SGW-38802
Revision 0

Results of Tritium Tracking and Groundwater Monitoring at the Hanford Site 200 Area State-Approved Land Disposal Site

Fiscal Year 2008

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management
Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-08RL14788

CH2MHILL
Plateau Remediation Company

P.O. Box 1600
Richland, Washington 99352

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EXECUTIVE SUMMARY

The Hanford Site's 200 Area Effluent Treatment Facility (ETF) processes contaminated aqueous wastes derived from Hanford Site facilities. The treated wastewater occasionally contains tritium, which cannot be removed by the ETF prior to the wastewater being discharged to the 200 Area State-Approved Land Disposal Site (SALDS). During the first 11 months of fiscal year 2008 (FY08) (September 1, 2007, to July 31, 2008), approximately 75.15 million L (19.85 million gal) of water were discharged to the SALDS. Groundwater monitoring for tritium and other constituents, as well as water-level measurements, is required for the SALDS by *State Waste Discharge Permit Number ST-4500* (Ecology 2000).

The current monitoring network consists of three proximal (compliance) monitoring wells and nine tritium-tracking wells. Quarterly sampling of the proximal wells occurred in October 2007 and in January/February 2008, April 2008, and August 2008. The nine tritium-tracking wells, including groundwater monitoring wells located upgradient and downgradient of the SALDS, were sampled in January through April 2008.

Water-level measurements taken in the three proximal SALDS wells indicate that a small groundwater mound is present beneath the facility, which is a result of operational discharges. The mound increased in FY08 due to increased ETF discharges from treating groundwater from extraction wells at the 200-UP-1 Operable Unit and the 241-T Tank Farm.

Maximum tritium activities increased by an order of magnitude at well 699-48-77A (to 820,000 pCi/L in April 2008) but remained unchanged in the other two proximal wells. The increase was due to higher quantities of tritium in wastewaters that were treated and discharged in FY07 beginning to appear at the proximal wells. The FY08 tritium activities for the other two proximal wells were 68,000 pCi/L at well 699-48-77C (October 2007) and 120,000 pCi/L at well 699-48-77D (October 2007). To date, no indications of a tritium incursion from the SALDS have been detected in the tritium-tracking wells. Concentrations of all chemical constituents were within Permit limits or were below method detection limits when sampled during FY08. A summary of the chemical constituent concentrations or method detection limits is provided in Table 3-2 in the main text discussion.

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LIST OF TERMS

ETF	Effluent Treatment Facility
FY	fiscal year
gpm	gallons per minute
HWIS	Hanford Well Information System
LLBG	Low-Level Burial Grounds
NTU	nephelometric turbidity unit
OU	operable unit
SALDS	State-Approved Land Disposal Site

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METRIC CONVERSION CHART

Into Metric Units			Out of Metric Units		
If You Know	*Multiply By*	*To Get*	*If You Know*	*Multiply By*	*To Get*
Length			**Length**		
inches	25.4	millimeters	millimeters	0.039	inches
inches	2.54	centimeters	centimeters	0.394	inches
feet	0.305	meters	meters	3.281	feet
yards	0.914	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.621	miles
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.76	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
acres	0.405	hectares	hectares	2.47	acres
Mass (weight)			**Mass (weight)**		
ounces	28.35	grams	grams	0.035	ounces
pounds	0.454	kilograms	kilograms	2.205	pounds
ton	0.907	metric ton	metric ton	1.102	ton
Volume			**Volume**		
teaspoons	5	milliliters	milliliters	0.033	fluid ounces
tablespoons	15	milliliters	liters	2.1	pints
fluid ounces	30	milliliters	liters	1.057	quarts
cups	0.24	liters	liters	0.264	gallons
pints	0.47	liters	cubic meters	35.315	cubic feet
quarts	0.95	liters	cubic meters	1.308	cubic yards
gallons	3.8	liters			
cubic feet	0.028	cubic meters			
cubic yards	0.765	cubic meters			
Temperature			**Temperature**		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius	Celsius	multiply by 9/5, then add 32	Fahrenheit
Radioactivity			**Radioactivity**		
picocuries	37	millibecquerels	millibecquerels	0.027	picocuries

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1.0 INTRODUCTION

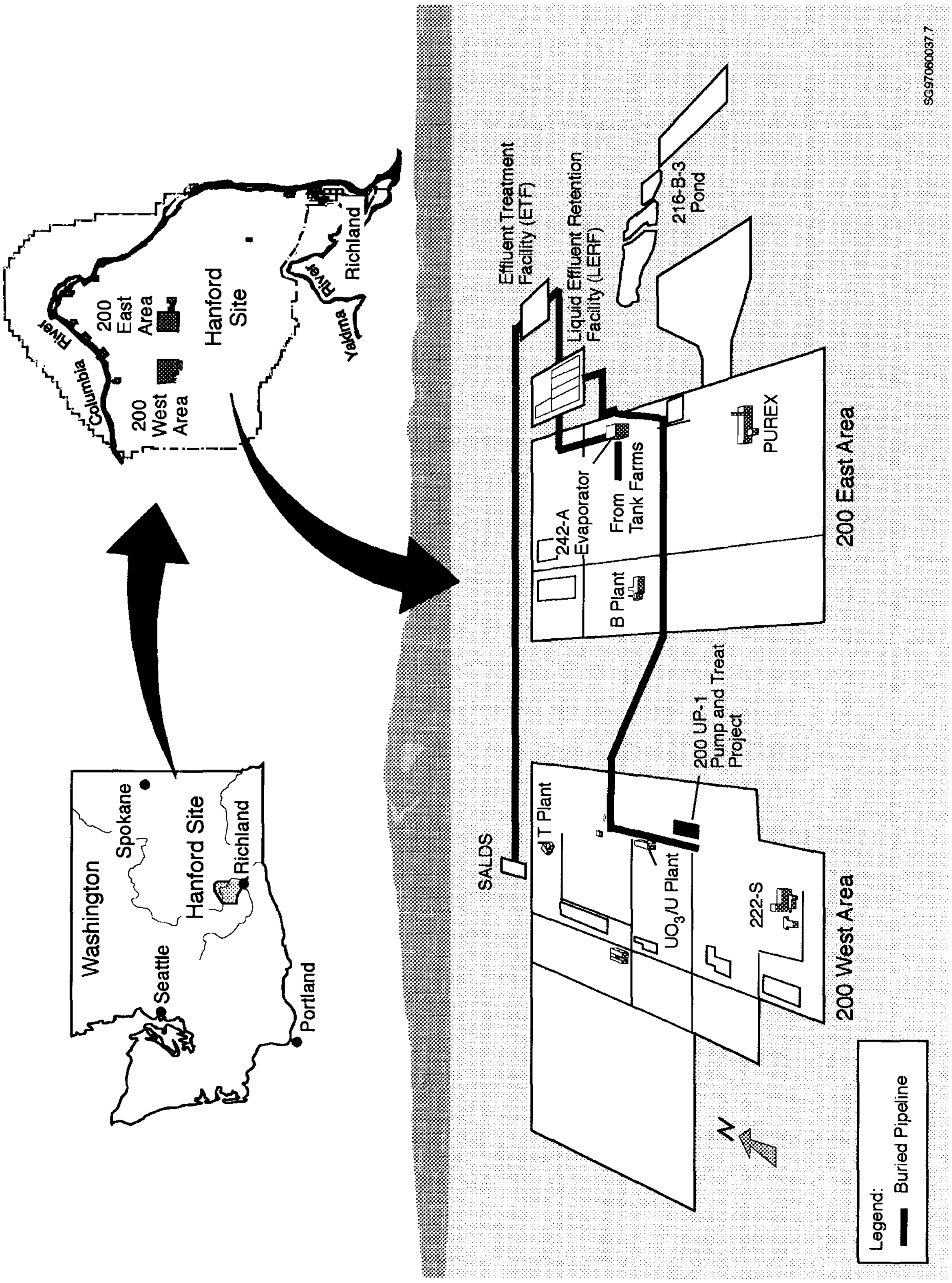
Treated water from the Hanford Site's 200 Area Effluent Treatment Facility (ETF) is discharged to the 600-211 State-Approved Land Disposal Site (SALDS) as allowed by *State Waste Discharge Permit Number ST-4500* (Ecology 2000). The Permit allows disposal of ETF effluents to the drain field, located 360 m (1,200 ft) north of the 200 West Area (Figure 1-1). In accordance with the Permit, groundwater in the vicinity of the SALDS is routinely sampled for tritium and water-level measurements are collected. Gross alpha, gross beta, strontium-90, and tritium are not assigned enforcement limits but are monitored and reported for informational purposes. This Permit also requires submitting an annual tritium-tracking report, as well as a groundwater monitoring plan that was prepared during the Permit cycle. The current plan (*Groundwater Monitoring and Tritium-Tracking Plan for the 200 Area State-Approved Land Disposal Site* [PNNL-13121]) provides additional guidance for selecting and reporting groundwater analyses. The results of groundwater sampling and analysis are also reported in quarterly discharge monitoring reports, and the quarterly reports for fiscal year 2008 (FY08) included the following:

- *Quarterly Discharge Monitoring Reports for the 200 Area Effluent Treatment and Treated Effluent Disposal Facilities Covering the July 2007 Through September 2007 Reporting Period*, Letter No. FH07011570 (Flyckt 2007)
- *Quarterly Discharge Monitoring Reports for the 200 Area Effluent Treatment and Treated Effluent Disposal Facilities Covering the October 2007 Through December 2007 Reporting Period*, Letter No. FH0800506 (Flyckt 2008c)
- *Quarterly Discharge Monitoring Reports for the 200 Area Effluent Treatment and Treated Effluent Disposal Facilities Covering the January 2008 Through March 2008 Reporting Period*, Letter No. FH0801142 (Flyckt 2008b)
- *Quarterly Discharge Monitoring Reports for the 200 Area Effluent Treatment and Treated Effluent Disposal Facilities Covering the April 2008 Through June 2008 Reporting Period*, Letter No. FH0801917 (Flyckt 2008a).

1.1 OBJECTIVE AND SCOPE

This report presents the results of groundwater monitoring and tritium-tracking samples from the SALDS facility during FY08. Due to the 30-day laboratory turnaround for analysis of proximal well groundwater samples, this report addresses available date extending from August 1, 2007, through September 30, 2008 (August 2007 data were not included in the FY07 report). Updated background information, which is necessary to understand the results of the groundwater analyses, is also provided on facility operations. Interpretive discussions and recommendations for future monitoring are also provided, where possible.

Figure 1-1. Location of the State-Approved Land Disposal Site and Related Infrastructure.



1.2 BACKGROUND

Background information presented in this section is based on PNNL-13121. New information on hydrogeology, modeling comparison, and discharges is also provided, where available.

The primary requirements of the Permit are that a groundwater monitoring plan must be agency-approved and that analytical results must be compared annually with Permit-prescribed limits. These comparisons are presented in tabular form and are discussed in Section 3.0 of this report. The groundwater monitoring plan includes the following objectives:

- Tracking changes in groundwater quality associated with the SALDS discharges
- Determining why these changes, if any, have occurred
- Tracking the migration rate of tritium in groundwater originating from the SALDS
- Comparing model predictions with observed results for the purpose of refining predictive model capability
- Correlating discharge events at SALDS with analytical results from groundwater monitoring
- Ensuring that groundwater data are accurately interpreted.

The groundwater monitoring well network (Figure 1-2) was designed to address these objectives using the existing wells shared with other nearby facilities (e.g., the Low-Level Burial Grounds [LLBG]) and dedicated wells drilled specifically for SALDS monitoring.

1.2.1 Hydrogeologic Setting and Conceptual Model

The nature of the geologic formations beneath the SALDS facility accounts for peculiarities in the movement of the SALDS effluent downward to the groundwater, as described in PNNL-13121. Groundwater chemical analyses indicate that well 699-48-77A, the southernmost but upgradient proximal well furthest from the SALDS, responded to discharges several months earlier than well 699-48-77D and approximately 2 years earlier than well 699-48-77C. The carbonate-cemented horizons of the Cold Creek unit occur within the vadose zone a few feet below the bottom of the SALDS drain field. This stratum consists of a thick but locally discontinuous layer of highly impermeable silt, gravel, and sand with significant interstitial calcium carbonate and other minerals as cementation. Effluent from the SALDS is diverted southward along the gentle dip of this horizon until a discontinuity or significant fracture is reached, whereupon it migrates downward into the Ringold Formation. This circumstance allows the infiltrating effluent to first reach groundwater at the more distant and southernmost proximal well (699-48-77A). Figure 1-3 presents the conceptual model for the SALDS and shows how discharges are thought to move to the water table. A more detailed conceptual model is presented in the FY03 annual report (*Results of Tritium Tracking and Groundwater Monitoring at the Hanford Site 200 Area State-Approved Land Disposal Site – Fiscal Year 2003* [PNNL-14449]).

Figure 1-2. Locations of State-Approved Land Disposal Site Groundwater Monitoring and Tritium-Tracking Network Wells.

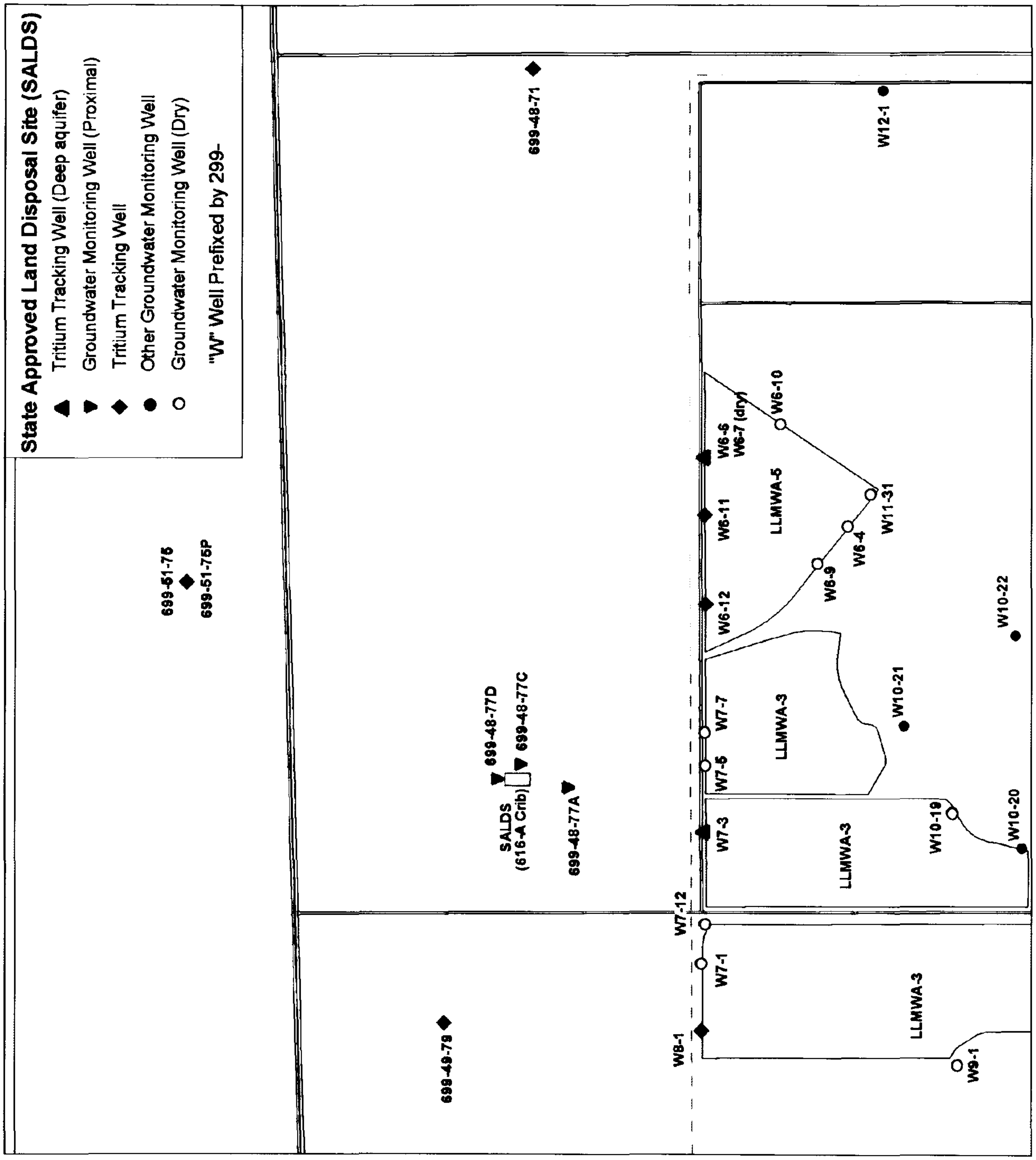
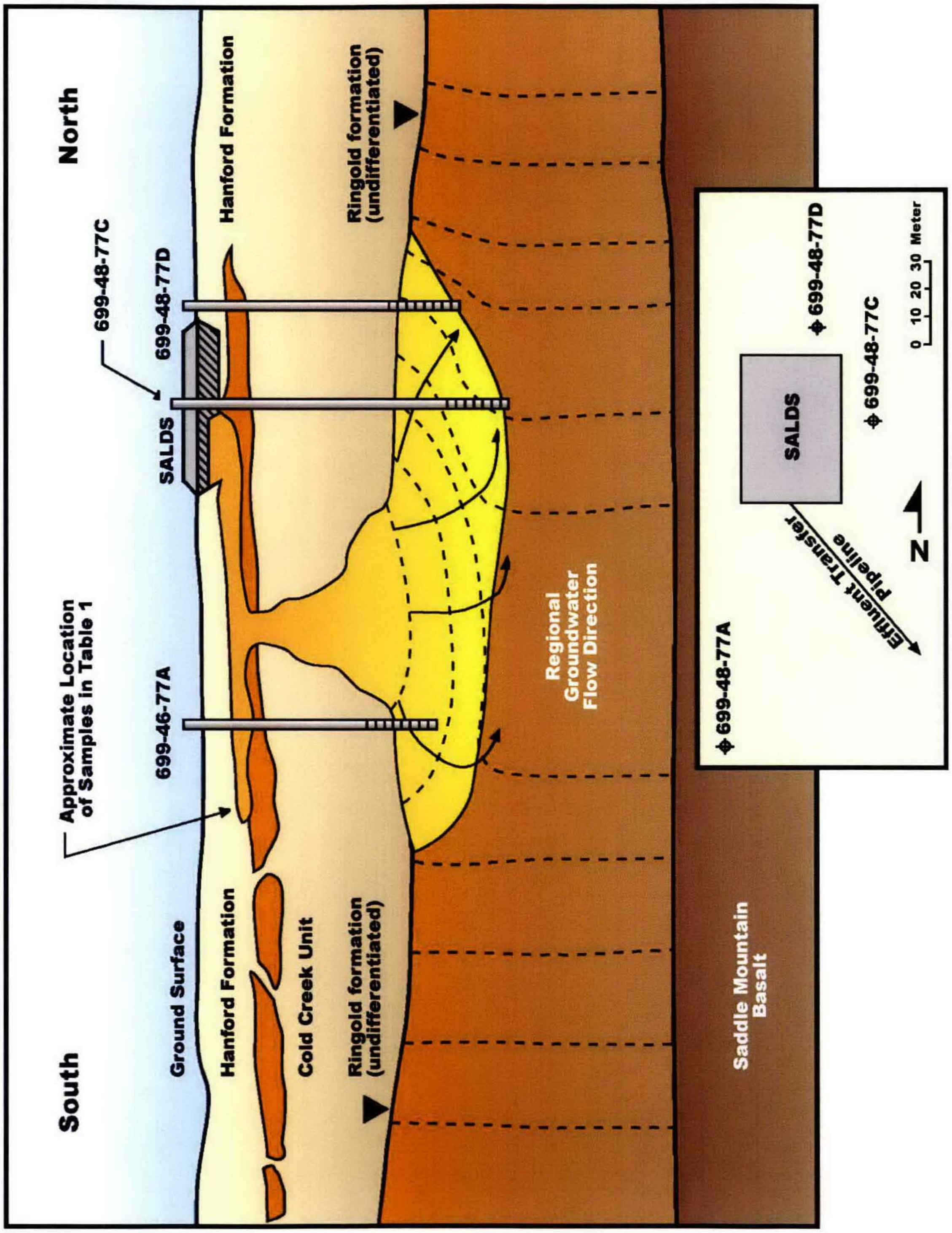


