwater mounding near SALDS creates a downward hydraulic gradient in the aquifer in the vicinity of the mound. However, this downward gradient is localized to the SALDS vicinity. Water-level measurements from a deep and shallow monitoring well pair (299-W6-6 and 299-W6-7) located 1 km (3,300 ft) southeast of SALDS did not indicate any substantial vertical gradient in this area during the 1990s and early 2000s (Figure 2-7); well 299-W6-7 became dry in 2005. As explained, the recent large water-level changes in well 299-W6-6 have been caused by operation of nearby 200-ZP-1 injection well 299-W6-13.

In Table 2-1, the March 2014 water-level measurements collected in the proximal and tritium-tracking wells, as well as other nearby wells, are compared with the previous set of synoptic measurements collected during March 2013. The water-level elevation increased in eight wells listed in Table 2-1 and decreased in six wells. The increases ranged from 0.244 m (0.80 ft) in tritium-tracking well 699-49-79 to 0.596 m (1.96 ft) in tritium-tracking well 299-W8-1 (well locations are shown in Figure 1-3). The declines ranged from 0.046 m (0.15 ft) in tritium-tracking well 699-51-75P to 1.993 m (6.54 ft) in tritium-tracking well 299-W6-6. As explained previously, 299-W6-6 is located only 9.8 m (32 ft) from 200-ZP-1 P&T injection well 299-W6-13, so it responds rapidly to changes in the injection flow rate. The water level increase in all three proximal wells averaged 0.260 m (0.85 ft). The average water-level change in the tritium-tracking wells was a decrease of 0.159 m (0.52 ft).

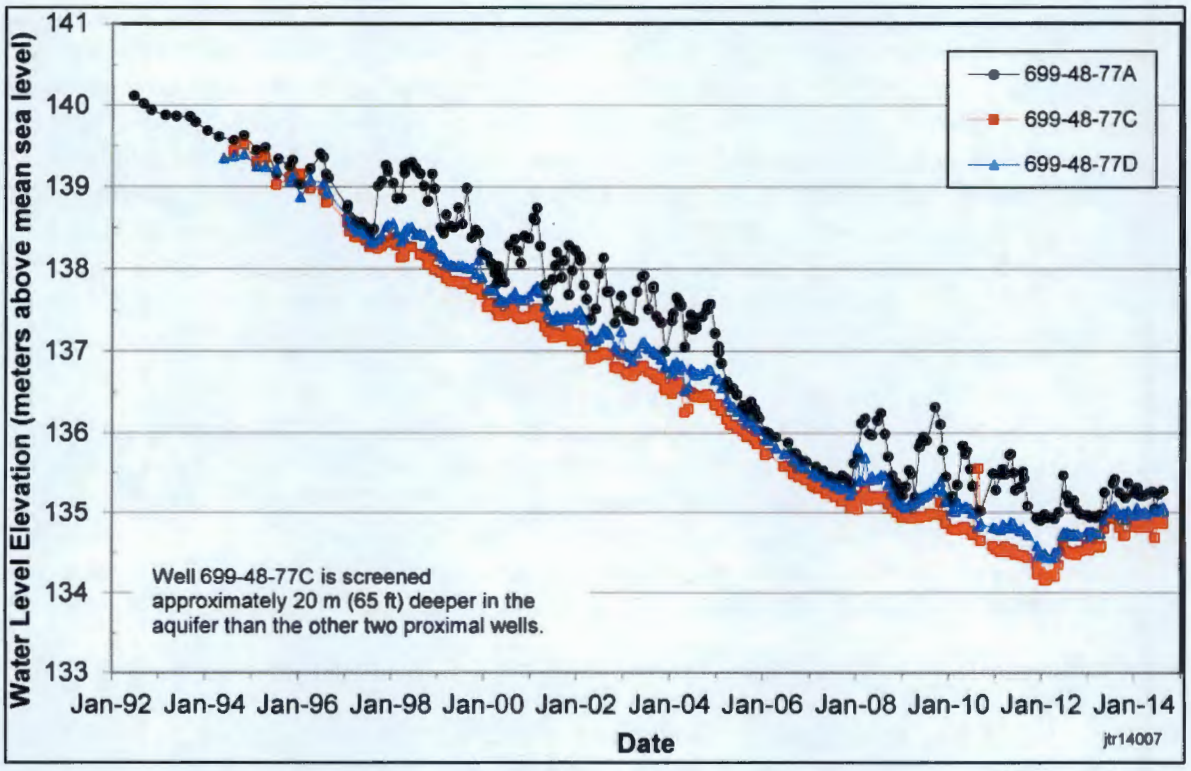

Figure 2-2. Water Levels in the SALDS Proximal Wells

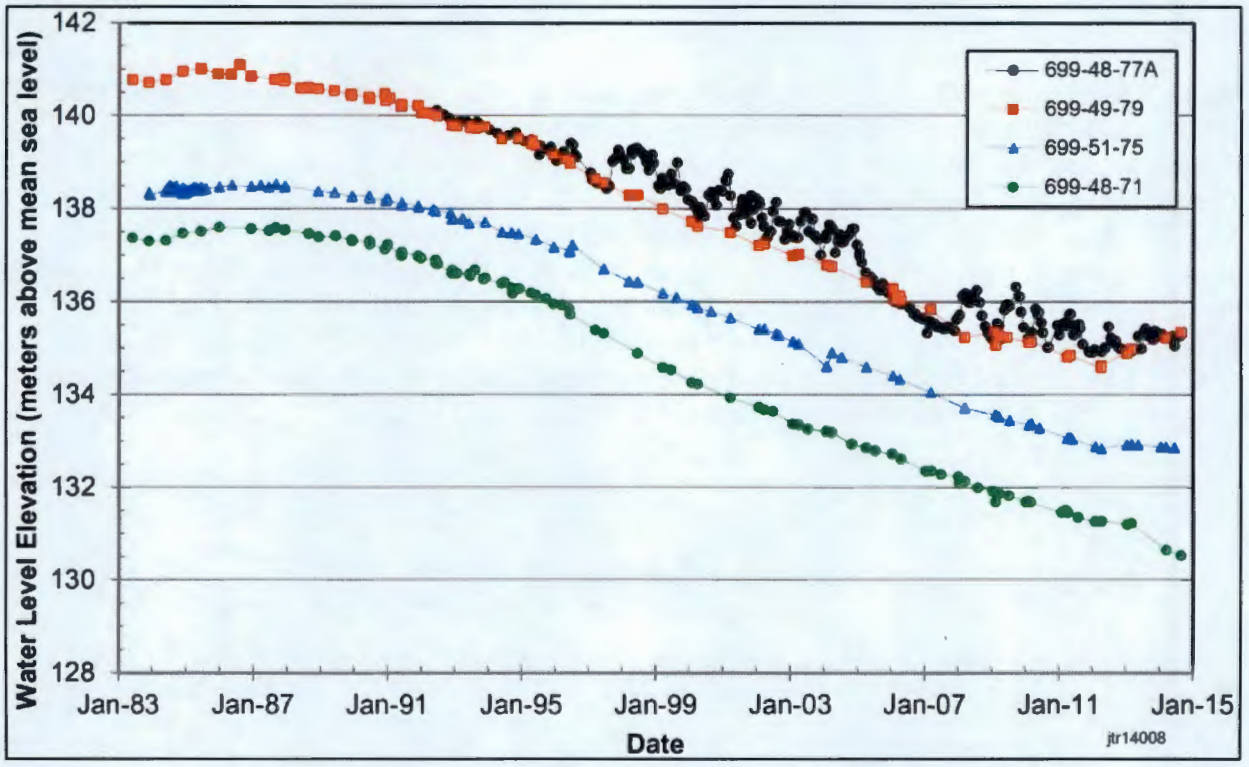

Figure 2-3. Water Levels in the Tritium-Tracking Wells North, Northwest, and East of the Site Compared with Well 699-48-77A

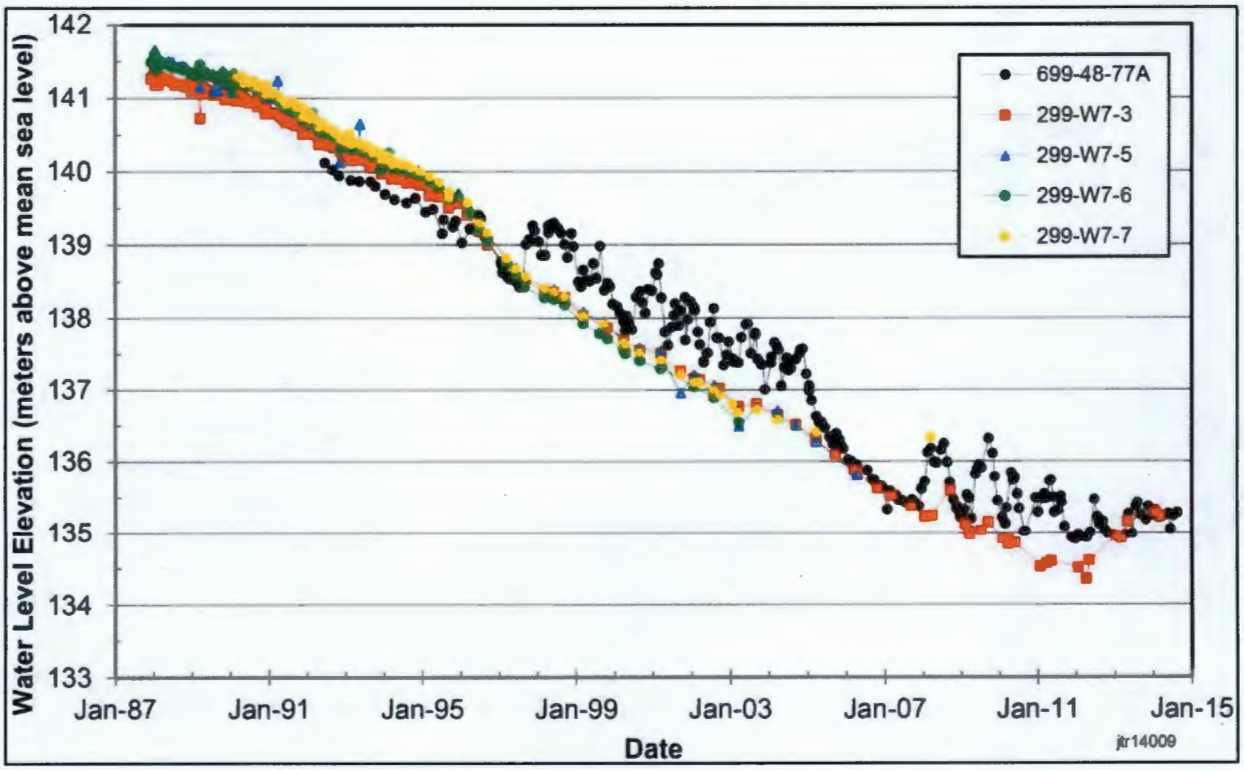

Figure 2-4. Water Levels in the Tritium-Tracking Wells South of SALDS Compared with Well 699-48-77A

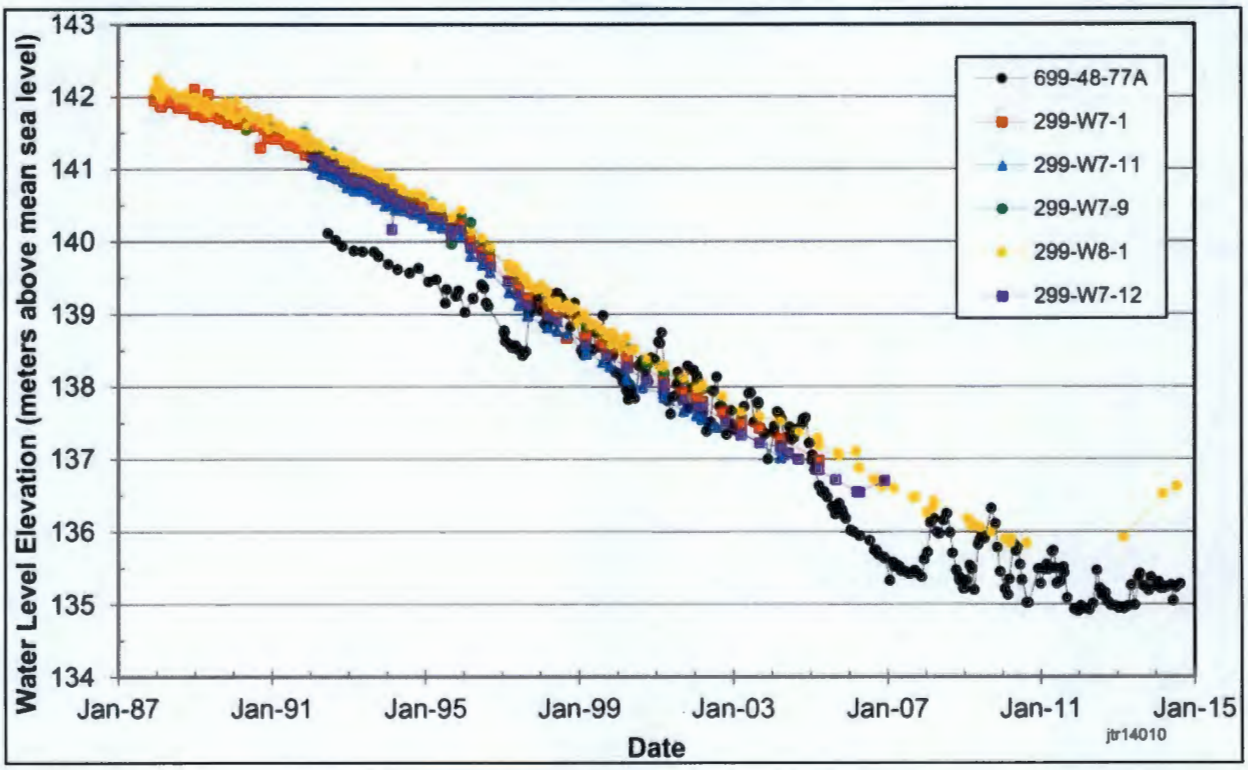

Figure 2-5. Water Levels in the Tritium-Tracking Wells Southwest of SALDS Compared with Well 699-48-77A

