
**Pacific Northwest
National Laboratory**

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U.S. Department of Energy

**Quarterly RCRA Groundwater
Monitoring Data for the Period
July through September 2006**

M. J. Hartman

February 2007



Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

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Pacific Northwest National Laboratory
Richland, Washington 99352

Summary

This report provides information about RCRA groundwater monitoring for the period July through September 2006. Eighteen *Resource Conservation and Recovery Act* (RCRA) sites were sampled during the reporting quarter.

Acronyms

AEA	<i>Atomic Energy Act</i>
CERCLA	<i>Comprehensive Environmental Response, Compensation, and Liability Act</i>
DOE	U.S. Department of Energy
EB	equipment blank
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FTB	full trip blank
FXR	field transfer blank
FY	fiscal year
HEIS	Hanford Environmental Information System
Lionville Laboratory	Lionville Laboratory, Incorporated, Lionville, Pennsylvania
MDA	minimum detectable activity
MDL	method detection limit
PNNL	Pacific Northwest National Laboratory
QC	quality control
RCRA	<i>Resource Conservation and Recovery Act</i>
RPD	relative percent difference
RSD	relative standard deviation
STL Richland	Severn Trent Laboratories, Incorporated, Richland, Washington
STL St. Louis	Severn Trent Laboratories, Incorporated, St. Louis, Missouri
TSD	treatment, storage, and/or disposal
WMA	waste management area

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1.0 Introduction

Eighteen *Resource Conservation and Recovery Act* (RCRA) sites¹ were sampled during the reporting quarter, as listed in Table 1.1. Sampled sites include eight monitored under groundwater indicator evaluation (“detection”) programs [40 CFR 265.93(b)], eight monitored under groundwater quality assessment programs [40 CFR 265.93(d)], and two monitored under final-status programs (WAC 173-303-645). This report presents results of statistical comparisons for the sites in detection monitoring and provides updated information for the sites in assessment monitoring. In addition, quarterly sampling results for Waste Management Area C are provided in Appendix A. These results are required during waste retrieval from the tank farm.

Groundwater monitoring objectives of RCRA, the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA), and the *Atomic Energy Act* (AEA) often differ slightly and the contaminants monitored are not always the same. For RCRA regulated units, monitoring focuses on non-radioactive dangerous waste constituents. Radionuclides (source, special nuclear and by-product materials) may be monitored in some RCRA unit wells to support objectives of monitoring under the AEA and/or CERCLA. Please note that pursuant to RCRA, the source, special nuclear and by-product material component of radioactive mixed waste are not regulated under RCRA and are regulated by the U.S. Department of Energy (DOE) acting pursuant to its AEA authority. Therefore, while this report may be used to satisfy RCRA reporting requirements, the inclusion of information on radionuclides in such a context is for information only and may not be used to create conditions or other restrictions set forth in any RCRA permit.

¹ A site is a treatment, storage, and/or disposal (TSD) unit or a waste management area associated with a TSD unit.

Table 1.1. Status of RCRA Sites, July through September 2006

Site	Routine Sampling?	DG Statistical Exceedance?	Comments
Detection Sites [40 CFR 265.93(b)] (sampled semiannually)			
1301-N Liquid Waste Disposal Facility ^(a)	Yes	Yes	See text.
1325-N Liquid Waste Disposal Facility ^(a)	Yes	Yes	See text.
1324-N/NA Facilities ^(a)	No	Not sampled	
216-B-3 Pond	Yes	No	
216-A-29 Ditch	No	Not sampled	
216-B-63 Trench	No	Not sampled	
216-S-10 Pond and Ditch	No	Not sampled	Current network 2 shallow and 1 deep DG wells ^(b)
LERF ^(a)	Yes	Not applicable	Current network 1 UG and 1 DG well. No statistical evaluation per Ecology.
LLWMA 1	No	Not sampled	
LLWMA 2	No	Not sampled	Wells monitoring the north part of the LLWMA are dry. ^(b)
LLWMA 3	Yes	Not applicable	Statistical comparisons suspended until new background baseline established.
LLWMA 4	Yes	Yes ^(c)	See text
SST WMA C	Yes	Not applicable	Sampled quarterly, but statistical evaluation performed semiannually.
NRDWL	Yes	Yes ^(c)	See text
Groundwater Quality Assessment Sites [40 CFR 265.93(d)] (sampled quarterly)			
Eight sites ^(d)	Yes	Not required	See updates in text.
Sites under a WAC 173-303-645 monitoring program			
Integrated Disposal Facility	Yes	Not applicable	No waste in place.
300 Area Process Trenches	Yes	Not applicable ^(e)	
183-H Solar Basins	No	Not sampled	
CM = Critical mean value(s). DG = Downgradient. LERF = Liquid Effluent Retention Facility. LLWMA = Low-level WMA.		NRDWL = Nonradioactive Dangerous Waste Landfill. SST = Single-shell tanks. UG = Upgradient. WMA = Waste management area.	
(a) These sites are incorporated into the Hanford Facility RCRA Permit (Ecology 1994), but continue to be monitored under interim-status programs, as specified in the Permit. (b) Well installation needs are addressed each year as part of the M-24 milestone process. (c) No indication of dangerous waste contamination from site; see text for explanation. (d) U-12 Crib, PUREX Crib, SST WMAs A-AX, B-BX-BY, S-SX, T, TX-TY, and U. (e) Site has entered corrective action monitoring because of previous exceedances.			

2.0 Comparison to Concentration Limits

Contamination indicator parameter data (pH, specific conductance, total organic halides, and total organic carbon) from downgradient wells were compared to background values at sites monitored under interim-status, detection requirements, as described in 40 CFR 265.93. Results of the comparisons are listed in Table 1.1. Additional explanation is provided in the following sections.

2.1 1301-N Liquid Waste Disposal Facility

Sampling of downgradient well 199-N-3 and upgradient well 199-N-57 was delayed from September to October, 2006 (see Section 3.0). Average specific conductance concentration in well 199-N-3 (1,504 $\mu\text{S}/\text{cm}$) exceeded the critical mean of this parameter (1,169 $\mu\text{S}/\text{cm}$). This was a continuation of a previously reported exceedance. Elevated specific conductance is caused by constituents sulfate, nitrate, sodium, and calcium. Prior assessment results (Hartman 1992) indicated the contamination came from non-hazardous constituents moving downgradient from the 1324-N/NA facilities.

Average total organic carbon concentration (3,950 $\mu\text{g}/\text{L}$) in well 199-N-3 also exceeded the upgradient/downgradient comparison value of 2,700 $\mu\text{g}/\text{L}$. The elevated total organic carbon may have come from a nearby hydrocarbon plume, but no hydrocarbon analyses were requested in this quarter. Verification sampling was scheduled for January 2007. Samples will be analyzed for total organic carbon (split samples sent to two laboratories) and total petroleum hydrocarbons.

2.2 1325-N Liquid Waste Disposal Facility

Sampling in downgradient well 199-N-41 was delayed from September to November 2007 (see Section 3.0). Average specific conductance in well 199-N-41 (504.5 $\mu\text{S}/\text{cm}$) and well 199-N-32 (440 $\mu\text{S}/\text{cm}$) continued to exceed the critical mean value (403 $\mu\text{S}/\text{cm}$). DOE notified the Washington State Department of Ecology (Ecology) of an earlier exceedance and transmitted the results of the groundwater quality assessment.² The high specific conductance is believed to have originated at an upgradient source, and passed the location of the upgradient well several years ago, so no verification sampling is required.

Average pH in two downgradient wells were outside of the critical range for this parameter. Average pH in well 199-N-32 (7.68) was below the lower limit of 7.80, while pH in well 199-N-41 (8.82) was above the upper limit of 8.35. The pH in well 199-N-32 was only slightly lower than recent values and is in line with other wells in the 100-N Area. The high value in well 199-N-41 was unusual for 100-N Area groundwater and is not in line with the historical trend for this well. Verification sampling was conducted in both wells in January and all results were within the critical range.

2.3 Low-Level Waste Management Area 4

New downgradient well 299-W15-224 was sampled for the first time during the reporting quarter. As expected, total organic halides concentrations in this well and three other downgradient wells exceeded

² Letter from KM Thompson (U.S. Department of Energy, Richland, Washington) to J Hedges (Washington State Department of Ecology), *Results of Assessment at the 1325-N Facility*, dated July 22, 2000.

the critical mean value of 43.9 µg/L. DOE reported an earlier exceedance in an older well to Ecology in 1999³ and again in 2006 (Hartman et al. 2006). These wells are within the known carbon tetrachloride plume and the elevated total organic halides concentrations are consistent with observed levels of carbon tetrachloride from Plutonium Finishing Plant operations. Because the exceedances of total organic halides were caused by the regional plume, detection monitoring will continue.

2.4 Nonradioactive Dangerous Waste Landfill

One upgradient well was not sampled as scheduled and one was delayed past the end of the reporting quarter (see Section 3.0). Critical mean values were revised to reflect that one upgradient well was not sampled. Average specific conductance concentrations from downgradient wells 699-25-34A (626.25 µS/cm) and 699-25-34B (626.5 µS/cm) continued to exceed the critical mean of 598 µS/cm. Verification sampling is not necessary because these specific conductance values are consistent with the trends. Previous exceedances were attributed to non-hazardous constituents from the adjacent Solid Waste Landfill.⁴

³ Letter from MJ Furman (U.S. Department of Energy, Richland, Washington) to S Leja (Washington State Department of Ecology) and D Sherwood (U.S. Environmental Protection Agency), *Quarterly Resource Conservation and Recovery Act (RCRA) Groundwater (GW) Monitoring Data for the Period January 1, 1999, Through March 31, 1999*, dated August 4, 1999.

⁴ Letter 01-GWVZ-025 from JG Morse (U.S. Department of Energy, Richland, Washington) to J Hedges (Washington State Department of Ecology), *Results of Assessment at the Non-Radioactive Dangerous Waste Landfill (NRDWL)*, dated June 7, 2001.

3.0 Wells Not Sampled

Sampling of numerous wells was delayed past the end of the scheduled quarter, or in some cases, cancelled. The delay in sampling was due to the backlog of wells that developed in part from access limitations created by severe wild fire danger during the summer. Other factors causing sampling delays included availability of purge water trucks, limited staff to perform groundwater sampling, and vapor monitoring at each well prior to the sampling event. Additional sampling teams are working to eliminate the sampling backlog in fiscal year (FY) 2007.

This report does not include a table of wells not sampled as scheduled during the reporting quarter. The FY 2006 annual report (Hartman et al. 2007) includes sampling status for RCRA sites during FY 2006 in Appendix B.

4.0 Status of Assessment Programs

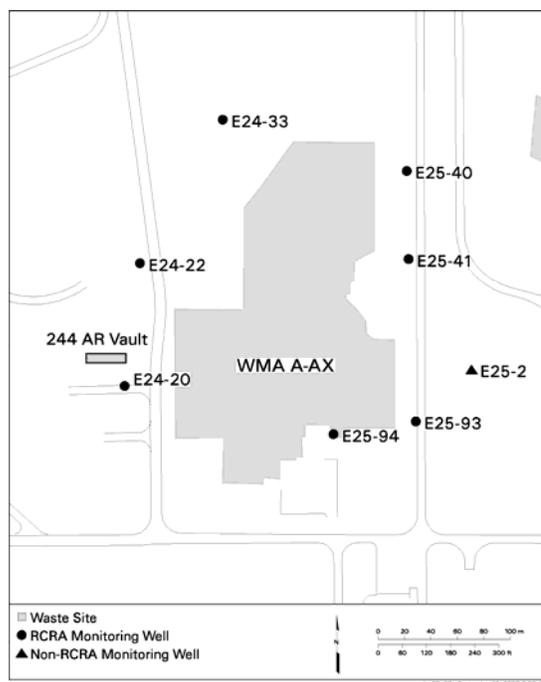
This section describes the eight RCRA sites currently monitored under groundwater quality assessment.

4.1 Single-Shell Tank Waste Management Area A-AX

The groundwater flow direction beneath this waste management area (WMA), based on local hydrographs and in situ flow measurements, is east southeast to southeast (Hartman et al. 2006). The aquifer thickness is ~27 meters, and although the water table has declined ~5 centimeters in the past year, there have been no observable changes in flow direction or rate this quarter.

Sampling of three wells (299-E24-33, 299-E25-41 and 299-E25-94) was delayed past the end of the reporting quarter (see Section 3.0). Results are available, so they are included in the following discussion.

The primary groundwater contaminants observed at this WMA are nitrate, sulfate and technetium-99. Nitrate concentrations were below the drinking water standard (45 mg/L) this quarter except in downgradient well 299-E25-93 where the value increased from 47.8 mg/L to 52.2 mg/L.



Technetium-99 results in September 2006 were similar to the previous quarter, varying from undetected in well 299-E25-40, east of the AX Tank Farm, to 6,320 pCi/L in well 299-E25-93, downgradient of the A Tank Farm. These values reflect a small decrease from last quarter's results. The concentration at well 299-E25-93 is much higher than other wells in the area. Concentrations in nearby wells were 299 pCi/L (299-E25-41, November 2006) and 600 pCi/L (299-E25-94, October 2006). Concentrations in upgradient well 299-E24-33 continued an increasing trend, from 697 pCi/L in June 2005 to 1,010 pCi/L in November 2006. Concentrations in this well have exceeded the drinking water standard (900 pCi/L) since March 2006. Perched water was found at depth during the installation of this well. The presence of the perched water along with elevated anion concentrations in the perched water suggests that water from or near the surface migrated to depth in the vicinity of the well. In addition, elevated coliform bacteria was observed in the groundwater at this well in 2005.

Sulfate concentrations are also elevated above background in groundwater beneath the site. Concentrations rose slightly between June and September in downgradient wells: from 70.2 mg/L to 73.1 mg/L in well 299-E25-2, and from 113 mg/L to 117 mg/L in well 299-E25-93. Values in other wells remained level, ranging from 55.9 mg/L in well 299-E25-40 to 61.3 mg/L in well 299-E24-22. With regional trends displaying increasing sulfate across the northern part of the 200 East Area, separating local effects from upgradient influences is difficult for this constituent.

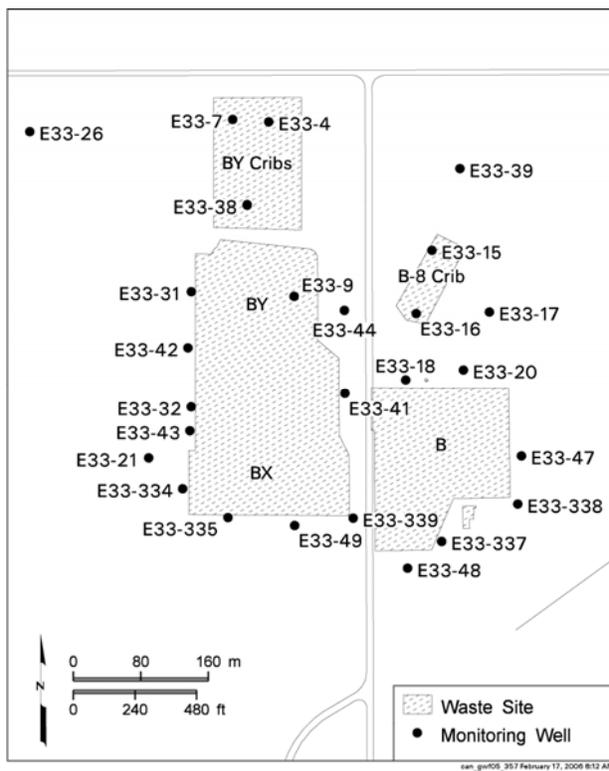
4.2 Single-Shell Tank Waste Management Area B-BX-BY

The aquifer is slowly receding back to pre-Hanford water levels along the basalt surface, which may leave the area under the BY cribs, the BY Tank Farm, most of the BX Tank Farm and possibly the north part of the B Tank Farm with no unconfined aquifer. There has been no change in flow direction or rate since the last quarterly report.

Wells 299-E33-26, 299-E33-39, and 299-E33-44 were not sampled during the reporting quarter (see Section 3.0). Sampling of well 299-E33-7 was delayed past the end of the reporting quarter (see Section 3.0) and results are not available for discussion in this report. Because well 299-E33-4, a supplemental well scheduled for sampling in May, was sampled late in July, the regularly scheduled August sampling was omitted. The well has very little water and was sampled with a peristaltic pump and bailer apparatus because it cannot be sampled with a conventional pump. A comparison of water levels with nearby wells and the lack of drawdown in the well after sampling indicate the well is in communication with the aquifer even though there is insufficient water to sample with a conventional pump.

Groundwater in this area is contaminated with nitrate, nitrite, sulfate, technetium-99, uranium, cyanide, tritium and cobalt-60. Contamination is attributed to several source areas, including WMA B-BX-BY and the surrounding cribs. Results for the past several years shows nitrate, sulfate, technetium-99, cyanide, uranium, and tritium concentrations increasing beneath the BY cribs and the BY Tank Farm.

A plume of uranium that likely had a source in the WMA extends northwest to beyond the 200 East Area northern boundary. In well 299-E33-26, uranium was at a concentration of 255 $\mu\text{g/L}$ in May 2006, the highest value to date in this well (no sample was collected in the reporting quarter). The uranium concentration was 338 $\mu\text{g/L}$ in August in well 299-E33-38, located in the south part of the BY cribs and north of BY Tank Farm. Concentrations in this well increased since monitoring began in 1991 but have been nearly stable since 2002. Uranium concentrations have increased sharply since 2004 in well 299-E33-31 located on the west side of the BY Tank Farm. The highest value in this well (202 $\mu\text{g/L}$) was reported in May 2006 and the result in the reporting quarter was 179 $\mu\text{g/L}$. Uranium increased from 49.3 $\mu\text{g/L}$ in May to 64.6 $\mu\text{g/L}$ in August in well 299-E33-42. Farther south in well 299-E33-32, the uranium concentration was 7.38 in August, part of an increasing trend. In well 299-E33-44, on the east side of the BY Tank Farm, uranium shows a decreasing trend (184 $\mu\text{g/L}$ in May 2006), while technetium-99 and nitrate are increasing sharply. The maximum uranium value at this location was 567 $\mu\text{g/L}$ in 2001.



North of the B Tank Farm, nitrate, sulfate, technetium-99, and uranium concentrations are increasing. However, the uranium center continues to be located under the BY Tank Farm in well 299-E33-9 (804 µg/L in June 2006). In addition, technetium-99, nitrate, and uranium concentrations are increasing along the south boundary of the WMA, with values of technetium-99 close to half the drinking water standard in one well. Nitrate, technetium-99, uranium, sulfate, and cyanide concentrations in the past year were the highest ever detected in this area since RCRA monitoring began in the early 1990s.