Figure 1-3. Conceptual Diagram of State-Approved Land Disposal Site Operational Effects.



Sedimentary units beneath the SALDS (i.e., Ringold Formation, Cold Creek unit, and Hanford formation) have been shown to contain leachable minerals such as calcium carbonate and sulfate-bearing minerals (*Characterization Report, C-018H Disposal Siting Evaluation* [WHC-SD-C018H-RPT]; *Characterization of Vadose Zone Sediment: Uncontaminated RCRA Borehole Core Samples and Composite Samples* [PNNL-13757-1]). All three of these stratigraphic units occur beneath the SALDS, extending from near the surface to approximately 75 m (246 ft) deep in the vadose zone. Natural mineral accumulations in these formations contribute a considerable load of dissolved solids to the groundwater as SALDS effluent percolates to the water table.

1.2.2 Groundwater Modeling

The Permit requires running an updated numerical groundwater model at least once during a Permit cycle to predict tritium movement and the distribution of tritium in the aquifer as a result of SALDS discharges. The Permit also requires that the model be reapplied "within 6 months of detection of the tritium plume in a new monitoring well." This requirement indicates that the numerical model will be reapplied when the tritium plume associated with the SALDS is positively identified in a location not predicted by the most recent model run, or within a well not previously affected by an incursion of SALDS-derived tritium. To date, no positive indications of tritium incursion have been detected in a new monitoring well.

The most recent model application was conducted in 2004 (*Results of Groundwater Modeling for Tritium Tracking at the Hanford Site 200 Area State-Approved Land Disposal Site – 2004* [PNNL-14898]). The model output graphically illustrates the predicted head distribution and tritium concentrations in groundwater near the SALDS for selected timeframes between 1996 and 2095. The updated model incorporates recent refinements to the Hanford Sitewide groundwater model and actual water volume and tritium release information reported through June 2004. Section 4.0 compares the most recent monitoring results to the updated numerical simulations.

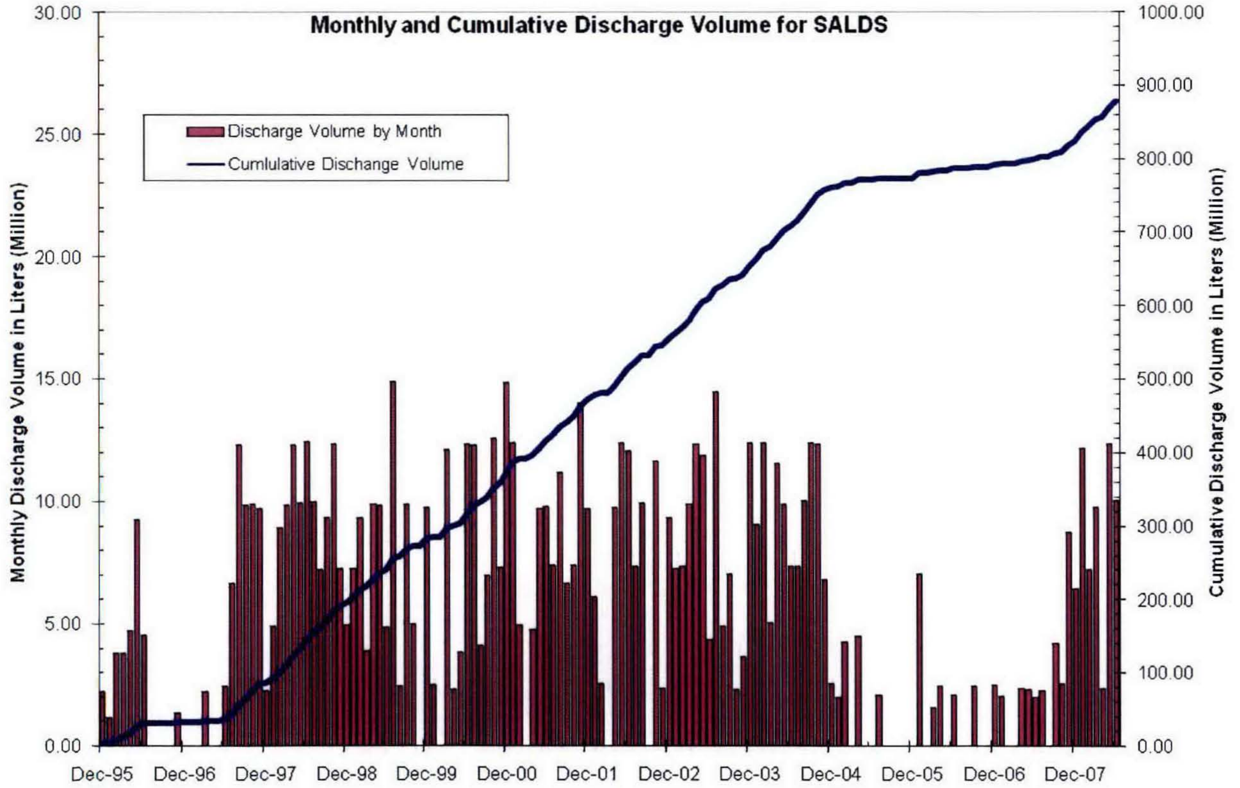
1.2.3 State-Approved Land Disposal Discharge Information

The first release of clean, tritium-rich water from the ETF to the SALDS occurred in December 1995. During that month and the subsequent 6 months, a total of 220 Ci of tritium were released, which comprises about 53% of the total inventory released to date. Discharge volumes of clean water remained relatively constant until FY05, with an average of approximately 95 million L (25 million gal) received each year. Starting in FY05, tritium consignments discharged to the site have been sporadic (as, for example, the period from January 2005 to April 2007, when the 200-UP-1 pump-and-treat system was not in operation). Intermittent campaigns have been conducted to treat 242-A evaporator process condensate and K Basins Project waste streams, which supply most of the tritium to the facility

Beginning in April 2007, the 200-UP-1 Operable Unit (OU) pump-and-treat system restarted and has pumped groundwater to the Liquid Effluent Retention Facility Basin 43 at an average rate of approximately 34 L/min (9 gallons per minute [gpm]) for treatment of uranium, technetium-99, carbon tetrachloride, and nitrate. A waste stream (184 L/min [49 gpm]) from two extraction wells near the 241-T Tank Farm was sent to the ETF for treatment during FY08. The contaminants of concern from these waste streams include technetium-99, carbon tetrachloride, trichloroethene, nitrate, uranium, tritium, and chromate. Treatment of these streams has significantly increased the amount of groundwater discharged to the SALDS, with the FY08 discharges averaging about 9 million L/month (2.4 million gal/month). Tritium concentrations are expected to range between 5,000 to >20,000 pCi/L. The ETF treatment system was shut down in July 2008 for process control upgrades, and no further discharges to the SALDS were made during the remainder of FY08. It is anticipated that the system will be restarted in early November 2008.

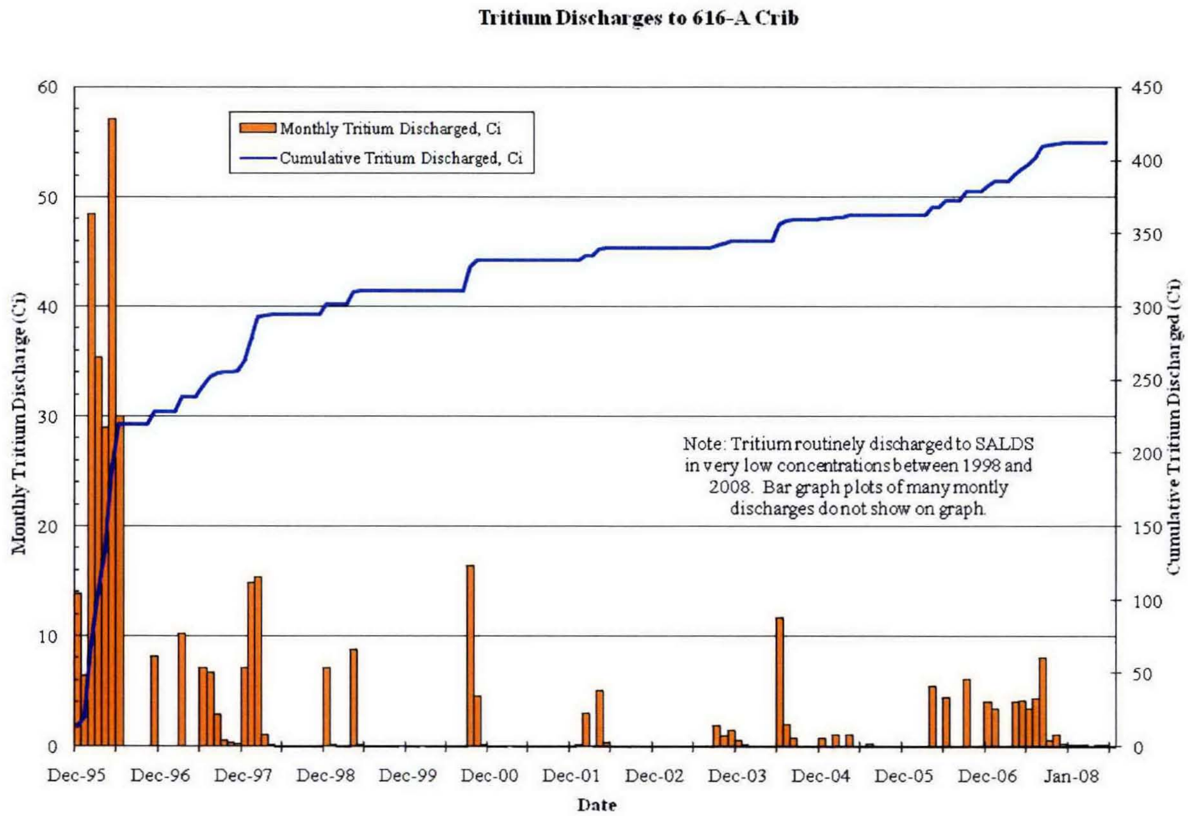
During FY08 (from October 1, 2007, through July 31, 2008), approximately 75.15 million L (19.85 million gal) of water were discharged to the SALDS, compared to approximately 13.9 million L (3.7 million gal) in FY07 and 13.2 million L (3.5 million gal) during the same period in FY06. The FY07 effluent was from treating high tritium-bearing waste streams from K East, K West, and the Cold Vacuum Drying Facility. The FY08 effluent was from treating low tritium-bearing groundwater streams from pump-and-treat systems at the 200-UP-1 OU and 241-T Tank Farm in the 200-ZP-1 OU. The highest discharge to the crib during FY08 occurred in May 2008, when 12.4 million L (3.3 million gal) were received. Total discharge volume to the SALDS since December 1995 is more than 878 million L (232 million gal) (Figure 1-4).

Figure 1-4. Monthly and Cumulative Discharge Volumes for the State-Approved Land Disposal Site through July 2008.



The total quantity of tritium discharged to the SALDS during FY08 (including August and September 2007) is 10 Ci, based on sampling at ETF prior to discharge. This includes approximately 9.7 Ci of tritium from the final treated K Basin wastewater, and approximately 0.4 Ci from treatment of groundwater, which reflects the low concentrations of tritium in these waste streams. The total quantity of tritium discharged to the SALDS from December 1995 through July 2008 is approximately 412.5 Ci. Monthly and cumulative quantities of tritium discharged to the SALDS are presented in Figure 1-5. This amounts to approximately 54% of the maximum amount of tritium (760 Ci) allowed by the Permit (Ecology 2000).

Figure 1-5. Monthly and Cumulative Tritium Mass Discharged to the State-Approved Land Disposal Site Through July 2008.



2.0 RESULTS OF FISCAL YEAR 2008 WATER-LEVEL MEASUREMENTS

Measurements of water levels in wells surrounding the SALDS are necessary for interpretation of local and regional water table elevations and groundwater flow direction. These measurements are used in combination with groundwater chemistry analyses to update conceptual and predictive models to forecast the possible movement of tritium from the SALDS facility.

2.1 SCHEDULE OF WATER-LEVEL MEASUREMENTS

Water levels are measured in all wells prior to each sampling event and are measured monthly in the proximal SALDS wells (699-48-77A, 699-48-77C, and 699-48-77D). Proximal and tritium-tracking wells are also sampled for other programs, including the LLBG and the 200-ZP-1 Groundwater OU and groundwater interest area. Therefore, water levels in each well may be measured several times per year.

Water levels have declined in recent years to the point where a number of tritium-tracking wells no longer intersect the groundwater table (see Section 3.1). As this occurs, water-level measurements and sampling in these wells are generally discontinued.