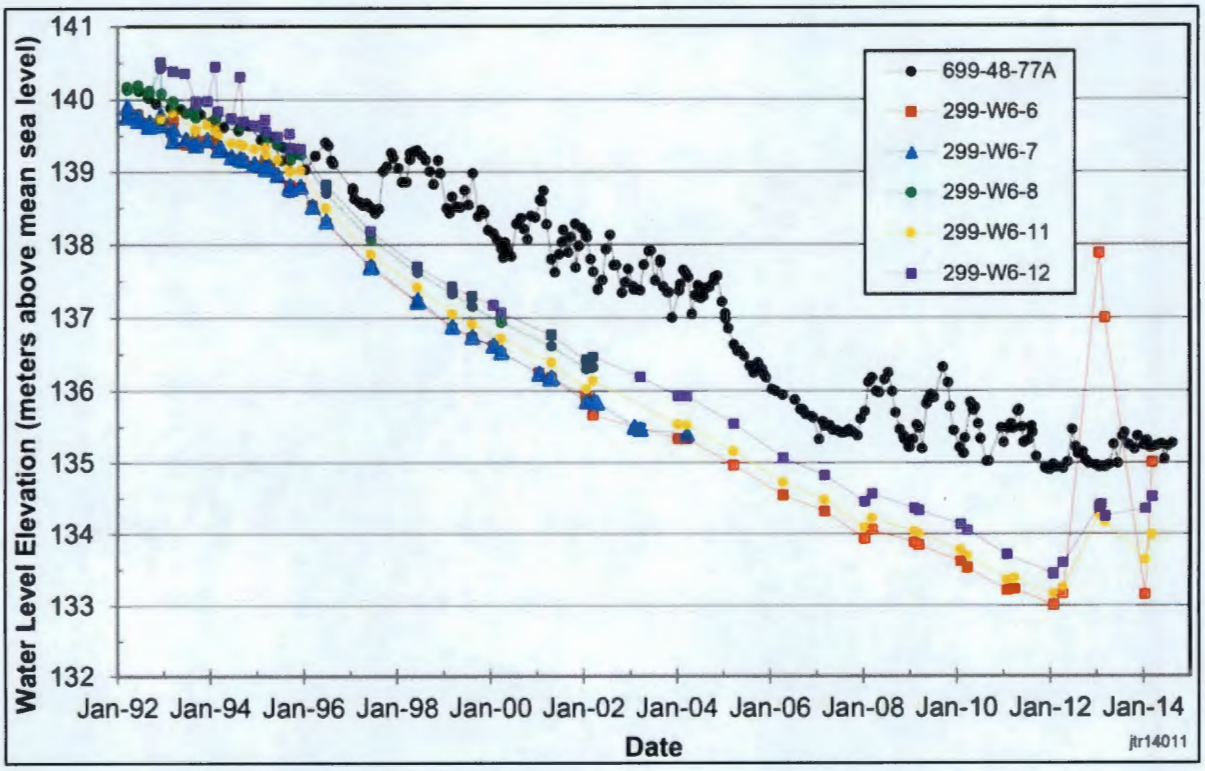

Figure 2-6. Water Levels in the Tritium-Tracking Wells Southeast of SALDS Compared with Well 699-48-77A

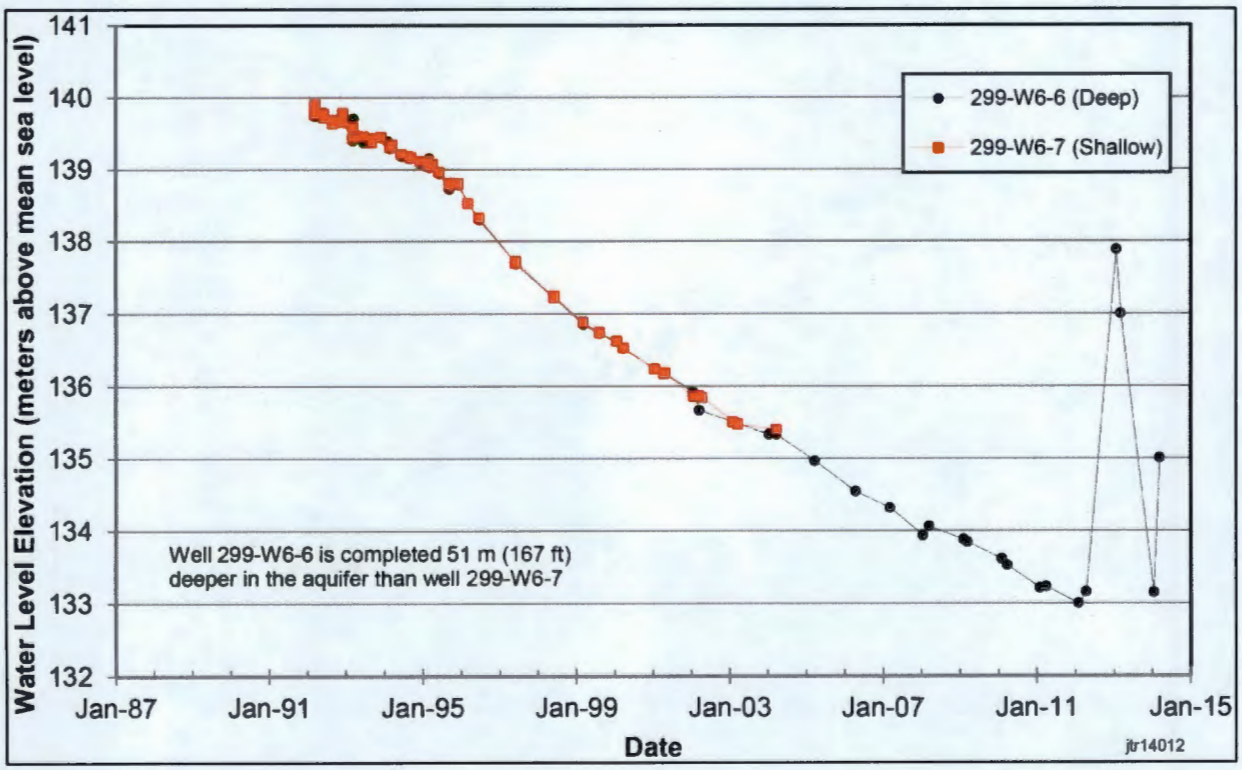

Figure 2-7. Water Levels in a Deep/Shallow Well Pair Southeast of SALDS

Table 2-1. Change in Water-Level Elevations

Well	March 2013 Elevation (m)	March 2014 Elevation (m)	Annual Rate of Change, 2013 to 2014 (m/yr)
Proximal Wells			
699-48-77A	134.940	135.216	0.276
699-48-77C*	134.575	134.835	0.260
699-48-77D	134.741	134.986	0.245
Tritium-Tracking Wells			
299-W6-6*	136.998	135.005	-1.993
299-W6-11	134.170	133.986	-0.184
299-W6-12	134.253	134.521	0.268
299-W7-3*	134.909	135.225	0.316
299-W8-1	135.919	136.515	0.596
699-48-71	131.224	130.641	-0.583
699-49-79	134.978	135.222	0.244
699-51-75	132.921	132.870	-0.051
699-51-75P*	132.915	132.869	-0.046
Other Wells			
299-W7-4	135.111	135.502	0.391
299-W11-18	133.275	132.965	-0.310
299-W12-1	130.581	Dry (<129.7)	Not Applicable
Average, All Wells (m/yr)			**-0.041**
Average, Tritium-Tracking Wells Only (m/yr)			**-0.159**
Average, Proximal Wells Only (m/yr)			**0.260**

* Well has an open interval below the water table (i.e., deep completion).

2.4 Well Longevity

A groundwater modeling study was conducted during 2011 to assess the effect that both the regional water table decline and operation of the 200-ZP-1 P&T system would have on well water levels within the 200 West Area and vicinity (SGW-50907). In that study, future water levels predicted from the modeling were compared to well screen elevations for all shallow-completed wells in use at that time, and wells that would become dry in the near future were identified. This study represents the best forecast of well longevity through the year 2020 for 200 West Area monitoring wells.

Results of the well longevity modeling study for the shallow-completed proximal and tritium-tracking wells are shown in Table 2-2. The modeling study indicated that water levels will increase in all but two of the shallow-screened wells between 2011 and 2013 in response to the P&T system (Table 2-2). This prediction has been confirmed by recent water-level measurements (Figures 2-2 through 2-7). The increases are predicted to range from 0.3 to 0.9 m (1 to 3 ft). Water levels are not expected to increase in wells 699-48-71 and 699-51-75, which are farther from the 200-ZP-1 injection wells. Thus,

some of the wells that are becoming dry are expected to be usable a few years longer than if the P&T system did not operate. However, all but three of the shallow-screened monitoring wells in the SALDS network are expected to be dry by 2015 to 2017.

Four of the SALDS network monitoring wells currently in use are expected to become dry no later than 2016. These are proximal well 699-48-77D and tritium-tracking wells 299-W6-11, 299-W6-12, and 299-W8-1. Predicted water levels in these wells, along with proximal well 699-48-77A (which became dry in 2011), are compared to actual water levels and screen bottom elevations in Figures 2-8 through 2-12. Actual water levels are lower than predicted water levels in the two proximal wells (Figures 2-8 and 2-9). This is because actual SALDS effluent discharges have been lower than discharge volumes assumed for the modeling, so the groundwater mound beneath SALDS is lower than anticipated. Because ETF has not operated since January 2014, and it is not expected to operate until late 2015, well 699-48-77D may become dry sooner than indicated by model predictions.

Actual water levels for wells 299-W6-11 and 299-W6-12 are in very good agreement with the predicted water levels (Figures 2-10 and 2-11). These wells are forecast to become sample dry in 2015 or 2016. The water level at well 299-W8-1 increased more than model predictions, which allowed for this well to be sampled during 2014 (Figure 2-12). This well will continue to be sampled until it becomes dry again. Only three of the shallow-screened SALDS monitoring wells (tritium-tracking wells 699-48-71, 699-49-79, and 699-51-75) are predicted to have more than 0.3 m (1 ft) of water after the year 2016 (Table 2-2). Four other wells in the SALDS network (299-W6-6, 299-W7-3, 699-48-77C, and 699-51-75P) are screened relatively deep in the aquifer and will be usable indefinitely.

Table 2-2. Well Open-Interval Bottom Elevations Compared to Predicted Water Levels

Well	Open-Interval Bottom Elevation (m)	Predicted Water Levels by Year (m NAVD88)									
		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
299-W6-11	131.71	133.27	134.22	133.86	133.56	132.50	132.07	131.76	131.51	131.28	131.07
299-W6-12	132.71	133.61	134.51	134.22	133.95	133.26	132.85	132.54	132.29	132.07	131.85
299-W8-1	136.1	135.50	136.12	136.11	135.96	135.76	135.49	135.23	135.01	134.80	134.56
699-48-71	124.5	131.32	130.88	130.40	130.04	129.77	129.48	129.24	129.02	128.82	128.75
699-48-77A	135.1	135.24	135.72	135.61	135.42	135.05	134.73	134.45	134.22	134.00	133.78
699-48-77D	134.2	134.98	135.80	135.23	135.04	134.69	134.38	134.11	133.88	133.67	133.44
699-49-79	125.8	134.65	134.89	134.86	134.73	134.52	134.28	134.04	133.83	133.63	133.42
699-51-75	127.72	132.93	132.94	132.80	132.62	132.32	132.03	131.78	131.56	131.35	131.17

Source: SGW-50907, *Predicted Impact of Future Water-Level Declines on Groundwater Well Longevity within the 200 West Area, Hanford Site.*

Note: Values are highlighted yellow for years in which a well is forecast to have less than 0.9 m (3 ft) of water above the bottom of the open interval and highlighted in red when the water level is within 0.3 m (1 ft) of the open-interval bottom.