Nitrate concentrations increased beneath the BY cribs, ranging up to 3,150 mg/L (July 2006, well 299-E33-4) during the reporting quarter. In well 299-E33-38, nitrate concentration increased from 815 mg/L in May to 1,040 mg/L in August. Other areas have shown smaller increases or slight decreases since the last quarter. The May 2006 value at well 299-E33-16, located at the 216-B-8 cribs, was 881 mg/L while the August 2006 value was 792 mg/L. On the southwest side of the WMA, nitrate increased from 41.2 to 85.9 mg/L in well 299-E33-43. On the south side of the WMA, nitrate increased in most wells. For example, levels increased from 19.9 to 28.3 mg/L in well 299-E33-337 between May and August. On the southeast side, concentrations increased from 28.8 to 35.9 mg/L in well 299-E33-47 during the same period. No sources are known to the south that could explain these increases. However, the increasing values observed just to the north explain these increasing trends along the south side of the WMA.

Similar, increasing trends are observed for technetium-99 concentrations. Prior to recent sampling, the highest level observed in the region was 23,100 pCi/L in the BY cribs in November 2004 in well 299-E33-4. The most recent value for this well (July 2006) was 42,900 pCi/L, a new maximum for the area. During the reporting quarter, the concentrations in the BY cribs increased in well 299-E33-38 from 15,800 pCi/L to 22,000 pCi/L, a value similar to that seen several years before just to the north.

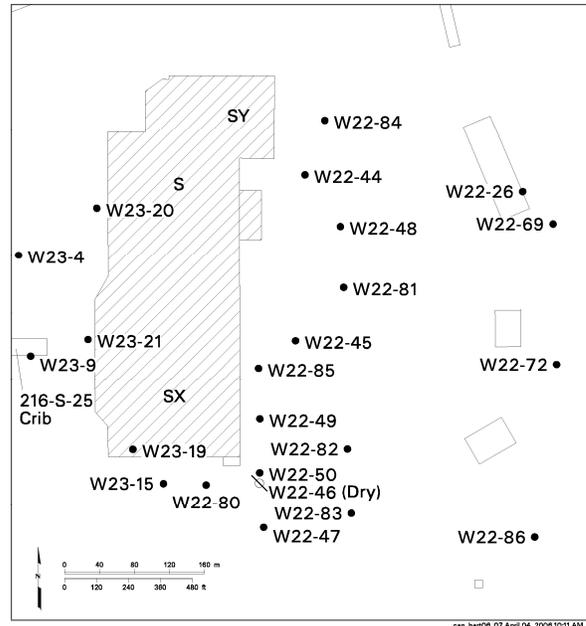
As with nitrate, technetium-99 concentrations decrease from north to south across the WMA. Technetium-99 values increased from 5,510 to 11,800 pCi/L in well 299-E33-16 and from 6,000 to 14,000 pCi/L in well 299-E33-18 since the previous quarter. On the southwest and south side of the WMA, technetium-99 concentrations increased in well 299-E33-43 from 222 pCi/L in May to 408 pCi/L in August and from 66.3 pCi/L to 419 pCi/L in well 299-E33-337.

In 2001, the center of the uranium plume was under and east of the BY Tank Farm in wells 299-E33-9 and 299-E33-44. However, in well 299-E33-44, uranium has been decreasing for several years while technetium-99, cyanide and nitrate levels increased overall. These are the signature contaminants found in the groundwater under the BY cribs to the north. Conversely, the current maximum uranium concentration is found under the BY Tank Farm, at 804 µg/L in well 299-E33-9. Farther south, at well 299-E33-18, uranium concentrations increased from the March 2006 value of 537 µg/L to 732 µg/L during the reporting quarter. Although at low levels, uranium continued to display increasing trends along the south boundary of the WMA, along with increasing nitrate and technetium-99.

4.3 Single-Shell Tank Waste Management Area S-SX

Groundwater beneath this site is contaminated with hexavalent chromium, nitrate, and technetium-99 attributed to two general source areas within the WMA. In addition, tritium and carbon tetrachloride are present in groundwater beneath the WMA, but their sources are from adjacent facilities.

Water-level measurements during the reporting quarter indicate that the water table has continued to decline at a rate between 0.2 and 0.3 meter per year. The gradient and flow direction are stable, with flow to the east-southeast over the general area of the WMA, based on water level and contaminant migration data. Only well 299-W23-19 was sampled as scheduled during the quarter (see Section 3.0). Sixteen of the remaining wells were sampled after the end of the reporting quarter (October and November) and wells 299-W22-84 and 299-W23-21 were not sampled. Results are available from the 17 wells sampled and are included in this report. Sampling scheduled for the fourth quarter of calendar year 2006 was conducted in December 2006 or January 2007 and results will be discussed in the next quarterly report.



Constituent concentrations in the north contaminant plume, with a source in S Tank Farm, changed significantly from the previous quarter. As shown in Figure 4.1 for well 299-W22-44 located on the north side of the plume, chromium, nitrate, and technetium-99 concentrations increased sharply from the previous quarter. Concentrations of the same constituents changed little in well 299-W22-48, located approximately 60 meters south of well 299-W22-44.

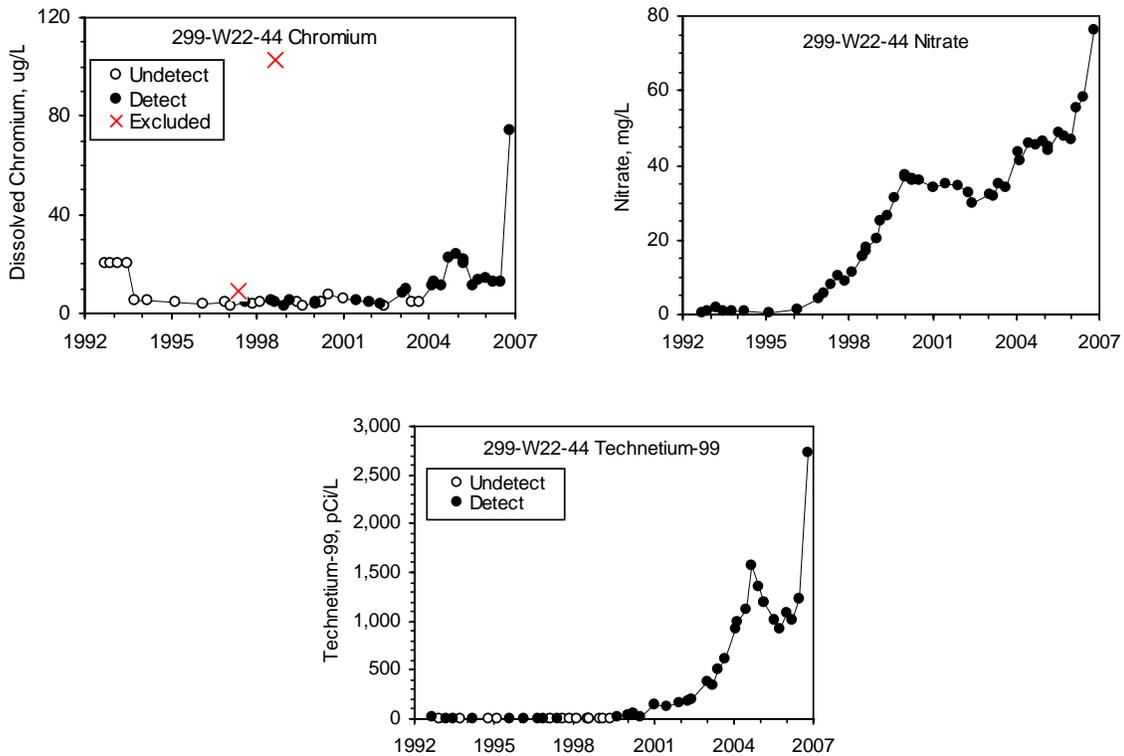


Figure 4.1. Contaminant Concentrations Downgradient of S Tank Farm: Dissolved (Filtered) Chromium, Nitrate, and Technetium-99

The turbidity in well 299-W22-48 remained high, 279 NTU, and all samples were filtered in the field. Concentrations of a number of the major groundwater constituents remained elevated above their usual trends. Hexavalent chromium, nitrate, and technetium-99 concentrations remained on trend and did not change as they did in well 299-W22-44.

In other wells, concentrations of the constituents of interest remained about the same as the previous quarter. Concentrations of chromium, nitrate, and technetium-99 remained above their respective drinking water standards in the source area and downgradient region as shown in Table 4.1. In the mid-plume region, as represented by well 299-W22-50, concentrations of the same three constituents remained at about the same level as in the April-June quarter, with nitrate and technetium-99 exceeding their drinking water standards. At this location in the plume, chromium is below its 100- $\mu\text{g/L}$ drinking water standard. At the far downgradient well 299-W22-86, concentrations of all three constituents of interest are lower, with only technetium-99 exceeding its drinking water standard.

Table 4.1. SX Tank Farm Plume Concentrations

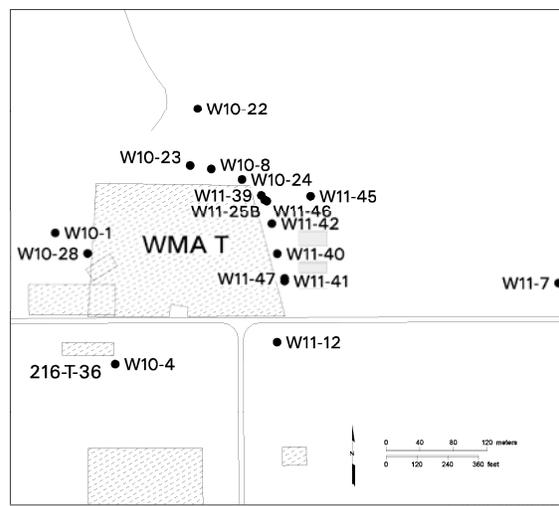
Constituent (units)	DWS	Location in the Plume			
		Source 299-W23-19 Sept. 2006	Mid-Plume 299-W22-50 Oct. 2006	Downgradient 299-W22-83 Oct. 2006	Far Downgradient 299-W22-86 Oct. 2006
Chromium ($\mu\text{g/L}$)	100	707	89.4	173	21.8
Nitrate (mg/L)	45	397	67.3	99.2	23.0
Technetium-99 (pCi/L)	900	43,200	6,600	13,800	2,250

DWS = drinking water standard

4.4 Single-Shell Tank Waste Management Area T

The monitoring network for WMA T includes fourteen wells that are sampled quarterly and two wells sampled semiannually. All wells in the monitoring network were sampled as scheduled during the reporting quarter. The groundwater flow direction at WMA T is between east-northeast and east-southeast at a rate of between ~ 0.017 and 0.28 meter per day.

Chromium, carbon tetrachloride, and trichloroethene continued to be the dangerous waste constituents found in the groundwater beneath WMA T. The source of the carbon tetrachloride and trichloroethene was liquid disposal associated with processes at the Plutonium Finishing Plant and not WMA T. Carbon tetrachloride and trichloroethene are monitored as part of the 200-ZP-1 Operable Unit. Nitrate and fluoride are also found in groundwater beneath the facility. In addition to the dangerous waste constituents, technetium-99, tritium, and cobalt-60, non-RCRA-regulated constituents, are found in groundwater at the WMA.



Chromium concentrations exceeded the drinking water standard (100 µg/L) in six wells during routine sampling at WMA T in August 2006. The plume exceeding the drinking water standard extends from the southwest corner of the WMA to the east and northeast of the WMA. The chromium concentration first exceeded the drinking water standard in upgradient well 299-W10-28 in February 2003 and peaked in May 2004 at 316 µg/L. Since that time, the concentration in the well has decreased and in August 2006 was less than the drinking water standard (89.8 µg/L).

As in the past, the highest chromium concentration was in well 299-W10-4, located south of the southwest corner of the WMA near the 216-T-36 crib. The concentration of chromium in the well was 489 µg/L, down from 565 µg/L during the previous quarter. The chromium concentration in this well has been decreasing since October 2004 when it peaked at 722 µg/L. The chromium concentrations exceeding the drinking water standard in downgradient water-table wells at WMA T were between 145 and 159 µg/L, similar to the previous quarter's concentrations.

The highest downgradient chromium concentration was in well 299-W11-46, located adjacent to well 299-W11-39 and screened between 6 and 12 meters below the water table. Here, the chromium concentration was 402 µg/L during the reporting period, up substantially from 293 µg/L during the previous quarter. This result and data from samples collected from well 299-W11-25B⁵ when it was drilled in early 2005 show that the highest downgradient chromium concentration at WMA T are at about 10 meters below the water table. The chromium plume extends at least 80 meters downgradient of the WMA to well 299-W11-45, screened between 8.5 and 13 meters below the water table, where the chromium concentration was 132 µg/L during the quarter.

There is a local, high nitrate plume beneath WMA T and within the regional 200 West Area plume centered southwest and west (upgradient) and extending east (downgradient) of the WMA. The nitrate concentrations remained above the 45-mg/L drinking water standard in all wells in the WMA T network during the reporting period and the local, high nitrate plume exceeds ten times the drinking water standard in both upgradient and downgradient wells along the south part of the WMA. The highest concentration of nitrate was in well 299-W10-4, where it increased from 2,870 mg/L during the previous quarter to 3,230 mg/L during the reporting period. The nitrate concentration in upgradient well 299-W10-28 increased from 1,820 mg/L during May 2006 to 2,740 mg/L in August 2006. This indicates an upgradient nitrate plume continues to migrate beneath the WMA.

Nitrate concentrations in downgradient monitoring wells during the reporting quarter remained fairly consistent or increased slightly from the previous quarter's concentrations. Concentrations in downgradient wells were between 226 and 1,080 mg/L. There does not appear to be any significant change from the previous quarter in the extent of the nitrate plume as indicated in water table wells at WMA T. The nitrate plume extends at least 80 meters downgradient of the WMA to well 299-W11-45 (screened between 8.5 and 13 meters below the water table) where the August concentration was 761 mg/L, an increase from the previous quarter.

A technetium-99 plume extends at least 80 meters downgradient of WMA T to well 299-W11-45, which had a technetium-99 concentration of 18,700 pCi/L in August 2006, down somewhat from 20,800 pCi/L during the previous quarter. The greatest technetium-99 concentration at the water table was 22,500 pCi/L in well 299-W11-39, located at the northern part of the downgradient (east) side of the

⁵ Drillers were unable to complete well 299-W11-25B successfully, and decommissioned the well in 2005.

WMA. The technetium-99 concentration in well 299-W11-46, located about 9 meters from well 299-W11-39 and screened between 6 and 12 meters below the water table, was 57,400 pCi/L in August 2006. The data from these two wells suggest that the highest technetium-99 concentrations at this location are about 10 meters below the water table.

The technetium-99 plume extends at least as far south as well 299-W11-41 along the east side of the WMA where the August concentration was 7,110 pCi/L. The technetium-99 concentration in adjacent well 299-W11-47, screened between 9.1 and 18 meters below the water table was 3,370 pCi/L. Whereas the data from the northern well pair 299-W11-39 and 299-W11-46 indicate highest technetium-99 concentrations at some depth below the water table at the northern part of the east side of the WMA, the data from well pair 299-W11-41 and 299-W11-47 suggest that the maximum concentrations are near the water table at the south part of the east side of the WMA.

The fluoride concentration exceeded the secondary drinking water standard of 2 mg/L in 12 wells at WMA T in August 2006. The highest fluoride concentration was 3.7 mg/L in well 299-W10-23, north of the WMA. The fluoride plume at WMA T extends from wells located southwest to north to east of the WMA. The configuration of the plume has not changed appreciably during the quarter.

Tritium exceeded the drinking water standard of 20,000 pCi/L in well 299-W11-12, located at the southeast corner of the WMA. The concentration was 40,400 pCi/L, unchanged from the previous quarter. The tritium concentration has been slowly decreasing in this well since late 1998.

In addition to the above contaminants, manganese and pH exceeded limits during the quarter, and cobalt-60 was detected. The manganese concentration was 86 µg/L in well 299-W11-39, above the secondary drinking water standard of 50 µg/L. The manganese concentration increased abruptly in late 2005 from 22 to 110 µg/L (filtered samples) and has decreased gradually since that time. Manganese concentration also exceeded the secondary standard in well 299-W11-47 (208 pCi/L). This is a new well and the manganese concentration is thought to be a result of drilling and to not represent the ambient manganese concentration in the aquifer. The pH exceeded the drinking water standard (8.5) in well 299-W10-24 (8.8). pH values between 8.5 and 9.1 have been common in the well throughout its sampling history. Finally, cobalt-60 was detected in well 299-W11-46 at 22 pCi/L during August 2006, well below the drinking water standard of 100 pCi/L. This is the third consecutive quarter that cobalt-60 has been detected in the well.

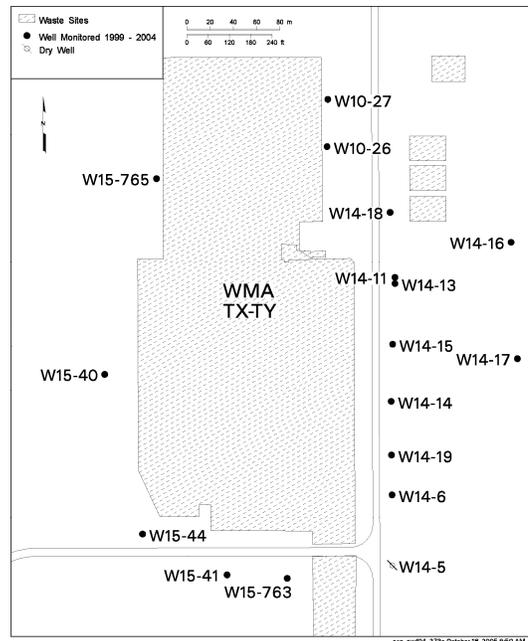
4.5 Waste Management Area TX-TY

The monitoring network for WMA TX-TY includes sixteen wells that are sampled quarterly. All upgradient wells for the WMA were converted to extraction wells for the 200-ZP-1 pump-and-treat system in July 2005. Groundwater flow direction varies beneath the WMA due to influences from the pump-and-treat operation. In the north part of the WMA, groundwater flow is changing from an eastward to a westward direction due to recently converted extraction wells. Although this change is not yet shown by the latest water-table map, it is inferred from increasing contaminant concentrations in the wells since July 2005.

All monitoring wells in the WMA TX-TY monitoring network were successfully sampled during the reporting period.

