



0059834

Department of Energy  
Richland Operations Office  
P.O. Box 550  
Richland, Washington 99352

01-GWVZ-031

AUG 2 2001

Ms. Jane Hedges  
Cleanup Section Manager  
Nuclear Waste Program  
State of Washington  
Department of Ecology  
1315 W. Fourth Avenue  
Kennewick, Washington 99336

RECEIVED  
JUL 14 2003  
EDMC

Mr. Douglas R. Sherwood  
Hanford Project Manager  
U.S. Environmental Protection Agency  
712 Swift Boulevard, Suite 5  
Richland, Washington 99352

Addressees:

QUARTERLY RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)  
GROUNDWATER MONITORING DATA FOR THE PERIOD JANUARY 1, 2001,  
THROUGH MARCH 31, 2001

Please find enclosed the subject report. The RCRA groundwater chemistry and water level data for the subject period have been verified and evaluated. The data are publicly available in electronic form in the Hanford Environmental Information System database. The electronic availability of the data and the summary provided below fulfill the reporting requirements of WAC 173-303 (and by reference 40 CFR 265.94). Verification of data included a completion check (requested analyses were received), quality control checks (field blanks, field duplicates, and blind samples), and project scientist evaluation.

Seventeen RCRA sites were sampled during the reporting quarter (see enclosure, Table 1). Sampled sites include nine monitored under indicator evaluation programs, seven monitored under groundwater quality assessment programs, and one monitored under final-status corrective action. Detailed information on salient issues during this quarter is included in the enclosure.

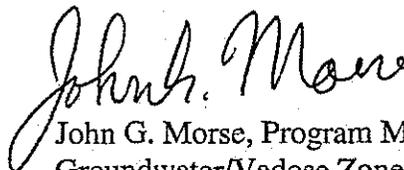
Addressees  
01-GWVZ-031

-2-

AUG 2 2001

If you have questions about this quarterly data transmittal, please contact Marvin J. Furman at (509) 373-9630.

Sincerely,

A handwritten signature in cursive script that reads "John G. Morse".

John G. Morse, Program Manager  
Groundwater/Vadose Zone Project

GWVZ:MJF

Enclosure

cc w/encl:

J. Caggiano, Ecology  
D. N. Goswami, Ecology  
A. D. Huckaby, Ecology  
M. J. Hartman, PNNL  
S. P. Luttrell, PNNL

## QUARTERLY RESOURCE CONSERVATION AND RECOVERY ACT GROUNDWATER MONITORING DATA FOR THE PERIOD JANUARY THROUGH MARCH, 2001.

Seventeen RCRA sites were sampled during the reporting quarter, as listed in Table 1. Sampled sites include nine monitored under indicator evaluation programs, seven monitored under groundwater quality assessment programs, and one monitored under final-status corrective action.

### 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, indicator evaluation requirements, as described in 40 CFR 265.93. Four of the nine sites sampled under indicator evaluation programs this quarter had an exceedance of a critical mean value, as previously reported. None indicated hazardous contamination from the RCRA units, as explained below.

**1324-N/NA Facilities.** Specific conductance at downgradient wells continued to exceed the critical mean. Groundwater quality assessment monitoring in 1992 indicated that the high conductivity is caused by the nonhazardous constituents sulfate and sodium. Because an assessment has already been completed and the high conductivity is caused by nonhazardous constituents, verification sampling and additional assessment monitoring will not be conducted. Well 199-N-59 contained too little water to be sampled in March. This well was installed when the site was active and the water table was higher than it is now. Ecology is aware that it can only be sampled when river stage is high for an extended period.

**1325-N Liquid Waste Disposal Facility.** Specific conductance in downgradient well 199-N-41 continued to exceed the critical mean value in March. DOE notified Ecology in January 2000 of a September 1999 exceedance in wells 199-N-41 and 199-N-81, and transmitted the results of the groundwater quality assessment in July 2000. The high specific conductance is believed to originate at an upgradient source, and passed the upgradient well several years ago.