NAVD88 = North American Vertical Datum of 1988

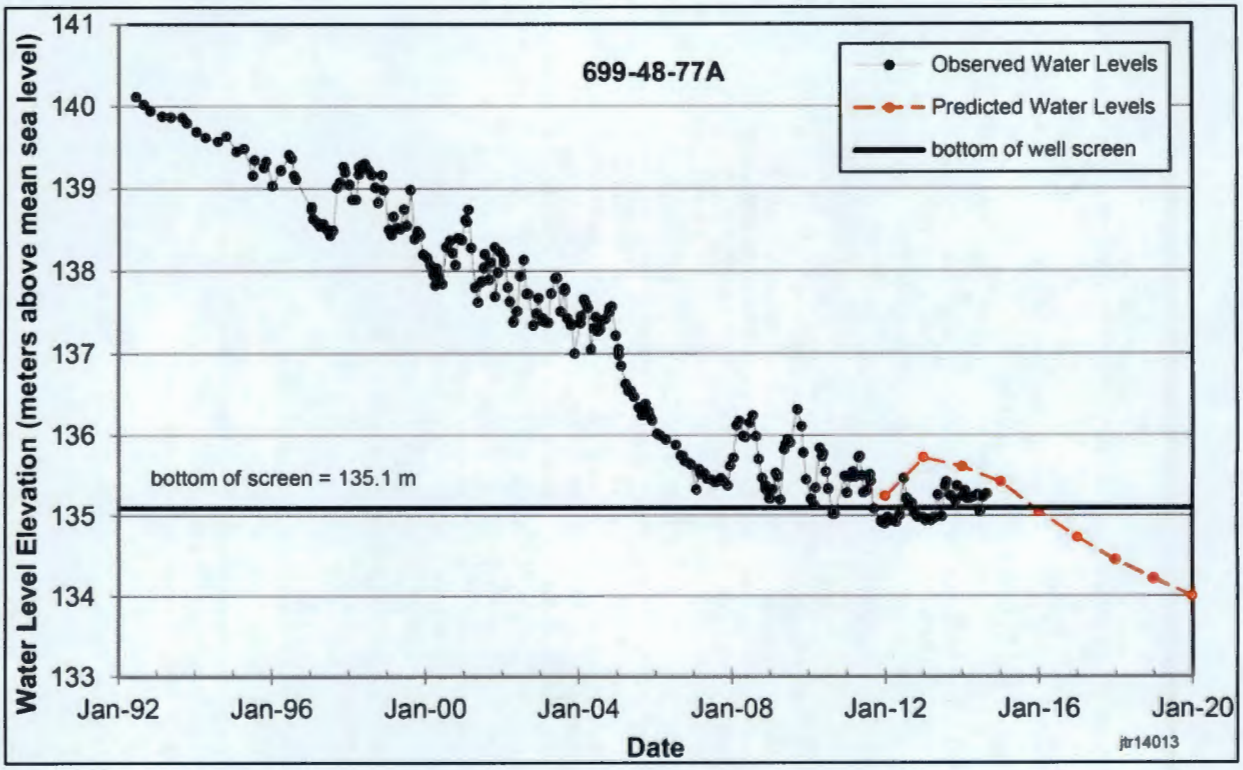

Figure 2-8. Water Remaining in Proximal Well 699-48-77A

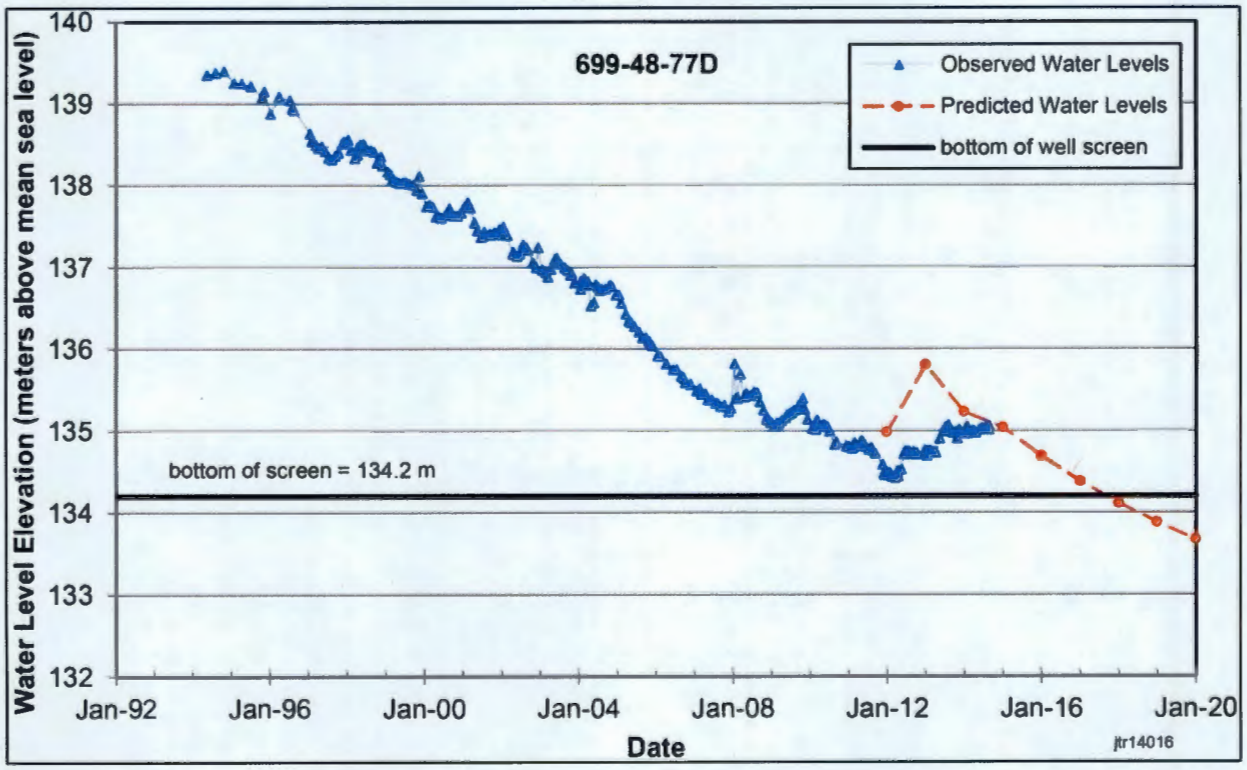

Figure 2-9. Water Remaining in Proximal Well 699-48-77D

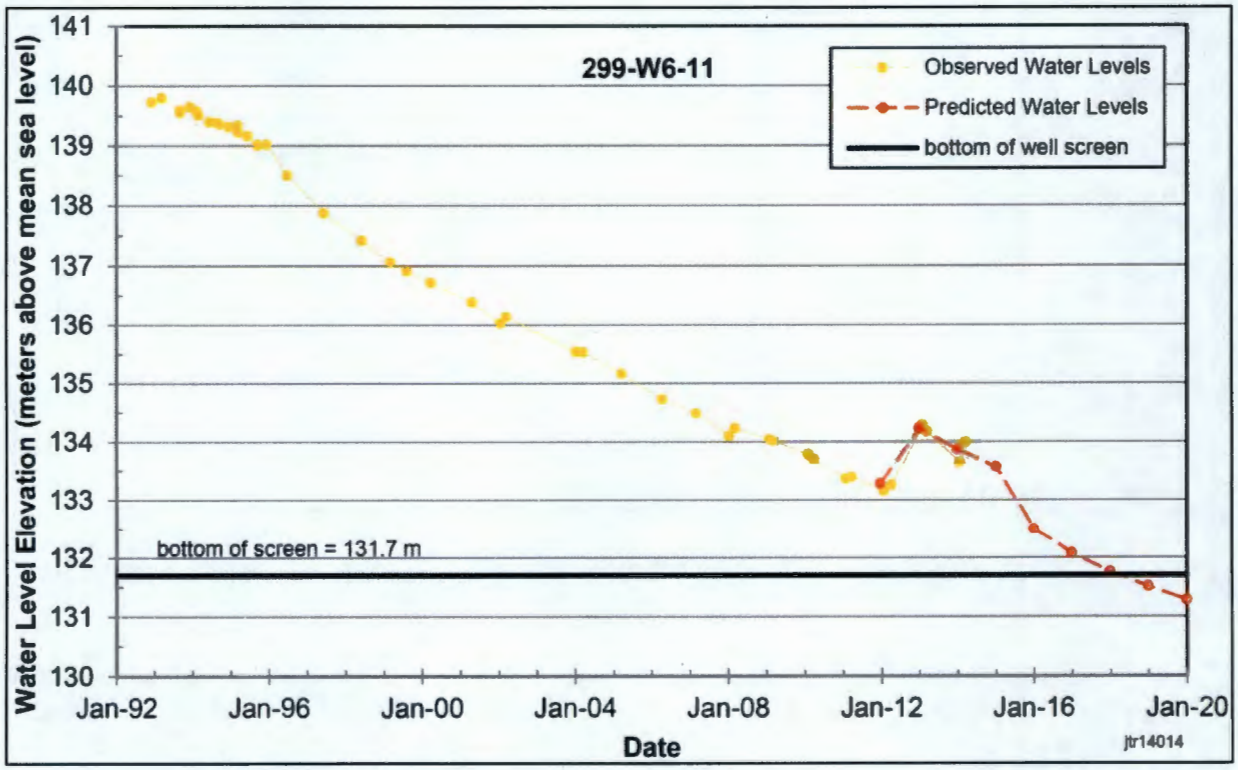

Figure 2-10. Water Remaining in Tritium-Tracking Well 299-W6-11

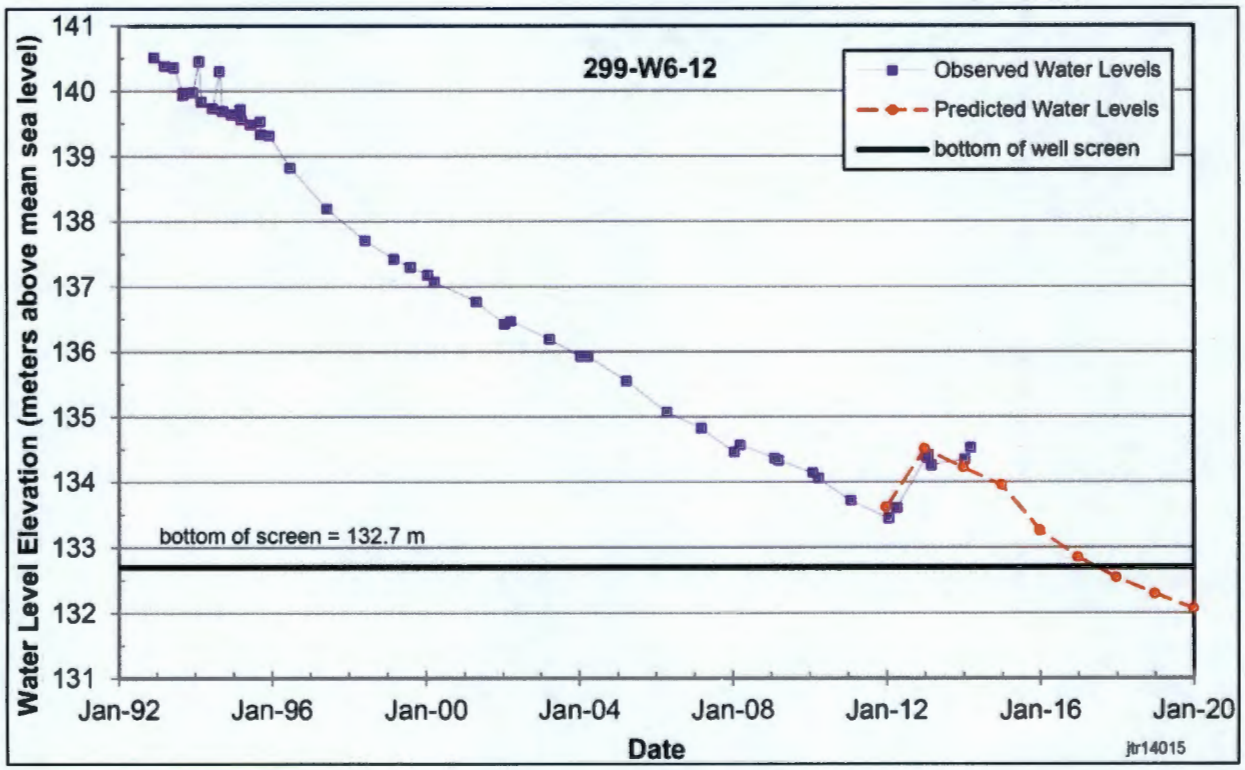

Figure 2-11. Water Remaining in Tritium-Tracking Well 299-W6-12

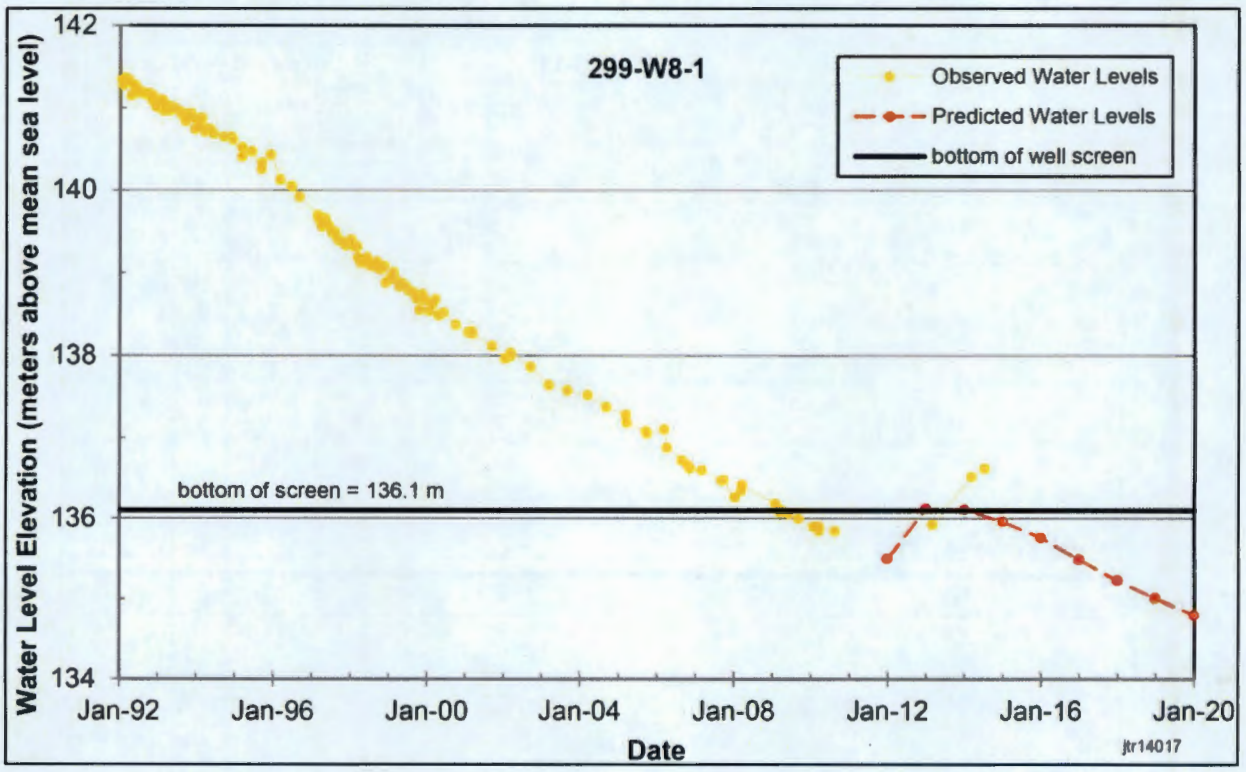

Figure 2-12. Water Remaining in Tritium-Tracking Well 299-W8-1

3 Results of Fiscal Year 2014 Groundwater Sampling

Groundwater sampling was scheduled quarterly in proximal wells 699-48-77C and 699-48-77D and annually to semiannually in tritium-tracking wells located in the SALDS vicinity. Proximal well 699-48-77A was not scheduled because it has too little water remaining to sample. As per agreement with Ecology, sampling of the SALDS proximal wells will continue only until they no longer produce representative data (12-NWP-035, "Status of Compliance Monitoring Wells at State Approved Land Disposal Site as Required by State Waste Discharge Permit ST-4500, Letter 12-EMD-0030, dated February 16, 2012"). Ecology has also agreed that no replacement wells are needed when a proximal well becomes dry because monitoring of ETF effluent would provide assurance that the Permit discharge limits would not be exceeded (12-NWP-035). As stated in Section 2.4, proximal well 699-48-77D is expected to become dry between 2015 and 2017. Proximal well 699-48-77C is completed deeper in the aquifer and is not expected to go dry. Table 3-1 shows the FY 2014 sampling schedule.

Table 3-1. Sampling Schedule for Fiscal Year 2014

Well	Sampling Frequency/Months*	Other Sampling Programs	Comments
299-W6-6	A/January	Ringold Confined; 200-ZP-1 OU	Deep well. FY 2014 sample date: January 2014.
299-W6-11	A/January	—	FY 2014 sample date: January 2014.
299-W6-12	A/January	—	FY 2014 sample date: January 2014.
299-W7-3	S/January, May	Ringold Confined; 200-ZP-1 OU	Deep well. FY 2014 sample dates: January and May 2014.
299-W8-1	A/July	—	FY 2014 sample date: July 2014.
699-48-71	A/January	200-ZP-1 OU	FY 2014 sample date: August 2014.
699-48-77C	Q/October, January, April, July	—	Sampled for 17 constituents/parameters listed in the Permit, including tritium. FY 2014 sample dates: October 2013 and January, April, and July (anions resampled in August) 2014.
699-48-77D	Q/October, January, April, July	—	Sampled for 17 constituents/parameters listed in the Permit, including tritium. FY 2014 sample dates: October 2013 and January, April, and July (anions resampled in August) 2014.
699-49-79	A/January	200-ZP-1 OU	FY 2014 sample date: August 2014.
699-51-75	S/January, May	200-ZP-1 OU	FY 2014 sample dates: January and June 2014.
699-51-75P	A/January	—	Deep piezometer in well 699-51-75. FY 2014 sample date: January 2014.

* Actual months of sampling may vary due to equipment failure, winter weather conditions, or accessibility restrictions caused by fire hazard; however, the sampling frequency is generally maintained.