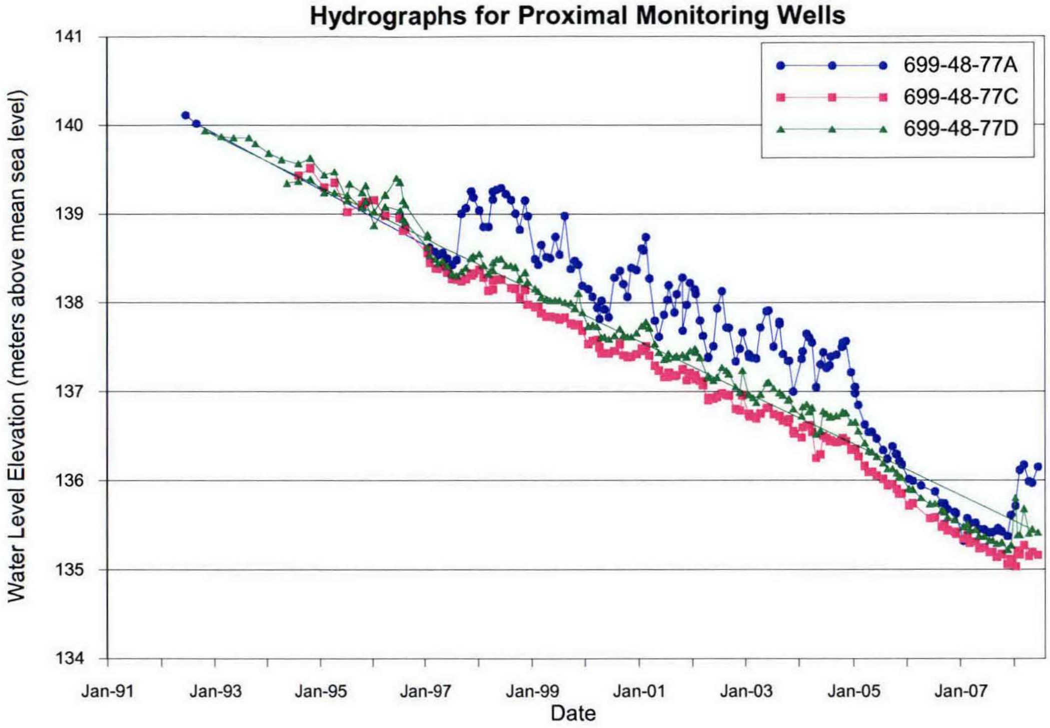
2.2 MEASUREMENT RESULTS AND HYDRAULIC HEAD DISTRIBUTION

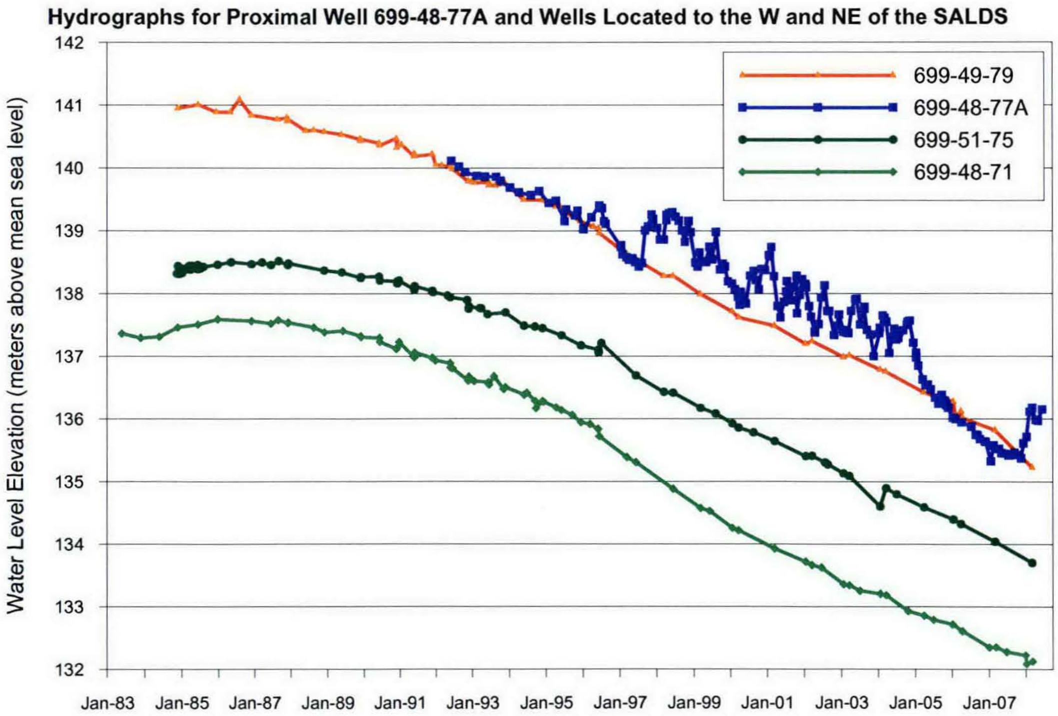
2.2.1 Water-Level Measurements and Results

Current hydrographs (through July 2008) for the SALDS proximal wells and tritium-tracking network are shown in Figures 2-1, 2-2, and 2-3. These wells are grouped by relative position to the SALDS. All of the wells in the 200 West Area have displayed a general water table decline since surface discharges associated with process operations were terminated at U Pond in 1985 and all non-permitted discharges were terminated in1995.

Virtually all water-level readings in active wells were taken in March 2008. Using all available data, the average decline of the water table in the SALDS area between March 2007 and March 2008 was calculated to be 0.09 m/yr (0.30 ft/yr), as shown in Table 2-1. This average rate of decline includes increasing water levels at the three proximal wells at the SALDS. Since a groundwater mound is currently present beneath the SALDS due to a relatively high level of pump-and-treat activity, the average rate of decline is considered to be artificially low since the rate is biased by the increase in water level elevations noted at the proximal wells. A less-biased rate of decline can be calculated by not considering the water-level changes in the proximal wells. This calculation shows that the average rate of decline of the water level in the area around the SALDS is 0.26 m/yr (0.85 ft/yr), which is very similar to the average calculated for the previous 12 months (0.27 m/yr [0.88 ft/yr]).

Figure 2-1. Hydrographs of State-Approved Land Disposal Site Proximal Wells (Top) and Tritium-Tracking Wells North, Northwest, and East of the Site (Bottom) Compared with Well 699-48-77A.





NOTE: Well 699-48-77C is completed (screened) approximately 20 m (65.6 ft) deeper within the aquifer than the other two proximal wells.

Figure 2-2. Hydrographs of Tritium-Monitoring Wells South (Top) and Southwest (Bottom) of the State-Approved Land Disposal Site Compared with Well 699-48-77A.

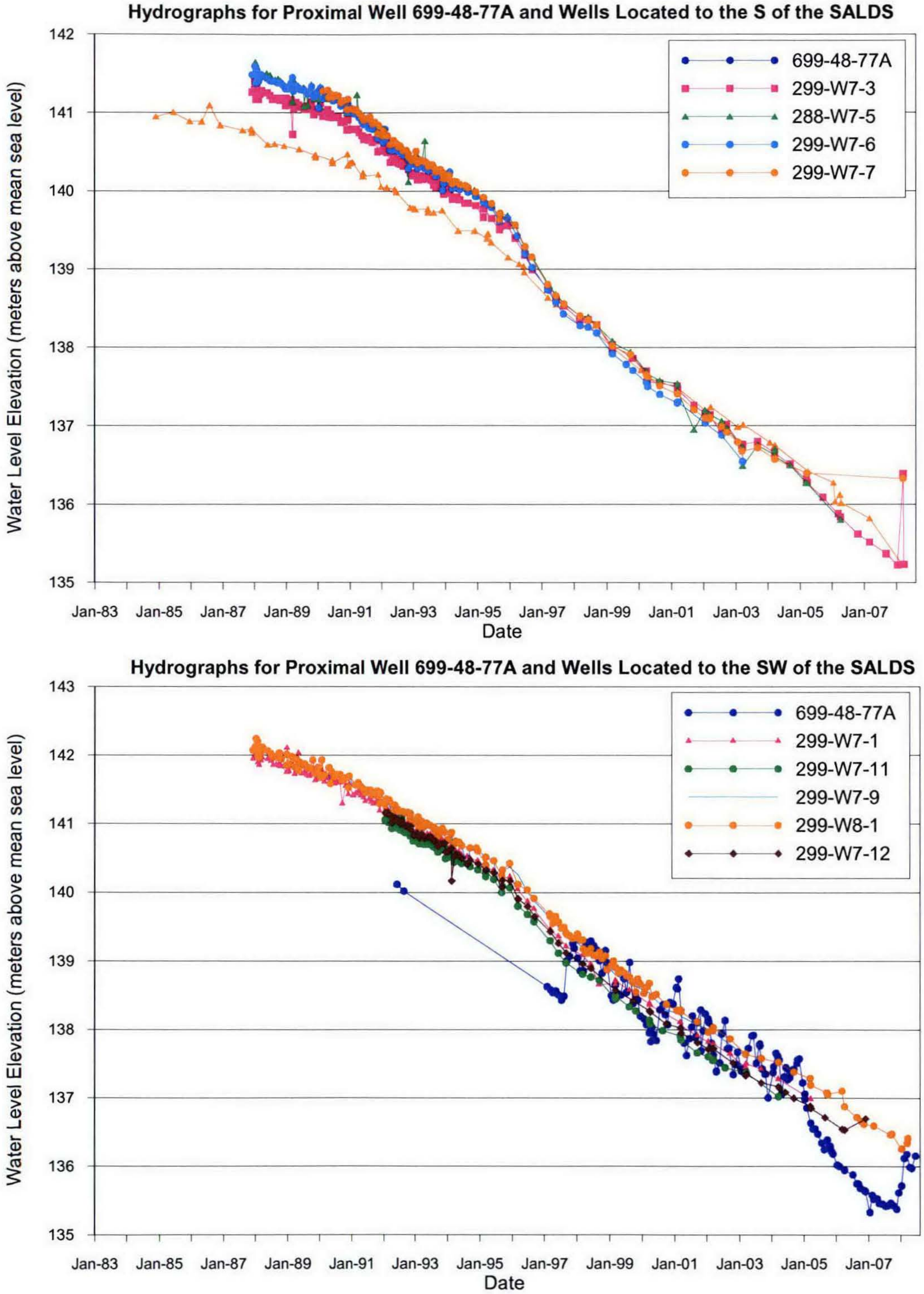
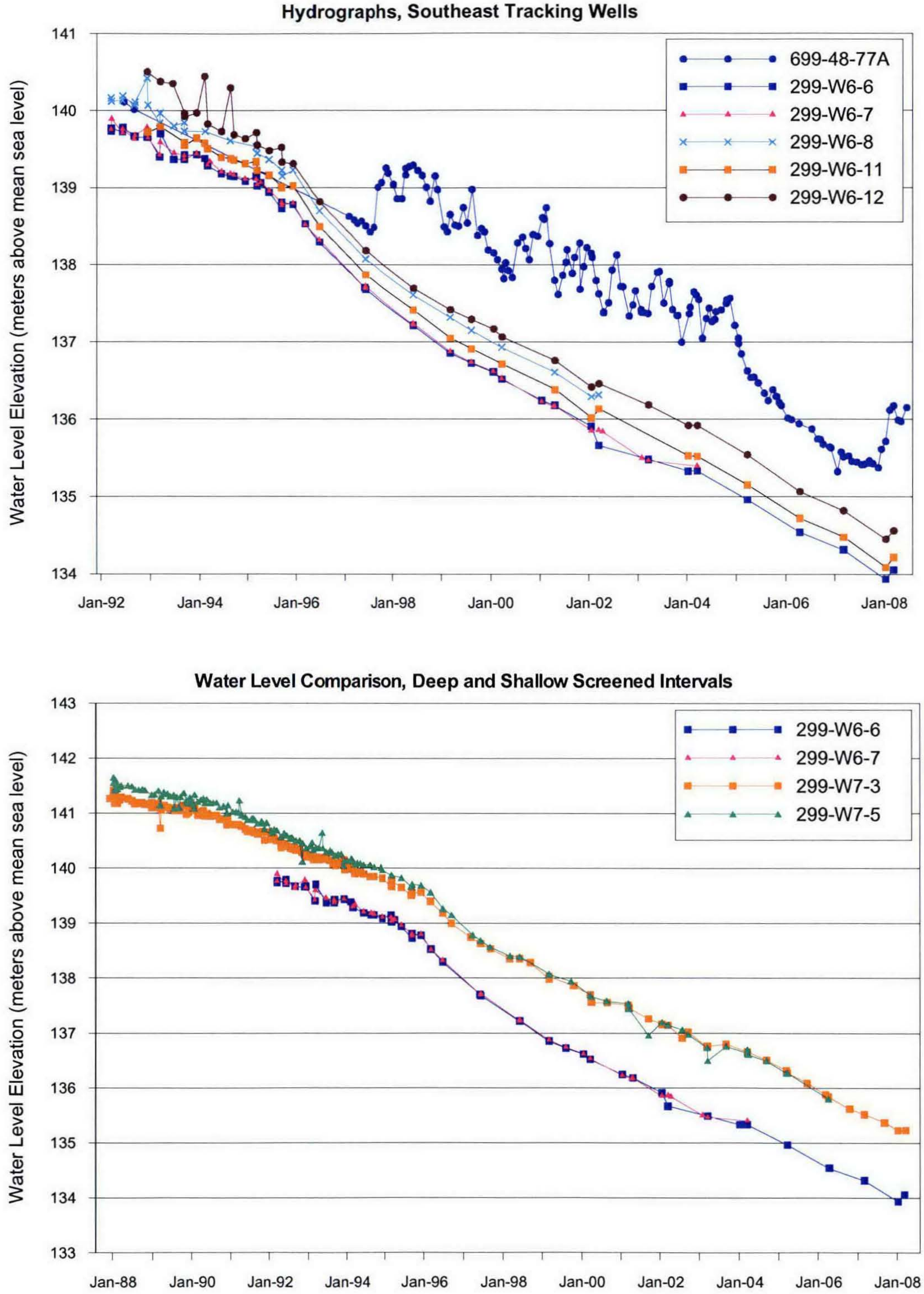


Figure 2-3. Hydrographs of Tritium-Monitoring Wells Southeast of the State-Approved Land Disposal Site Compared with Well 699-48-77A (Top) and Deep/Shallow Companion Wells (Bottom).



NOTE: Well 299-W6-6 is completed approximately 51 m (167 ft) deeper in the aquifer than well 299-W6-7.

Table 2-1. Change in Water Table Elevation (in meters), March 2007 Versus March 2008.

Well	March 2007	March 2008	Change from 2007 to 2008
699-48-77A[a]	135.52	136.179	+ 0.659
699-77-C[a]	135.30	135.27	- 0.03
699-48-77D[a]	135.30	135.684	+ 0.385
699-49-79[b]	135.82	136.125	+ 0.305
299-W8-1[b]	136.59	136.343	- 0.247
299-W7-12[b]	136.70	136.544	- 0.156
299-W7-4[b]	135.71	No data	--
299-W10-21[b]	135.71	135.665	- 0.045
299-W10-20[b]	136.26	136.063	- 0.197
299-W7-7[b]	136.33	136.330	-- (dry)
299-W10-22[b]	135.18	134.662	- 0.518
299-W6-12[b]	134.82	134.563	- 0.257
299-W6-11[b]	134.48	134.221	- 0.259
299-W12-1[b]	132.89	132.565	- 0.325
699-48-71[b]	132.36	132.130	- 0.240
699-51-75[b]	134.04	133.706	- 0.334
12-month average (all wells)	--	--	**- 0.090 m**
12 month average (distal wells only)	--	--	**- 0.258 m**
12 month average, proximal SALDS wells	-	-	**+ 0.338 m**

[a] Proximal well.
[b] Distal well.
SALDS = State-Approved Land Disposal Site

Although not present in March 2007, a groundwater mound was observed in March 2008 at the SALDS and is centered on well 699-48-77A (Figure 2-4). Although well 699-48-77A is located upgradient from the SALDS, it has generally has a higher hydraulic head than surrounding wells due to movement of the discharge water along the Cold Creek unit (as described in Section 1.2.1). The mound is due to an increased treatment rate at the ETF (largely due to the addition of groundwater from two extraction wells at the 241-T Tank Farm) and a resulting greater rate of discharge to the SALDS. In the period from March 1997 to March 2005, the SALDS site received an average of 7.98 million L (2.1 million gal) of water per month, which yielded a 0.5- to 1.0-m (1.6- to 3.3-ft)-high mound around the crib. During the period from March 2005 through March 2007, about 1.15 million L/month (304,700 gal/month) were discharged to the crib, and a groundwater mound was not present. The discharge rate during the first half of FY08 (October 2007 through March 2008) averaged 7.5 million L/month (2 million gal/month), which is similar to the discharge rate prior to March 2005 when a comparable groundwater mound was present.

When present, groundwater mounding near the SALDS creates a localized downward hydraulic gradient in the aquifer. Historically, deep and shallow tritium-tracking wells 299-W6-6 and 299-W6-7 have not indicated a vertical hydraulic gradient away from the SALDS vicinity (see bottom plot in Figure 2-3). Well 299-W6-7 was completed at the water table, and well 299-W6-6 was completed 51 m (167 ft) deeper in the aquifer. Well 299-W6-7 is currently dry and has been dropped from the sampling schedule.