Chromium, carbon tetrachloride, nitrate, and trichloroethene continued to be the dangerous waste constituents detected in the groundwater beneath WMA TX-TY. The source of the carbon tetrachloride and trichloroethene was liquid disposal associated with processes at the Plutonium Finishing Plant and not WMA TX-TY. Carbon tetrachloride and trichloroethene are monitored as part of the 200-ZP-1 Operable Unit. In addition to the dangerous waste constituents, iodine-129, technetium-99, and tritium, non-RCRA-regulated constituents, are found in groundwater at the WMA.

Chromium concentration exceeded the 100- $\mu\text{g/L}$ drinking water standard in two wells during the reporting period. The chromium plume is restricted to the vicinity of well 299-W14-13 and adjacent well 299-W14-11, located at the central part of the east (downgradient) side of the WMA. The chromium concentration has not exceeded the drinking water standard in wells located north, south, or east of this area. The highest chromium concentration was in well 299-W14-13 (726 $\mu\text{g/L}$); adjacent well 299-W14-11, screened between 6.7 and 9.8 meters below the water table, had 139 $\mu\text{g/L}$ chromium in August 2006.



Nitrate continued to exceed the 45-mg/L drinking water standard in all wells in the WMA TX-TY monitoring network during the reporting period. The highest nitrate concentration was 465 mg/L in well 299-W14-13 at the east side of the WMA. This was down somewhat from the previous quarter's concentration of 500 mg/L. The nitrate concentration increased dramatically during the past year at well 299-W10-27, the northernmost downgradient well at the WMA. The nitrate concentration increased from 153 mg/L in November 2005 to 433 mg/L in August 2006. The increase in nitrate is accompanied by increases in calcium, magnesium, and chromium. The reason for the increases is not known but may be related to changes in flow direction caused by the conversion of upgradient monitoring wells to 200-ZP-1 extraction wells. More information is needed before making a definite connection. The regional nitrate plume at WMA TX-TY is attributed to past disposal practices throughout the 200 West Area. The relatively local high nitrate concentration east of WMA TX-TY may be due to one or a combination of nearby liquid disposal facilities and/or the WMA.

Nitrate and technetium-99 concentrations in upgradient wells 299-W15-765 and 299-W15-40 began to increase abruptly in September 2005, shortly after the wells were converted to extraction wells for the 200-ZP-1 pump-and-treat operation in July 2005. Figure 4.2 shows nitrate in well 299-W15-765 as an example. The increases are attributed to contaminants being drawn to the wells from beneath the WMA.

Technetium-99 concentrations exceeded the 900-pCi/L drinking water standard in six wells at WMA TX-TY during the reporting period. The highest concentration was 7,850 pCi/L in well 299-W14-13. The technetium-99 concentration in adjacent well 299-W14-11, screened between 6.7 and 9.8 meters below the water table, was 3,160 pCi/L. These concentrations are slightly higher than those measured during the previous quarter. The technetium-99 plume found east of the WMA was restricted to the area of the two wells during the reporting period.

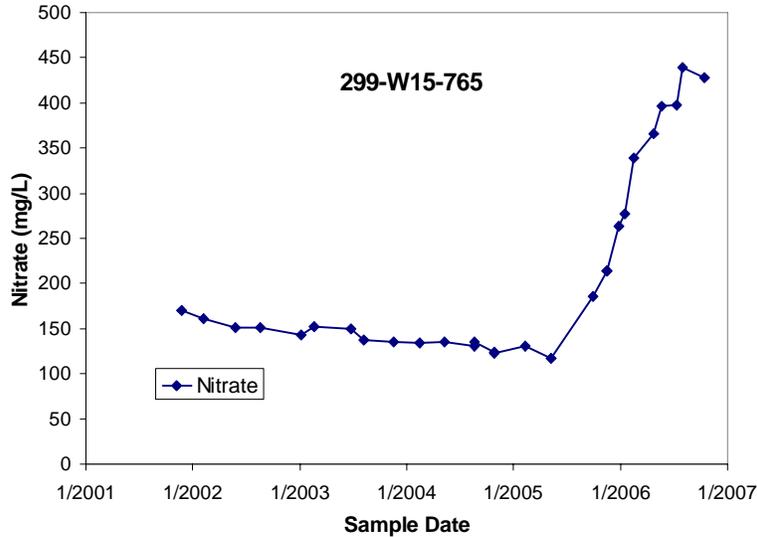


Figure 4.2. Nitrate Concentration in Extraction Well 299-W15-765, West of WMA TX-TY

Technetium-99 concentrations also exceeded the drinking water standard in wells 299-W15-41, 299-W15-44, 299-W15-763, and 299-W15-765 (Figure 4.3). All of these wells are affected by the 200-ZP-1 pump-and-treat system, and the technetium-99 found in these wells probably is drawn toward the wells due to extraction operations (wells 299-W15-44 and 299-W15-765 are extraction wells). Technetium-99 has also been increasing in the third converted upgradient well (extraction 299-W15-40), but the levels are much lower (120 pCi/L).

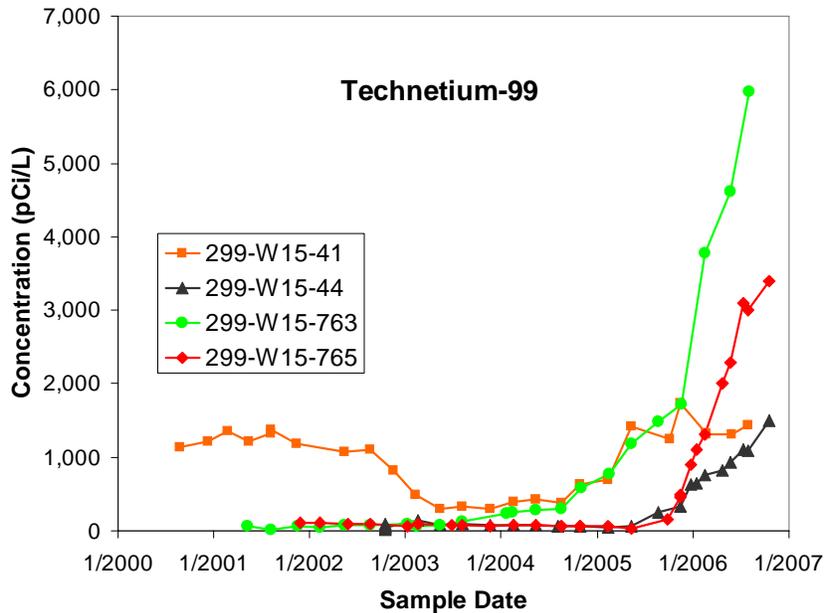


Figure 4.3. Technetium-99 Concentration in Wells Affected by the 200-ZP-1 Pump-and-Treat at WMA TX-TY. Wells 299-W15-44 and 299-W15-765 were converted to extraction wells in July 2005.

Tritium exceeded the 20,000-pCi/L drinking water standard in three wells during the reporting period at WMA TX-TY. The highest tritium concentration was 1,680,000 pCi/L in well 299-W14-13, essentially unchanged from the previous quarter. The tritium concentration in adjacent, deeper well 299-W14-11 was 346,000 pCi/L, up substantially from 247,000 pCi/L during the previous quarter. Tritium also exceeded the drinking water concentration in well 299-W14-15 (44,900 pCi/L), located south of the well pair 299-W14-13 and 299-W14-11.

Manganese exceeded the 50 µg/L secondary drinking water standard in well 299-W10-27 in August 2006 with a concentration of 171 µg/L. This well has had a history of high manganese concentrations since it was drilled in 2001.

Iodine-129 exceeded the 1 pCi/L drinking water standard in wells 299-W14-13 and 299-W14-11 in August 2006. The concentration of iodine-129 in well 299-W14-13 was 42.7 pCi/L. Iodine-129 concentration has been increasing in this well since November 2005 (Figure 4.4). Iodine-129 was also detected in deeper, adjacent well 299-W14-11 for the first time in a routine sample, at 10.5 and 9.68 pCi/L in duplicates.

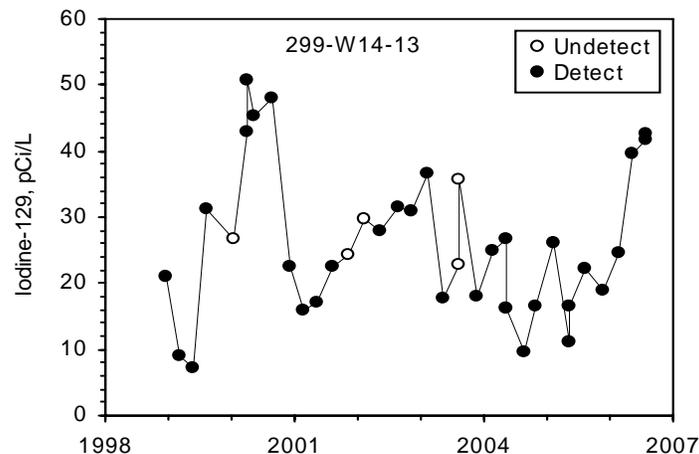


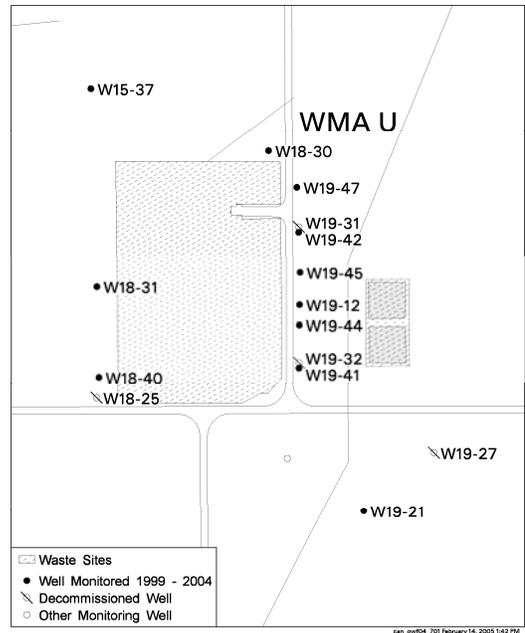
Figure 4.4. Iodine-129 Concentration in Well 299-W14-13, East of WMA TX-TY

4.6 Single-Shell Tank Waste Management Area U

This WMA, which has been in assessment monitoring since 1999, has affected groundwater quality with elevated concentrations of chromium, nitrate, and technetium-99. In the past, contamination was limited to the south half of the downgradient (east) side of the WMA, but in the last half of 2004, technetium-99 concentrations began to rise rapidly in several of the downgradient wells in the north half of the WMA. Carbon tetrachloride also is present beneath the WMA at concentrations above the drinking water standard; the only well analyzed for carbon tetrachloride during the quarter, 299-W19-30, had a concentration of 170 µg/L. The carbon tetrachloride is associated with the regional plume with sources upgradient of the WMA. All wells in the monitoring network were sampled as scheduled during the reporting quarter.

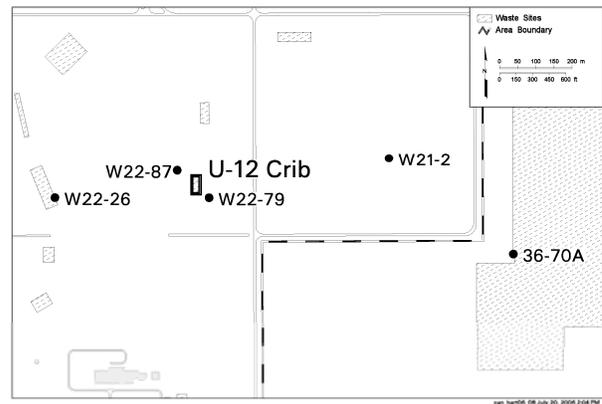
Water-level measurements indicate that the water table has continued to decline at a rate of about 0.3 meter per year. All of the wells responded similarly so the gradient and flow direction as determined from water levels are stable, with the interpreted flow direction to the east at a rate of 0.008 to 0.2 meter per day.

While chromium has exceeded the 100- $\mu\text{g/L}$ drinking water standard in the past, concentrations have been below 10 $\mu\text{g/L}$ for the past year. Technetium-99 and nitrate trends remained similar to those reported previously. These constituents are present beneath the WMA from three sources: a nitrate source and a technetium-99 source within the WMA and a nitrate source upgradient (west) of the WMA. The highest nitrate concentrations and the only two that exceeded the 45-mg/L drinking water standard were in wells 299-W19-41 (73 mg/L) and 299-W19-44 (109 mg/L). The highest technetium-99 concentration was 1,300 pCi/L in well 299-W19-47. The 900 pCi/L technetium-99 drinking water standard was exceeded in two wells, 299-W19-45, and 299-W19-47, located on the north half of the downgradient margin of the WMA. The concentration was barely below the standard, 899 pCi/L, in well 199-W19-42, part of an increasing trend. These results suggest that the technetium-99 plume is still migrating to the northern wells and the nitrate plume is still migrating to the southern wells on the downgradient side of the WMA.



4.7 216-U-12 Crib

The groundwater monitoring network currently consists of one upgradient and three downgradient upper aquifer monitoring wells (Williams and Chou 2006). The site is undergoing assessment for elevated specific conductance, and nitrate and is sampled quarterly. Sampling was delayed at all the network wells; only well 699-36-70A was sampled during September. The other three wells were sampled in October and November (see Section 3.0). The results are available and are included in the following discussion.



In May 2005, DOE requested that the 216-U-12 crib be administratively closed. Two draft Tri-Party Agreement (Ecology et al. 1989) change requests to reclassify the crib as a past-practice unit are currently being reviewed. If this decision is approved, RCRA groundwater monitoring will be discontinued at the time the RCRA Part A Permit Application is closed out. The groundwater in the vicinity of the crib would continue to be monitored as part of the CERCLA 200-UP-1 Operable Unit.

Based on data from a regional network of wells, the groundwater flow direction beneath the crib has remained relatively unchanged, toward the east-southeast for years. Water levels continued to decline around the 216-U-12 crib but the rate of decline appears to be decreasing. The rate of decline is ~0.13 meter per year.

In downgradient well 299-W22-79, nitrate concentration decreased slightly in September from June and remained on a declining trend well below the drinking water standard. Specific conductance was measured at 285 μ S/cm, essentially flat, and nitrate was measured at ~26.1 mg/L.

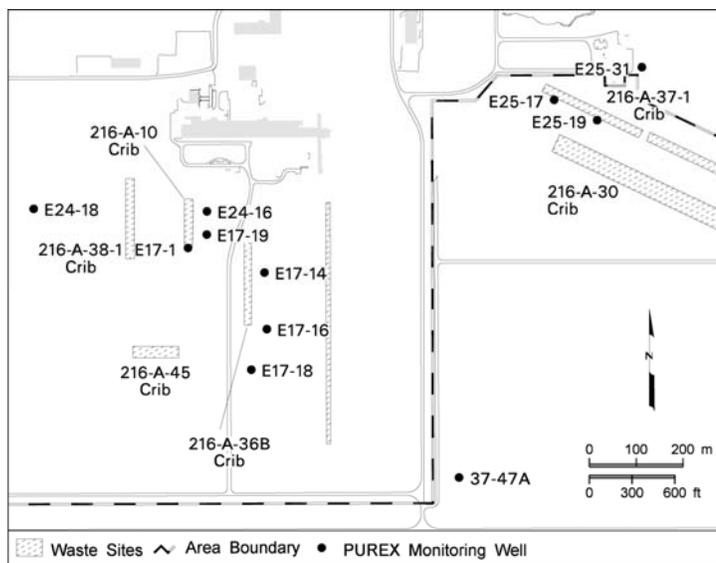
Nitrate concentrations in downgradient well 699-36-70A, the farthest well from the 216-U-12 crib, decreased slightly to about 58.3 mg/L in September, continuing a decreasing trend.

For downgradient well 299-W21-2, nitrate continued a downward trend at 58 mg/L, yet remained above the drinking water standard. This well is located about midway between the 216-U-12 crib and well 699-36-70A, and the regional plume maps suggest that the highest concentrations of the commingled nitrate plume have passed through this area and continue to spread downgradient of this well.

Nitrate and specific conductance concentrations in the upgradient well, 299-W22-87 (sampled October 2006), were 2.2 mg/L and 222 μ S/cm, respectively. Both constituents are essentially the same as reported during June. There are insufficient data to define trends in this new well.

4.8 PUREX Cribs (216-A-10, 216-A-36B, and 216-A-37-1)

Three of the near-field network wells (one well near each of the three cribs) were sampled as scheduled during the reporting quarter. PUREX cribs network wells are sampled quarterly as required by 40 CFR 265.93 (d)(7)(i) to determine if there are any changing contaminant conditions near the three PUREX cribs. Water levels were measured at each well at the time of sampling. Nitrate was the only dangerous waste constituent in groundwater that continued to exceed its drinking water standard (45 mg/L) in one or more of the wells sampled. Radioactive constituents (not regulated under RCRA) that continued to exceed drinking water standards included iodine-129, strontium-90, gross beta, and tritium.



Differences in water-table elevations from well to well at the PUREX cribs are very small because of the extremely low gradient of the water table. During the reporting period, the greatest water-level difference between wells was 0.081 meter over the distance from well 299-E24-16 to 299-E25-19 (a distance of about 850 meters). The gradient between these two wells is 0.0001, which is too low to

determine groundwater flow rate or flow direction reliably. However, groundwater flow directions determined from the movement of groundwater contamination plumes indicate that the regional flow is toward the southeast.

Nitrate was reported at levels greater than the drinking water standard at the wells monitoring the 216-A-36B and 216-A-10 cribs. The highest concentration during the reporting period was 127 mg/L at well 299-E17-14, located near the 216-A-36B crib. The trend at this well is generally stable. Another well at the 216-A-10 crib (299-E24-16) has an increasing trend for nitrate (Figure 4.5).

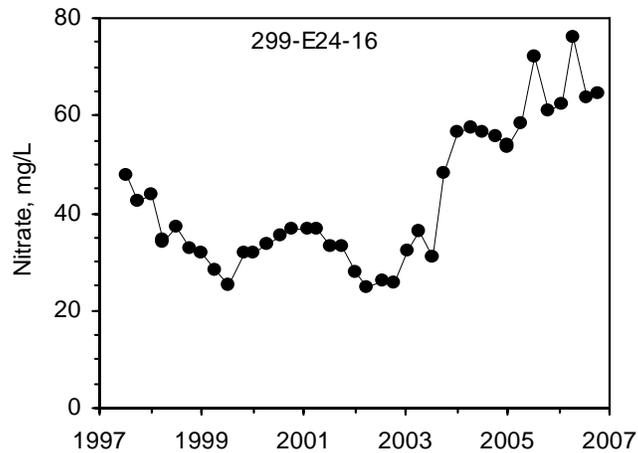


Figure 4.5. Nitrate Concentrations in Well 299-E24-16 Near the 216-A-10 Crib

5.0 Quality Control

Highlights of the groundwater project's quality control (QC) program for July-September 2006 are summarized in the following list. Appendix B contains more specific QC information. Data related to QC issues have been flagged in the database or are undergoing further review.