A = annually
FY = fiscal year
OU = operable unit
Q = quarterly
S = semiannually

Since 1996, most analyses of groundwater samples from the proximal wells had been performed by an onsite laboratory (the Waste Sampling and Characterization Facility [WSCF]). DOE shut down this laboratory in April 2014. Samples collected after this time were analyzed by either TestAmerica (Richland, Washington or St. Louis, Missouri) or GEL Laboratories (Charleston, South Carolina). TestAmerica Richland is typically used for radionuclide analyses, while TestAmerica St. Louis (TASL) or GEL is used for nonradionuclide analyses. Samples collected through early April were primarily analyzed by WSCF, but samples after this time were analyzed by TASL or GEL.

As a result of the laboratory change, issues occurred during the July sampling that necessitated resampling of the proximal wells. Instrument problems prevented the anion analysis from being completed within the holding time for nitrate, so the proximal wells were resampled on August 8, 2014. The analysis of this sample was cancelled when it was discovered that the TASL laboratory failed to perform a special permit-required quality control sample. The proximal wells were sampled again on August 22, 2014. The GEL laboratory also failed to perform the special quality control sample, but the lab was able to reanalyze the sample and report the results. The nitrate result was not reported because the analysis was not completed within holding time.

Section 3.1 summarizes FY 2014 groundwater sampling results for proximal wells 699-48-77C and 699-48-77D. Section 3.2 discusses results of the tritium analyses, including the tritium-tracking wells. All tritium sample results are provided in Appendix A.

3.1 Proximal Well Sampling and Analyses for Fiscal Year 2014

Quarterly samples from proximal wells 699-48-77C and 699-48-77D were analyzed for tritium and the other 16 constituents/parameters listed in the Permit, Special Condition S2(B) (Ecology, 2000). The Permit sets concentration limits for acetone, benzene, cadmium (total), chloroform, copper (total), lead (total), mercury (total), field pH, sulfate, tetrahydrofuran, and total dissolved solids. Gross alpha, gross beta, strontium-90, tritium, specific conductance, and temperature are also listed in the Permit but are not assigned concentration limits; they are reported for informational purposes. Results for all of these parameters are reported quarterly in discharge monitoring reports. Additional parameters (i.e., alkalinity, dissolved oxygen, and turbidity) are used to determine general groundwater characteristics and verify the quality of analytical results. Table 3-2 lists the maximum concentrations for these constituents in the proximal wells and the corresponding sampling months for FY 2014.

Table 3-2. Constituent Maximum or Range of Concentrations in Groundwater and Corresponding Sampling Month for the SALDS Proximal Wells, Fiscal Year 2014

Constituent (Permit Limit)	Well 699-48-77C	Well 699-48-77D
Constituents with Permit Limits		
Acetone (160 µg/L)	<6.7 (U)[a]	<6.7 (U)[a]
Benzene (5 µg/L)	<1.0 (U)[a]	<1.0 (U)[a]
Cadmium, Total (10 µg/L)	<0.2 (U)[a]	0.75 (B); July 2014
Chloroform (6.2 µg/L)	<1.0 (U)[a]	<1.0 (U)[a]
Copper, Total (70 µg/L)	1.38 (B); April 2014	2.02; October 2013
Lead, Total (50 µg/L)	0.444 (B); April 2014	0.350 (B); April 2014

Table 3-2. Constituent Maximum or Range of Concentrations in Groundwater and Corresponding Sampling Month for the SALDS Proximal Wells, Fiscal Year 2014

Constituent (Permit Limit)	Well 699-48-77C	Well 699-48-77D
Mercury, Total (2 μg/L)	<0.1 (U)[a]	0.094 (B); July 2014
Field pH, pH Units (6.5 to 8.5)[b]	7.8 to 8.1	7.9 to 8.1
Sulfate (250,000 μg/L)	3,990; August 2014	25,900; January 2014
Tetrahydrofuran (100 μg/L)	<2.0 (U)[a]	<2.0 (U)[a]
Total Dissolved Solids (500,000 μg/L)	163,000; October 2013	223,000; October 2013
Other Constituents Listed in the Permit		
Gross Alpha, pCi/L	<2.1 (U)[a]	<3.4 (U)[a]
Gross Beta, pCi/L	4.0; April 2014	5.8; October 2013
Strontium-90, pCi/L	<1.6 (U)[a]	4.6 (B); October 2013
Tritium, pCi/L	83,000; October 2013	60,500; July 2014
Field Specific Conductance, μS/cm[b]	171 to 187	259 to 284
Field Temperature, °C[b]	18.2 to 19.4	16.6 to 19.3
Additional Constituents Not Listed in the Permit		
Alkalinity, mg/L	84 to 86	98 to 100
Dissolved Oxygen, mg/L[b]	8.63 to 9.13	9.39 to 10.11
Turbidity, NTU[b]	0.4 to 1.7	3.5 to 4.8

Note: All concentrations are stated in μg/L, unless otherwise indicated.

a. Not detected in any sample.

b. Four analyses were performed per sample event. Values reported in this table are the averages of the four analyses, except that maximum values are used for specific conductance and temperature.

B = detected at a value less than the contract-required detection limit but greater than or equal to the instrument detection limit/method detection limit, as appropriate (i.e., a low-level detection)

NTU = nephelometric turbidity unit

U = not detected; detection limits (for nonradionuclides) or minimum detectable activity (for radionuclides) are indicated, as applicable

There were no exceedances of a Permit limit during FY 2014. Acetone, benzene, cadmium, chloroform, and tetrahydrofuran were reported below detection limits in both proximal wells for all of the samples collected during FY 2014. Low-level detections occurred for copper and lead, but the reported concentrations were well below permit limits. Field pH measurements were within the 6.5 to 8.5 limits in all samples collected from the proximal wells during FY 2014. The minimum pH value of 7.8 was observed in 699-48-77C, and the maximum pH of 8.1 occurred in both proximal wells. The maximum sulfate concentration was 25,900 μg/L in 699-48-77D, well below the Permit limit of 250,000 μg/L. The maximum total dissolved solids result was 223,000 μg/L in 699-48-77D, below the 500,000 μg/L Permit limit.

During FY 2014, gross beta results ranged from below detection limits to a maximum of 5.8 pCi/L in the proximal wells, which is below the Hanford Site background value of 8.96 pCi/L (95th percentile value provided in DOE/RL-96-61, *Hanford Site Background: Part 3, Groundwater Background*). Strontium-90 results ranged from below detection limits to a maximum of 4.6 pCi/L (flagged as a low-level detection). The maximum is probably a false positive result, which has been an issue with the WSCF laboratory in the past (DOE/RL-2011-118, *Hanford Site Groundwater Monitoring for 2011*). All of the gross alpha analyses in the proximal wells were nondetects during FY 2014. There are no Permit limits associated with gross alpha, gross beta, or strontium-90.

3.2 Results of Tritium Analyses (Tritium Tracking)

The proximal wells are sampled quarterly for a suite of constituents, including tritium, but the other SALDS network monitoring wells are sampled annually or semiannually for tritium only (i.e., tritium-tracking wells). Nine tritium-tracking wells were sampled between January and August 2014, which is one more than during FY 2013. Well 299-W8-1, which had become dry during 2010, was found to have enough water to sample again due to operation of nearby injection wells for the 200-ZP-1 P&T system. Due to generally declining water levels throughout the 200 West Area, 10 of the 19 tritium-tracking wells listed in the monitoring plan (PNNL-13121) are dry and no longer in use. Five wells that were successfully sampled are screened in the upper portion of the aquifer near the water table; the other three wells are screened at greater depths, including one well (699-51-75P) that is a piezometer nested within well 699-51-75 but has an open interval 41 m (135 ft) deeper in the aquifer than the well. Five tritium-tracking wells were also sampled for other programs during FY 2014 (Table 3-1). The tritium sample results for all of the network wells are provided in Appendix A.

Tritium-tracking well 699-51-75P was sampled during 2014 using a bailer, but efforts continue to develop a better method for sampling this well. The open interval for this piezometer is located 50 m (160 ft) below the water table. This piezometer has historically been sampled by the airlift method, but the airlift tubing was removed from the well in 2012 because it was not yielding water to the surface. Since then, this well has been sampled using a bailer. However, the bailer method is not likely to yield a representative sample because the bailer draws water only from the top of the water column in the piezometer, which is 50 m (160 ft) above the open interval. An attempt to install a bladder pump in this well during FY 2014 failed because the pump was too large to lower past the welded casing joints of the 2 in. (5.1 cm) diameter piezometer. Efforts will continue during FY 2015 to identify a pump small enough to be installed in this piezometer that can still provide the required lifting power to raise water to the surface.

3.2.1 Tritium in the Proximal Monitoring Wells

This section describes tritium concentration responses in the proximal wells to SALDS discharges. It addresses both long-term trends and current concentrations. Maximum tritium concentrations in the proximal wells during FY 2014 and the associated sampling dates are shown in Table 3-2.

3.2.1.1 Long-Term Trends

Groundwater in the proximal wells has been affected by tritium discharges since 1996 (Figure 3-1). Peak tritium concentrations occurred in September 1997 (2,000,000 pCi/L) and February 1998 (2,100,000 pCi/L) in wells 699-48-77A and 699-48-77D, respectively, in response to initial discharges to SALDS between December 1995 and June 1996. The tritium concentration trend in well 699-48-77C is attenuated and time-lagged compared to the other wells. The peak concentration in this well occurred in February 2001, which is 3 years after the peak occurred in 699-48-77D, and the concentration was lower at 980,000 pCi/L. The lower concentration was caused primarily by dispersion. Well 699-48-77C is

screened approximately 20 m (65 ft) below the water table, and as the plume migrated to this depth, it mixed with uncontaminated groundwater. Radiological decay would also have been a factor in the reduced concentration because tritium has a relatively short half-life (12.3 years), but dispersion was the primary factor.

Since the time of peak concentrations in the proximal wells, tritium concentrations have generally trended downward, although periods of increasing or fluctuating concentrations have occurred. From 1999 to 2005, concentration changes in well 699-48-77A were irregular (Figure 3-1), with periodic highs and lows of significant amplitude (sometimes two order-of-magnitude changes). These fluctuations were likely caused by the annual campaigns of the 242-A evaporator wastewater during that time, which was high in tritium. In April 2008, the 820,000 pCi/L tritium concentration was the highest level seen in well 699-48-77A in a decade (Figure 3-2). This was likely due to several intermittent ETF campaigns in 2006 and 2007 to treat wastewater from the K Basins project, which had tritium levels similar to those of 242-A evaporator wastewater. These intermittent campaigns restarted in FY 2010 with ETF again treating wastewater from the K Basins project. This may explain the fluctuation in tritium results observed during FY 2011 before well 699-48-77A became dry.

Well 699-48-77D is located nearest to SALDS, yet this well showed a tritium concentration increase starting in September 1997, more than one year later than more distant well 699-48-77A. There are two causes for this delay: (1) the SALDS drain field fills from the southern end of the facility farthest away from 699-48-77D, and (2) discharged water in the vadose zone moves to the south along the CCU, which has a southward dip (Section 1.2.1). These two conditions direct the subsurface flow of effluent away from 699-48-77D, so the effluent actually reaches the groundwater closer to well 699-48-77A. This interpretation is consistent with the low specific conductance values that were measured in 699-48-77A (ranging from 89 to 98 µS/cm when this well was last sampled in FY 2011). This indicates that a substantial portion of SALDS effluent, which is very low in specific conductance, has mixed with groundwater near well 699-48-77A.

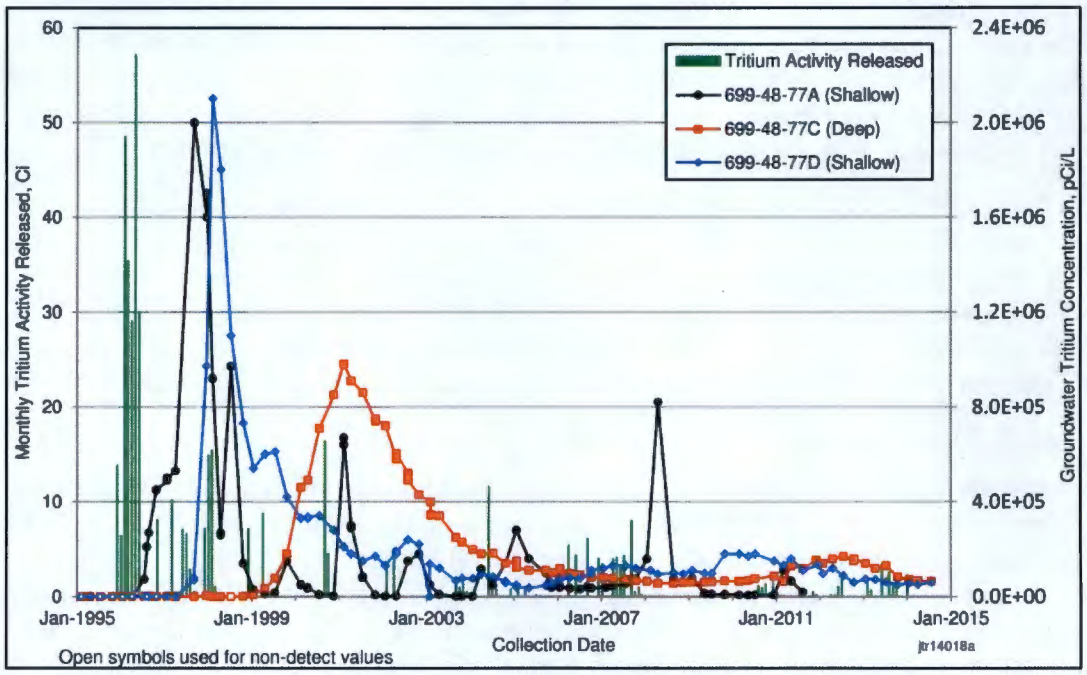

Figure 3-1. SALDS Tritium Releases and Concentration Trends in the Proximal Wells from 1995 through July 2014

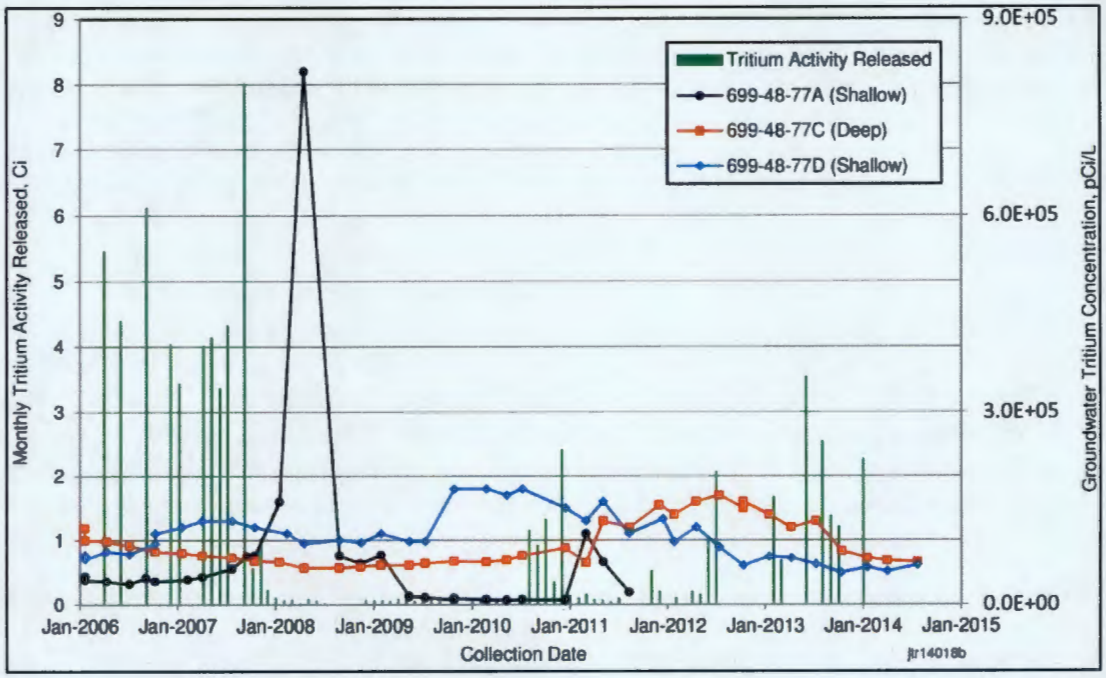

Figure 3-2. SALDS Tritium Releases and Concentration Trends in the Proximal Wells from 2006 through July 2014

3.2.1.2 Current Trends

During FY 2014, the tritium concentration declined in 699-48-77C and increased slightly in 699-48-77D (Figures 3-1 and 3-2). The decline in 699-48-77C was from 83,000 pCi/L in October 2013 to 65,600 pCi/L in July 2014 (a 21 percent reduction). The annual average concentration in this well declined by 47 percent (from 136,000 pCi/L to 72,000 pCi/L) between FYs 2013 and 2014. The concentration in this well reached a peak during July 2012 at 170,000 pCi/L and has been declining since. This pulse of tritium is consistent with an attenuated, time-lagged response to the ETF treatment of wastewater from the K Basins project released to SALDS during 2006 and 2007. The recent tritium concentration declines are in response to the reduced amount of tritium released from SALDS during 2008 to 2010.