2.2.2 Groundwater Flow

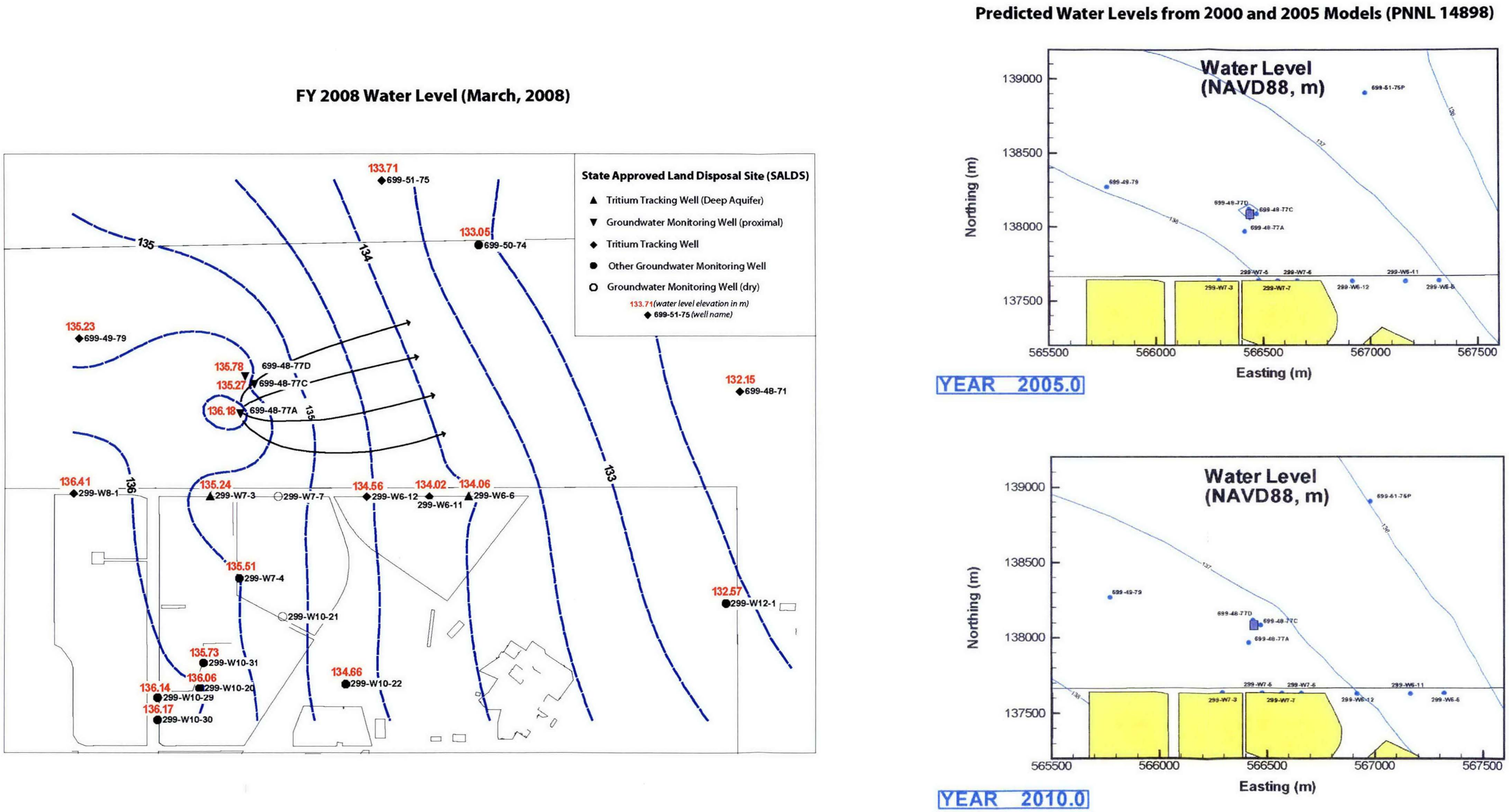
The arrows in Figure 2-4 denoting the interpreted groundwater flow paths indicate that effluent from the SALDS could eventually reach wells located south and east of the facility. The distance that effluent travels from the SALDS to the south before turning east is not known but, based on model predictions, is assumed to be small. Interpretation of the flow paths shown in Figure 2-4 indicates that wells 699-51-75 and 699-48-71 (located 1,000 m [3,280 ft] to 2,000 m [6,560 ft] east and northeast of the SALDS) are regionally downgradient of the facility and are in a reasonable location for intercepting SALDS effluent. Increasing concentration trends of carbon tetrachloride (and nitrate at well 699-48-71), observed as part of the 200-ZP-1 OU monitoring (*Summary of Hanford Site Groundwater Monitoring for Fiscal Year 2006* [PNNL-16346]), suggest a more northerly flow of these contaminants from the south and southwest. Increasing tritium concentration trends at this well are considered to be related to contaminated groundwater flowing from the south and southwest rather than from the SALDS facility.

The interpreted flow direction near the SALDS presents a more easterly component for the past few years (in comparison with PNNL-13121 and PNNL-14898), which is a likely result of the continuing regional decline in water levels combined with the SALDS effects. The SALDS crib appears to be close to a divide in flow between groundwater moving around the west end of Gable Butte and toward the 100-B/C Area and groundwater flowing to the east toward Gable Gap. The general decline in head, primarily resulting from discontinuation of 200 West Area operational discharges to ponds, is evident in Figures 2-1 through 2-3. An overall decline of approximately 6.0 m (19.7 ft) may be expected at the existing wells based on trend data from well 699-49-79; however, agricultural irrigation west of the Hanford Site may prevent groundwater elevations from reaching pre-Hanford levels. The discharge of effluent from treating 200-UP-1 OU pump-and-treat groundwater, along with the additional discharge of effluent from treating groundwater from wells near the 241-T Tank Farm, has resulted in an expanded groundwater mound around the crib.

2.2.3 Well Construction and Other Considerations

Most of the tritium-tracking wells located south of the SALDS facility were constructed with 6.1-m (20-ft) screens. As shown in Table 2-2, the remaining tritium-tracking wells screened in the upper aquifer will be dry before the year 2018 if the water table continues to decline at the current rate of 0.26 m/yr (0.85 ft/yr). Only wells 299-W7-3 and 299-W6-6 (which are screened deeper in the aquifer) would survive past 2018 at the current rate of decline. The head-versus-time plots for wells 299-W7-5 (now dry), 299-W6-11, and 299-W6-12 (Figures 2-5 through 2-7) show the elevation of the screen bottom and generally support the calculated dry dates for the wells listed in Table 2-2. Figure 2-8 shows the head-versus-time plot for well 299-W7-7 (now dry).

Figure 2-4. Water-Table Map and Interpreted Groundwater Flow Directions in the State-Approved Land Disposal Area for March 2008 and Modeled Water Levels for 2005 and 2010.



NOTE: PNNL-14898, *Results of Groundwater Modeling for Tritium Tracking at the Hanford Site 200 Area State-Approved Land Disposal Site – 2004.*

Table 2-2. Calculated Dry Dates for Remaining Tritium Monitoring Wells, Both at and South of the State-Approved Land Disposal Site.

Well	Surface Elevation (Z in HWIS) (m)	Depth to Screen Bottom/Elevation (m)	March 2008 Water Table Elevation (m)	Saturated Screen Thickness (m)	Saturated Screen Divided by 0.26 m/yr = Years Until Well Is Dry	Calculated Dry Well Date[a]
299-W7-12	208.678	73.08 / 135.6	136..544	136.54 – 135.6 = 0.94	0.94 ÷ 0.26 = 3.6	3.6 years = 2011
299-W7-1	210.968	74.7 / 136.27	--	0	0	Dry in 2006 (sample-dry in 2004)
299-W7-3	206.45	143.29 / 63.13	135.39	135.52 - 63.13 = 73.26	73.26 ÷ 0.26 = 282[b]	--
299-W7-5	205.437	69.73 / 135.7	--	0	0	Dry in 2007 (sample-dry in 2005)
299-W7-7	205.90	69.45 / 136.45	--	0	0	Dry in 2006 (sample-dry in 2004)
299-W7-6	207.219	73.48 / 133.74	--	0	0	Dry in 2006 (sample-dry in 2003)
299-W6-6	215.439	130.88 / 84.56	134.06	134.06 - 84.56 = 49.50	49.76 ÷ 0.26 =191[b]	--
299-W6-12	211.091	78.47 / 132.75	134.56	134.56 – 132.77 = 1.79	1.79 ÷ 0.26 = 6.8	2014
299-W6-11	214.388	76.49 / 131.8	134.22	134.22 - 131.79 = 2.43	2.43 ÷ 0.26 = 9.3	2017
299-W8-1	214.29	129.54 / 78.71	136.41	136.41 – 78.71 = 57.70	57.70 ÷ 0.26 = 221.9	--
299-W7-11	206.664	70.64 / 136.02	--	0	0	Dry in 2006 (sample-dry in 2002)
699-48-77A	205.922	70.85 / 135.07	136.72	136.72 - 135.07 = 1.65	1.65 ÷ 0.26 = 6.3	2014
699-48-77D	204.634	71.55 / 133.08	135.68	135.68 - 133.08 = 2.60	2.60 ÷ 0.26 = 10	2018

[a] Calculated dry dates do not necessary agree with dates shown on Figures 2-1 through 2-7. The calculated dates are based on the short-term rate of change over a 1 year period, while the dates shown on the figures are based on long-term trends over periods that extend from 5 to 8 years.
[b] Calculation invalid; water-level decline is not expected to exceed approximately 6 m (20 ft) in the foreseeable future.
HWIS = Hanford Well Information System

Figure 2-5. Tritium-Tracking Well 299-W7-5, Head Versus Screen.

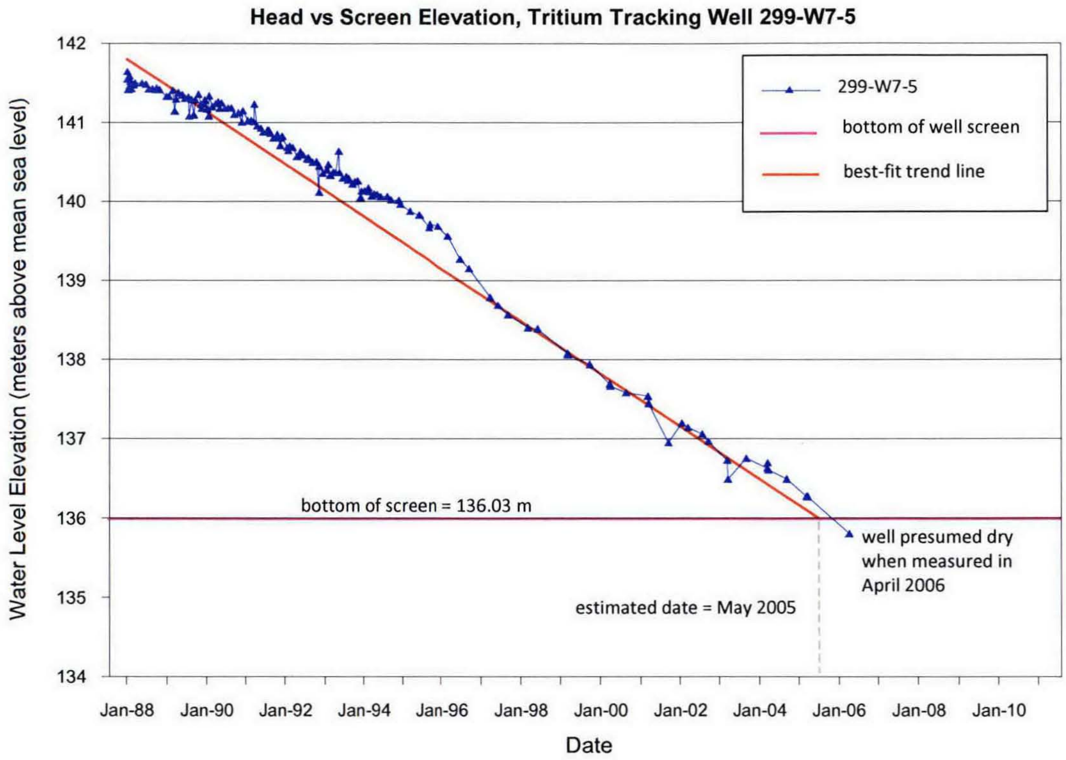


Figure 2-6. Tritium-Tracking Well 299-W6-11, Head Versus Screen.

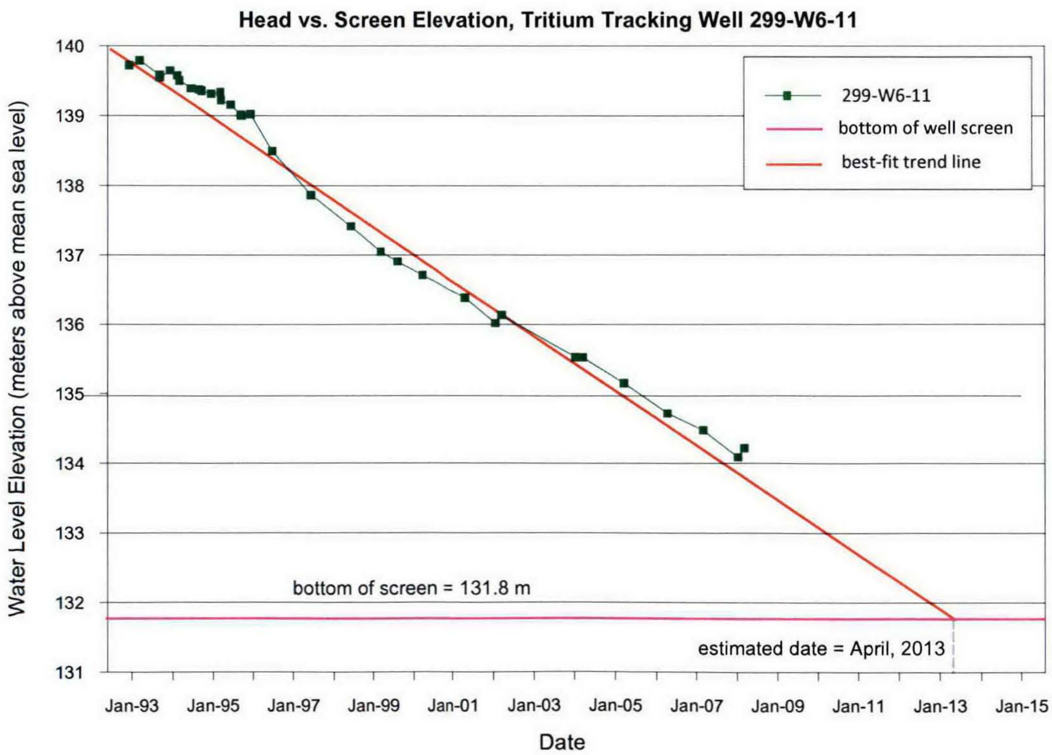


Figure 2-7. Tritium-Tracking Well 299-W6-12, Head Versus Screen.

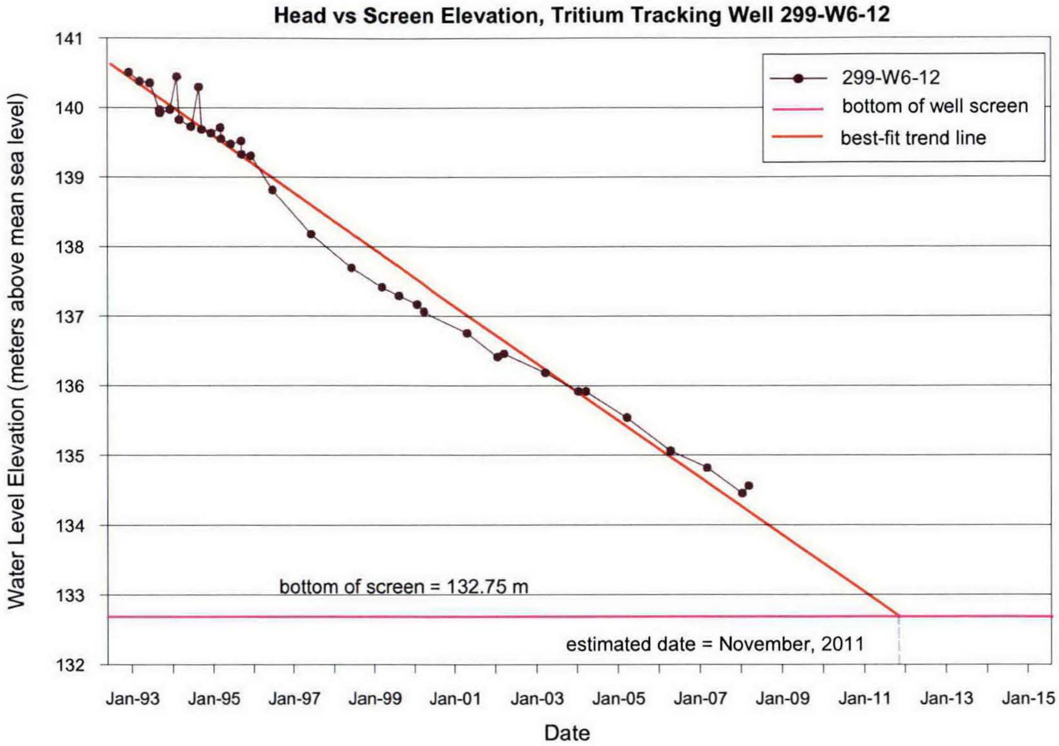


Figure 2-8. Tritium-Tracking Well 299-W7-7, Head Versus Screen.

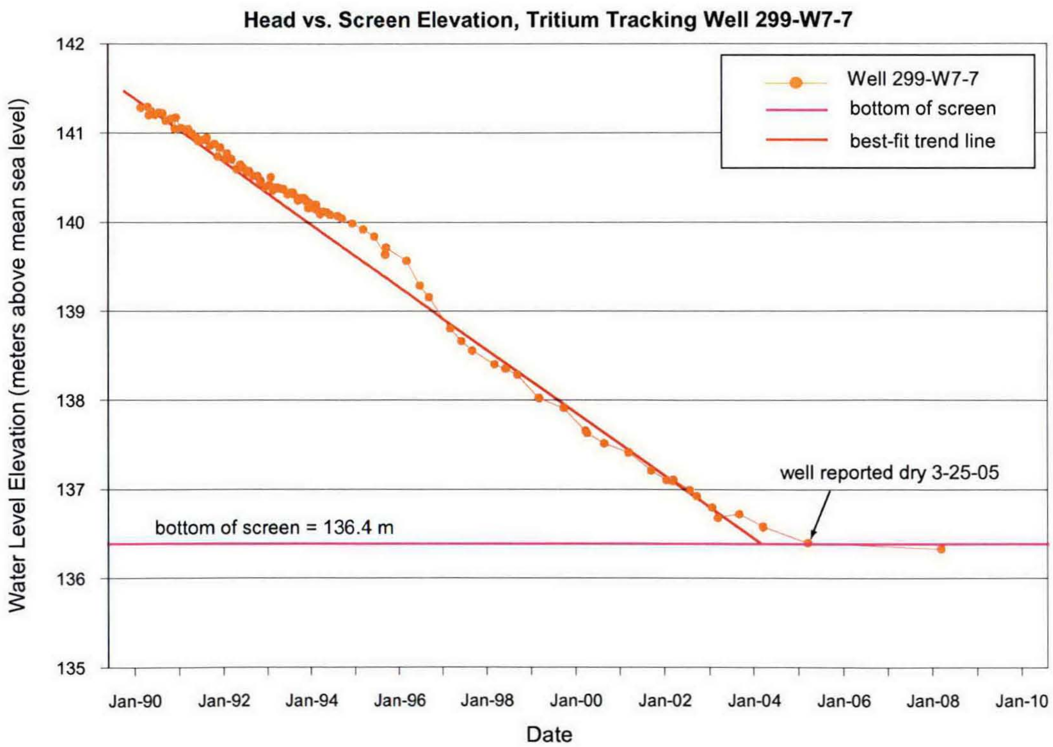


Figure 2-5 for well 299-W7-5 has been revised to adjust a measuring error due to well stick-up. The FY07 SALDS report (*Results of Tritium Tracking and Groundwater Monitoring at the Hanford Site 200 Area State Approved Land Disposal Site – Fiscal Year 2007* [SGW-34996]) noted that the well was dry yet, yet it indicated that the water level was 0.8 m (2.65 ft) above the bottom of the screen. A re-examination of the data indicates that the stick-up was not accounted for in the figure prepared for the FY07 report. The error has been corrected in this report.