- Ninety-nine results were flagged with an H due to missed holding times. Nitrite, nitrate, total organic carbon, and total organic halides account for the majority of the flagged results.
- Most of the field duplicate results demonstrated good precision, although the relative percent differences for four pairs of results failed to meet the acceptance criteria. Alkalinity, nitrogen in nitrate, potassium, and gross beta were the constituents with out-of-limit results.
- Approximately 4% of the field blank results exceeded the QC limits. Methylene chloride, chloride, and carbon tetrachloride had the greatest number of out-of-limit results. Overall, the field blank results should have little impact on the interpretation of July-September groundwater data.
- Laboratory performance on the analysis of blind standards was good overall. Severn Trent Laboratories, Incorporated, St. Louis, Missouri (STL St. Louis) had two unacceptable results for total organic halides. Severn Trent Laboratories, Incorporated, Richland, Washington (STL Richland) had three out-of-limit results for tritium.
- Overall, 84% of the results from a volatiles interlaboratory comparison study were acceptable. Analyses were performed by STL St. Louis, an on-site mobile laboratory, and the Waste Sample Characterization Facility.
- Performance-evaluation study results were available from one MAPEP study, one RadChem Proficiency Testing Study and one QuiK Response (Water Pollution) study this quarter. The majority of the labs' results were within the acceptance limits, indicating good performance overall.
- Approximately 95% of the laboratory QC results for this quarter were within the acceptance limits, suggesting that most of the analyses were in control and reliable data were generated.

6.0 References

40 CFR 265.93(b) and (d). “Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities; Preparation, Evaluation, and Response.” U.S. Environmental Protection Agency, *Code of Federal Regulations*.

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Appendix A

Groundwater Data for Waste Management Area C July to September 2006

Appendix A

Groundwater Data for Waste Management Area C July to September 2006

Well Name	Sample Date	Filtered	Constituent	Result	Units	Lab Qualifier	Review Qualifier
299-E27-12	10/24/2006	N	Specific Conductance	367	uS/cm		
299-E27-12	10/24/2006	N	Temperature	18.1	Deg C		
299-E27-12	10/24/2006	N	Turbidity	0.79	NTU		
299-E27-12	10/24/2006	N	Nitrate	9300	ug/L	CDN	
299-E27-12	10/24/2006	N	Chloride	11000	ug/L	DN	
299-E27-12	10/24/2006	N	Sulfate	48200	ug/L	D	
299-E27-12	10/24/2006	N	Fluoride	210	ug/L	N	
299-E27-12	10/24/2006	N	Nitrite	13.1	ug/L	UN	
299-E27-12	10/24/2006	N	Alkalinity	97000	ug/L		
299-E27-12	10/24/2006	Y	Potassium	5320	ug/L		
299-E27-12	10/24/2006	Y	Vanadium	18.9	ug/L	B	
299-E27-12	10/24/2006	Y	Antimony	44.8	ug/L	U	
299-E27-12	10/24/2006	Y	Manganese	3.6	ug/L	B	
299-E27-12	10/24/2006	Y	Calcium	46700	ug/L	CN	
299-E27-12	10/24/2006	Y	Cobalt	5	ug/L	U	
299-E27-12	10/24/2006	Y	Barium	39	ug/L	B	
299-E27-12	10/24/2006	Y	Sodium	12500	ug/L		
299-E27-12	10/24/2006	Y	Chromium	3.1	ug/L	U	
299-E27-12	10/24/2006	Y	Cadmium	2.3	ug/L	U	
299-E27-12	10/24/2006	Y	Silver	5.2	ug/L	U	
299-E27-12	10/24/2006	Y	Beryllium	0.51	ug/L	U	
299-E27-12	10/24/2006	Y	Magnesium	14100	ug/L		
299-E27-12	10/24/2006	Y	Zinc	16.2	ug/L	B	
299-E27-12	10/24/2006	Y	Nickel	7.5	ug/L	U	
299-E27-12	10/24/2006	Y	Strontium	248	ug/L		
299-E27-12	10/24/2006	Y	Copper	2.8	ug/L	U	
299-E27-12	10/24/2006	Y	Iron	25	ug/L	U	
299-E27-12	10/24/2006	N	Cyanide	2.4	ug/L	U	
299-E27-12	10/24/2006	N	Gross beta	42.5	pCi/L		
299-E27-12	10/24/2006	N	Europium-152	-1.79	pCi/L	U	
299-E27-12	10/24/2006	N	Ruthenium-106	0.489	pCi/L	U	
299-E27-12	10/24/2006	N	Cobalt-60	-0.35	pCi/L	U	
299-E27-12	10/24/2006	N	Potassium-40	-8.82	pCi/L	U	
299-E27-12	10/24/2006	N	Cesium-137	1.16	pCi/L	U	
299-E27-12	10/24/2006	N	Antimony-125	0.68	pCi/L	U	
299-E27-12	10/24/2006	N	Europium-154	-1.39	pCi/L	U	
299-E27-12	10/24/2006	N	Beryllium-7	-15.4	pCi/L	U	
299-E27-12	10/24/2006	N	Europium-155	2	pCi/L	U	
299-E27-12	10/24/2006	N	Cesium-134	-0.0093	pCi/L	U	

Well Name	Sample Date	Filtered	Constituent	Result	Units	Lab Qualifier	Review Qualifier
299-E27-12	10/24/2006	N	pH Measurement	8.22	pH		
299-E27-12	10/24/2006	N	Technetium-99	138	pCi/L		
299-E27-12	10/24/2006	N	Uranium	3.05	ug/L		
299-E27-13	9/28/2006	N	Specific Conductance	385	uS/cm		
299-E27-13	9/28/2006	N	Temperature	18.6	Deg C		
299-E27-13	9/28/2006	N	Turbidity	5.23	NTU		
299-E27-13	9/28/2006	N	Nitrate	16400	ug/L	D	
299-E27-13	9/28/2006	N	Chloride	13900	ug/L	CDN	
299-E27-13	9/28/2006	N	Nitrite	65.7	ug/L	N	F
299-E27-13	9/28/2006	N	Fluoride	260	ug/L		
299-E27-13	9/28/2006	N	Sulfate	69700	ug/L	D	
299-E27-13	9/28/2006	N	Alkalinity	88000	ug/L		
299-E27-13	9/28/2006	Y	Potassium	6850	ug/L		
299-E27-13	9/28/2006	Y	Iron	25	ug/L	U	
299-E27-13	9/28/2006	Y	Copper	2.8	ug/L	U	
299-E27-13	9/28/2006	Y	Strontium	197	ug/L		
299-E27-13	9/28/2006	Y	Nickel	7.5	ug/L	U	
299-E27-13	9/28/2006	Y	Zinc	9.6	ug/L	U	
299-E27-13	9/28/2006	Y	Manganese	2.5	ug/L	U	
299-E27-13	9/28/2006	Y	Calcium	38800	ug/L	C	
299-E27-13	9/28/2006	Y	Cobalt	5	ug/L	U	
299-E27-13	9/28/2006	Y	Barium	25.8	ug/L	B	
299-E27-13	9/28/2006	Y	Sodium	12500	ug/L		
299-E27-13	9/28/2006	Y	Chromium	4.2	ug/L	B	
299-E27-13	9/28/2006	Y	Cadmium	2.3	ug/L	U	
299-E27-13	9/28/2006	Y	Silver	5.2	ug/L	U	
299-E27-13	9/28/2006	Y	Antimony	44.8	ug/L	U	
299-E27-13	9/28/2006	Y	Beryllium	0.51	ug/L	U	
299-E27-13	9/28/2006	Y	Vanadium	18.4	ug/L	B	
299-E27-13	9/28/2006	Y	Magnesium	11300	ug/L		
299-E27-13	9/28/2006	N	Cyanide	2.4	ug/L	U	
299-E27-13	9/28/2006	N	Gross beta	504	pCi/L		
299-E27-13	9/28/2006	N	Europium-152	1.11	pCi/L	U	
299-E27-13	9/28/2006	N	Cesium-134	2.85	pCi/L	U	
299-E27-13	9/28/2006	N	Cobalt-60	-1.03	pCi/L	U	
299-E27-13	9/28/2006	N	Europium-154	0.538	pCi/L	U	
299-E27-13	9/28/2006	N	Europium-155	-0.813	pCi/L	U	
299-E27-13	9/28/2006	N	Beryllium-7	20.9	pCi/L	U	
299-E27-13	9/28/2006	N	Antimony-125	-0.446	pCi/L	U	
299-E27-13	9/28/2006	N	Cesium-137	-0.812	pCi/L	U	
299-E27-13	9/28/2006	N	Potassium-40	-40.7	pCi/L	U	
299-E27-13	9/28/2006	N	Ruthenium-106	-6.11	pCi/L	U	
299-E27-13	9/28/2006	N	pH Measurement	8.54	pH		
299-E27-13	9/28/2006	N	Technetium-99	2540	pCi/L		
299-E27-13	9/28/2006	N	Uranium	2.19	ug/L		

Well Name	Sample Date	Filtered	Constituent	Result	Units	Lab Qualifier	Review Qualifier
299-E27-14	9/28/2006	N	Specific Conductance	883	uS/cm		
299-E27-14	9/28/2006	N	Temperature	19	Deg C		
299-E27-14	9/28/2006	N	Turbidity	1.19	NTU		
299-E27-14	9/28/2006	N	Nitrate	77500	ug/L	D	
299-E27-14	9/28/2006	N	Chloride	41200	ug/L	CDN	
299-E27-14	9/28/2006	N	Fluoride	230	ug/L		
299-E27-14	9/28/2006	N	Sulfate	244000	ug/L	D	
299-E27-14	9/28/2006	N	Nitrite	6240	ug/L	DN	F
299-E27-14	9/28/2006	N	Alkalinity	80000	ug/L		
299-E27-14	9/28/2006	Y	Potassium	11200	ug/L		
299-E27-14	9/28/2006	Y	Beryllium	0.51	ug/L	U	
299-E27-14	9/28/2006	Y	Manganese	2.5	ug/L	U	
299-E27-14	9/28/2006	Y	Calcium	101000	ug/L	C	
299-E27-14	9/28/2006	Y	Cobalt	5	ug/L	U	
299-E27-14	9/28/2006	Y	Barium	69.1	ug/L	B	
299-E27-14	9/28/2006	Y	Sodium	24700	ug/L		
299-E27-14	9/28/2006	Y	Chromium	4.3	ug/L	B	
299-E27-14	9/28/2006	Y	Cadmium	2.3	ug/L	U	
299-E27-14	9/28/2006	Y	Silver	5.2	ug/L	U	
299-E27-14	9/28/2006	Y	Antimony	44.8	ug/L	U	
299-E27-14	9/28/2006	Y	Vanadium	15.5	ug/L	B	
299-E27-14	9/28/2006	Y	Zinc	9.6	ug/L	U	
299-E27-14	9/28/2006	Y	Magnesium	29600	ug/L		
299-E27-14	9/28/2006	Y	Strontium	486	ug/L		
299-E27-14	9/28/2006	Y	Copper	2.8	ug/L	U	
299-E27-14	9/28/2006	Y	Nickel	10.9	ug/L	B	
299-E27-14	9/28/2006	Y	Iron	25	ug/L	U	
299-E27-14	9/28/2006	N	Cyanide	2.4	ug/L	U	
299-E27-14	9/28/2006	N	Gross beta	604	pCi/L		
299-E27-14	9/28/2006	N	Europium-152	-0.889	pCi/L	U	
299-E27-14	9/28/2006	N	Ruthenium-106	2.44	pCi/L	U	
299-E27-14	9/28/2006	N	Cobalt-60	1.52	pCi/L	U	
299-E27-14	9/28/2006	N	Potassium-40	-2.88	pCi/L	U	
299-E27-14	9/28/2006	N	Cesium-137	0.816	pCi/L	U	
299-E27-14	9/28/2006	N	Antimony-125	-0.8	pCi/L	U	
299-E27-14	9/28/2006	N	Europium-154	3.36	pCi/L	U	
299-E27-14	9/28/2006	N	Beryllium-7	1.83	pCi/L	U	
299-E27-14	9/28/2006	N	Europium-155	1.5	pCi/L	U	
299-E27-14	9/28/2006	N	Cesium-134	-0.173	pCi/L	U	
299-E27-14	9/28/2006	N	pH Measurement	8.1	pH		
299-E27-14	9/28/2006	N	Technetium-99	2460	pCi/L		
299-E27-14	9/28/2006	N	Uranium	2.64	ug/L		
299-E27-15	10/24/2006	N	Specific Conductance	447	uS/cm		
299-E27-15	10/24/2006	N	Temperature	18.4	Deg C		
299-E27-15	10/24/2006	N	Turbidity	0.61	NTU		

Well Name	Sample Date	Filtered	Constituent	Result	Units	Lab Qualifier	Review Qualifier
299-E27-15	10/24/2006	N	Nitrate	18100	ug/L	CDN	
299-E27-15	10/24/2006	N	Chloride	18100	ug/L	DN	
299-E27-15	10/24/2006	N	Nitrite	13.1	ug/L	UN	
299-E27-15	10/24/2006	N	Fluoride	200	ug/L	N	
299-E27-15	10/24/2006	N	Sulfate	84700	ug/L	D	
299-E27-15	10/24/2006	N	Alkalinity	88000	ug/L		
299-E27-15	10/24/2006	Y	Potassium	5740	ug/L		
299-E27-15	10/24/2006	Y	Copper	2.8	ug/L	U	
299-E27-15	10/24/2006	Y	Nickel	8.7	ug/L	B	
299-E27-15	10/24/2006	Y	Beryllium	0.51	ug/L	U	
299-E27-15	10/24/2006	Y	Silver	5.2	ug/L	U	
299-E27-15	10/24/2006	Y	Manganese	11.9	ug/L	B	
299-E27-15	10/24/2006	Y	Calcium	51300	ug/L	CN	
299-E27-15	10/24/2006	Y	Cobalt	5.2	ug/L	B	
299-E27-15	10/24/2006	Y	Barium	46.6	ug/L	B	
299-E27-15	10/24/2006	Y	Sodium	17000	ug/L		
299-E27-15	10/24/2006	Y	Chromium	3.1	ug/L	U	
299-E27-15	10/24/2006	Y	Cadmium	2.3	ug/L	U	
299-E27-15	10/24/2006	Y	Antimony	44.8	ug/L	U	
299-E27-15	10/24/2006	Y	Vanadium	19	ug/L	B	
299-E27-15	10/24/2006	Y	Zinc	9.6	ug/L	U	
299-E27-15	10/24/2006	Y	Magnesium	18700	ug/L		
299-E27-15	10/24/2006	Y	Strontium	331	ug/L		
299-E27-15	10/24/2006	Y	Iron	25	ug/L	U	
299-E27-15	10/24/2006	N	Cyanide	2.4	ug/L	U	
299-E27-15	10/24/2006	N	Gross beta	48	pCi/L		
299-E27-15	10/24/2006	N	Europium-152	1.67	pCi/L	U	
299-E27-15	10/24/2006	N	Ruthenium-106	-14.7	pCi/L	U	
299-E27-15	10/24/2006	N	Cobalt-60	-0.853	pCi/L	U	
299-E27-15	10/24/2006	N	Potassium-40	21.4	pCi/L	U	
299-E27-15	10/24/2006	N	Cesium-137	0.863	pCi/L	U	
299-E27-15	10/24/2006	N	Antimony-125	-4.33	pCi/L	U	
299-E27-15	10/24/2006	N	Europium-154	-0.171	pCi/L	U	
299-E27-15	10/24/2006	N	Beryllium-7	-8.45	pCi/L	U	
299-E27-15	10/24/2006	N	Europium-155	-2.9	pCi/L	U	
299-E27-15	10/24/2006	N	Cesium-134	0.238	pCi/L	U	
299-E27-15	10/24/2006	N	pH Measurement	8.32	pH		
299-E27-15	10/24/2006	N	Technetium-99	160	pCi/L		
299-E27-15	10/24/2006	N	Uranium	2.98	ug/L		
299-E27-21	9/29/2006	N	Specific Conductance	402	uS/cm		
299-E27-21	9/29/2006	N	Temperature	18.8	Deg C		
299-E27-21	9/29/2006	N	Turbidity	0.9	NTU		
299-E27-21	9/29/2006	N	Nitrate	21200	ug/L	DN	
299-E27-21	9/29/2006	N	Nitrite	1350	ug/L	N	F
299-E27-21	9/29/2006	N	Chloride	10200	ug/L	CDN	

Well Name	Sample Date	Filtered	Constituent	Result	Units	Lab Qualifier	Review Qualifier
299-E27-21	9/29/2006	N	Fluoride	220	ug/L	N	
299-E27-21	9/29/2006	N	Sulfate	62200	ug/L	DN	
299-E27-21	9/29/2006	N	Alkalinity	85000	ug/L		
299-E27-21	9/29/2006	Y	Potassium	8150	ug/L		
299-E27-21	9/29/2006	Y	Copper	2.8	ug/L	U	
299-E27-21	9/29/2006	Y	Nickel	7.5	ug/L	U	
299-E27-21	9/29/2006	Y	Beryllium	0.51	ug/L	U	
299-E27-21	9/29/2006	Y	Silver	5.2	ug/L	U	
299-E27-21	9/29/2006	Y	Manganese	2.5	ug/L	U	
299-E27-21	9/29/2006	Y	Calcium	46300	ug/L	C	
299-E27-21	9/29/2006	Y	Cobalt	5	ug/L	U	
299-E27-21	9/29/2006	Y	Barium	28.4	ug/L	B	
299-E27-21	9/29/2006	Y	Sodium	14500	ug/L		
299-E27-21	9/29/2006	Y	Chromium	3.1	ug/L	U	
299-E27-21	9/29/2006	Y	Cadmium	2.3	ug/L	U	
299-E27-21	9/29/2006	Y	Antimony	44.8	ug/L	U	
299-E27-21	9/29/2006	Y	Vanadium	22.5	ug/L	B	
299-E27-21	9/29/2006	Y	Zinc	9.6	ug/L	U	
299-E27-21	9/29/2006	Y	Magnesium	13500	ug/L		
299-E27-21	9/29/2006	Y	Strontium	228	ug/L		
299-E27-21	9/29/2006	Y	Iron	25	ug/L	U	
299-E27-21	9/29/2006	N	Cyanide	2.4	ug/L	U	
299-E27-21	9/29/2006	N	Gross beta	180	pCi/L		
299-E27-21	9/29/2006	N	Europium-152	-3.2	pCi/L	U	
299-E27-21	9/29/2006	N	Ruthenium-106	-0.387	pCi/L	U	
299-E27-21	9/29/2006	N	Cobalt-60	1.23	pCi/L	U	
299-E27-21	9/29/2006	N	Potassium-40	-34.6	pCi/L	U	
299-E27-21	9/29/2006	N	Cesium-137	0.775	pCi/L	U	
299-E27-21	9/29/2006	N	Antimony-125	-0.183	pCi/L	U	
299-E27-21	9/29/2006	N	Europium-154	-2.26	pCi/L	U	
299-E27-21	9/29/2006	N	Beryllium-7	7.63	pCi/L	U	
299-E27-21	9/29/2006	N	Europium-155	-1.12	pCi/L	U	
299-E27-21	9/29/2006	N	Cesium-134	-0.374	pCi/L	U	
299-E27-21	9/29/2006	N	pH Measurement	7.97	pH		
299-E27-21	9/29/2006	N	Technetium-99	672	pCi/L		
299-E27-21	9/29/2006	N	Uranium	2.01	ug/L		
299-E27-22	9/29/2006	N	Specific Conductance	650	uS/cm		
299-E27-22	9/29/2006	N	Temperature	20.9	Deg C		
299-E27-22	9/29/2006	N	Turbidity	1.2	NTU		
299-E27-22	9/29/2006	N	Nitrate	34500	ug/L	DN	
299-E27-22	9/29/2006	N	Nitrite	3280	ug/L	N	F
299-E27-22	9/29/2006	N	Chloride	42800	ug/L	CDN	
299-E27-22	9/29/2006	N	Fluoride	170	ug/L	N	
299-E27-22	9/29/2006	N	Sulfate	151000	ug/L	DN	
299-E27-22	9/29/2006	N	Alkalinity	95000	ug/L		