The tritium concentration increased in 699-48-77D from 49,000 pCi/L in October 2013 to 60,500 pCi/L in July 2014 (a 23 percent increase). From FYs 2013 to 2014, however, the annual average tritium activity declined by 19 percent (from 67,000 pCi/L to 54,000 pCi/L). Thus, the increasing concentrations during FY 2014 represented a trend reversal. This indicates that after a period of reduced tritium discharges between 2008 and 2010, tritium released from SALDS since 2010 has now reached this well.

3.2.2 Tritium-Tracking Wells

Sample results during FY 2014 continued to indicate that the tritium plume from SALDS has not reached any of the tritium-tracking wells. Tritium was not detected in wells 299-W8-1, 699-49-79, and 699-51-75, located southwest, west, and northeast of SALDS, respectively (Figure 3-3). Tritium was also not detected in two of the three deep tritium-tracking wells (299-W7-3 and 699-51-75P). Tritium was detected in the remaining tritium-tracking wells southeast and east of SALDS, but the sources are past waste disposal sites in the 200 West Area and the currently active injection wells for the 200-ZP-1 P&T system. The P&T system was described in Section 2.1.

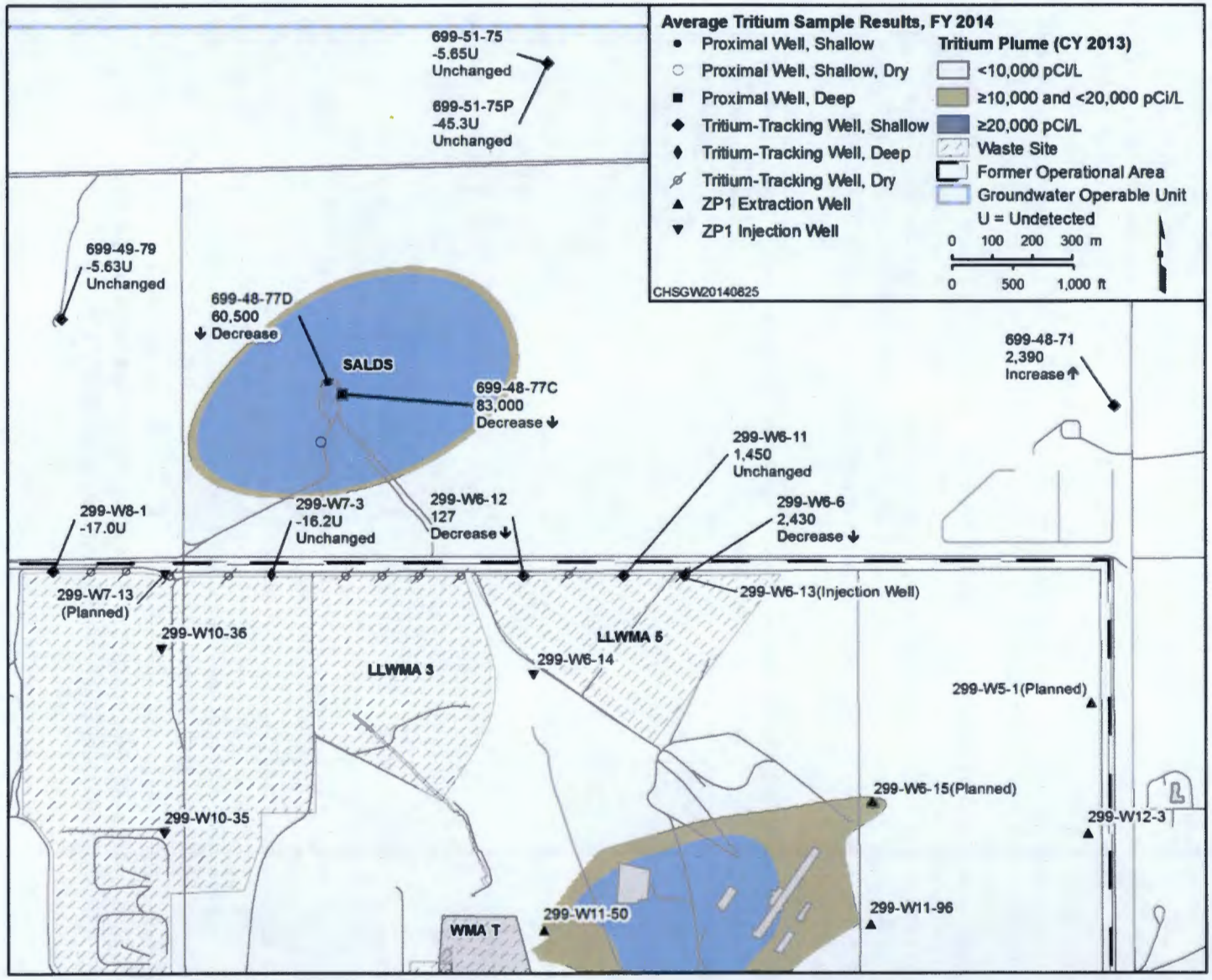

Figure 3-3. Average Tritium Activities in Groundwater for SALDS Tritium-Tracking Network for Fiscal Year 2014

The most substantial concentration changes in the tritium-tracking wells continued to occur in deep well 299-W6-6, located southeast of SALDS. Tritium was not detected in this well during FY 2012, but the sample result for January 2013 was 3,770 pCi/L and the result for January 2014 was 2,430 pCi/L (Figures 3-3 and 3-4). As explained in Section 2.1, an injection well for the 200-ZP-1 P&T system (299-W6-13) was installed during 2011 only 9.8 m (32 ft) from well 299-W6-6 (Figure 1-3). The injection well began operating during 2012 and receives water from the 200 West Groundwater Treatment Facility. Just like ETF, the 200 West Groundwater Treatment Facility does not remove tritium from the water. During 2013, the monthly average tritium concentration in the injected effluent ranged from 1,400 to 5,000 pCi/L (DOE/RL-2014-26). Injection of this water into well 299-W6-13 is the cause of the tritium occurrence in well 299-W6-6. Thus, groundwater well 299-W6-6 no longer provides useful information for tracking the tritium plume from SALDS.

Migration of tritium from past wastewater disposal sites in the 200 West Area has affected the shallow tritium-tracking wells along the northern margin of the 200 West Area. FY 2014 concentrations in this area were 127 pCi/L in 299-W6-12 and 1,450 pCi/L in 299-W6-11. Many of the shallow-screened wells in this area exhibited elevated tritium concentrations prior to the start of SALDS discharges (Figures 3-4 and 3-5), further supporting the interpretation that the tritium originates from other 200 West Area waste sites.

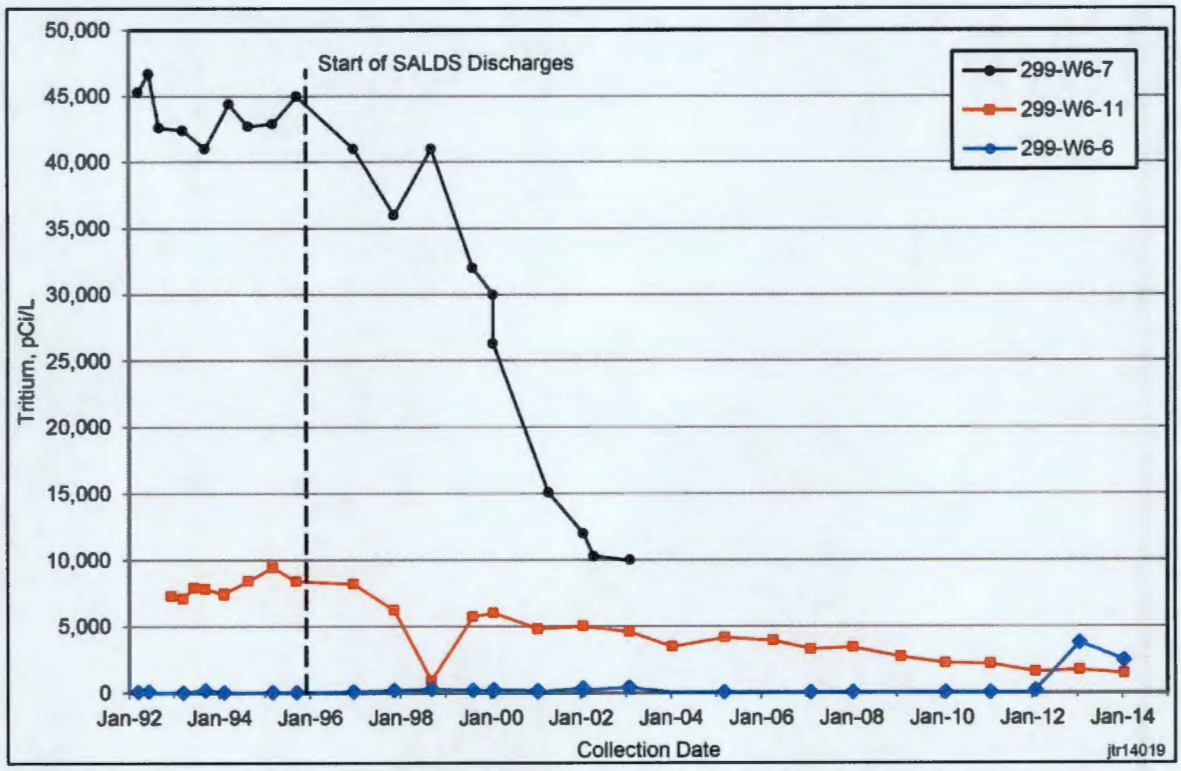

Figure 3-4. Tritium Activity Trends in Wells Southeast of SALDS Showing Remnant Effects of the Tritium Plume from the 200 West Area

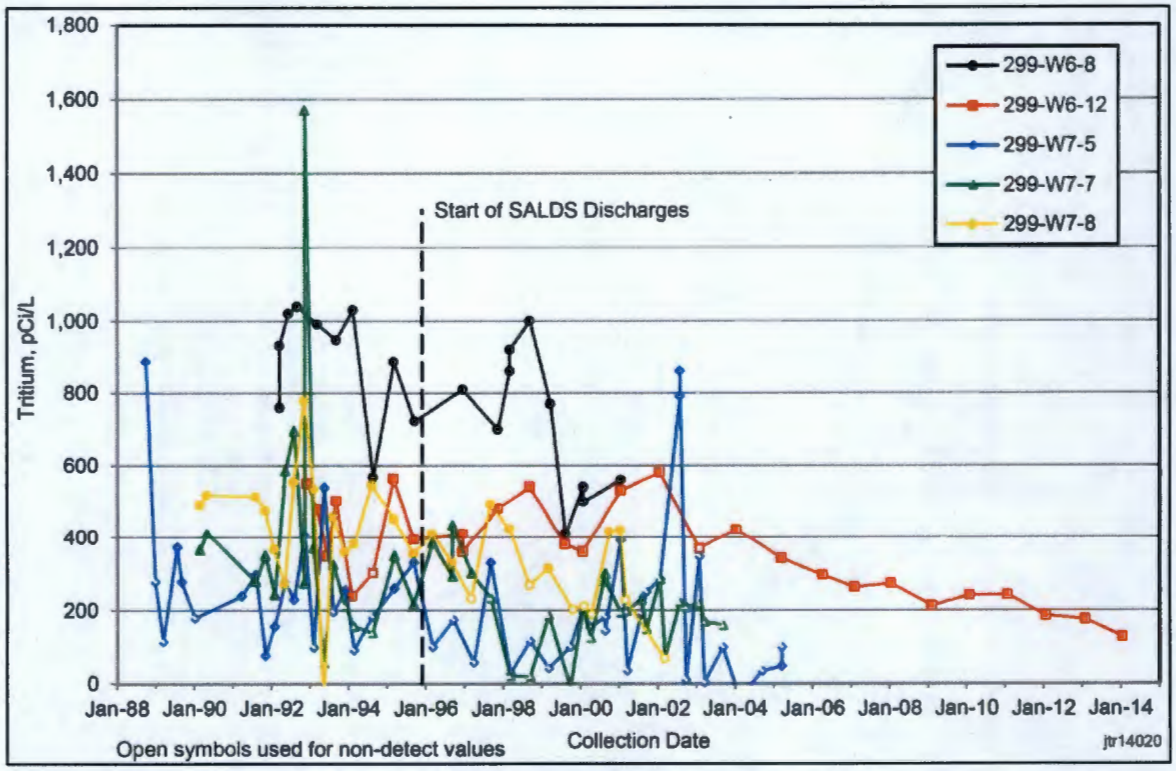

Figure 3-5. Tritium Concentrations in Wells South of SALDS Showing Remnant Effects of the Tritium Plume from the 200 West Area

Well 699-48-71, located 1.9 km (1.2 mi) to the east of SALDS, continued to show an increase in tritium concentration, from 1,520 pCi/L in FY 2013 to 2,390 pCi/L in FY 2014. Tritium concentrations have been increasing in this well since 2004. Although this well is located downgradient of the SALDS crib, the large distance to this well suggests that discharges from SALDS are not the source of tritium in groundwater at this location. This is also supported by the tritium modeling results, which predict that the SALDS plume should not reach this well prior to the year 2030 (Figure 4-1 in Chapter 4). Tritium at well 699-48-71 is part of the same plume that has impacted wells along the northern margin of the 200 West Area and originated from past wastewater disposal sites (Figure 3-3).