The head-versus-time plots for proximal monitoring wells 699-48-77A and 699-48-77D are presented in Figures 2-9 and 2-10, respectively. Best-fit trend lines have been provided to estimate the time at which each well is expected to go dry. With the restart and addition of pump-and-treat water from the 200-UP-1 OU and the 241-T Tank Farm wells, well 699-48-77A is expected to remain active until mid-2011 (based on the long-term trend). After that, or with cessation of pump-and-treat activities at the ETF, a replacement well may be needed. The head-versus-time plot for groundwater monitoring well 699-48-77D is presented in Figure 2-10 and shows that this well should remain active until 2015 at the current rate of decline.

The wells are expected to be "sample dry" several years before they are completely dry. The plot for well 299-W7-5, which was reported sample dry in 2004, shows that water levels were obtained in April 2006. However, the absence of FY07 and FY08 water-level data indicates that the aquifer had dropped below the bottom elevation of the screen (i.e., measured water levels were likely from water in the sump and are not representative).

2.2.4 Model Comparison

The current groundwater levels are approximately 2.3 m (7.5 ft) lower than those predicted by modeling (PNNL-14898) (also see discussion in Section 4.1 of this document), presumably related to lower rates of regional groundwater recharge. The current regional water level (based on the water level at well 699-51-75, which is located a considerable distance from the groundwater mounding proximal to the SALDS) is approximately 0.5 m (1.6 ft) below the water level predicted in PNNL-14898 for the year 2030 (when discharge to the SALDS facility is planned to cease).

Figure 2-9. Groundwater Monitoring Well 699-48-77A, Head Versus Screen.

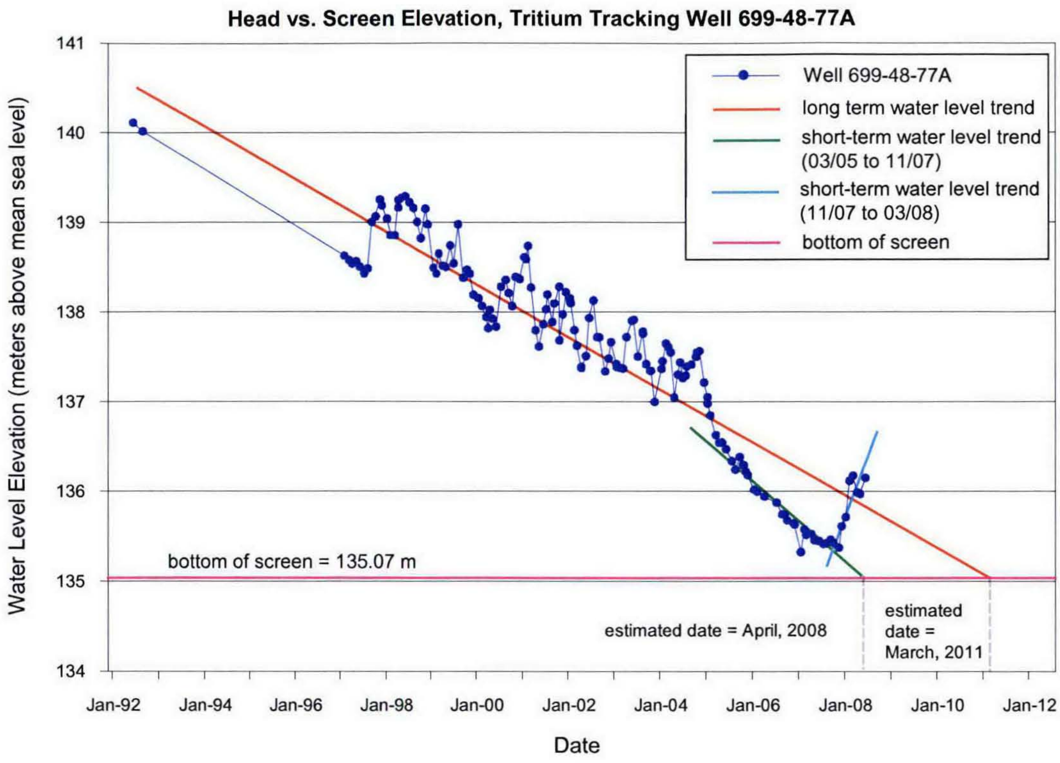
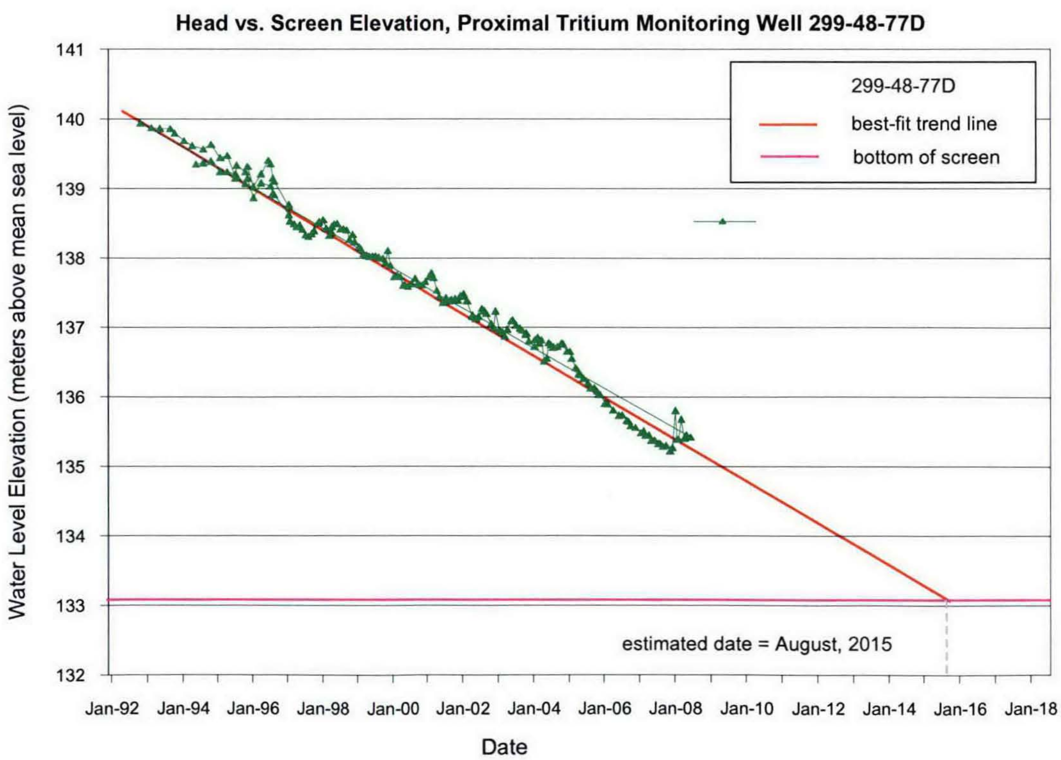


Figure 2-10. Groundwater Monitoring Well 699-48-77D, Head Versus Screen.



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3.0 RESULTS OF FISCAL YEAR 2008 GROUNDWATER ANALYSES FOR THE STATE-APPROVED LAND DISPOSAL SITE

Groundwater is analyzed quarterly for tritium in the SALDS proximal wells (699-48-77A, 699-48-77C, and 699-48-77D) and annually to semi-annually in the tritium-tracking wells located in the vicinity of the facility (Table 3-1). Tritium results from FY08 are discussed in Section 3.2 and are listed in Appendix A. Tritium samples for Pacific Northwest National Laboratory's Sitewide monitoring program are taken annually at these wells.

In addition to tritium, groundwater from the proximal wells is analyzed for 17 constituents, as required by *State Waste Discharge Permit Number ST-4500*, Special Condition S2(B) (Ecology 2000). Enforcement limits were set for acetone, benzene, cadmium (total), chloroform, copper (total), lead (total), mercury (total), pH, sulfate, tetrahydrofuran, and total dissolved solids. Gross alpha, gross beta, strontium-90, and tritium are not assigned enforcement limits but are monitored and reported for informational purposes. Results for all of these parameters are reported quarterly in discharge monitoring reports. Additional parameters (e.g., alkalinity, dissolved oxygen, specific conductance, pH, temperature, turbidity, and water level) are sought for determination of general groundwater characteristics and for verifying the quality of analytical results. Maximum concentrations for these constituents and the corresponding sample months for FY08 are discussed below and are listed in Table 3-2. Groundwater levels are discussed in Section 2.0.

3.1 GROUNDWATER SAMPLING AND ANALYSIS FOR FISCAL YEAR 2008

Samples for the three proximal wells were collected in October 2007, as well as in January/February, April, and August 2008. Tritium-tracking wells are sampled on an annual or semi-annual basis for tritium only. The tritium-tracking wells were sampled in January through May 2008. Some of the tritium-tracking wells are also sampled for a broader range of constituents for the LLBG facility and Sitewide groundwater surveillance program. The tritium results from these programs, in addition to those collected specifically for the SALDS, are included in Appendix A.

Declining regional water levels are causing shallow wells in the SALDS tritium-tracking network along the northern perimeter of LLWMA-3/5 to go dry. As of July 2008, 10 wells in the original SALDS tritium-tracking network are sample dry (Table 3-1). Of the five active wells along the northern perimeter of LLBG-3/5, two wells are screened deeper in the aquifer. Well 299-W7-5 became dry in 2006, and repeat sampling in 2007 was not successful. Water levels were not obtained at this well. A total of 12 wells are currently used for tritium tracking (including well 699-51-75, which is co-located with a deeper piezometer [well 699-W51-75P]), and 17 wells are used for water-level measurements.

Wells 699-51-75, 699-48-71, and 699-49-79 are older wells that are sampled with dedicated submersible electric pumps. Well 699-51-75P is a piezometer nested within well 699-51-75 but is completed 41 m (135 ft) deeper in the aquifer and is sampled with an airlift hose. This method is acceptable when sampling for tritium only. All other wells are sampled using dedicated pumps.

Table 3-1. Sampling Schedule for State-Approved Land Disposal Site Wells.

Well	Sampling Frequency/Months[a]	Other Sampling Programs	Comments
299-W6-6	A / January	Surv-3	Deep companion to well 299-W6-7 (screen 418 to 429 ft).
299-W6-11	A / January	--	--
299-W6-12	A / January	Surv-3	--
299-W7-3	S / January, May	LLBG	Deep completion.
299-W8-1	A / January	LLBG	--.
699-48-71	A / January	Surv-3	--
699-48-77A	Q / October, January, April, July	Surv-3	Sampled for tritium and 15 constituents required by Permit.
699-48-77C	Q / October, January, April, July	Surv-3	Sampled for tritium and 15 constituents required by Permit. Deep completion.
699-48-77D	Q / October, January, April, July,	Surv-3	Sampled for tritium and 15 constituents required by Permit.
699-49-79	A / January	Surv-3	Actually sampled in February due to electrical problems with the pump.
699-51-75	S / January, May,	Surv-3	Sampled in February and May due to pump problems.
699-51-75P	A / January	--	Deep piezometer in well 699-51-75.

[a] Actual months of sampling may vary slightly due to winter weather or accessibility restrictions caused by fire hazard; however, sampling frequency is maintained.
A = annual
LLBG = Low-Level Burial Grounds
Q = quarterly
S = semi-annually
Surv-3 = Hanford Sitewide surveillance sampling

3.2 RESULTS OF TRITIUM ANALYSES (TRITIUM TRACKING)

Groundwater in the three proximal wells has been affected by tritium discharges since 1996. Figure 3-1 shows tritium activities in the proximal wells since groundwater monitoring began at the SALDS. Results of the tritium analyses for the tritium-tracking well network for FY08 are presented as trend plots in Figure 3-2. Individual and average FY08 values are listed in Appendix A. Figure 3-3 shows the entire network, average tritium values at each well, and whether concentrations increased, decreased, or remained unchanged from last year.

Table 3-2. Maximum or Range of Concentrations of Constituents in Groundwater and Corresponding Sample Month for State-Approved Land Disposal Site Wells, Fiscal Year 2008 (Including September 2007 Samples).

Constituent (Permit Limit)	**Well 699-48-77A**	**Well 699-48-77C**	**Well 699-48-77D**
Acetone (160)	<1.0 (U)[a]	<1.0 (U)[a]	<1.0 (U)[a]
Benzene (5)	<1.0 (U)[a]	<1.0 (U)[a]	<1.0 (U)[a]
Cadmium, total (10)	<4 (U)[a]	0.1 (U)[a]	0.11; February 2008
Chloroform (6.2)	<1.0 (U)[a]	<1.0 (U)[a]	<1.0 (U)[a]
Copper, total (70)	7.4; September 2007	0.61; August 2008	1.79; October 2007
Lead, total (50)	0.628; October 2007	<0.1 (U)[a]	0.12; February 2008
Mercury, total (2)	<0.05 (U)[a]	<0.05 (U)[a]	<0.05 (U)[a]
Laboratory pH, pH units[b] (6.5 to 8.5)	7.91 to 8.28	7.72 to 8.01	8.07 to 8.19
Field pH, pH units[b] (6.5 to 8.5)	8.03 to 8.26	7.81 to 8.00	7.94 to 8.14
Sulfate (250,000)	5,850; January 2008	3,650; January 2008	23,400; April 2008
Tetrahydrofuran (100)	<2 (U)[a]	<2 (U)[a]	<2.0 (U)[a]
Total dissolved solids (500,000)	134,000; October 2007	197,000; April 2008	219,000; October 2008
Gross alpha, pCi/L[c]	1.4; October 2007	1.2; April 2008	2.6; October 2007
Gross beta, pCi/L[c]	3.6; October 2007, August 2008	8.5; April 2008	8.4; August 2008
Strontium-90, pCi/L[c]	1.2; October 2007	1.5; October 2007	2.5; April 2008
Tritium, pCi/L[c]	820,000; April 2008	68,000; October 2007	120,000; October 2007
Alkalinity, mg/L[b, d]	60 to 77	100 to 110	120
Field conductivity, µS/cm[c]	159; September 2007	197; October 2007	283; October 2007
Dissolved oxygen, mg/L[d]	12.58; October 2007	9.30; October 2007	10.62; October 2007
Field temperature, °C[c]	22	18.1	18.7
Turbidity, NTU[d]	13.8	0.83	8.53

NOTE; All concentrations in µg/L, unless otherwise noted.

[a] Not detected in any sample.

[b] Range of quarterly averages (pH, conductivity, dissolved oxygen, and temperature) or values (alkalinity) for fiscal year 2008.

[c] Constituent is not assigned an enforcement limit, but is subject to routine monitoring and reporting.

[d] Constituent is sought for evaluation of groundwater character and analytical quality and is not subject to *State Waste Discharge Permit Number ST-4500* conditions (Ecology 2000).

NTU = nephelometric turbidity unit

(U) = not detected; multiple minimum detection limits or lower thresholds of detection are indicated, where applicable

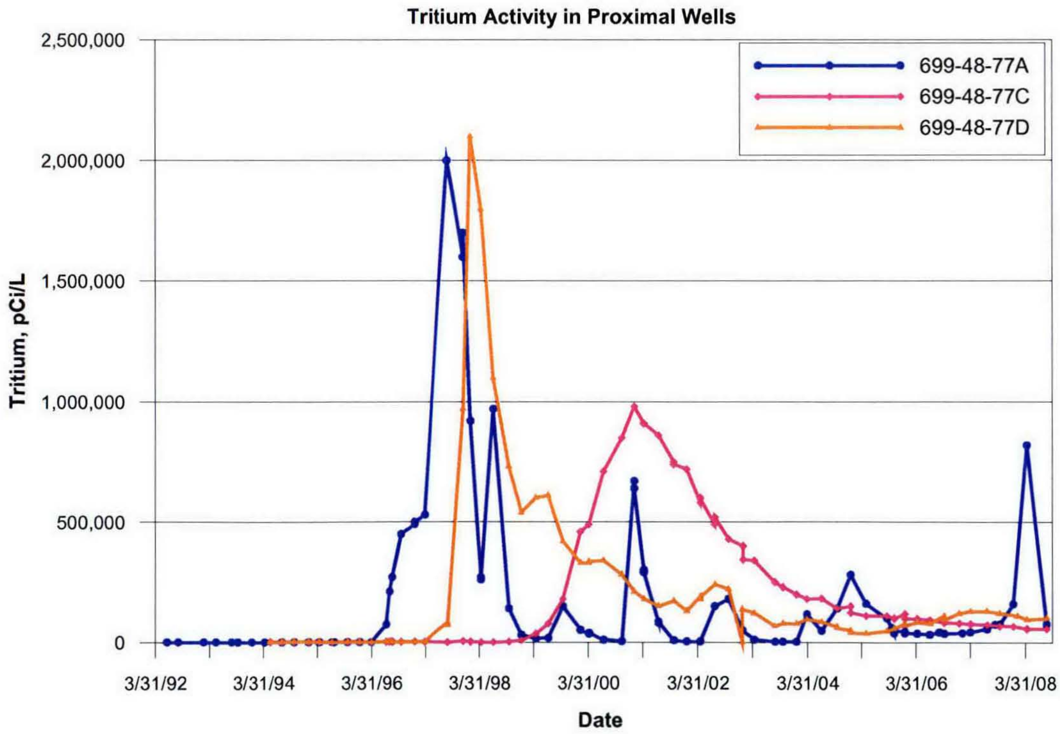
3.2.1 Proximal Monitoring Wells

Tritium activities increased in one of three proximal monitoring wells in FY08 compared to FY07 and remained unchanged (i.e., <20% change from the previous year) in two wells (Figures 3-1 and 3-3). The maximum tritium concentrations in these wells and the dates that they were sampled in FY08 are as follows:

- Well 699-48-77A: 820,000 pCi/L (April 2008)
- Well 699-48-77C: 68,000 pCi/L (October 2007)
- Well 699-48-77D: 120,000 pCi/L (October 2007).