Well Name	Sample Date	Filtered	Constituent	Result	Units	Lab Qualifier	Review Qualifier
299-E27-22	9/29/2006	Y	Potassium	8190	ug/L		
299-E27-22	9/29/2006	Y	Copper	2.8	ug/L	U	
299-E27-22	9/29/2006	Y	Nickel	7.5	ug/L	U	
299-E27-22	9/29/2006	Y	Beryllium	0.51	ug/L	U	
299-E27-22	9/29/2006	Y	Silver	5.2	ug/L	U	
299-E27-22	9/29/2006	Y	Manganese	4.3	ug/L	B	
299-E27-22	9/29/2006	Y	Calcium	77500	ug/L	C	
299-E27-22	9/29/2006	Y	Cobalt	5	ug/L	U	
299-E27-22	9/29/2006	Y	Barium	47.3	ug/L	B	
299-E27-22	9/29/2006	Y	Sodium	16300	ug/L		
299-E27-22	9/29/2006	Y	Chromium	5.2	ug/L	B	
299-E27-22	9/29/2006	Y	Cadmium	2.3	ug/L	U	
299-E27-22	9/29/2006	Y	Antimony	44.8	ug/L	U	
299-E27-22	9/29/2006	Y	Vanadium	14.6	ug/L	B	
299-E27-22	9/29/2006	Y	Zinc	9.6	ug/L	U	
299-E27-22	9/29/2006	Y	Magnesium	22300	ug/L		
299-E27-22	9/29/2006	Y	Strontium	418	ug/L		
299-E27-22	9/29/2006	Y	Iron	98.4	ug/L	B	
299-E27-22	9/29/2006	N	Cyanide	2.4	ug/L	U	
299-E27-22	9/29/2006	N	Gross beta	17.7	pCi/L		
299-E27-22	9/29/2006	N	Europium-152	3.89	pCi/L	U	
299-E27-22	9/29/2006	N	Potassium-40	-16.3	pCi/L	U	
299-E27-22	9/29/2006	N	Cobalt-60	-0.113	pCi/L	U	
299-E27-22	9/29/2006	N	Ruthenium-106	7.3	pCi/L	U	
299-E27-22	9/29/2006	N	Cesium-137	0.0197	pCi/L	U	
299-E27-22	9/29/2006	N	Antimony-125	-1.29	pCi/L	U	
299-E27-22	9/29/2006	N	Europium-154	-2.41	pCi/L	U	
299-E27-22	9/29/2006	N	Beryllium-7	-3.66	pCi/L	U	
299-E27-22	9/29/2006	N	Europium-155	-1.09	pCi/L	U	
299-E27-22	9/29/2006	N	Cesium-134	-0.856	pCi/L	U	
299-E27-22	9/29/2006	N	pH Measurement	8.17	pH		
299-E27-22	9/29/2006	N	Technetium-99	47	pCi/L		
299-E27-22	9/29/2006	N	Uranium	3.14	ug/L		
299-E27-23	9/29/2006	N	Specific Conductance	437	uS/cm		
299-E27-23	9/29/2006	N	Temperature	19.3	Deg C		
299-E27-23	9/29/2006	N	Turbidity	1.39	NTU		
299-E27-23	9/29/2006	N	Nitrate	27400	ug/L	DN	H
299-E27-23	9/29/2006	N	Nitrite	1280	ug/L	N	F
299-E27-23	9/29/2006	N	Chloride	14600	ug/L	CDN	
299-E27-23	9/29/2006	N	Fluoride	240	ug/L	N	
299-E27-23	9/29/2006	N	Sulfate	87100	ug/L	DN	
299-E27-23	9/29/2006	N	Alkalinity	81000	ug/L		
299-E27-23	9/29/2006	Y	Potassium	6750	ug/L		
299-E27-23	9/29/2006	Y	Iron	25	ug/L	U	
299-E27-23	9/29/2006	Y	Copper	2.8	ug/L	U	

Well Name	Sample Date	Filtered	Constituent	Result	Units	Lab Qualifier	Review Qualifier
299-E27-23	9/29/2006	Y	Vanadium	22.2	ug/L	B	
299-E27-23	9/29/2006	Y	Antimony	44.8	ug/L	U	
299-E27-23	9/29/2006	Y	Cadmium	2.3	ug/L	U	
299-E27-23	9/29/2006	Y	Manganese	2.5	ug/L	U	
299-E27-23	9/29/2006	Y	Calcium	54300	ug/L	C	
299-E27-23	9/29/2006	Y	Cobalt	5	ug/L	U	
299-E27-23	9/29/2006	Y	Barium	34.9	ug/L	B	
299-E27-23	9/29/2006	Y	Sodium	14300	ug/L		
299-E27-23	9/29/2006	Y	Chromium	4.4	ug/L	B	
299-E27-23	9/29/2006	Y	Silver	5.2	ug/L	U	
299-E27-23	9/29/2006	Y	Beryllium	0.51	ug/L	U	
299-E27-23	9/29/2006	Y	Magnesium	15700	ug/L		
299-E27-23	9/29/2006	Y	Zinc	9.6	ug/L	U	
299-E27-23	9/29/2006	Y	Nickel	7.5	ug/L	U	
299-E27-23	9/29/2006	Y	Strontium	274	ug/L		
299-E27-23	9/29/2006	N	Cyanide	2.4	ug/L	U	
299-E27-23	9/29/2006	N	Gross beta	597	pCi/L		
299-E27-23	9/29/2006	N	Europium-152	-3.9	pCi/L	U	
299-E27-23	9/29/2006	N	Europium-155	1.77	pCi/L	U	
299-E27-23	9/29/2006	N	Beryllium-7	1.92	pCi/L	U	
299-E27-23	9/29/2006	N	Europium-154	1.4	pCi/L	U	
299-E27-23	9/29/2006	N	Antimony-125	-1.81	pCi/L	U	
299-E27-23	9/29/2006	N	Cesium-134	1.18	pCi/L	U	
299-E27-23	9/29/2006	N	Cesium-137	0.258	pCi/L	U	
299-E27-23	9/29/2006	N	Cobalt-60	3.56	pCi/L	U	
299-E27-23	9/29/2006	N	Ruthenium-106	-20.9	pCi/L	U	
299-E27-23	9/29/2006	N	Potassium-40	-55.3	pCi/L	U	
299-E27-23	9/29/2006	N	pH Measurement	7.99	pH		
299-E27-23	9/29/2006	N	Technetium-99	4050	pCi/L		
299-E27-23	9/29/2006	N	Uranium	2.21	ug/L		
299-E27-4	9/29/2006	N	Specific Conductance	457	uS/cm		
299-E27-4	9/29/2006	N	Temperature	19.2	Deg C		
299-E27-4	9/29/2006	N	Turbidity	0.85	NTU		
299-E27-4	9/29/2006	N	Nitrate	25700	ug/L	DN	
299-E27-4	9/29/2006	N	Chloride	17500	ug/L	CDN	
299-E27-4	9/29/2006	N	Fluoride	220	ug/L	N	
299-E27-4	9/29/2006	N	Sulfate	94800	ug/L	DN	
299-E27-4	9/29/2006	N	Nitrite	1310	ug/L	N	F
299-E27-4	9/29/2006	N	Alkalinity	91000	ug/L		
299-E27-4	9/29/2006	Y	Potassium	7460	ug/L		
299-E27-4	9/29/2006	Y	Calcium	53800	ug/L	C	
299-E27-4	9/29/2006	Y	Sodium	12800	ug/L		
299-E27-4	9/29/2006	Y	Chromium	4.1	ug/L	B	
299-E27-4	9/29/2006	Y	Cadmium	2.3	ug/L	U	
299-E27-4	9/29/2006	Y	Silver	5.2	ug/L	U	

Well Name	Sample Date	Filtered	Constituent	Result	Units	Lab Qualifier	Review Qualifier
299-E27-4	9/29/2006	Y	Antimony	44.8	ug/L	U	
299-E27-4	9/29/2006	Y	Beryllium	0.51	ug/L	U	
299-E27-4	9/29/2006	Y	Vanadium	18.1	ug/L	B	
299-E27-4	9/29/2006	Y	Zinc	9.6	ug/L	U	
299-E27-4	9/29/2006	Y	Magnesium	15300	ug/L		
299-E27-4	9/29/2006	Y	Manganese	2.5	ug/L	U	
299-E27-4	9/29/2006	Y	Cobalt	5	ug/L	U	
299-E27-4	9/29/2006	Y	Barium	38.7	ug/L	B	
299-E27-4	9/29/2006	Y	Iron	25	ug/L	U	
299-E27-4	9/29/2006	Y	Copper	2.8	ug/L	U	
299-E27-4	9/29/2006	Y	Strontium	272	ug/L		
299-E27-4	9/29/2006	Y	Nickel	7.5	ug/L	U	
299-E27-4	9/29/2006	N	Cyanide	2.4	ug/L	U	
299-E27-4	9/29/2006	N	Gross beta	989	pCi/L		
299-E27-4	9/29/2006	N	Europium-152	0.812	pCi/L	U	
299-E27-4	9/29/2006	N	Potassium-40	3.16	pCi/L	U	
299-E27-4	9/29/2006	N	Ruthenium-106	0.188	pCi/L	U	
299-E27-4	9/29/2006	N	Europium-155	0.399	pCi/L	U	
299-E27-4	9/29/2006	N	Beryllium-7	-20.6	pCi/L	U	
299-E27-4	9/29/2006	N	Europium-154	-3.44	pCi/L	U	
299-E27-4	9/29/2006	N	Antimony-125	-1.53	pCi/L	U	
299-E27-4	9/29/2006	N	Cesium-134	2.46	pCi/L	U	
299-E27-4	9/29/2006	N	Cesium-137	-0.618	pCi/L	U	
299-E27-4	9/29/2006	N	Cobalt-60	0.921	pCi/L	U	
299-E27-4	9/29/2006	N	pH Measurement	8.01	pH		
299-E27-4	9/29/2006	N	Technetium-99	3980	pCi/L		
299-E27-4	9/29/2006	N	Uranium	2.67	ug/L		
299-E27-7	10/24/2006	N	Specific Conductance	697	uS/cm		
299-E27-7	10/24/2006	N	Temperature	19.4	Deg C		
299-E27-7	10/24/2006	N	Turbidity	2	NTU		
299-E27-7	10/24/2006	N	Nitrate	28800	ug/L	CDN	
299-E27-7	10/24/2006	N	Fluoride	180	ug/L	N	
299-E27-7	10/24/2006	N	Nitrite	13.1	ug/L	UN	
299-E27-7	10/24/2006	N	Sulfate	176000	ug/L	D	
299-E27-7	10/24/2006	N	Chloride	42200	ug/L	DN	
299-E27-7	10/24/2006	N	Alkalinity	80000	ug/L		
299-E27-7	10/24/2006	Y	Potassium	9140	ug/L		
299-E27-7	10/24/2006	Y	Iron	32	ug/L	B	
299-E27-7	10/24/2006	Y	Nickel	7.5	ug/L	U	
299-E27-7	10/24/2006	Y	Manganese	5.1	ug/L	B	
299-E27-7	10/24/2006	Y	Calcium	89100	ug/L	CN	
299-E27-7	10/24/2006	Y	Cobalt	5	ug/L	U	
299-E27-7	10/24/2006	Y	Barium	52.6	ug/L	B	
299-E27-7	10/24/2006	Y	Sodium	16700	ug/L		
299-E27-7	10/24/2006	Y	Chromium	3.1	ug/L	U	

Well Name	Sample Date	Filtered	Constituent	Result	Units	Lab Qualifier	Review Qualifier
299-E27-7	10/24/2006	Y	Cadmium	2.3	ug/L	U	
299-E27-7	10/24/2006	Y	Silver	5.2	ug/L	U	
299-E27-7	10/24/2006	Y	Antimony	44.8	ug/L	U	
299-E27-7	10/24/2006	Y	Beryllium	0.51	ug/L	U	
299-E27-7	10/24/2006	Y	Vanadium	12.7	ug/L	B	
299-E27-7	10/24/2006	Y	Zinc	11.4	ug/L	B	
299-E27-7	10/24/2006	Y	Magnesium	26700	ug/L		
299-E27-7	10/24/2006	Y	Copper	2.8	ug/L	U	
299-E27-7	10/24/2006	Y	Strontium	504	ug/L		
299-E27-7	10/24/2006	N	Cyanide	2.4	ug/L	U	F
299-E27-7	10/24/2006	N	Gross beta	17	pCi/L		
299-E27-7	10/24/2006	N	Europium-152	-1.14	pCi/L	U	
299-E27-7	10/24/2006	N	Ruthenium-106	3.4	pCi/L	U	
299-E27-7	10/24/2006	N	Potassium-40	4.63	pCi/L	U	
299-E27-7	10/24/2006	N	Cesium-137	0.618	pCi/L	U	
299-E27-7	10/24/2006	N	Antimony-125	3.1	pCi/L	U	
299-E27-7	10/24/2006	N	Beryllium-7	14.3	pCi/L	U	
299-E27-7	10/24/2006	N	Europium-155	0.266	pCi/L	U	
299-E27-7	10/24/2006	N	Europium-154	-4.71	pCi/L	U	
299-E27-7	10/24/2006	N	Cesium-134	-1.35	pCi/L	U	
299-E27-7	10/24/2006	N	Cobalt-60	0.115	pCi/L	U	
299-E27-7	10/24/2006	N	pH Measurement	8.04	pH		
299-E27-7	10/24/2006	N	Technetium-99	38.3	pCi/L		
299-E27-7	10/24/2006	N	Uranium	3.19	ug/L		

Laboratory Qualifier Definitions:

- B – INORGANICS and WETCHEM - The analyte was detected at a value less than the contract required detection limit (RDL), but greater than or equal to the IDL/MDL (as appropriate).
- C – INORGANICS/WETCHEM: The analyte was detected in both the sample and the associated QC blank, and the sample concentration was $\leq 5X$ the blank concentration.
- D – Analyte was identified in an analysis at a secondary dilution factor (i.e., dilution factor different than 1.0).
- N – Spike sample recovery is outside control limits.
- U – Analyzed for but not detected above limiting criteria. Limiting criteria may be any of the following: value reported < 0 ; value reported $<$ counting error ; value reported $<$ total analytical error; value_rptd \leq contract MDL/IDL/MDA/PQL . Note - When another qualifier accompanies a "U" qualifier the result is always considered non-detected. The qualifier combinations "UJ" and "UL" indicate that the result was non-detected, but the detection limit (i.e., value reported in the VALUE_RPTD or MIN_DETECTABLE_ACTIVITY [rad analysis only] fields was estimated.

Review Qualifier Definitions:

- F – The result is undergoing further review.
- H – Laboratory holding time exceeded before the sample was analyzed.

Appendix B

Quality Control Report July to September 2006

Appendix B

Quality Control Report July to September 2006

B.1 Highlights

- Ninety-nine results were flagged with an H due to missed holding times. Nitrite, nitrate, total organic carbon, and total organic halides account for the majority of the flagged results.
- Most of the field duplicate results demonstrated good precision, although the relative percent differences for four pairs of results failed to meet the acceptance criteria. Alkalinity, nitrogen in nitrate, potassium, and gross beta were the constituents with out-of-limit results.
- Approximately 4% of the field blank results exceeded the quality control (QC) limits. Methylene chloride, chloride, and carbon tetrachloride had the greatest number of out-of-limit results. Overall, the field blank results should have little impact on the interpretation of third quarter groundwater data.
- Laboratory performance on the analysis of blind standards was good overall. Severn Trent Laboratories, Incorporated, St. Louis, Missouri (STL St. Louis) had two unacceptable results for total organic halides. Severn Trent Laboratories, Incorporated, Richland, Washington (STL Richland) had three out-of-limit results for tritium.
- Overall, 84% of the results from a volatiles interlaboratory comparison study were acceptable. Analyses were performed by STL St. Louis, an on-site mobile laboratory, and the Waste Sample Characterization Facility.
- Performance-evaluation study results were available from one MAPEP study, one RadChem Proficiency Testing Study and one QuiK Response (Water Pollution) study this quarter. The majority of the labs' results were within the acceptance limits, indicating good performance overall.
- Approximately 95% of the laboratory QC results for this quarter were within the acceptance limits, suggesting that most of the analyses were in control and reliable data were generated.

This QC report presents information on laboratory performance and field QC sample results for the third quarter of calendar year 2006. Routine chemical and radiochemical analyses were performed by STL St. Louis and STL Richland for Hanford Groundwater Performance Assessment Project samples. A small number of hexavalent chromium analyses were performed by Pacific Northwest National Laboratory (PNNL). Supplemental analyses of blind standards were performed by Lionville Laboratory, Incorporated, Lionville, Pennsylvania (Lionville Laboratory), Eberline Services (Richmond, California), and two on-site laboratories: a mobile laboratory and the Waste Sample Characterization Facility. The on-site laboratories are managed and staffed by Fluor Hanford, Inc. STL St. Louis, STL Richland, Lionville Laboratory, and Eberline Services operate under contracts with Fluor Hanford, Inc.