3.3 Results of Other Constituent Analyses

After discharges began at SALDS, several anions and metals increased in concentration in the proximal wells and then rapidly declined. Specific conductance (a measure of total ions in solution) at well 699-48-77A clearly shows a well-defined spike in the months after SALDS discharges began in December 1995 (Figure 3-6), with values peaking at approximately 845 µS/cm in August 1996. This was likely due to transport of soluble mineral species that were dissolved from the vadose zone during initial percolation of SALDS effluents (PNNL-11633, *Origin of Increased Sulfate in Groundwater at the ETF Disposal Site*; PNNL-11665, *Tritium Monitoring in Groundwater and Evaluation of Model Predictions for the Hanford Site 200 Area Effluent Treatment Facility*). This spike in dissolved constituents was a temporary effect associated with initial wetting of the vadose zone sediments beneath the facility.

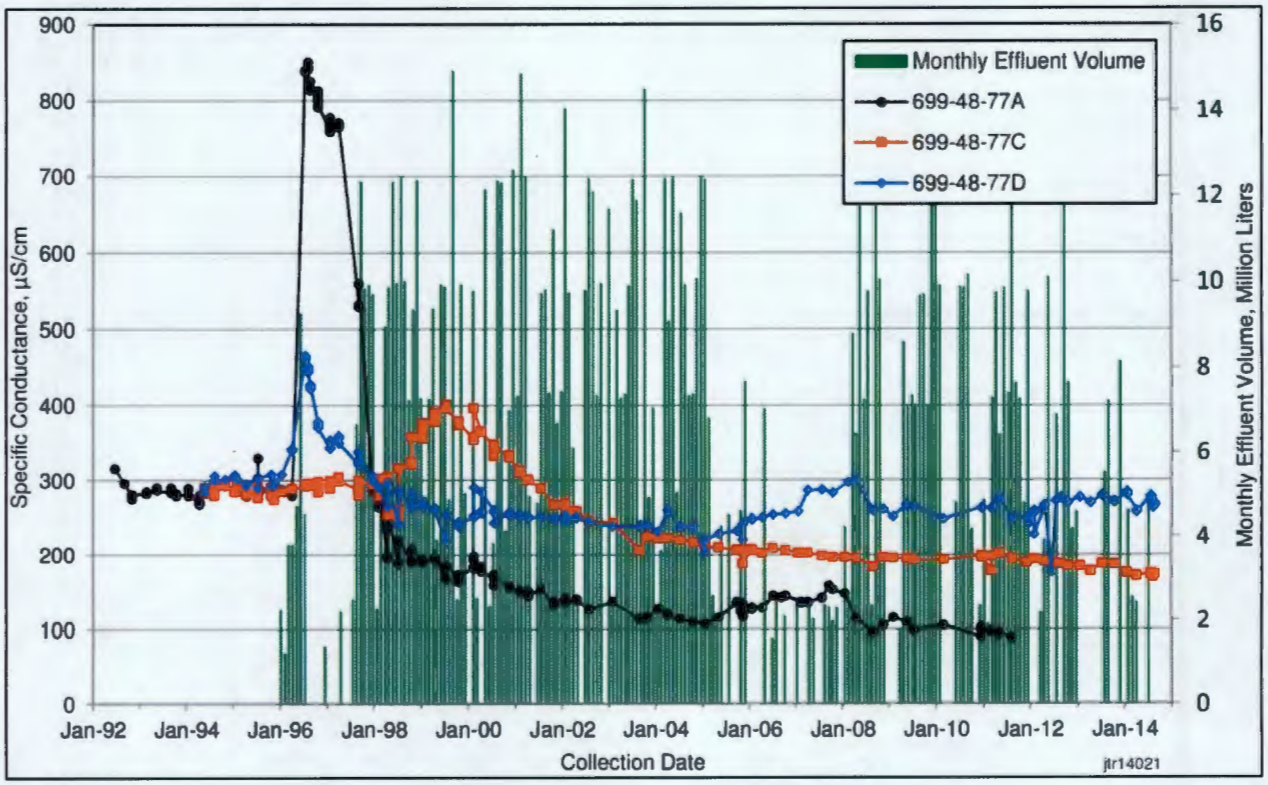

Figure 3-6. Specific Conductance in the SALDS Proximal Wells

Currently, specific conductance in the proximal wells is related to the volume of effluent released from SALDS. SALDS effluent is very low in specific conductance. For example, average monthly values for July 2013 through June 2014 were less than 2.0 µS/cm. The Hanford Site groundwater background for specific conductance has a geometric mean of 348 µS/cm (DOE/RL-96-61). Thus, mixing of SALDS effluent with groundwater reduces specific conductance in the monitoring wells because of dilution, and the amount of reduction depends on the volume of effluent released. Conversely, during periods of reduced discharges, specific conductance in the monitoring wells increases because of less dilution. This occurred during the period of reduced effluent volumes released from SALDS between 2005 and 2007 (Figure 3-6). Specific conductance in shallow proximal wells 699-48-77A and 699-48-77D increased during this time and peaked in late 2007 and early 2008. A slight peak in specific conductance was observed during early 2011, in deep proximal well 699-48-77C, which is likely the attenuated, time-lagged response to the 2005 to 2007 period of reduced effluent discharges.

A map showing specific conductance in the SALDS vicinity in relation to the tritium plume is provided in Figure 3-7. As expected, the tritium plume from SALDS is associated with low specific conductance in the groundwater because of the low specific conductance of the SALDS effluent. A region of high specific conductance occurs in the eastern part of the mapped area. This denotes the region of contamination originating from the 200 West Area.

During FY 2014, the maximum field specific conductance readings in the proximal wells were 187 µS/cm in 699-48-77C and 284 µS/cm in 699-48-77D. The trend was slightly increasing at 699-48-77D between 2012 and 2013 (Figure 3-6), which was likely in response to reduced effluent discharges since August 2011. The trend has been relatively stable for 2013 to 2014. Specific conductance has been declining at 699-48-77C since 2011. This decline is likely the attenuated, time-lagged response to the increase in SALDS discharges from 2007 to 2011.

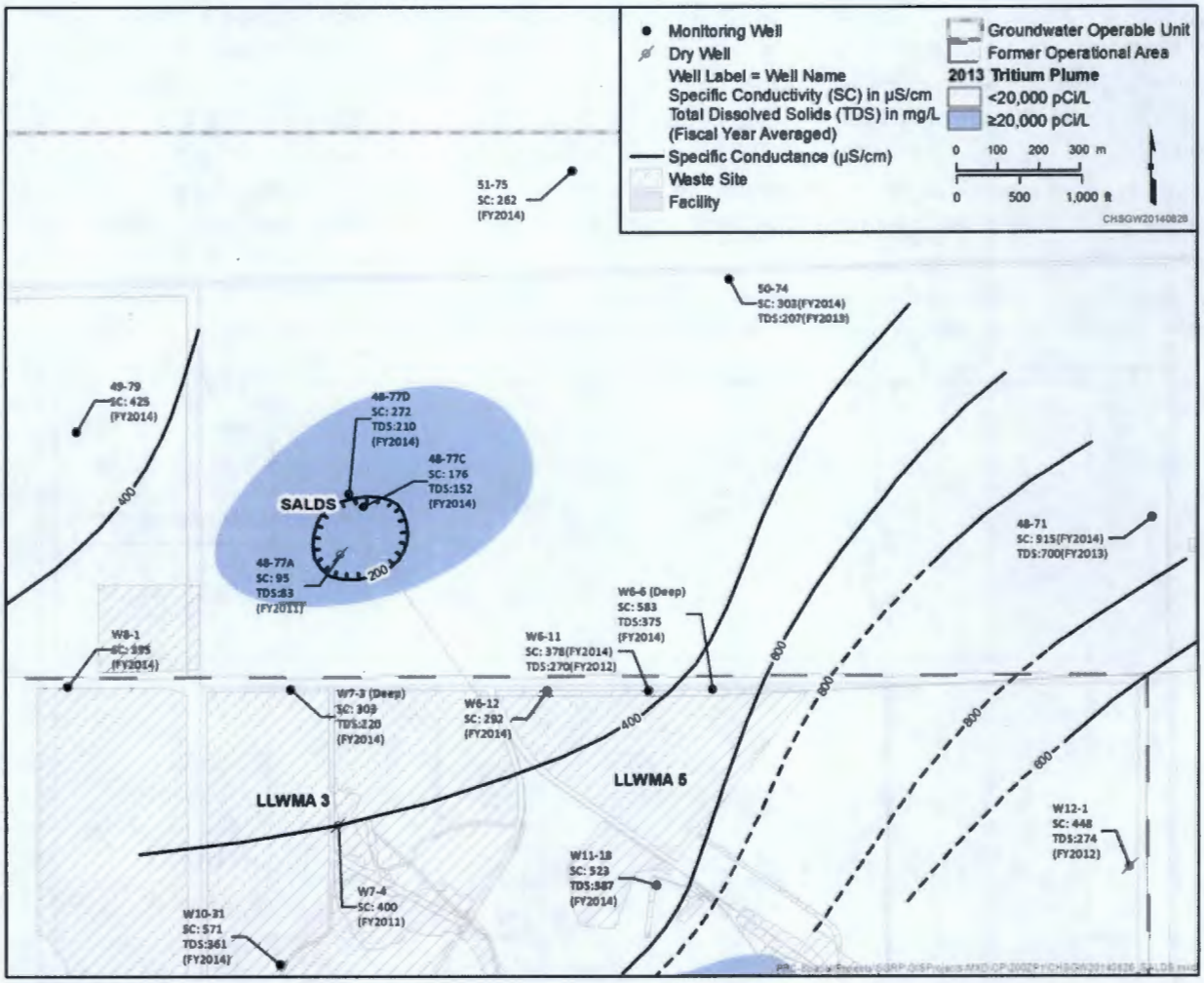

Figure 3-7. Comparison of Specific Conductance and the Tritium Plume in the SALDS Vicinity

During FY 2014, the maximum concentration of total dissolved solids in the proximal wells was 163 mg/L in 699-48-77C and 223 mg/L in 699-48-77D. Analytical results for total dissolved solids in both wells trended upward between 2011 and 2013, and then changed to downward during 2014 (Figure 3-8). Because specific conductance is an indirect measure of total ions in solution, it is expected that total dissolved solids and specific conductance would trend together. However, recent trends in total dissolved solids (i.e., since 2011) do not correlate with trends in specific conductance (compare Figure 3-6 with Figure 3-8). During the 2010 to 2011 timeframe, the technique of analyzing total dissolved solids at the WSCF laboratory was changed from a manual to an automated method which resulted in less overall statistical variability in the analytical results. While it is possible that there was some analytical bias that changed over time with the new method causing an apparent trend in the total dissolved solids results not representative of actual groundwater conditions, recent results from the TASL laboratory are on trend with the WSCF analyses. Thus, the reason that recent specific conductance and total dissolved solids trends do not correlate is unknown.

Figures 3-9 through 3-12 provide trend plots for chloride, sulfate, calcium, and sodium in the proximal wells. These constituents are leached from the soil, and they are naturally present in groundwater, so the sample results are not directly representative of ETF effluent. However, these constituents provide useful information regarding the effect of SALDS discharges on groundwater. Chloride, sulfate, and calcium

exhibit the same trends as described previously for specific conductance. Sharp increases were observed in concentrations in the shallow proximal wells (699-48-77A and 699-48-77D) shortly after discharges began in 1995 due to leaching from the soil column. More recent trends exhibit an inverse relationship with discharge volume, indicating dilution in the aquifer by SALDS discharges. The trends at deep well 699-48-77C exhibit the same attenuated, time-lagged response that was observed for specific conductance. The sodium trends also exhibit an increase in concentration shortly after the start of effluent discharges, but the relative increase was lower than for the other constituents (Figure 3-12). More recent sodium concentrations do not appear to trend with the other constituents, and there is no obvious relationship with effluent discharge volumes. This suggests that the effluent is continuing to leach sodium from the soil column, so the concentration in the leachate is similar to the concentration in groundwater.