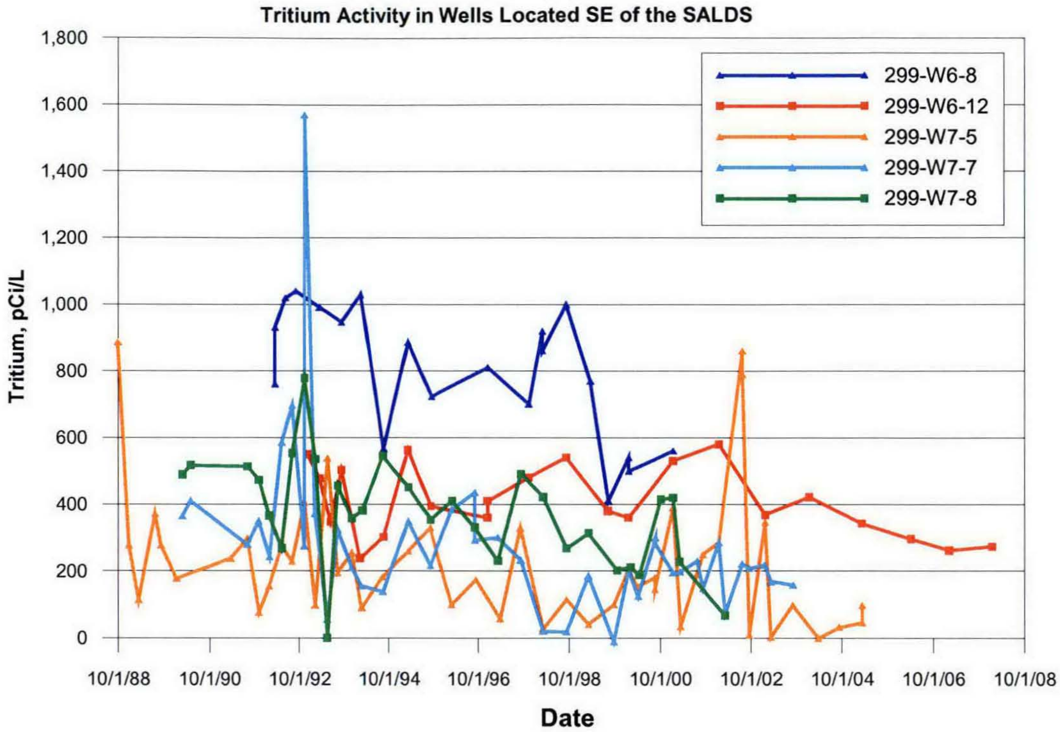
3.2.1.1 Long-Term Trends. Figure 3-1 shows that peak tritium concentrations occurred in September 1997 (2,100,000 pCi/L) and February 1998 (2,100,000 pCi/L) in wells 699-48-77A and 699-48-77D, respectively. The peak concentration in well 699-48-77C (980,000 pCi/L) was delayed until February 2001, likely because this well is screened approximately 20 m (65.6 ft) deeper in the aquifer and it took longer for the plume front to migrate to this depth. Additionally, tritium incursions to deeper well 699-48-77C have been lower in magnitude, and cyclical variations are also absent. These differences are attributed to the deeper screen setting and the dilution and attenuation of the plume as it moves vertically through the aquifer.

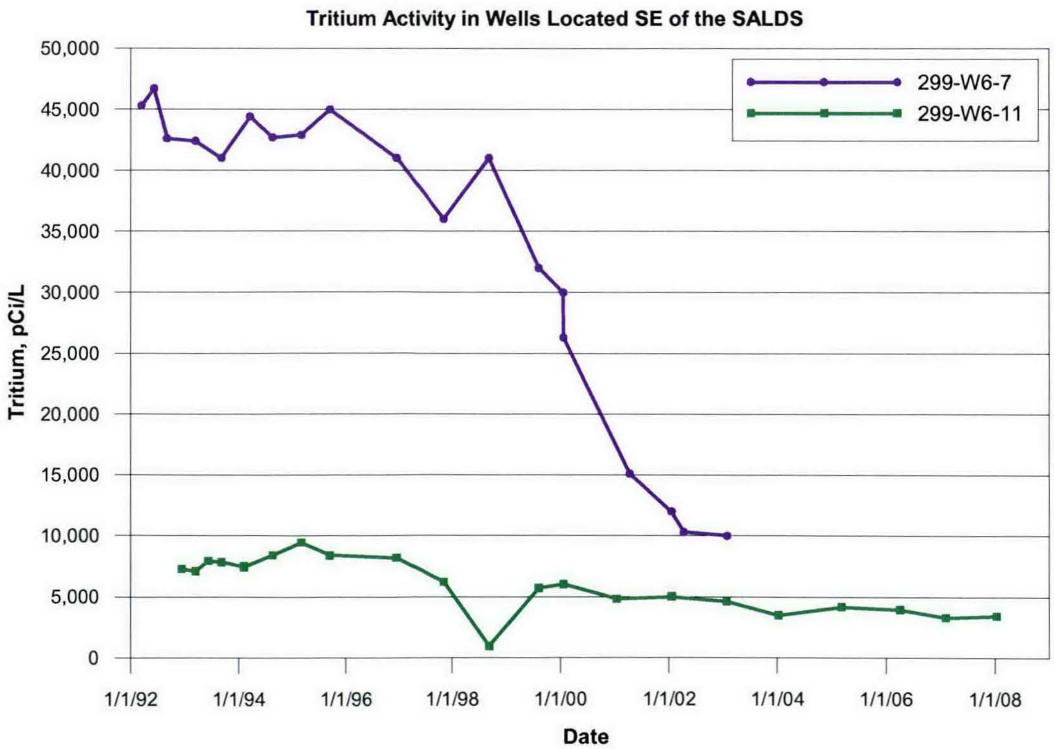
Figure 3-1. Tritium Activity Trends in State-Approved Land Disposal Site Proximal Wells Through July 2008.



NOTE: Well 699-48-77C is completed approximately 20 m (65.6 ft) deeper in the aquifer than wells 699-48-77A and 699-48-77D.

Figure 3-2. Tritium Activity Trends in Wells Southeast of the State-Approved Land Disposal Site Showing Remnant Effects of the Tritium Plume from the 200 West Area.





Since the time of peak concentrations in these wells, the trends have been generally downward. However, changes in well 699-48-77A are irregular (Figure 3-1), with what appears to be roughly annual highs and lows of significant amplitude (sometimes two order-of-magnitude changes) from 1999 to 2005. These fluctuations likely reflect the annual campaigns of the 242-A evaporator wastewater, which is high in tritium. The most recent tritium analysis (820,000 pCi/L in April 2008) is the highest level seen in well 688-48-77A in a decade. This is likely due to several intermittent ETF campaigns in 2006 and 2007 to treat wastewater from the K Basins Project, which has tritium levels similar to 242-A evaporator wastewater.

Well 699-48-77D is located nearest to the SALDS yet showed a tritium incursion starting in September 1997, more than one year later than more distant well 699-48-77A. The reason for this delay is two-fold: (1) the SALDS drain field fills from the southern end of the facility furthest away from well 699-48-77D, and (2) discharged water initially moves to the south due to effects of the Cold Creek unit beneath the SALDS (see Section 1.2.1). These two conditions direct the subsurface flow of effluent away from well 699-48-77D so it actually reaches the groundwater nearer to well 699-48-77A. A suggestion of a quasi-annual fluctuation is seen in the concentration trend line for well 699-48-77D (Figure 3-1), but the amplitude is significantly lower than that for well 699-48-77A.

The 6.1-m (20-ft) well screen at 699-48-77C is installed approximately 23 m (75 ft) deeper in the aquifer than at wells 699-48-77A and 699-48-77D. Peak tritium activity from the initial tritium release reached 980,000 pCi/L in February 2001, an approximate 3-year delay from peak concentrations at the other two wells. Because of the well's deeper position in the aquifer, tritium incursions from the SALDS operation have been historically lower at this well. During times of high discharge, the hydraulic head beneath the SALDS increases and effluent is forced deeper into the aquifer, more readily affecting well 699-48-77C.

3.2.1.2 Current Trends. The current tritium trends at the three wells are mixed. Well 699-48-77A has dramatically increased in FY08 above the FY07 trend, while well 699-48-77C continues to slowly decline. Well 699-48-77D had gradually increased over the previous 2 years to the April and July 2007 concentrations of 130,000 pCi/L, but it has subsequently declined somewhat to the most recent concentration of 100,000 pCi/L in August 2008. Since hydrogeologic considerations (discussed above) show that wells 699-48-77C and 699-48-77D respond more slowly to changes in the composition of the discharged water, it is likely that tritium concentrations will show increasing trends at these two wells in the near future. Some of the changes noted may also be due, in part, to reductions and shifts in overall groundwater direction flow.

3.2.2 Tritium Plume-Monitoring Wells

Tritium activities were generally unchanged in the tritium-tracking wells (Figures 3-2 and 3-4). Data for the tritium wells are listed in Appendix A. Wells located southeast of the SALDS have exhibited elevated activities of tritium as a result of past disposal practices in the 200 West Area. Tritium activities in well 299-W6-11 have slowly decreased over the past several years (Figure 3-2, bottom graph). Prior to becoming sample dry in 2003, tritium concentrations in well 299-W6-7 had declined steadily from >40,000 pCi/L in 1993 to about 10,000 pCi/L in 2002.

Figure 3-3. Average Tritium Activities in Groundwater for State-Approved Land Disposal Site Tritium-Tracking Network for Fiscal Year 2008.

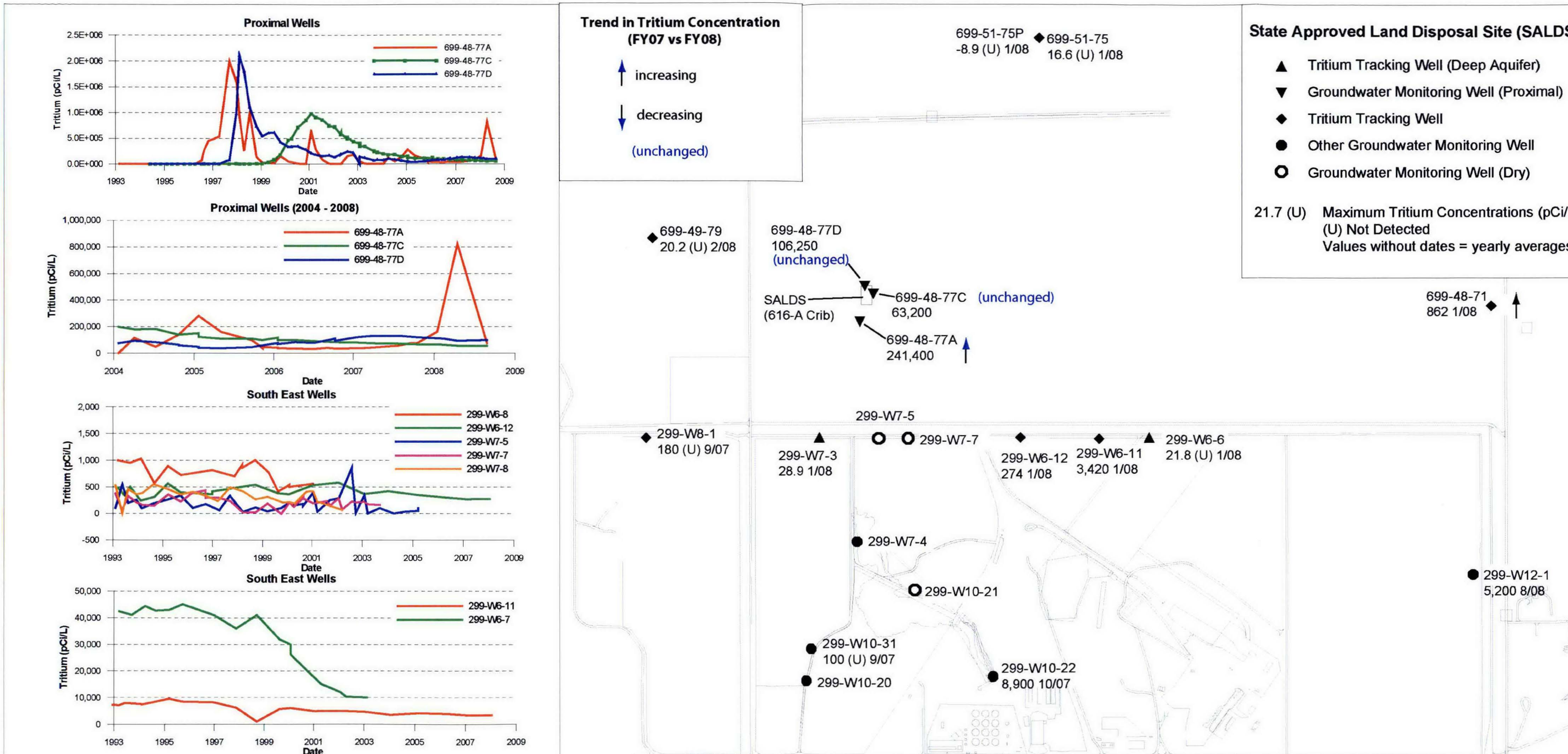
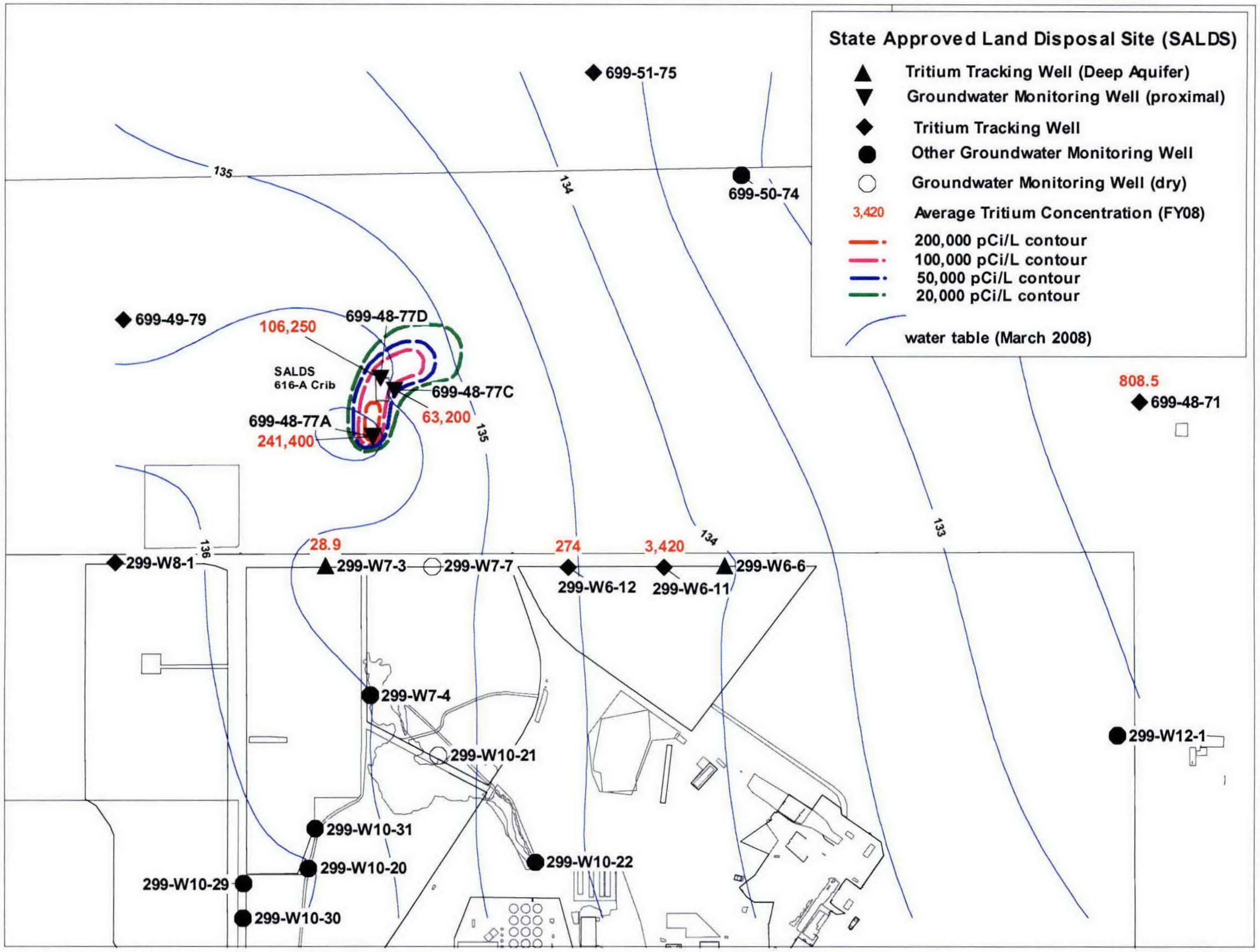


Figure 3-4. State-Approved Land Disposal Site Tritium Plume, Fiscal Year 2008.