Groundwater sampling was conducted by Fluor Hanford, Inc. nuclear chemical operators under the direction of Duratek Federal Services of Hanford, Inc. The tasks conducted by the samplers and Duratek Federal Services of Hanford, Inc. included bottle preparation, sample set coordination, field measurements, sample collection, sample transport and shipping, well pumping, and coordination of purgewater containment and disposal.

Table B.1 summarizes the data completeness for the Groundwater Performance Assessment Project. The determination of completeness is made by dividing the number of results judged to be valid by the total number of results evaluated and multiplying by 100. Data judged to be valid are results that have not been flagged as suspect, rejected, having a missed holding time, or associated with out-of-limit method blanks or field QC samples. Ninety-five percent of the quarter's results were considered valid. This percentage is unchanged from the previous quarter (the value reported in the previous quarterly report, 89%, was incorrect). Roughly two-thirds of this quarter's flags resulted from detection of anions, metals, and volatile organic compounds in field and method blanks. The majority of these results were at levels near the method detection limits; thus, the overall impact of sample contamination or false-detection on data quality is believed to be minor.

A total of 99 results were flagged with an H this quarter to indicate the recommended holding time had been exceeded. For STL St. Louis, 54 anion results, 27 total organic carbon results, 15 total organic halide results, 1 total petroleum hydrocarbon result (diesel range), and 1 cyanide result were flagged. One hexavalent chromium result was flagged for PNNL. Most of the missed holding times were associated with sample re-analyses that were triggered by a laboratory problem (typically instrument problems or calibration issues). The remainder were primarily caused by samples being received outside of holding time. Some of these shipping delays resulted from the need to screen samples for radiation prior to shipment.

B.2 Field QC Data

Field QC samples include field duplicates, split samples, and field blanks. Quadruplicate samples collected at many wells for total organic carbon and total organic halides analyses also provide useful QC data. Field blanks collected during the third quarter of 2006 included full trip blanks and field transfer blanks. In general, the desired collection frequency for field duplicates and full trip blanks is one sample per 20 well trips. The target collection frequency for field transfer blanks is one blank on each day in which routine well samples are collected for analysis of volatile organic compounds. Equipment blanks are normally collected once per 10 well trips for portable Grundfos pumps or as needed for special projects. Split samples are also collected on an as-needed basis. Table B.2 lists the number of QC samples and their frequencies of collection for this quarter. Results from each type of QC sample are summarized below.

B.2.1 Field Duplicates

Field duplicates provide a measure of the overall sampling and analysis precision. Evaluation of field-duplicate data is based on the relative percent difference (RPD) statistic, which is calculated for each matching pair of results. Field duplicates with at least one result greater than five times the method detection limit (MDL) or minimum detectable activity (MDA) must have RPDs less than 20% to be considered acceptable. Duplicates with RPDs outside this range are flagged with a Q in the database.

Table B.1. Completeness Summarized by Method

HEIS Method Name	Total Results	Suspect Results	Rejected Results	Field QC Flags	Missed Holding Times	Method Blank Qualifiers	Results Flagged ^(a)
General Chemical Parameters							
120.1_CONDUCT	4	-	-	-	-	-	0
120.1_CONDUCT_FLD	339	-	-	-	-	-	0
170.1_TEMP_FLD	339	-	-	-	-	-	0
180.1_TURBIDITY_FLD	288	-	-	-	-	-	0
310.1_ALKALINITY	170	1	-	2	-	-	3
360.1_OXYGEN_FLD	158	-	-	-	-	-	0
410.4_COD	6	-	-	-	-	-	0
9020_TOX	128	-	-	-	15	-	15
9060_TOC	151	-	-	-	27	-	27
9223_COLIFORM	7	-	-	-	-	-	0
PH_ELECT_FLD	339	-	-	-	-	-	0
REDOX_PROBE_FLD	101	-	-	-	-	-	0
Ammonia and Anions							
300.0_ANIONS_IC	1,064	7	-	40	54	159	231
350.1_AMMONIA	11	-	-	-	-	-	0
9012_CYANIDE	36	-	-	-	1	-	1
Metals							
6010_METALS_ICP	3,579	-	-	40	-	130	136
6020_METALS_ICPMS	14	-	-	-	-	-	0
7470_HG_CVAA	1	-	-	-	-	-	0
CR6_HACH_M	19	-	-	-	1	-	1
Volatile Organic Compounds							
8260_VOA_GCMS	2,600	-	-	93	-	24	101
VOA_B&K_FLD	6	-	-	-	-	-	0
VOA_GC_FLD	30	-	-	-	-	-	0
Semivolatile Organic Compounds							
8040_PHENOLIC_GC	51	-	-	-	-	-	0
8270_SVOA_GCMS	246	-	-	-	-	-	0
WTPH_DIESEL	3	-	-	-	1	-	1
Radiological Parameters							
906.0_H3_LSC	135	-	-	-	-	-	0
9310_ALPHABETA_GPC	266	-	-	2	-	-	2
BETA_GPC	3	-	-	-	-	-	0
C14_LSC	3	-	-	-	-	-	0
GAMMA_GS	220	-	-	-	-	-	0
GAMMALL_GS	405	-	-	-	-	-	0
I129LL_ETVDSK_SEP_GS	3	-	-	-	-	-	0
I129LL_SEP_LEPS_GS	30	-	-	-	-	-	0
PUISO_PLATE_AEA	14	-	-	-	-	-	0

Table B.1. (contd)

HEIS Method Name	Total Results	Suspect Results	Rejected Results	Field QC Flags	Missed Holding Times	Method Blank Qualifiers	Results Flagged ^(a)
SRISO_SEP_PRECIP_GPC	38	-	-	-	-	-	0
TC99_ETVDSK_LSC	91	-	-	-	-	-	0
TC99_SEP_LSC	14	-	-	-	-	-	0
TRITIUM_ELECT_LSC	19	-	-	3	-	-	3
UIISO_PLATE_AEA	21	-	-	-	-	-	0
UTOT_KPA	85	-	-	-	-	-	0

(a) Total number of flagged results may be less than the sum of individual flags because some results have more than one flag.
 HEIS = Hanford Environmental Information System.
 QC = Quality control.

Table B.2. Quality Control Samples for Third Quarter 2006

QC Samples	Number of Well Trips	Number of QC Samples ^(a)	Frequency
Field duplicates	183	11	6%
Split samples	0 ^(b)	0	NA
TOC quadruplicates	63 ^(c)	27	43%
TOX quadruplicates	49 ^(c)	22	45%
Full trip blanks	183	10	5%
Field transfer blanks	VOC samples collected on 17 Days	17	100% ^(d)
Equipment blanks	0 ^(e)	0	NA

(a) Values listed do not include field duplicates, split samples, and blanks collected for interim-action groundwater monitoring or non-routine sampling events (i.e., special projects).
 (b) Number of well trips scheduled for split samples.
 (c) Number of well trips in which TOC and/or TOX samples were collected.
 (d) Number of days with field transfer blanks divided by the number of days that VOC samples were collected (i.e., 17/17).
 (e) Number of routine sampling events in which non-dedicated sampling equipment was used (no wells were sampled with a portable Grundfos pump this quarter).
 QC = Quality control.
 TOC = Total organic carbon.
 TOX = Total organic halides.
 VOC = Volatile organic compounds.

Eleven field duplicates were collected and analyzed during the third quarter of 2006 to produce 324 pairs of results. Overall, the results demonstrate good sampling and analysis precision. Four pairs of qualifying duplicate results had relative percent differences greater than 20%. Table B.3 lists the pairs of results with poor precision. The low alkalinity result from well 699-42-E9B is an outlier based on historical data; reanalysis has been requested from the laboratory. Low concentrations probably account for the high RPD for nitrogen in nitrate because the concentrations were close to the method's quantitation limits.

Table B.3. Field Duplicate Results that Exceeded Quality Control Limits

Constituent	Well	Method	Filtered	Result 1		Result 2		RPD
General Chemistry Parameters								
Alkalinity	699-42-E9B	EPA 310.1	No	44,000 µg/L		148,000 µg/L		108%
Ammonia and Anions								
Nitrogen in nitrate	699-42-E9B	EPA 300.0	No	17.7 µg/L	U	124 µg/L		150%
Metals								
Potassium	699-42-E9B	EPA 6010	Yes	12,100 µg/L		8,280 µg/L		37%
Radiological Parameters								
Gross beta	399-3-20	EPA 9310	No	30.5 pCi/L		37.9 pCi/L		22%
EPA = U.S. Environmental Protection Agency. N = Associated matrix spike was outside acceptance limits. RPD = Relative percent difference. U = Undetected.								

B.2.2 Total Organic Carbon and Total Organic Halides Quadruplicates

Samples for total organic carbon and total organic halides analyses are normally collected in quadruplicate in accordance with *Resource Conservation and Recovery Act* (RCRA) requirements. While these samples are not intended as QC samples, quadruplicates may provide useful information about the overall sampling and analysis precision for organic indicator parameters. For the purposes of this discussion, total organic carbon and total organic halides quadruplicate data were evaluated based on the relative standard deviation (RSD) for each set of quadruplicate results. Each quadruplicate set having an RSD greater than 20% and at least one result greater than five times the method detection limit was considered to have poor precision.

For the third quarter, none of the 25 total organic carbon quadruplicates and three out of 20 total organic halide quadruplicates failed to meet the evaluation criteria (Table B.4). One of the quadruplicates in the table appeared to contain an outlier. Removing the outlier drops the RSD below the QC limits. The quadruplicates from well 299-W15-224 were analyzed outside of the holding time.

Table B.4. Total Organic Halides Quadruplicates with Low Precision

Well	MDL (µg/L)	Result 1 (µg/L)		Result 2 (µg/L)		Result 3 (µg/L)		Result 4 (µg/L)		RSD
299-W15-224	26	63.2	DH	139	DH	109	DH	90.7	DH	32%
299-W15-152	2.6 ^(a)	19.6		21	D	18.2	D	11.2	D	25%
299-W15-94	52 ^(b)	350	D	717	D	668	D	480	D	31%
Shaded cell indicates apparent outlier. (a) The dilution factor was 2 for the three diluted samples from this well, resulting in an MDL of 5.2 µg/L. The samples were diluted because of an analytical problem. (b) The dilution factor ranged from 20 to 50 for this set of quadruplicates, resulting in an MDL range from 52 to 130 µg/L. D = Sample was diluted. H = Holding time was exceeded. MDL = Method detection limit. RSD = Relative standard deviation.										

B.2.3 Field Blanks

Full trip blanks, field transfer blanks, and equipment blanks are used to check for contamination resulting from field activities and/or bottle preparation. Definitions of full trip blanks, field transfer blanks, and equipment blanks are provided in Section A.4. In general, the QC limit for blank results is two times the method detection limit (MDL) or instrument detection limit for chemistry methods and two times the minimum detectable activity for radiochemistry methods. For common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the QC limit is five times the MDL. Blank results that exceed these limits may indicate a contamination or false-detection problem for regular groundwater samples. Results from groundwater samples that are associated with an out-of-limit field blank are flagged with a Q in the database.

A total of 936 results were produced from the third quarter field blank samples. Approximately 4.2% of the results (i.e., 39 results) exceeded the QC limits for field blanks. The percentage of out-of-limit results was about the same as the value from last quarter (3.8%). Table B.5 lists the third quarter field blank results that were greater than the QC limits. Results that exceeded the QC limits by a factor of 5 or more are shaded in gray. Most of the flagged results were for chloride and methylene chloride; however, results were also flagged for sulfate, calcium, magnesium, sodium, acetone, chloroform, carbon tetrachloride, and tritium. The potential impacts on the data are minor in most cases. For example, although chloride, sulfate, calcium, magnesium, and sodium had field blank results that were greater than the QC limits, the blank concentrations were significantly lower than the levels of these constituents in most of this quarter's groundwater samples.

Four of the constituents (i.e., chloride, sulfate, calcium, and methylene chloride) that had out-of-limit field blank results also had out-of-limit method blank results. Consequently, some of the results in Table B.5 may have been caused by laboratory contamination or false-positive detection. Acetone and methylene chloride are common laboratory contaminants that have been detected in previous quarters' method blanks. Low-level detection of these constituents in Hanford groundwater samples should be viewed as tentative.

Table B.5. Field Blank Results that Exceeded Quality Control Limits

Constituent Name	Blank Type ^(a)	Result	QC Limit	Result/QC Limit
Ammonia and Anions				
Chloride	FTB	47 µg/L	46 µg/L	1.0
Chloride	FTB	62 µg/L	46 µg/L	1.3
Chloride	FTB	63 µg/L	46 µg/L	1.4
Chloride	FTB	140 µg/L	46 µg/L	3.0
Chloride	FTB	170 µg/L	46 µg/L	3.7
Sulfate	FTB	180 µg/L	100 µg/L	1.8
Metals				
Calcium	FTB	79 µg/L	72 µg/L	1.1
Magnesium	FTB	260 µg/L	216 µg/L	1.2
Magnesium	FTB	342 µg/L	216 µg/L	1.6
Sodium	FTB	228 µg/L	220 µg/L	1.0

Table B.5. (contd)

Constituent Name	Blank Type ^(a)	Result	QC Limit	Result/QC Limit
Volatile Organic Compounds				
Acetone	FXR	14 µg/L	4.0 µg/L	3.5
Carbon tetrachloride	FXR	0.44 µg/L	0.3 µg/L	1.5
Carbon tetrachloride	FTB	0.45 µg/L	0.3 µg/L	1.5
Carbon tetrachloride	FXR	0.71 µg/L	0.3 µg/L	2.4
Chloroform	FXR	1.7 µg/L	0.38 µg/L	4.5
Methylene chloride	FXR	0.78 µg/L	0.5 µg/L	1.6
Methylene chloride	FTB	1.3 µg/L	0.5 µg/L	2.6
Methylene chloride	FXR	1.4 µg/L	0.5 µg/L	2.8
Methylene chloride	FTB	1.8 µg/L	0.5 µg/L	3.6
Methylene chloride	FXR	1.9 µg/L	0.5 µg/L	3.8
Methylene chloride	FXR	2.5 µg/L	0.5 µg/L	5.0
Methylene chloride	FXR	2.7 µg/L	0.5 µg/L	5.4
Methylene chloride	FXR	2.8 µg/L	0.5 µg/L	5.6
Methylene chloride	FXR	2.9 µg/L	0.5 µg/L	5.8
Methylene chloride	FXR	2.9 µg/L	0.5 µg/L	5.8
Methylene chloride	FXR	3.0 µg/L	0.5 µg/L	6.0
Methylene chloride	FXR	3.4 µg/L	0.5 µg/L	6.8
Methylene chloride	FXR	3.7 µg/L	0.5 µg/L	7.4
Methylene chloride	FXR	4.1 µg/L	0.5 µg/L	8.2
Methylene chloride	FXR	4.2 µg/L	0.5 µg/L	8.4
Methylene chloride	FXR	4.4 µg/L	0.5 µg/L	8.8
Methylene chloride	FTB	4.7 µg/L	0.5 µg/L	9.4
Methylene chloride	FXR	4.7 µg/L	0.5 µg/L	9.4
Methylene chloride	FXR	5.3 µg/L	0.5 µg/L	10.6
Methylene chloride	FXR	5.4 µg/L	0.5 µg/L	10.8
Methylene chloride	FXR	6.0 µg/L	0.5 µg/L	12.0
Methylene chloride	FXR	8.6 µg/L	0.5 µg/L	17.2
Methylene chloride	FXR	24 µg/L	0.5 µg/L	48.0
Radiological Parameters				
Tritium	FTB	40.9 pCi/L	12.18 pCi/L	3.4
Shaded cells indicate results that exceeded the QC limits by a factor of 5 or more. (a) FTB = Full trip blank, FXR = Field transfer blank, EB = Equipment blank. QC = Quality control.				

B.3 Laboratory QC Data

B.3.1 Blind Standards

Double-blind standards containing known amounts of selected anions, organic compounds, and radionuclides were prepared and submitted to STL Richland and STL St. Louis in July. Duplicates of the

total organic carbon and gross beta standards were submitted concurrently to Lionville Laboratory and Eberline Services, respectively. In addition, several standards spiked with volatile organic compounds were submitted to Severn Trent St. Louis, an on-site mobile laboratory, and the Waste Sample Characterization Facility. The mobile laboratory and Waste Sample Characterization Facility are operated by Fluor Hanford, Inc. In most cases, the standards were prepared using groundwater from background wells. However, the conductivity standards were prepared commercially in deionized water. Standards for indicator analyses were spiked using the following constituents: potassium hydrogen phthalate was used to prepare total organic carbon standards, 2,4,5-trichlorophenol was used to prepare total organic halides-phenol standards, and total organic halides-volatile organic analysis standards were prepared using a mixture of carbon tetrachloride, chloroform, and trichloroethene. Gross alpha and gross beta standards were spiked with plutonium-239 and strontium-90, respectively. The standards' spiked concentrations and analytical results are listed in Tables A.6 and A.7. Shaded values in the tables were outside the QC limits, as described in the following paragraphs.