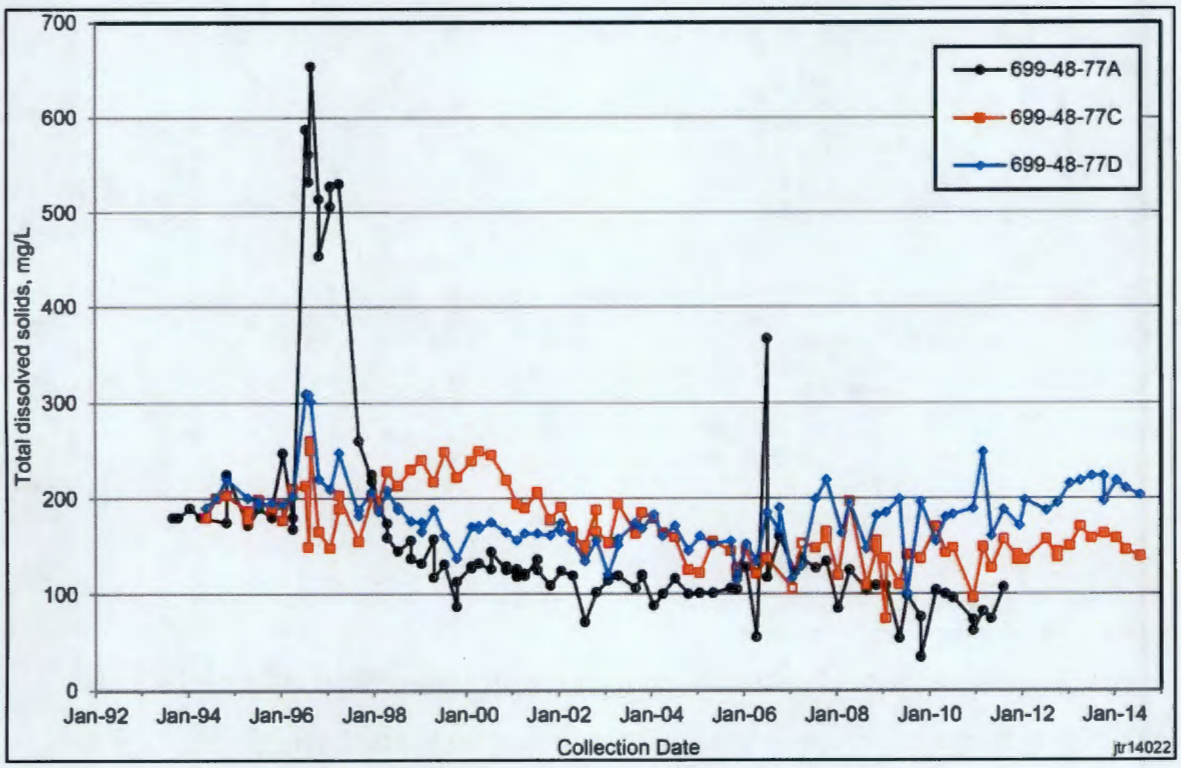

Figure 3-8. Total Dissolved Solids in the SALDS Proximal Wells

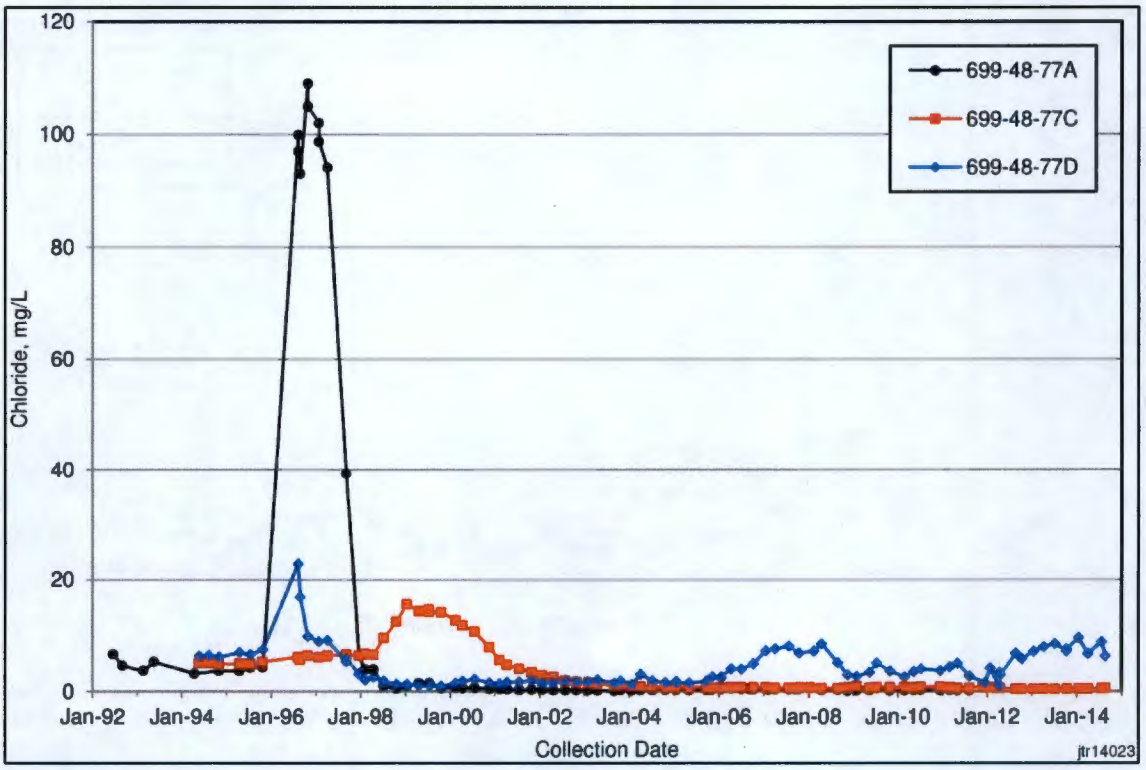

Figure 3-9. Chloride Concentrations in the SALDS Proximal Wells

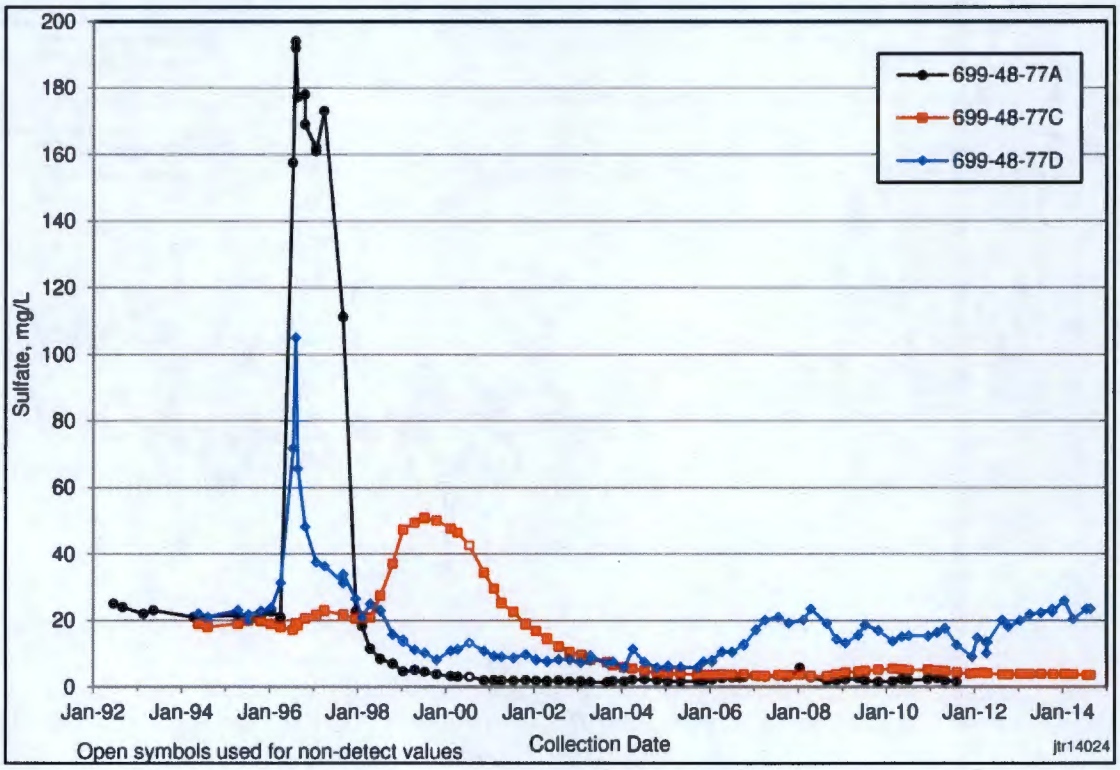

Figure 3-10. Sulfate Concentrations in the SALDS Proximal Wells

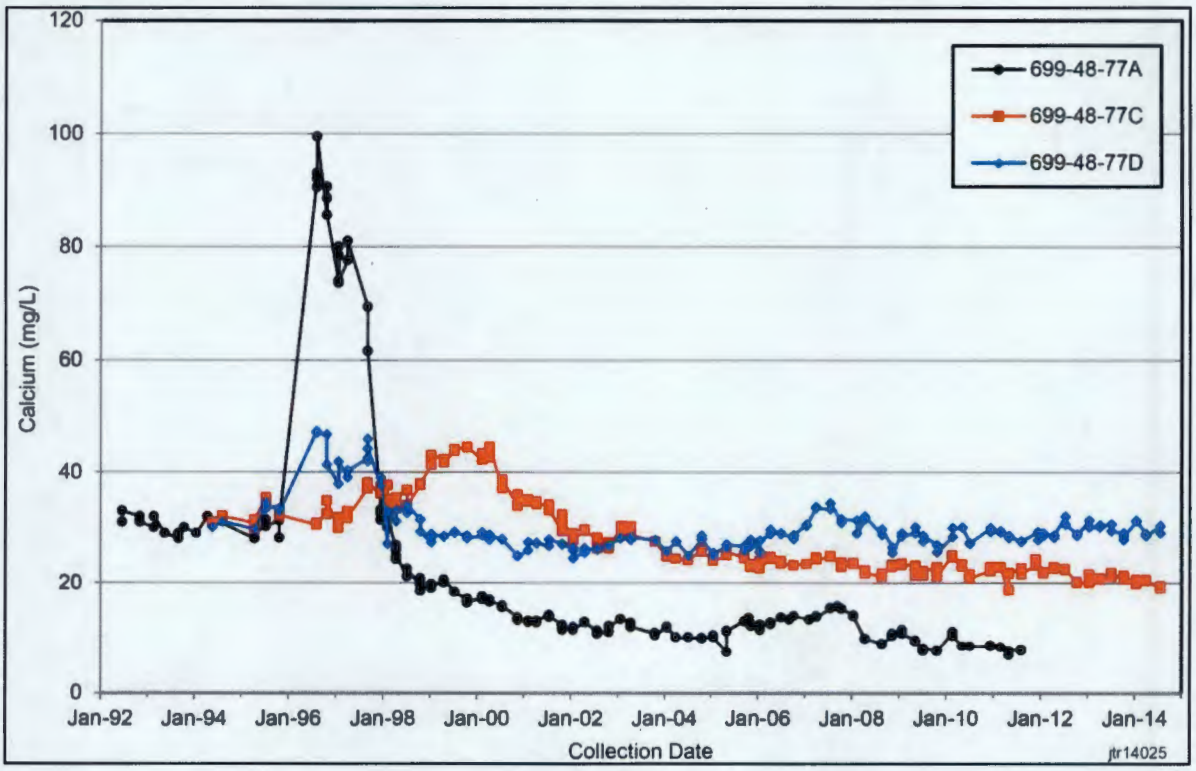

Figure 3-11. Calcium Concentrations in the SALDS Proximal Wells

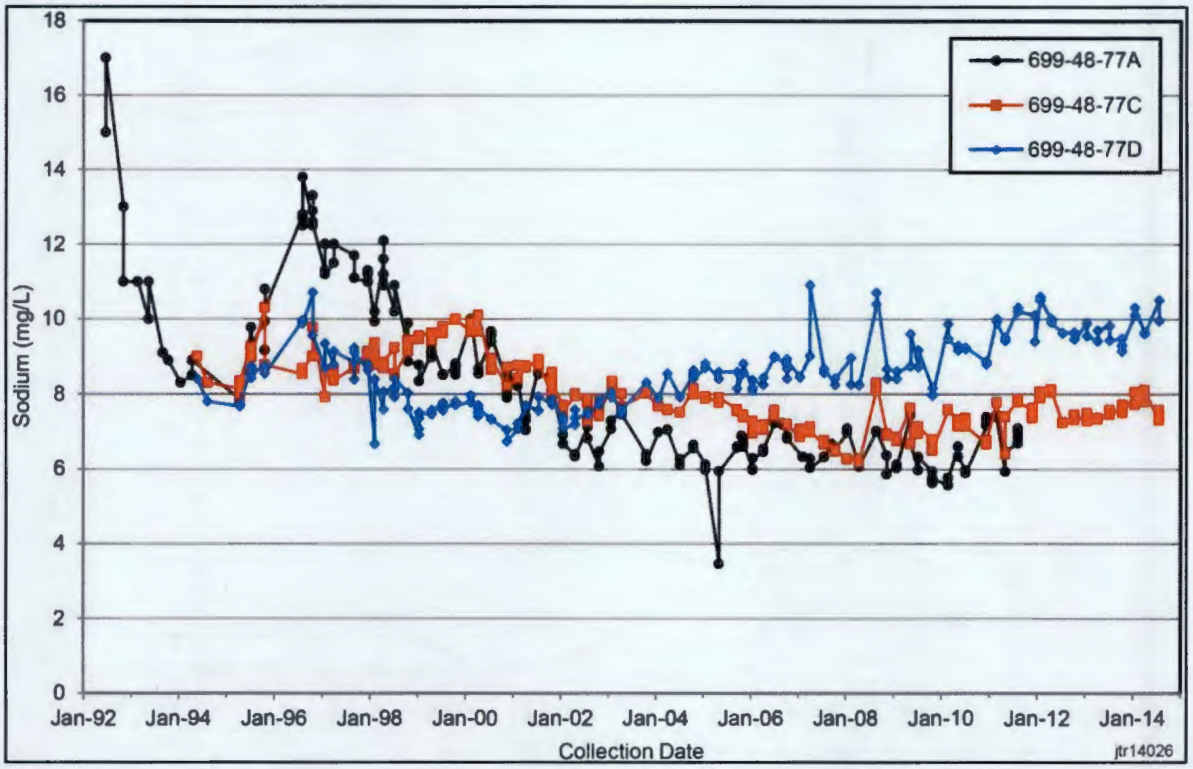

Figure 3-12. Sodium Concentrations in the SALDS Proximal Wells

4 Groundwater Modeling and Site Analysis

DOE performs numerical modeling of the tritium plume at least every 5 years. The model was last updated during FY 2011 (SGW-51085) and included tritium migration and fate predictions based on both the latest calibration of the groundwater model and the latest information regarding the forecast operation of the final remedy 200-ZP-1 P&T system. For convenience, the summary description of the modeling update that was provided in SGW-51085 is repeated in the remainder of this section. Additional details regarding the modeling are presented in Appendix B of SGW-51085.

4.1 Analysis Approach

Modeling was performed using the CP groundwater model that was first described in DOE/RL-2008-56, *200 West Area Pre-Conceptual Design for Final Extraction/Injection Well Network: Modeling Analyses*. The CP model simulates conditions from the 1940s through the present (calibration period) and is then used to simulate likely future conditions under assumed extraction and injection rates for the final remedy 200-ZP-1 groundwater P&T system. The CP model was updated in 2010 (ECF-HANFORD-10-0371, *Central Plateau Version 3 MODFLOW Model*; CP-47631) and included an improved calibration of the flow field to historical water-level measurements compared to previous versions of the model. The migration and fate of the SALDS tritium plume were simulated using historical tritium releases from the start of facility operation through June 2011, along with future projected tritium releases.

In addition to model simulations, analyses were completed using a water-level mapping and particle-tracking technique to verify that the flow field simulated by the CP model in the SALDS vicinity was in reasonable agreement with actual field conditions determined using water-level measurements. Results of this comparison are provided in SGW-51085.

4.2 Tritium Plume Migration and Fate

The CP model was used to simulate migration and fate of the SALDS tritium plume. Figure 4-1 shows results for the year 2030 (Appendix B in SGW-51085 shows the results for 2000 through 2030 at 5 year intervals). Modeling was completed using two effective porosity assumptions (0.13 and 0.18), and results for both are shown in Figure 4-1. Under either assumption, the tritium plume is not anticipated to reach tritium-tracking wells 699-51-75 or 699-48-71 by the year 2030. However, some locations along the northern margin of the 200 West Area are expected to exhibit measurable concentrations of SALDS-derived tritium by 2030, although the model indicates that concentrations would be below the drinking water standard of 20,000 pCi/L.