Well 699-W6-11, the easternmost of the remaining tritium monitoring wells, has had slowly declining tritium concentrations below 5,000 pCi/L since 2001. The maximum tritium concentrations (9,450 pCi/L) occurred in 1995, prior to the start of SALDS operations. The FY08 tritium concentration in well 299-W6-11 was 3,420 pCi/L, which is essentially unchanged from 3,290 pCi/L in FY07.

Tritium was trending slightly downward in 2007 in well 299-W6-12 (Figure 3-2, top graph), located just west of well 299-W6-11. Tritium remained essentially unchanged at 263 pCi/L in FY07 and 274 pCi/L in FY08. Previously, tritium concentrations have been nearly 600 pCi/L in this well; however, the source is believed to be an older tritium plume originating within the 200 West Area.

No water samples for analysis were obtained at well 299-W7-5 in FY08. The FY05 concentration in this well was 46.3 pCi/L (Figure 3-2, top graph), which is near the detection limit for tritium; however, tritium in this well reached a maximum of 860 pCi/L in July 2002. Figure 3-2 shows that tritium was present prior to operation of the SALDS in 1995; therefore, tritium at this well also originated from a pre-existing plume in the 200 West Area. Numerical modeling implies that tritium from the SALDS could eventually reach this well location after the well has gone dry. Another well, 299-W8-1 (located to the west of well 299-W7-5), has rarely detected tritium in concentrations above the 25 pCi/L detection limit and did not exceed the detection limit during FY08.

Distal tracking well 699-48-71, located 2 km (1.2 mi) to the east of the SALDS crib, showed a 26% increase in tritium concentration between FY07 (631 pCi/L) and FY08 (797 pCi/L). Tritium concentrations have been increasing at this well since about 1993 and, although the well is downgradient of the SALDS crib, other contaminant trends and the distance involved suggest that the SALDS crib is not likely the primary source of tritium in groundwater at this location.

3.3 RESULTS OF OTHER CONSTITUENT ANALYSES

Groundwater from the proximal wells is analyzed for a list of 15 constituents (including tritium) required by the *State Waste Discharge Permit Number ST-4500*, Special Condition S1(A) (Ecology 2000). Permit limits are set for the following constituents: acetone, benzene, cadmium (total), chloroform, copper (total), lead (total), mercury (total), pH, sulfate, tetrahydrofuran, and total dissolved solids. There are no assigned limits for gross alpha, gross beta, strontium-90, and tritium, but these constituents are monitored and the concentrations are reported. Additional parameters (e.g., alkalinity, dissolved oxygen, temperature, and turbidity) are monitored for determination of general groundwater characteristics and for verifying the quality of analytical results. Maximum concentrations for these constituents and the corresponding sample months for FY08 are listed in Table 3-2.

All 11 constituents with Permit limits were below the limits in the proximal wells during FY08.[1] Acetone, benzene, cadmium, chloroform, and tetrahydrofuran were reported below detection limits in all three wells for all of the samples collected during FY08. Three target metals (i.e., lead, mercury, cadmium, and copper) were found at near-detection concentrations in one or more of the proximal wells. At well 699-48-77A, maximum concentrations of copper, lead, and mercury were present at 1.58 µg/L, 0.628 µg/L, and less than detection, respectively.

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[1] Samples were collected in October 2007 and January/February, April, and August 2008.

This concentration of contaminants is attributed to the relatively rapid migration of contaminated discharges to the groundwater near this well.

Laboratory and field pH measurements were within the 6.5 to 8.5 criterion in all samples collected from proximal wells during FY08. This criterion was also satisfied in FY06 and FY07.

Gross-alpha concentrations ranged between 1.2 and 2.6 pCi/L in the proximal wells during FY08. Gross-beta values ranged between 3.6 and 8.5 pCi/L in these wells. There are no Permit limits associated with gross alpha or gross beta. Strontium-90 was detected in all three proximal wells in FY08, ranging from 1.5 to 3.8 pCi/L in well 699-48-77A.

Several anions and metals increased in concentration after startup of the SALDS. As previously discussed, this was likely due to transport of dissolved soluble mineral species in the vadose zone during percolation of SALDS effluents (*Origin of Increased Sulfate in Groundwater at the ETF Disposal Site* [PNNL-11633]; *Tritium Monitoring in Groundwater and Evaluation of Model Predictions for the Hanford Site 200 Area Effluent Treatment Facility* [PNNL-11665]). The specific conductance of well 699-48-77A, a measure of total ions in solution, clearly shows a definite spike in the months after the SALDS discharge began in December 1995 (Figure 3-5). During FY08, total dissolved solids ranged between 134,000 and 219,000 μg/L. In general, the concentrations of total dissolved solids and specific conductance observed over the past few years appear to be slowly increasing or stable in FY08.

Since well 699-48-77C is screened approximately 20 m (65.6 ft) below the water table, the vertical downward component of groundwater movement is due to mounded water. Thus, chemical contaminants in SALDS discharges are significantly delayed and subdued in the deeper well with respect to the two shallow wells. The peak concentrations of conductivity and total dissolved solids are shown in Figures 3-5 and 3-6, respectively. Specific conductance values have gradually increased in wells 699-48-77A and 699-48-77D since the ETF ceased discharge of high volumes of effluent from treated groundwater from the 200-ZP-1 OU pump-and-treat system in March 2006. This effluent, along with additional volumes from treatment of groundwater from the 241-T Tank Farm pump-and-treat system, was restarted in September 2007, but no decrease in conductivity has yet been seen. Total dissolved solids trends at these three wells are highly variable and do not show clear trends.

Similar delayed behavior is seen in Figures 3-7 and 3-8 for chloride, sulfate, calcium, and sodium in the proximal wells. These constituents are leached from the soil, so the results do not represent the ETF effluent. Only sulfate analyses are required by the Permit, but all four are useful for tacking groundwater movement. For example, the initial increase in sulfate concentration in wells 699-48-77A and 699-48-77D in December 1995 occurred within 6 months after the start of disposal to the SALDS. Sulfate concentrations did not increase in well 699-48-77C until late 1998, or 3 years after the start of disposal. For the above analytes, since 2005, concentrations are increasing at well 699-48-77D, although the results from FY08 suggest that the trend has stabilized. At wells 699-48-77A and 699-48-77C, the concentrations are slowly declining or are stable.

Figure 3-5. Trend Plots for Conductivity in State-Approved Land Disposal Site Proximal Wells.

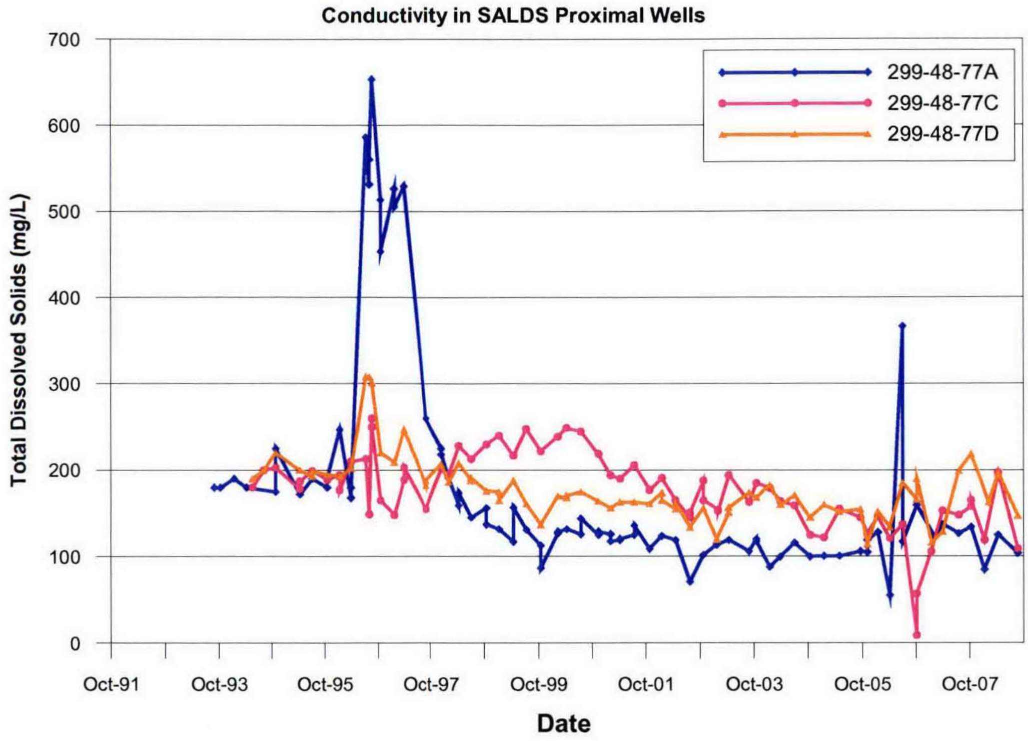


Figure 3-6. Trend Plots for Total Dissolved Solids in State-Approved Land Disposal Site Proximal Wells.

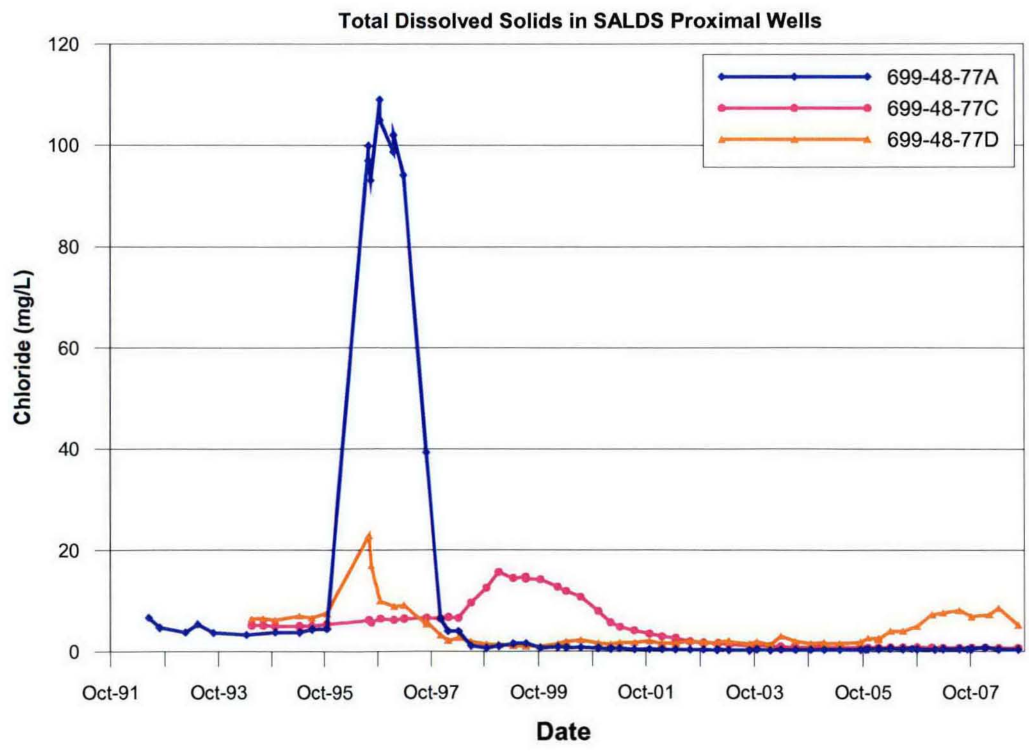
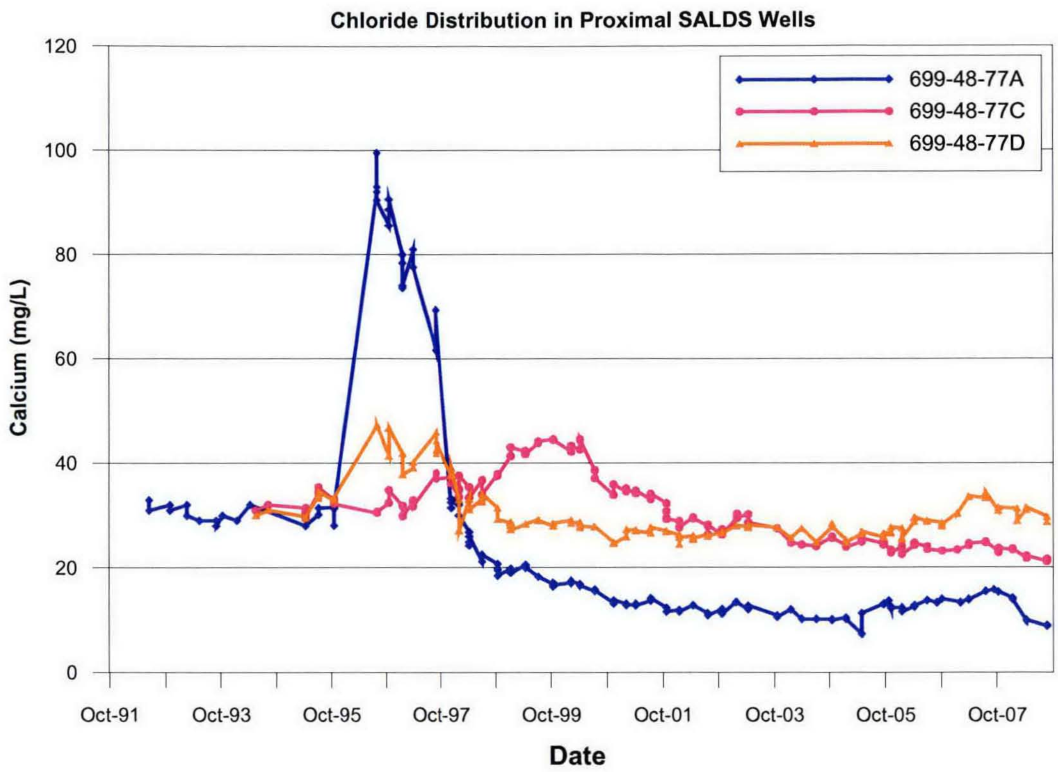


Figure 3-7. Trend Plots for Chloride (Top) and Sulfate (Bottom) in State-Approved Land Disposal Site Proximal Wells.