Table B.6. Blind Standard Results

Constituent	Spike Amount	Lab	Result 1	Recovery	Result 2	Recovery	Result 3	Recovery	Mean	RSD
General Chemical Parameters										
Conductivity	445 $\mu\text{S}/\text{cm}$	SL	450	101%	460	103%	443	100%	451	2%
TOC ^(a)	2010 $\mu\text{g}/\text{L}$	LL	2200	110%	—	—	—	—	2200	—
TOC ^(b)	2010 $\mu\text{g}/\text{L}$	SL	2000	100%	1800	90%	1800	90%	1850	5%
TOX (phenol) ^(c)	44.1 $\mu\text{g}/\text{L}$	SL	43.3	98%	83.5	189%	71.2	162%	61.4	31%
TOX (VOA)	46.9 $\mu\text{g}/\text{L}$	SL	46.8	100%	52.4	112%	40.8	87%	46.7	12%
Anions										
Cyanide	52 $\mu\text{g}/\text{L}$	SL	50.3	97%	53.6	103%	52.1	100%	52.0	3%
Fluoride	2000 $\mu\text{g}/\text{L}$	SL	2300	115%	2300	115%	2300	115%	2300	0%
Nitrate as N	11295 $\mu\text{g}/\text{L}$	SL	11000	97%	11400	101%	11200	99%	11200	2%
Radiological Parameters										
Gross alpha	99.87 pCi/L	RL	71.9	72%	72.5	73%	82.5	83%	75.6	8%
Gross beta ^(d)	117 pCi/L	ES	125	107%	119	102%	121	103%	122	3%
Gross beta ^(d)	117 pCi/L	RL	110	94%	119	102%	129	110%	119	8%
Plutonium-239	2 pCi/L	RL	1.77	88%	1.55	78%	2.43	122%	1.92	24%
Strontium-90	101.77 pCi/L	RL	90.3	89%	107	105%	93.1	92%	96.8	9%
Technetium-99	101.8 pCi/L	RL	111	109%	113	111%	113	111%	112	1%
Tritium	263 pCi/L	RL	244	93%	254	97%	260	99%	253	3%
Tritium	10137 pCi/L	RL	28300	279%	28600	282%	29400	290%	28800	2%
Uranium-238	335.4 $\mu\text{g}/\text{L}$	RL	346	103%	352	105%	359	107%	352	2%
QC = Quality control. SL = Severn Trent St. Louis. RL = Severn Trent Richland. LL = Lionville Laboratory. ES = Eberline Services.					RSD = Relative standard deviation. TOC = Total organic carbon. TOX = Total organic halides. VOA = Volatile organic analysis.					
Shaded cells indicate values outside the QC limits.										
(a) Due to a planning error, only one TOC standard was submitted to LL.										
(b) TOC standards were submitted to SL in quadruplicate. The fourth TOC result was 1,800 $\mu\text{g}/\text{L}$, and the recovery was 90%.										
(c) TOX phenol standards were submitted to SL in quadruplicate. The fourth result was 47.8 $\mu\text{g}/\text{L}$, and the recovery was 108%.										
(d) The gross beta spike amount is based on equal contributions from Sr-90 and Y-90 and has been corrected by adding the average gross beta activity of the source-water well (699-49-100C) to the original spiked amount. The average gross beta activity of well 699-49-100C was calculated from quarterly measurements made since the second quarter of last year.										

Table B.7. Volatile Organic Compound Interlaboratory Comparison Study

Laboratory	Spike Concentration (µg/L)	Result 1 (µg/L)	Recovery 1	Result 2 (µg/L)	Recovery 2	Result 3 (µg/L)	Recovery 3
Carbon Tetrachloride							
SL	20.1	21	105%	23	114%	24	119%
	673	660	98%	670	100%	650	97%
	2616	3,100	119%	2,600	99%	2,600	99%
WS	20.1	12	60%	14	70%	16	80%
	673	660	98%	670	100%	630	94%
	2,616	2,300	88%	2,300	88%	2,200	84%
MO	20.1	15	75%	16.1	80%	15.2	76%
	673	ND ^(b)	—	570	85%	590	88%
	2,616 ^(a)	2,048	78%	2,073	79%	2,036	78%
	2,616 ^(b)	1997	76%	1,862	71%	2,232	85%
Chloroform							
SL	20.4	23	113%	24	118%	25	122%
WS	20.4	15	74%	18	88%	17	83%
MO	20.4	18.7	92%	19.6	96%	18.9	93%
Trichloroethene							
SL	12.6	13	103%	14	111%	14	111%
WS	12.6	7.2	57%	8.4	67%	9.1	72%
MO	12.6	10.5	83%	11.2	89%	10.6	84%
SL = Severn Trent St. Louis				MO = mobile laboratory			
WS = Waste Sample Characterization Facility				ND = non-detected result			
Shaded cells are outside QC limits.							
(a) Samples were analyzed within 2 days of preparation. A fourth result of 1,997 µg/L (76% recovery) is not shown in the table.							
(b) Samples were analyzed 14 days after preparation.							

The acceptance limits for blind standard recoveries are generally 75% to 125% except for radionuclides, which have a ± 30% acceptance range. Most of the results were acceptable, indicating good performance overall. STL St. Louis had two out-of-limit results for total organic halides. STL Richland had three unacceptable results for tritium. Both Waste Sample Characterization Facility and the mobile laboratory had two out-of-limit results for carbon tetrachloride. The Waste Sample Characterization Facility also had unacceptable results for chloroform (1) and trichloroethene (3). All of the results from Lionville Laboratory (total organic carbon) and Eberline Services (gross beta) were acceptable.

Total organic halide results from STL St. Louis were improved compared to last quarter, but two results were outside the control limits. The associated standards were spiked with 2,4,5-trichlorophenol, and the measured concentrations were biased high (162% and 189% recoveries). Reasons for the anomalous results are unknown. Other QC indicators from STL St. Louis such as the laboratory QC data and Water Pollution study results have demonstrated acceptable performance for this method. Moreover, since no total organic halide results for regular groundwater samples were flagged as suspect this quarter, the problems with the blind standards appear to be isolated.

This quarter's blind standards containing volatile organic compounds were incorporated into a laboratory intercomparison study. The study was requested by Fluor Hanford, Inc. to evaluate the performance of the mobile laboratory relative to that of Waste Sample Characterization Facility and STL St. Louis. Previous monitoring data indicated that the mobile laboratory's results for carbon tetrachloride were often ~30% higher than those from other laboratories. Most of the blind standards in this study were spiked with carbon tetrachloride only, although the lowest-concentration samples also contained chloroform and trichloroethene. Standards were submitted to the laboratories in triplicate, except for one group that was submitted to the mobile laboratory to investigate holding times. Table B.7 lists the standards' concentrations and the individual results from the three laboratories. Overall, the laboratories performed well; 84% of the results were within the $\pm 25\%$ acceptance limits. All of STL St. Louis' results were acceptable. The Waste Sample Characterization Facility had out-of-limit results for carbon tetrachloride (2), chloroform (1), and trichloroethene (3). All of the unacceptable results were for the standards spiked at the lowest concentrations. The mobile laboratory had two unacceptable results for carbon tetrachloride. The first of these was a non-detected result for a mid-level standard; presumably this was caused by over-dilution of the sample. A minor factor evaluated in this study was whether delays in analysis affect the mobile laboratory's results. This was evaluated with the highest-concentration standards containing carbon tetrachloride. The mobile laboratory was provided with seven of these samples, and the laboratory was asked to analyze four relatively quickly and to analyze the remaining samples near the end of the 14-day holding time. In general, the holding time did not appear to impact the results, although one of the samples analyzed on the fourteenth day had an unacceptably low recovery (71%). A final observation from this study is that the mobile laboratory's results tended to be approximately 10% to 30% lower than those from STL St. Louis and the Waste Sample Characterization Facility. This contradiction with previous data may be related to the use of new instrumentation and procedures at the mobile laboratory.

Two sets of tritium standards were submitted to STL Richland this quarter. While the recoveries for the low-level standards were acceptable, the regular-level results were approximately three times greater than the spiking levels. STL Richland re-analyzed the samples, but the re-analysis results were similar to the original values. Moreover, the last time STL Richland analyzed regular-level standards (December 2005), the associated recoveries were approximately 300%. STL Richland's performance on tritium analyses in national performance-evaluation programs (e.g., Mixed Analyte Performance Evaluation Program) has been acceptable, and no groundwater results for tritium were flagged as suspect this quarter. Therefore, we suspect that there may have been a problem with the make-up of the blind standards. The spiking solution was analyzed by a PNNL laboratory in January 2007, and the results suggest that the spiking solution was significantly more concentrated than anticipated. Nonetheless, the difference between the measured and calculated concentrations does not account for the three-fold bias in the blind standards' results. A new spiking solution will be ordered and used for future tritium standards. In addition, an independent analysis of the next set of standards will be performed to verify their concentrations.

B.3.2 Environmental Resources Associates Water Supply/Water Pollution Programs

STL St. Louis and Lionville Laboratory participate in the U.S. Environmental Protection Agency (EPA)-sanctioned Water Supply/Water Pollution Performance Evaluation studies conducted by Environmental Resources Associates. Every month, standard water samples are distributed as blind standards to participating laboratories. These samples contain specific organic and inorganic analytes at

concentrations unknown to the participating laboratories. After analysis, the laboratories submit their results to the study administrator. Regression equations are used to determine acceptance and warning limits for the study participants. These laboratories also may participate in Environmental Resources Associate's QuiK™ Response program, which is specifically designed to quickly demonstrate successful corrective action. The results of these studies, expressed in this report as a percentage of the results that the performance evaluation provider found acceptable, independently verify the level of laboratory performance.

A report from one QuiK Response study (090806C) was received from STL St. Louis this quarter. The percentage of acceptable results for 34 semivolatile organic analytes was 100%.

B.3.3 Mixed Analyte Performance Evaluation Program

The Mixed Analyte Performance Evaluation Program is conducted by the U.S. Department of Energy (DOE) independent of the Hanford Groundwater Performance Assessment Project. In this program, samples containing metals, volatile and semivolatile organic compounds, and radionuclides are sent to participating laboratories in January and July.

Mixed Analyte Performance Evaluation Program results for aqueous samples were available from STL St. Louis, STL Richland, Eberline Services, and Lionville Laboratory this quarter (MAPEP-06-MaW16, -GrW16, and -OrW16). All results from STL St. Louis were acceptable, though one result (iron-55) was acceptable with warning. STL St. Louis does not analyze samples for the Groundwater Program for iron-55. Similarly, all results from STL Richland were acceptable, but one result (technetium-99) was acceptable with warning. All results from Eberline Services and Lionville Laboratory were acceptable.

B.3.4 InterLaB RadCheM Proficiency Testing Program Studies

The InterLaB RadCheM Proficiency Testing Program is conducted by Environmental Resource Associates. Control limits are based on the National Standards for Water Proficiency Testing Studies Criteria Document, December 1998.

The results from one RadCheM PE study were received from Eberline Services this quarter (RAD-66). The following were analyzed with acceptable results: barium-133, cesium-134, cesium-137, cobalt-60, gross beta, radium-226, radium-228, strontium-89, strontium-90, tritium, uranium (natural), uranium (natural) mass, and zinc-65. Gross alpha was not evaluated.

B.3.5 Multi-Media Radiochemistry Proficiency Testing Studies

The Multi-Media Radiochemistry Proficiency Testing Program is conducted by Environmental Resource Associates and is designed to evaluate the performance of participating laboratories through the analysis of air filter, soil, vegetation, and water samples containing radionuclides. Only the water results are considered in this report. Control limits are based on the guidelines contained in the U.S. Department of Energy report EML-564, *Analysis of Environmental Measurements Laboratory (EML) Quality Assessment Program (QAP) Data Determination of Operational Criteria and Control Limits for Performance Evaluation Purposes* (Pan 1995).

No new results were available this quarter.

B.3.6 Laboratory QC Data from Severn Trent Laboratories

Laboratory QC data provide a means of assessing laboratory performance and the suitability of a method for a particular sample matrix. These data are not currently used for in-house validation of individual sample results unless the laboratory is experiencing unusual performance problems with an analytical method. Laboratory QC data include the results from method blanks, laboratory control samples, matrix spikes, matrix spike duplicates, surrogates, and matrix or laboratory duplicates.

Different criteria are used to evaluate the various laboratory QC parameters. Results for method blanks are evaluated based on the frequency of detection above the blank QC limits. In general, these limits are two times the MDL for chemical constituents and two times the minimum detectable activity (MDA) for radiochemistry components. For common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the QC limit is five times the MDL. Results for laboratory control samples, matrix spikes, and surrogates are evaluated by comparing the recovery percentages with minimum and maximum control limits. For matrix duplicates, only those samples with values five times greater than the MDL or MDA are considered. Quantifiable matrix duplicates are evaluated by comparing the RPD with an acceptable RPD maximum for each constituent.

As an aid in identifying the most problematic analytes, a distinction has been made between QC data that were slightly out of limits and QC data that were “significantly out-of-limits.” For method blanks, “significantly out-of-limits” was defined to mean results were greater than twice the QC limit. For laboratory control samples, matrix spikes, and duplicates, “significantly out-of-limits” means the results were outside the range of the QC limits plus or minus 10 percentage points (e.g., if the QC limits are 80% to 120%, significantly out-of-limits would mean less than 70% or greater than 130%).

Most of the third quarter laboratory QC results were within acceptance limits, suggesting that the analyses were in control and reliable data were generated. Table B.8 provides a summary of the QC data by listing the percentage of QC results that were out of limits for each analyte category and QC parameter. Table B.9 lists the individual constituents that had out-of-limit method blanks, including the concentration range for method blanks above the detection limit. Table B.10 summarizes the out-of-limit results for the other QC parameters. The number of significantly out-of-limit results is also indicated in Tables A.9 and A.10. Finally, Table B.11 lists the constituents, analysis dates, and wells having data associated with the significantly out-of-limit QC results. Groundwater sample data associated with blank results that are out of limits could have a contamination or false-detection problem. Groundwater sample data associated with laboratory control samples or matrix spikes that are out of limits should be evaluated for potential biases. It should be noted that these tables incorporate all QC data that were reported for the quarter, including QC results for both original and reanalysis data. However, when samples are re-analyzed, only one set of results (i.e., either the original results or the reanalysis results) are retained in HEIS. Thus, it is possible that some of the QC data described in this report may no longer be associated with current results in HEIS.

Some of the more significant findings from the laboratory QC data are summarized below. Substantial differences between data for last quarter and this quarter are noted for constituent classes; if no comments are made, the data are reasonably similar. To make it easier to compare results between this

quarter and the previous quarter, constituents that were cited for the same reason in both quarters are italicized.

Table B.8. Percentage of Out-of-Limit QC Results by Category

	General Chemistry Parameters	Ammonia and Anions	Metals	VOC	SVOC	Radiological Parameters	Total
Method Blanks	0	12.5	0.7	0.9	0	0	1.9
Lab Control Samples	3.6	0.4	0.3	2.6	2.3	0.3	1.4
Matrix Spikes	3.0	46.9	2.2	2.1	0.3	7.1	5.6
Matrix Duplicates	2.1	1.6	0.2	1.7	1.2	1.7	1.4
Surrogates	—	—	—	1.0	0	—	0.9
SVOC = Semivolatile organic compounds. VOC = Volatile organic compounds.							

Table B.9. Method Blanks with Out-of Limit Results

Constituent	Number Out of Limits ^(a)	Number of Analyses	Concentration Range of Detections
Ammonia and Anions			
Chloride	34(10)	50	0.048 – 0.18 mg/L
Sulfate	1	50	0.14 mg/L
Metals			
Calcium	3	31	78.8 – 133 µg/L
Iron	1	31	84.1 µg/L
Volatile Organic Compounds			
1,4-Dioxane	1	26	30 µg/L
Acetonitrile	1	4	11 µg/L
Methylene chloride	5(4)	26	0.51 – 2.5 µg/L
(a) Numbers in parentheses are the number of results that were significantly out of limits as defined in the text.			

- The relative number of out-of-limit results (2.6%) was about the same as that for last quarter (2.2%). This quarter showed an increase in the number of out-of-limit method blanks for volatile organic compounds, laboratory control samples for general chemistry parameters and semivolatile organic compounds, matrix spikes for ammonia and anions and metals, duplicates for general chemistry parameters, and surrogates. There was a decrease in the number of out-of-limit laboratory control samples for metals and radiological parameters, matrix spikes for general chemistry parameters, volatile organic compounds, and semivolatile organic compounds, and duplicates for semivolatile organic compounds.
- Two or more method blank results exceeded the QC limits for *chloride*, *calcium*, and *methylene chloride*.

- Out-of-limit blank results for chloride, sulfate, and calcium, were, in general, not significant because results for most Hanford groundwater samples were significantly higher (at least five times) than the blank values. Many sample results for other constituents with out-of-limit blank results were comparable to the blank values.
- Relative to last quarter, fewer metals and radiological parameters but more general chemistry parameters and semivolatile organic compounds had laboratory control samples that were out of limits. None of the laboratory control samples were significantly out of limits.
- Compared to last quarter, fewer general chemistry parameters, volatile organic compounds, and semivolatile organic compounds but more ammonia and anions and metals had matrix spike results that were out of limits. *Total organic halides, chloride, cyanide, fluoride, nitrogen in ammonia, nitrogen in nitrate, nitrogen in nitrite, phosphate, sulfate, cadmium, calcium, chromium, iron, magnesium, manganese, sodium, acetone, bromomethane, carbon disulfide, carbon tetrachloride, chloromethane, dichlorodifluoromethane, iodomethane, technetium-99, and uranium* had matrix spike results that were significantly out of limits.
- Matrix duplicates had more general chemistry parameters and fewer semivolatile organic compounds with out-of-limit results compared to last quarter. Matrix duplicates were significantly out of limits for coliform, chloride, nitrogen in ammonia, *nitrogen in nitrate, nitrogen in nitrite, 1,4-dioxane, 1-butanol, 2-butanone, gross alpha, and plutonium 239/240.*
- Surrogates were significantly out of limits for *dibromofluoromethane* and *o-terphenyl*.

A.3.7 Laboratory QC Data from Eberline Services and Lionville Laboratory

Third quarter QC data from Lionville Laboratory are limited to total organic carbon. Third quarter QC data from Eberline Services are limited to gross beta. All of the QC data were within limits.

Project scientists requiring additional information about the laboratory QC data are encouraged to contact Debbie Sklarew or Chris Thompson.

B.4 Field Blank Definitions

Full Trip Blank (FTB) – A field blank sample that is used to check for sample contamination resulting from sample bottles, preservatives, and sample storage and handling. FTBs are initially prepared in the laboratory by filling a preserved bottle set with Type II reagent water. After the bottles have been sealed, they are transported to the field in the same storage container that will be used for groundwater samples collected that day. FTBs are not removed from the storage container until they have been delivered to the laboratory. Normally, FTBs are analyzed for the same constituents as the samples from an associated well.

Field Transfer Blank (FXR) – A field blank sample that is used to check for in-the-field sample contamination by volatile organic compounds. FXRs are prepared near a well sampling site by filling preserved volatile organic analysis (VOA) sample bottles with Type II reagent water that has been transported to the field. FXRs are normally prepared at the same time VOA samples are being collected

from the well. After collection, the FXR bottles are sealed and placed in the same sample storage container as the rest of the samples. FXRs are not removed from the storage container until they have been delivered to the laboratory.

Equipment Blank (EB) – A field blank sample that is used to check for sample contamination caused by unclean sampling equipment or the sampling equipment itself. Generally, equipment blanks are only collected at wells that are sampled using non-dedicated pumps. EBs are prepared by passing Type II reagent water through the pump or manifold after the equipment has been decontaminated (sometimes just prior to sampling a well) and collecting the rinsate in preserved bottles. EBs are placed in the same container as other field samples and are not removed from the container until they have been delivered to the lab. Typically, EBs are analyzed for the same constituents as the samples from the associated well.