The results in Figure 4-1 differ slightly from results presented in the earlier model update performed in FY 2010 (SGW-47923, *Results of Tritium Tracking and Groundwater Monitoring at the Hanford Site 200 Area State-Approved Land Disposal Site, Fiscal Year 2010*) in that the distal end of the tritium plume is now simulated to migrate toward the south by the year 2030. The reason for this difference can be seen in Figure 4-2, which compares the FYs 2010 and 2011 model update results for the year 2030 (for an effective porosity of 0.13) and shows the assumptions used for each update regarding the predicted operation of the final remedy 200-ZP-1 P&T system extraction and injection wells. The FY 2010 model update assumed uniform flow rates for all extraction and injection wells (depicted in Figure 4-2 by the uniform symbol size for the extraction and injection wells). The extraction and injection rates used for the FY 2011 model update resulted from an optimization analysis of the P&T system to maximize the recovery of carbon tetrachloride (the principal contaminant being remediated) from the aquifer (SGW-50390, *FY 2011 Simulation-Optimization of the 200-ZP-1 Remedy Using the Central Plateau Model*). The optimized flow rates are predicted to be higher in the eastern extraction wells compared to

the western wells, resulting in a larger area of water table drawdown along the eastern margin of the 200 West Area, toward which the tritium plume is predicted to migrate.

It should be emphasized that the 200-ZP-1 extraction and injection rates used in both the FYs 2010 and 2011 model updates are conjecture based upon current knowledge of the individual well and total system capacity of the 200-ZP-1 P&T system. As such, actual flow rates may differ from those presented in either of these model updates. However, the modeling results do indicate that the ultimate fate of the SALDS tritium plume will be affected by operation of the P&T system, as shown in Figure 4-2.

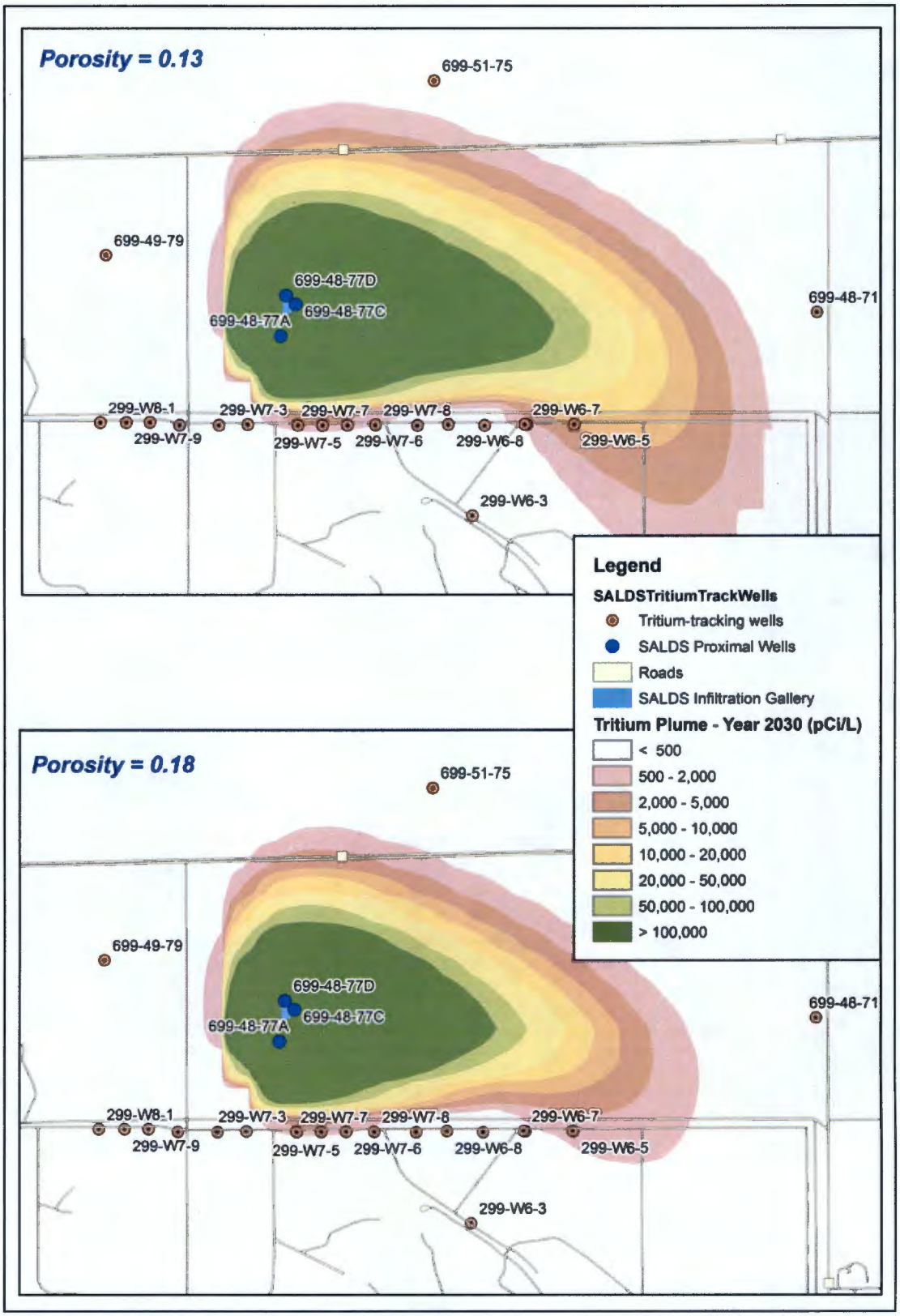

Figure 4-1. Simulated Tritium Distribution as a Result of SALDS Operation in Year 2030

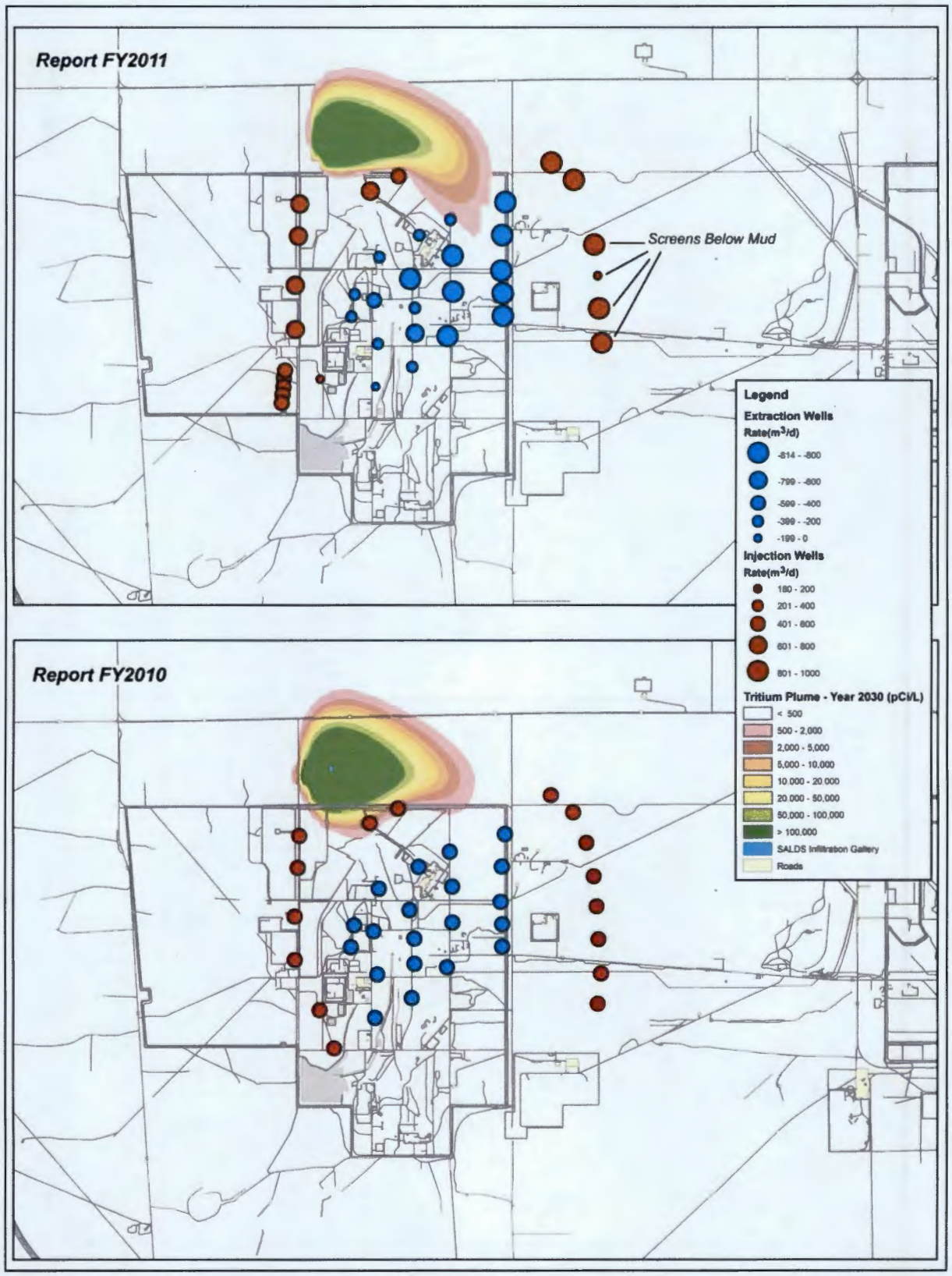

Figure 4-2. Comparison of Model Updates Performed in Fiscal Years 2010 and 2011 Along with Different 200-ZP-1 P&T System Flow Rates Used in Simulations

5 References

12-NWP-035, 2012, "Status of Compliance Monitoring Wells at State Approved Land Disposal Site as Required by State Waste Discharge Permit ST-4500, Letter 12-EMD-0030, dated February 16, 2012" (letter to R.J. Corey, U.S. Department of Energy, Richland Operations Office, from R. Bond, Nuclear Waste Program), Washington State Department of Ecology, Richland, Washington, March 16. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=1203200658.

40 CFR122.2, "EPA Administered Permit Programs: The National Pollutant Discharge Elimination System", "Definitions", *Code of Federal Regulations.* Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=8c24e36c16c63988fae7fb3a7c1a2713&node=se40.22.122_12&rgn=div8

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

CP-47631, 2011, *Model Package Report: Central Plateau Groundwater Model Version 3.3*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

DOE/RL-96-61, 1997, *Hanford Site Background: Part 3, Groundwater Background*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D197226378.

DOE/RL-2008-56, 2009, *200 West Area Pre-Conceptual Design for Final Extraction/Injection Well Network: Modeling Analyses*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2009-38, 2009, *Description of Modeling Analyses in Support of the 200-ZP-1 Remedial Design/Remedial Action Work Plan*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0095363.

DOE/RL-2011-118, 2012, *Hanford Site Groundwater Monitoring for 2011*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0091795.

DOE/RL-2014-10, 2014, *2014 Evaluation of Tritium Removal and Mitigation Technologies for Wastewater Treatment*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0086036.

DOE/RL-2014-26, 2014, *Calendar Year 2013 Annual Summary Report for the 200-ZP-1 and 200-UP-1 Operable Unit Pump-and-Treat Operations*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0083706.

ECF-HANFORD-10-0371, 2010, *Central Plateau Version 3 MODFLOW Model*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0084305.

Ecology, 2000, *State Waste Discharge Permit Number ST 4500*, Washington State Department of Ecology, Kennewick, Washington. Available at: http://www.ecy.wa.gov/programs/nwp/pdf/4500dp.pdf.

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

PNNL-11633, 1997, *Origin of Increased Sulfate in Groundwater at the ETF Disposal Site*, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www.osti.gov/energycitations/servlets/purl/548888-AscOkj/webviewable/548888.pdf.

PNNL-11665, 1997, *Tritium Monitoring in Groundwater and Evaluation of Model Predictions for the Hanford Site 200 Area Effluent Treatment Facility*, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www.osti.gov/energycitations/servlets/purl/554804-aEgmwz/webviewable/554804.pdf.

PNNL-13121, 2000, *Groundwater Monitoring and Tritium-Tracking Plan for the 200 Area State-Approved Land Disposal Site*, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-13121.pdf.

SGW-38802, 2008, *Results of Tritium Tracking and Groundwater Monitoring at the Hanford Site 200 Area State-Approved Land Disposal Site Fiscal Year 2008*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://www.osti.gov/scitech/servlets/purl/943300.

SGW-47923, 2010, *Results of Tritium Tracking and Groundwater Monitoring at the Hanford Site 200 Area State-Approved Land Disposal Site, Fiscal Year 2010*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=1011190085.

SGW-50390, 2011, *FY 2011 Simulation-Optimization of the 200-ZP-1 Remedy Using the Central Plateau Model*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

SGW-50907, 2011, *Predicted Impact of Future Water-Level Declines on Groundwater Well Longevity within the 200 West Area, Hanford Site*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

SGW-51085, 2011, *Results of Tritium Tracking and Groundwater Monitoring at the Hanford Site 200 Area State Approved Land Disposal Site, Fiscal Year 2011*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

SGW-56060, 2013, *Results of Tritium Tracking and Groundwater Monitoring at the Hanford Site 200 Area State Approved Land Disposal Site, Fiscal Year 2013*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

Train v. Colorado Public Interest Research Group, Inc. (426 U.S. 1 1976). Available at: http://openjurist.org/426/us/1/train-v-colorado-public-interest-research-group-inc

Appendix A

State-Approved Land Disposal Site Tritium Groundwater Sample Results for Fiscal Year 2014

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Table A-1. State-Approved Land Disposal Site Tritium Groundwater Sample Results for Fiscal Year 2014

Well	Date Sampled	2014 Tritium Analyses (pCi/L)	Lab Qualifier	2013 Tritium Maximum (pCi/L)	2014 Tritium Maximum (pCi/L)	Trend
299-W6-11	1/20/2014	1,450	—	1,720	1,450	Unchanged
299-W6-12	1/20/2014	127	—	175	127	Decreasing
299-W6-6	1/17/2014	2,430	—	3,770	2,430	Decreasing
299-W7-3	1/20/2014	<23.4	U	U	U	Unchanged
	5/6/2014	<22.0	U			
299-W8-1	7/22/2014	<24.1	U	NA	U	NA
699-48-71	8/27/2014	2,390	—	1,530		Increasing
699-48-77C	10/14/2013	83,000	—	160,000	83,000	Decreasing
	1/17/2014	72,000	—			
	4/1/2014	68,000	—			
	7/22/2014	65,600	—			
699-48-77D	10/13/2013	49,000	—	74,000	60,500	Decreasing
	10/13/2013	49,000	—			
	1/17/2014	57,000	—			
	4/1/2014	51,000	—			
	7/22/2014	60,500	—			
699-49-79	8/27/2014	<23.9	U	U	U	Unchanged
699-51-75	1/17/2014	<23.6	U	U	U	Unchanged
	6/16/2014	<22.2	U			
699-51-75P	1/17/2014	<23.6	U	U	U	Unchanged

Note:

Increasing = 20% higher average concentration in FY 2014 than in FY 2013.

Decreasing = 20% lower average concentration in FY 2014 than in FY 2013.

Unchanged = FY 2014 average concentration within 20% of FY 2013 value.

FY = fiscal year

NA = not applicable

U = less than detection

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