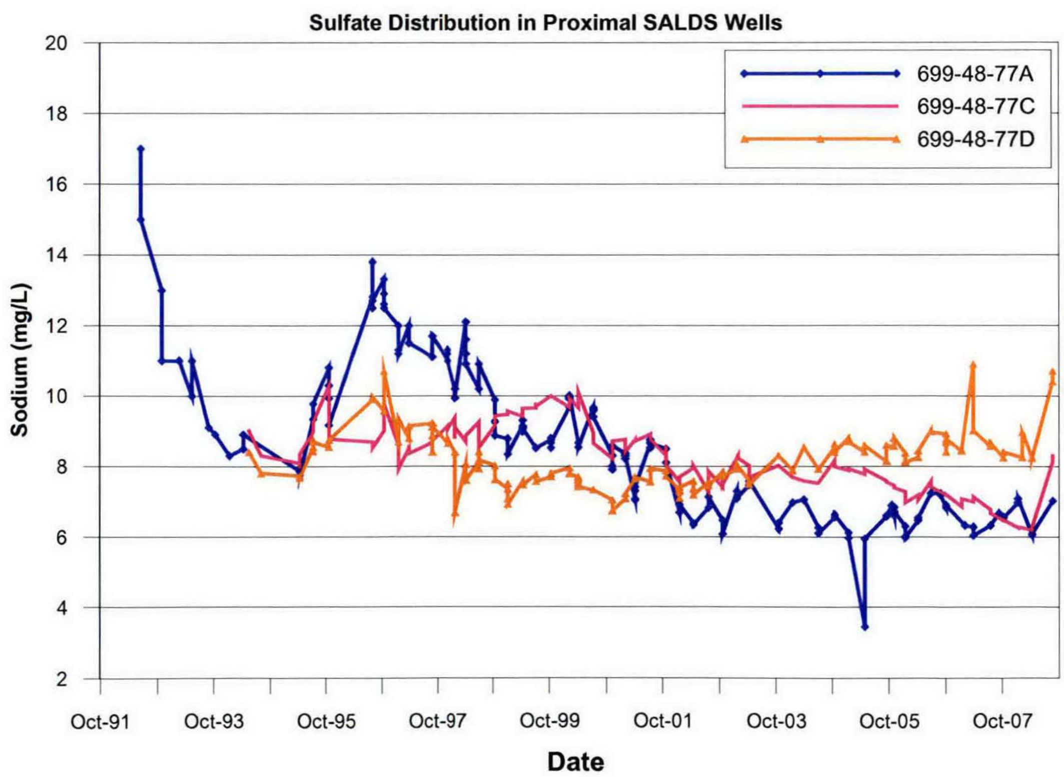
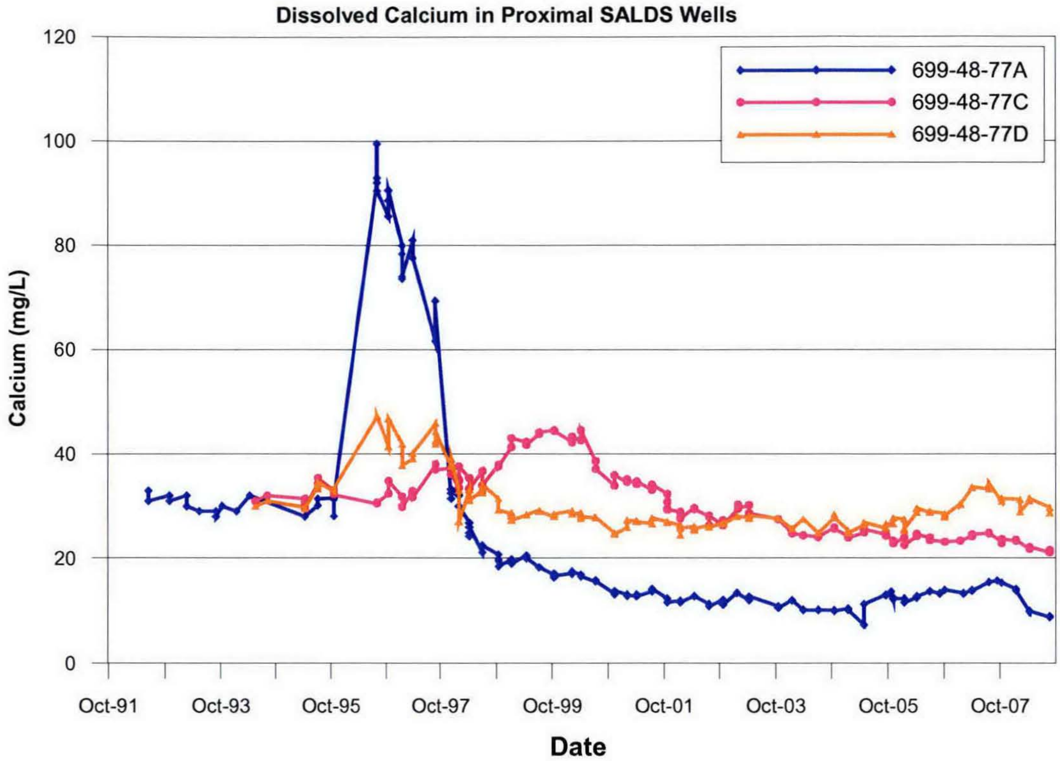
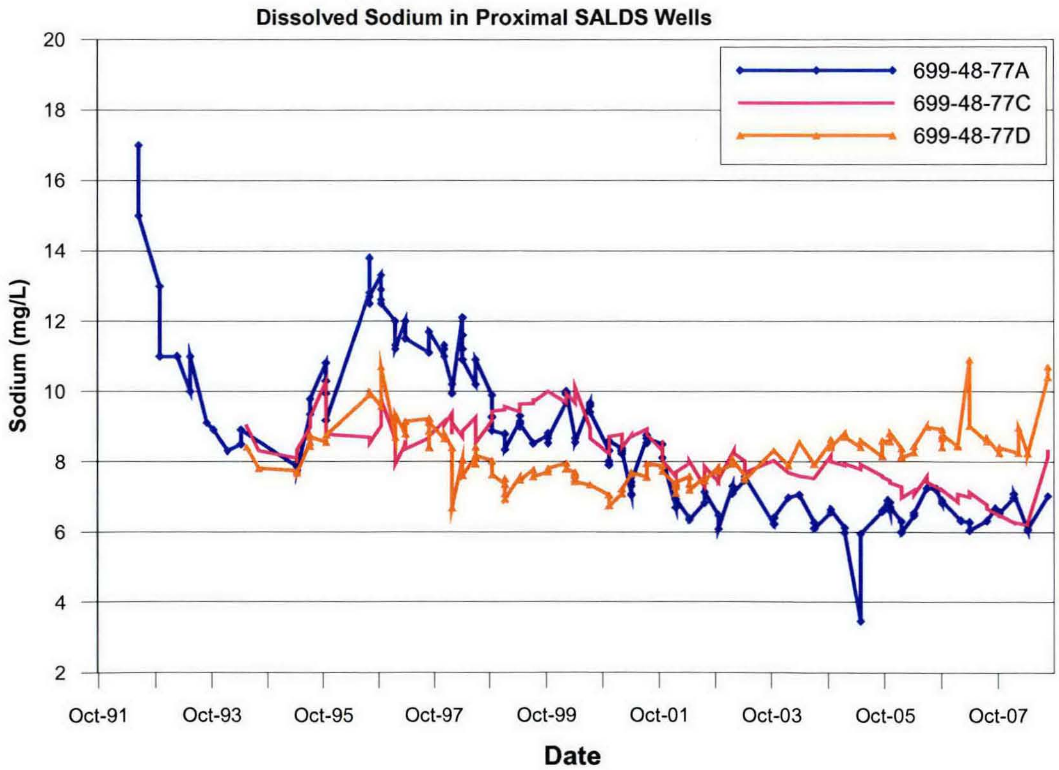


Figure 3-8. Trend Plots for Dissolved Calcium (Top) and Dissolved Sodium (Bottom) for State-Approved Land Disposal Site Proximal Wells.





4.0 SITE ANALYSIS AND CONCLUSIONS

The regional decline in the water table in the 200 West Area has reduced the number of tritium-tracking wells located south of the SALDS to five: 299-W8-1, 299-W7-3, 299-W6-12, 299-W6-11, and 299-W6-6. All of these wells are located along the northern edge of the 200 West Area and LLBG-3/5. Because of the close spacing of wells in this area, the loss of wells is becoming more critical for tracking the tritium plume that is originating from the SALDS. The discussion presented in this section focuses on additional topics that may have the greatest effects on SALDS operation.

4.1 NUMERICAL MODEL COMPARISONS

The simulated tritium plume, as defined by the 500 pCi/L contour, is expected to reach the line of tritium-tracking wells along the northern border of the 200 West Area between the years 2020 and 2030 (Figure 4-1) (PNNL-14898). Previous modeling simulations using higher tritium inventories and liquid waste volumes (PNNL-11665) predicted that the plume would reach the northern boundary of the 200 West Area between the years 2000 and 2005.

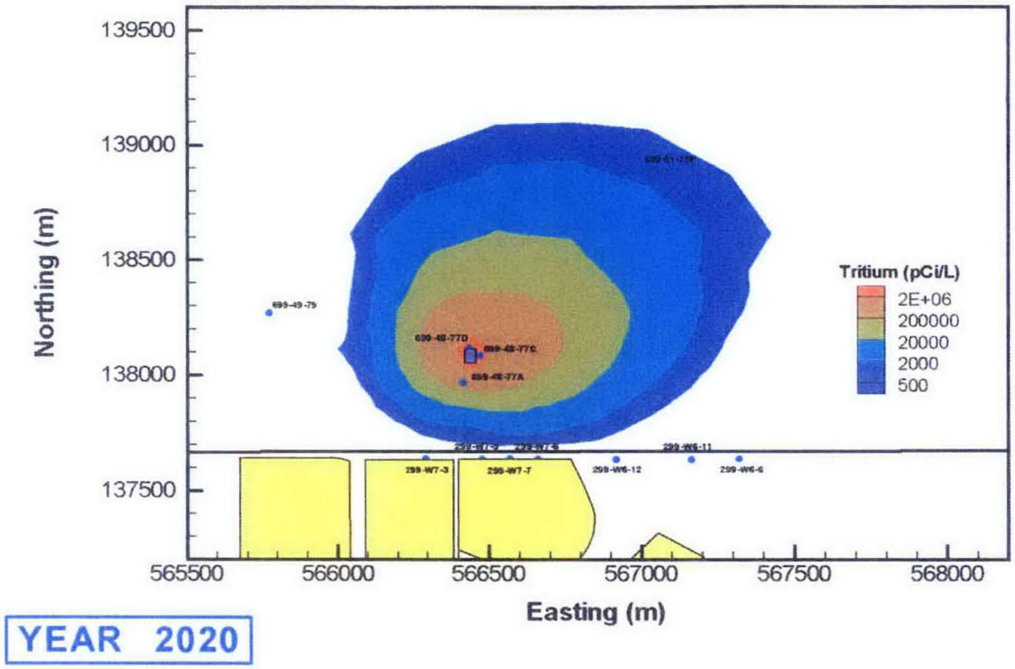
Wells 299-W7-7 and 299-W7-6, located south of the SALDS, were also predicted to detect tritium from the facility by calendar year 2000, but tritium was not detected in these wells prior to their going dry in 2003 and 2004, respectively. Modeling of the vertical distribution of tritium beneath the SALDS predicted activities of >200,000 pCi/L at well 699-48-77C, which is screened approximately 45 m (148 ft) below the top of the aquifer. The maximum tritium activity in this well was 980,000 pCi/L in February 2001 while the maximum (and most recent) tritium activity measured in FY08 was 820,000 pCi/L in April 2008.

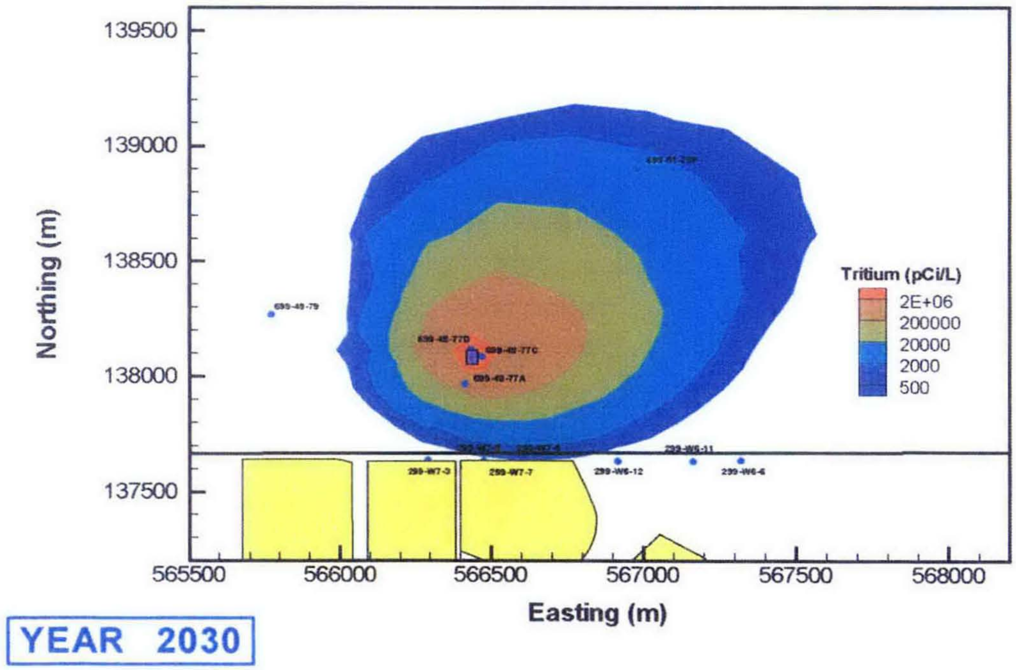
It should be noted that although actual discharge volumes to date are in line with model assumptions, the model assumed that a total of approximately 745 Ci would be discharged to the SALDS by the end of calendar year 2002. This compares to the 412.5 Ci discharged thus far, which may eventually result in a disparity between the activities observed in the tritium-tracking wells versus the predicted activities.

The predicted hydraulic potential distribution in the area surrounding SALDS for 2005 (Figure 3-3) is approximately 2.2 m (7.2 ft) higher than current field-derived measurements (Figure 2-4). Also, the March 2008 water table surface (Figure 2-4) indicates a more easterly component of flow in the vicinity of the SALDS than model predictions for the 2005 water table surface.

Despite some discrepancy between the predicted hydraulic potential distribution in the model predictions and the observed water levels in March 2008, the 2004 model is a reasonable estimate of hydraulic head and tritium dispersal in the SALDS area. The updated model (2004) incorporates recent refinements to the Hanford Sitewide groundwater model and the actual water volume and tritium release information available through June 2004. Future updates to the model need to consider the future effects of pump-and-treat activities around the 241-T Tank Farm on the SALDS tritium plume. While treated effluent from the 241-T Tank Farm pump-and-treat system will only minimally increase the total amount of tritium discharged at the SALDS, a potentially more significant concern is the impact that drawdown near the tank farm could potentially have on the plume rate and the direction of movement.

Figure 4-1. Predicted Tritium Distribution as a Result of State-Approved Land Disposal Site Operation in Years 2020 (Top) and 2030 (Bottom).





NOTE: Figures from PNNL-14898, *Results of Groundwater Modeling for Tritium Tracking at the Hanford Site 200 Area State-Approved Land Disposal Site – 2004*

4.2 CONCLUSIONS

The SALDS tritium-tracking network consists of five wells located to the south of the SALDS, one well located to the northeast (this well consists of a co-located shallow aquifer well and a deep aquifer piezometer), one well located to the northwest, and one well located to the east of the SALDS. Thus far, the remainder of the network appears adequate to track tritium from the facility for the near term. Wells 299-W6-11 and 299-W6-12 are the most advantageously positioned to detect any tritium migrating to the south of the SALDS facility. Tritium has been detected in the LLBG wells to the south at low concentrations, but this is attributed to a 200 West Area tritium plume that was in existence prior to operation of the SALDS.

A consistent downward hydraulic head is indicated by the head differences between shallow proximal wells (699-48-77A and 699-48-77D) and the deep proximal well (699-48-77C). However, due to 2 years of low, sporadic discharges in FY06 and FY07, the gradient has declined from past levels. This gradient has forced tritium deeper in the aquifer in the immediate vicinity of the SALDS, although at lesser concentrations. In FY08, the hydraulic gradient has increased due to increased effluent discharge from ETF treatment of groundwater from the 200-UP-1 OU and the 241-T Tank Farm. South of the SALDS mound, the vertical hydraulic gradient appeared to be negligible at wells 299-W6-6 and 299-W6-7 through March 2004, when the last water level was measured in well 299-W6-7.

In general, tritium activities in most wells near the SALDS either show a long-term decline or are unchanging. Tritium activity in well 699-48-77A has reversed its decline, with a sharp increase from 43,000 pCi/L in April 2007 to 820,000 pCi/L in April 2008. The increase was due to higher quantities of tritium in K Basin wastewaters that were treated and discharged in FY07 beginning to appear at the well. Although tritium levels in the proximal wells may increase from year to year, no indications of tritium incursions have been detected in the distal tritium-tracking network.

During the past few years, concentrations of sulfate, specific conductance, and total dissolved solids have declined and are now below background levels in the three SALDS proximal wells. This is because the dilution of the groundwater in the vicinity of the SALDS has now replaced the earlier plume of soil-derived dissolved solids.

If the water decline continues at the current rate (0.26 m/yr [0.85 ft/yr]), only the wells screened deep in the aquifer will survive to beyond the year 2020, when in accordance with 2004 numerical simulations, the tritium plume is expected to reach the northern boundary of the 200 West Area.

Since the SALDS groundwater monitoring began in 1995, 10 of the 15 tritium-tracking wells to the south of the facility have become dry or unusable. This southern array of wells was selected not as upgradient monitoring points (as they have sometimes been mistakenly labeled), but rather to resolve the influence of the SALDS tritium from the tritium plume emanating from the northeast corner of the 200 West Area. As more of these wells become dry, the ability to differentiate between these two tritium sources may be impaired, but downgradient detection of SALDS tritium should be unaffected.

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APPENDIX A

STATE-APPROVED LAND DISPOSAL SITE TRITIUM RESULTS FOR FISCAL YEAR 2008

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Table A-1. State-Approved Land Disposal Site Tritium Results, Fiscal Year 2008.

Well	Date Sampled	2008 Tritium Analyses (pCi/L)	Lab Qualifier	2007 Tritium Maximum (pCi/L)	2008 Yearly Avg. (pCi/L)	2008 Max. Versus 2007 Max.
299-W6-11	01/15/08	3,420		3,290	3,420	Unchanged
299-W6-12	01/16/08	274		263	274	Unchanged
299-W6-6	01/15/08	21.8	U	--	--	--
299-W7-3	01/16/08	28.9		19.6	28.9	Increasing
	03/27/08	-15.0	U			
	05/27/08	-25.7	U			
299-W8-1	01/15/08	9.11	U	38.3	--	--
	03/25/08	-120	U			
699-48-71	01/03/08	820		640	808.5	Increasing
	01/03/08	760				
	01/15/08	862				
	01/15/08	792				
699-48-77A	09/16/07	75,000		56,000	241,400	Increasing
	10/15/07	76,000				
	01/15/08	160,000				
	04/25/08	820,000				
	08/25/08	76,000				
699-48-77C	10/15/07	68,000		82,000	63,200	Unchanged
	10/15/07	68,000				
	01/15/08	66,000				
	04/15/08	57,000				
	08/25/08	57000				
699-48-77D	10/15/07	120,000		130,000	106,250	Unchanged
	2/13/08	110,000				
	04/15/08	95,000				
	08/25/08	100,000				
699-49-79	02/13/08	20.2	U	--	--	--
699-51-75	02/13/08	16.6	U	8.9	--	--
	06/10/08	1.43	U			
699-51-75P	01/15/08	-8.88	U	8.8	--	--

NOTE: Increase = 20% higher maximum concentration in FY08 than in FY07, decrease = 20% lower concentration in FY08 than in FY07, unchanged = FY08 concentration within 20% of FY07 value

-- = change or average not applicable due to less than detection values (less than detection values not used to calculate annual averages

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