B.5 References

EPA. 1986. “Gross Alpha and Gross Beta.” Method 9310 in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*. U. S. Environmental Protection Agency Publication SW-846. Available at <http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm>

EPA. 1979. “Alkalinity.” Method 310.1, U.S. Environmental Protection Agency

EPA. 1991. *The Determination of Inorganic Anions in Water by Ion Chromatography*. Method 300.0, U.S. Environmental Protection Agency, Washington, D.C.

EPA. 1996. “Inductively Coupled Plasma-Atomic Emission Spectrometry” Method 6010B, in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*. U. S. Environmental Protection Agency Publication SW-846. Available at <http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm>

Pan V. 1995. *Analysis of Environmental Measurements Laboratory (EML) Quality Assessment Program (QAP) Data Determination of Operational Criteria and Control Limits for Performance Evaluation Purposes*. EML-564, Environmental Measurements Laboratory, U.S. Department of Energy, New York.

RCRA – *Resource Conservation and Recovery Act*. 1976. Public Law 94-580, as amended, 90 Stat. 2795, 42 USC 6901 et seq.

Table B.10. Laboratory Spikes and Duplicates with Out-of-Limit Results

Constituent	Number Out of Limits ^(a)	Number of Analyses
Laboratory Control Samples		
<i>General Chemistry Parameters</i>		
Total organic carbon	2	12
<i>Ammonia and Anions</i>		
Phosphate	1	10
<i>Metals</i>		
Potassium	2	31
<i>Volatile Organic Compounds</i>		
1,1,1-Trichloroethane	3	26
1,1-Dichloroethene	2	26
Benzene	2	26
Carbon disulfide	3	26
Carbon tetrachloride	3	28
cis-1,2-Dichloroethene	1	27
Methylene chloride	1	26
Styrene	2	4
trans-1,2-Dichloroethene	3	26
<i>Semivolatile Organic Compounds</i>		
2-Chloronaphthalene	1	1
Oil and grease	2	2
Pentachlorophenol	1	9
<i>Radiological Parameters</i>		
Gross alpha	1	22
Matrix Spikes and Matrix Spike Duplicates		
<i>General Chemistry Parameters</i>		
Total organic halides	2(2)	24
<i>Ammonia and Anions</i>		
Chloride	25(7)	52
Cyanide	4(2)	12
Fluoride	23(12)	52
Nitrogen in ammonia	5(1)	7
Nitrogen in nitrate	19(6)	52
Nitrogen in nitrite	40(35)	52
Phosphate	6(5)	8
Sulfate	14(3)	52
<i>Metals</i>		
Cadmium	5(2)	66
Calcium	5(3)	66
Chromium	3(3)	66
Copper	2	66

Table B.10. (contd)

Constituent	Number Out of Limits ^(a)	Number of Analyses
Iron	2(2)	66
Magnesium	1(1)	66
Manganese	4(4)	66
Silver	1	66
Sodium	4(3)	66
Strontium (elemental)	1	66
<i>Volatile Organic Compounds</i>		
1,1-Dichloroethene	1	54
2-Chloro-1,3-butadiene	1	8
Acetone	4(3)	54
Bromomethane	1(1)	8
Carbon disulfide	6(5)	54
Carbon tetrachloride	3(3)	56
Chloroethane	1	8
Chloromethane	2(1)	8
Dichlorodifluoromethane	2(1)	8
Ethyl methacrylate	2	8
Iodomethane	2(1)	8
Styrene	2	8
TPH gasoline	1	12
trans-1,2-Dichloroethene	3	54
Vinyl acetate	3	54
<i>Semivolatile Organic Compounds</i>		
Oil and grease	1	2
<i>Radiological Parameters</i>		
Technetium-99	2(1)	23
Uranium	1(1)	19
Duplicates		
<i>General Chemistry Parameters</i>		
Coliform	1(1)	3
Total organic halides	1	23
<i>Ammonia and Anions</i>		
Chloride	2(1)	102
Fluoride	1	102
Nitrogen in ammonia	1(1)	13
Nitrogen in nitrate	1(1)	102
Nitrogen in nitrite	4(3)	103
<i>Metals</i>		
Antimony	1	33

Table B.10. (contd)

Constituent	Number Out of Limits ^(a)	Number of Analyses
<i>Volatile Organic Compounds</i>		
1,4-Dioxane	8(2)	50
1-Butanol	9(5)	50
2-Butanone	3(1)	50
4-Methyl-2-pentanone	1	50
Acetone	1	50
Bromomethane	1	8
Carbon disulfide	1	50
Tetrahydrofuran	1	50
<i>Semivolatile Organic Compounds</i>		
4-Nitrophenol	1	5
Phenol	1	12
<i>Radiological Parameters</i>		
Gross alpha	2(1)	21
Gross beta	1	22
Plutonium-239/240	1(1)	4
Tritium	2	30
Uranium-235	1	5
Surrogates		
<i>Volatile Organic Compounds</i>		
1,2-Dichloroethane-d4	1	318
4-Bromofluorobenzene	1	318
Dibromofluoromethane	8(1)	318
o-Terphenyl	4(4)	35
(a) Numbers in parentheses are the number of results that were significantly out of limits as defined in the text.		

Table B.11. Wells Associated with Laboratory QC Parameters with Significantly Out-of-Limit Results

Constituent	Analysis Date	Wells with Associated Data
Method Blanks		
Chloride	07/8/06	699-50-74, 699-56-43, 699-S29-E16A, 699-S32-E13A, 699-S41-E13A
	07/11/06	199-D5-39, 699-S6-E4K, 699-S6-E4L
	07/13/06	699-19-88
	07/18/06	199-H4-2, 199-K-29
	07/22/06	299-E24-24, 299-E25-19, 299-W11-43, 299-W15-15, 299-W15-224, N116mArray-3A, APT1
	08/04/06	299-W11-41, 299-W11-42, 299-W11-45, 299-W11-46, 299-W11-47, 299-W18-40, 299-W19-12, 299-W19-41, 299-W19-42, 299-W19-44, 299-W19-45, 299-W19-47
	08/15/06	199-K-111A
	08/19/06	299-E33-334, 299-E33-335, 299-E33-337, 299-E33-338, 299-E33-339
	08/24/06	299-W11-7, 299-W11-39, 299-W13-1, 299-W14-14, 299-W15-1, 299-W15-2, 299-W15-11
	09/15/06	399-1-2, 399-1-23
Methylene chloride	08/23/06	299-W11-18, 299-W11-37, 299-W15-30, 299-W15-94, 299-W15-152
	09/07/06	299-W19-39, 299-W19-43, 299-W19-46, 299-W19-48, 299-W22-20, 299-W22-26, 299-W23-9
	09/15/06	699-22-35, 699-38-70B, 699-38-70C, 699-40-65
	10/04/06	299-W10-14, 299-W10-29, 299-W10-30, 299-W10-31, 299-W11-6, 299-W19-105
Matrix Spikes or Matrix Spike Duplicates		
Total organic halides	10/10/06	299-E18-1, 299-E32-2
	10/24/06	299-W19-105
Chloride	07/22/06	299-E24-24, 299-E25-19, 299-W11-43, 299-W15-15, 299-W15-224, N116mArray-3A, APT1
	08/03/06	199-K-34, 199-N-126, 199-N-127, 299-W14-6, 299-W14-15, 299-W14-16, 299-W14-17, 299-W14-18, 299-W14-19, 299-W15-40, 299-W15-41, 299-W15-44, 299-W15-765, 299-W18-30
	08/24/06	299-W11-7, 299-W11-39, 299-W13-1, 299-W14-14, 299-W15-1, 299-W15-2, 299-W15-11
	09/15/06	399-1-2, 399-1-23
	10/02/06	199-N-21, 299-E27-4, 299-E27-21, 299-E27-22, 299-E27-23
	10/04/06	299-W10-14, 299-W10-29, 299-W10-30, 299-W10-31, 299-W11-6, 299-W12-1, 299-W19-105
Cyanide	08/03/06	299-E33-4
	08/08/06	299-W14-13
Fluoride	07/22/06	299-E24-24, 299-E25-19, 299-W11-43, 299-W15-15, 299-W15-224, N116mArray-3A, APT1
	08/15/06	199-K-111A
	08/22/06	299-E33-47
	08/24/06	299-W11-7, 299-W11-39, 299-W14-14, 299-W15-1, 299-W15-2, 299-W15-11

Table B.11. (contd)

Constituent	Analysis Date	Wells with Associated Data
	08/25/06	299-W15-35, 299-W15-37, 299-W15-42, 299-W15-45, 299-W15-49, 299-W15-50, 299-W17-1, 399-1-2
	08/29/06	299-E33-3, 299-E33-15, 299-E33-16, 299-E33-20, 299-E33-38, 299-W15-17, 299-W18-16
	09/07/06	699-22-35, 699-25-34D, 699-38-70B, 699-38-70C, 699-40-65, 699-50-59
	09/15/06	399-1-2, 399-1-23
	09/22/06	199-D5-43, 199-K-130, 199-N-14, 199-N-123, 299-E17-22, 299-E17-23, 299-E17-25, 299-E17-26, 299-E24-20, 299-E24-21, 299-E24-22, 699-36-70A
	09/27/06	199-D5-36, 199-N-18, N116mArray-9A, N116mArray-2A, N116mArray-3A, N116mArray-4A, N116mArray-6A, N116mArray-7A, N116mArray-8A, N116mArray-10A, N116mArray-11A, N116mArray-12A, N116mArray-13A, N116mArray-14A, NVP2-116.0, NS-2A-87cm
	09/28/06	199-N-16, 299-E18-1, 299-E25-2, 299-E25-40, 299-E32-2, 299-W23-19
	10/02/06	299-E25-93, 299-E27-13, 299-E27-14
Nitrogen in ammonia	09/19/06	299-W15-35
Nitrogen in Nitrate	07/22/06	299-E24-24, 299-E25-19, 299-W11-43, 299-W15-15, 299-W15-224, N116mArray-3A, APT1
	08/08/06	299-E33-18
	08/24/06	299-W11-7, 299-W11-39, 299-W13-1, 299-W14-14, 299-W15-1, 299-W15-2, 299-W15-11
	09/26/06	399-3-19, 399-3-20
	10/02/06	199-N-21, 299-E27-4, 299-E27-21, 299-E27-22, 299-E27-23
	10/04/06	299-W10-14, 299-W10-29, 299-W10-30, 299-W10-31, 299-W11-6, 299-W12-1, 299-W19-105
Nitrogen in Nitrite	07/12/06	699-S6-E4A, 699-S20-E10, 699-S37-E14
	07/13/06	699-19-88
	07/20/06	299-E17-14, 299-E17-22, 299-E17-23, 299-E17-26, 299-E18-1, 299-E24-16, 299-E24-21
	07/22/06	299-E24-24, 299-E25-19, 299-W11-43, 299-W15-15, 299-W15-224, N116mArray-3A, APT1
	07/26/06	299-E33-4, 699-42-E9B
	07/29/06	299-E33-18
	08/03/06	299-W10-8, 299-W10-24, 299-W10-26, 299-W10-27, 299-W10-28, 299-W11-12
	08/04/06	299-W10-1, 299-W10-8, 299-W10-23, 299-W10-24, 299-W10-26, 299-W10-27, 299-W10-28, 299-W11-12, 299-W14-13, 299-W15-763
	08/05/06	299-E17-22, 299-E17-23, 299-E17-25, 299-E17-26, 299-E24-21, 299-E24-24, 299-E28-8, 299-W14-11, 299-W18-31, 299-W22-50
	08/09/06	199-D5-43, 199-N-122, 199-N-123
	08/12/06	199-D4-23, 199-K-27

Table B.11. (contd)

Constituent	Analysis Date	Wells with Associated Data	
	08/15/06	199-K-111A	
	08/18/06	299-W11-18, 299-W11-37, 299-W11-40, 299-W15-30, 299-W15-94, 299-W15-152	
	08/19/06	299-E33-334, 299-E33-335, 299-E33-337, 299-E33-338, 299-E33-339	
	08/22/06	299-E33-47	
	08/24/06	299-W11-7, 299-W11-39, 299-W13-1, 299-W14-14, 299-W15-1, 299-W15-2, 299-W15-11	
	08/25/06	299-W15-35, 299-W15-37, 299-W15-42, 299-W15-45, 299-W15-49, 299-W15-50, 299-W17-1, 399-1-2	
	08/30/06	299-E28-17, 299-W19-34A, 299-W19-37	
	08/31/06	299-W19-39, 299-W19-43, 299-W19-46, 299-W19-48, 299-W19-49, 299-W22-20, 299-W22-26, 299-W23-4, 299-W23-9, 299-W26-14	
	09/01/06	699-23-34B, 699-24-33, 699-24-34A, 699-24-34B, 699-24-34C, 699-S28-E13A, 699-S34-E15	
	09/02/06	299-E33-48, 299-E33-49, 699-25-33A, 699-25-34A, 699-25-34B, 699-26-33, 699-26-34A, 699-26-35C	
	09/07/06	699-22-35, 699-25-34D, 699-38-70B, 699-38-70C, 699-40-65, 699-50-59	
	09/08/06	299-E18-1	
	09/13/06	199-K-111A	
	09/15/06	399-1-2, 399-1-23	
	09/16/06	199-N-27, 199-N-32, 199-N-46	
	09/19/06	199-K-129, 199-N-2, 199-N-67, 199-N-147	
	09/21/06	199-N-75, 199-N-76, 199-N-80, 199-N-81, 199-N-92A, 199-N-99A, 299-E33-18, 299-E33-41	
	09/22/06	199-D5-43, 199-K-130, 199-N-14, 199-N-123, 299-E17-22, 299-E17-23, 299-E17-25, 299-E17-26, 299-E24-20, 299-E24-21, 299-E24-22, 299-E24-24, 699-36-70A	
	09/26/06	399-3-19, 399-3-20	
	09/28/06	199-N-16, 299-E18-1, 299-E25-2, 299-E25-40, 299-E32-2, 299-W23-19	
	09/29/06	299-E25-93, 299-E27-13, 299-E27-14	
	09/30/06	199-N-21, 299-E27-4, 299-E27-21, 299-E27-22, 299-E27-23	
	10/04/06	299-W10-14, 299-W10-29, 299-W10-30, 299-W10-31, 299-W11-6, 299-W12-1, 299-W19-105	
	Phosphate	07/22/06	N116mArray-3A, APT1
		09/12/06	199-N-103A, 199-N-105A, 199-N-106A, 199-N-119, 199-N-120, 199-N-121
		09/16/06	199-N-46
		09/22/06	199-N-123
		09/27/06	N116mArray-2A, N116mArray-3A, N116mArray-4A, N116mArray-6A, N116mArray-7A, N116mArray-8A, N116mArray-9A, N116mArray-10A, N116mArray-11A, N116mArray-12A, N116mArray-13A, N116mArray-14A, NS-2A-87cm, NVP2-116.0

Table B.11. (contd)

Constituent	Analysis Date	Wells with Associated Data
Sulfate	07/22/06	299-E24-24, 299-E25-19, 299-W11-43, 299-W15-15, 299-W15-224, N116mArray-3A, APT1
	08/24/06	299-W11-7, 299-W11-39, 299-W13-1, 299-W14-14, 299-W15-1, 299-W15-2, 299-W15-11
	09/15/06	399-1-2, 399-1-23
Cadmium	10/02/06	199-N-18, 199-N-74
Calcium	08/09/06	299-W10-1, 299-W10-23, 299-W14-13
	08/25/06	299-W10-4
	10/02/06	199-N-18, 199-N-74
Chromium	08/09/06	299-W10-1, 299-W10-23, 299-W14-13
	08/25/06	299-W10-4
Iron	10/02/06	199-N-18, 199-N-74
Magnesium	08/25/06	299-W10-4
Manganese	07/31/06	199-N-128, 199-N-129, 299-W15-83, 299-W18-21, 299-W18-22, 299-W18-23, 399-1-12
	10/02/06	199-N-18, 199-N-74
Sodium	08/01/06	199-N-128, 199-N-129, 299-W15-83, 299-W18-21, 299-W18-22, 299-W18-23, 399-1-12
	08/25/06	299-W10-4
Acetone	08/30/06	299-W15-35, 299-W15-42, 299-W15-45, 299-W15-49, 299-W15-50, 299-W18-23
	09/11/06	299-W15-7, 299-W15-47, 699-25-33A, 699-26-35C, 699-48-77A
Bromomethane	07/07/06	699-30-66
Carbon disulfide	07/07/06	699-30-66
	09/15/06	699-22-35, 699-38-70B, 699-38-70C, 699-40-65
Carbon tetrachloride	08/23/06	299-W11-18, 299-W15-152
Chloromethane	07/07/06	699-30-66
Dichlorodifluoromethane	07/07/06	699-30-66
Iodomethane	07/07/06	699-30-66
Technetium-99	09/12/06	199-K-27, 299-E33-1A
Uranium	09/13/06	299-E28-17, 299-W19-34A, 299-W19-37, 299-W19-39, 299-W19-43, 299-W19-46, 299-W19-48, 299-W19-49, 299-W22-20, 299-W22-26, 299-W23-4, 299-W23-9, 299-W26-14
Duplicates		
Coliform	09/20/06	299-E24-22
Chloride	08/21/06	199-K-109A, 299-E33-1A, 299-E33-2, 299-E33-13, 299-E33-31, 299-E33-32
Nitrogen in ammonia	09/29/06	299-W15-47, 699-22-35, 699-23-34B, 699-24-33, 699-24-34A, 699-24-34B, 699-24-34C, 699-48-77A
Nitrogen in Nitrate	08/08/06	299-E33-18

Table B.11. (contd)

Constituent	Analysis Date	Wells with Associated Data
Nitrogen in Nitrite	07/22/06	299-E24-24, 299-E25-19, 299-W11-43, 299-W15-15, 299-W15-224, N116mArray-3A, APT1
	09/13/06	199-K-111A
	09/29/06	299-E25-93, 299-E27-13, 299-E27-14
1,4-Dioxane	07/28/06	299-W11-43, 299-W15-31A, 299-W15-83, 299-W18-21, 299-W18-22, 299-W18-23, 399-1-10A, 399-1-12
	08/04/06	299-W10-23
1-Butanol	07/19/06	699-49-100C
	09/07/06	299-W19-39, 299-W19-43, 299-W19-46, 299-W19-48, 299-W22-20, 299-W22-26, 299-W23-9
	09/15/06	699-22-35, 699-38-70B, 699-38-70C, 699-40-65
	09/27/06	399-1-18A, 399-1-18B, 399-3-19, 399-3-20
2-Butanone	07/11/06	399-1-23, 399-3-11, 399-3-12, 399-3-19, 399-3-20, 699-50-74, 699-S6-E4K, 699-S6-E4L, 699-S27-E9B, 699-S29-E16A
Gross alpha	11/07/06	199-N-80, 199-N-123, 399-3-19, 399-3-20

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