**Low-Level Waste Management Area 4.** Critical mean values were revised this quarter because downgradient well 29-W15-18 went dry. The network now consists of three upgradient and two downgradient wells, and is out of compliance with RCRA requirements. TOX continued to exceed the critical mean value in downgradient well 299-W15-16. This well used to be an upgradient well, and as reported earlier, the exceedance is believed to originate at an upgradient source.

**Nonradioactive Dangerous Waste Landfill.** Specific conductance in two downgradient wells (699-25-34A and B) exceeded the critical mean value in March. This constituent had been trending upward and no verification was necessary. DOE notified Ecology of the exceedance (reference 1) and submitted an assessment report (reference 2). We believe the increased specific conductance is caused by increases in concentrations of nonhazardous constituents (bicarbonate, sulfate, calcium, and magnesium) from the adjacent Solid Waste Landfill. Therefore, detection monitoring will continue.

### Status of Assessment Programs

**Single-Shell Tanks WMA B-BX-BY:** Although groundwater flow direction is highly uncertain, direct measurements of flow direction, collected in August 2000, provide evidence of primarily a southerly flow direction across the WMA. These results are in agreement with interpretations based on contaminant migration and hydrographs. Although there was no apparent change in flow rate this quarter, preliminary results from the colloidal borescope investigation indicate that flow rates are slower in the north half of

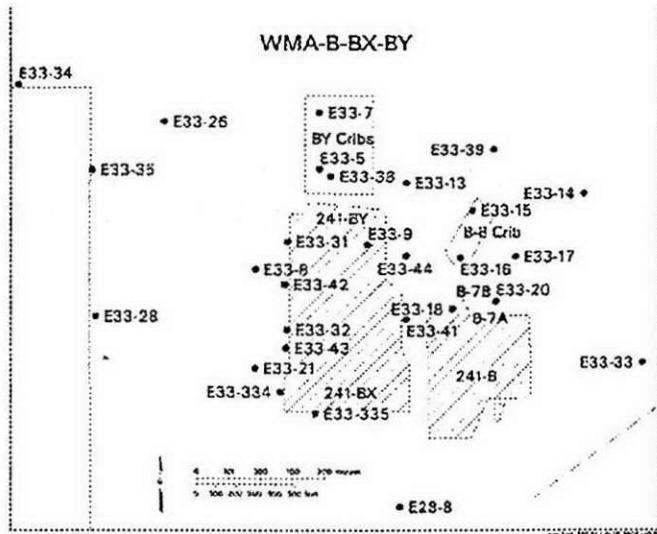
the WMA than in the south. Drilling of the new RCRA groundwater monitoring wells began in July 2001. They are located to provide partial coverage at the southeast corner of the WMA.

Upgradient (north) of the WMA, the BY Crib plume (consisting of nitrate, technetium-99, cyanide and cobalt-60) continues to migrate south into the WMA. Technetium-99 concentrations in well 299-E33-7 appear to have leveled off at least for this quarter (Figure 1). Farther south, the contaminant levels are lower but continue to increase. In general, nitrate values decreased from last quarter's values. For example from last quarter, the

concentration in well 299-E33-38 dropped from 531 mg/L to 452 mg/L. Cyanide continued to rise in the north part of the BY Cribs at 423  $\mu\text{g/L}$ , an increase from 253  $\mu\text{g/L}$  seen last quarter. Although this is the highest value found in the area recently, cyanide was at 386  $\mu\text{g/L}$  in February 2000. It should be noted that levels over 1,000  $\mu\text{g/L}$  were reported in a well north of the WMA near the basalt subcrop in 1988. Cyanide (21.4  $\mu\text{g/L}$ ) was found farther south, than previously seen in the recently abandoned Office of River Protection well located in the BX tank farm southwest of well 299-E33-41. On the west side of the WMA, cyanide was found in well 299-E33-42 at 14.8  $\mu\text{g/L}$ , which is the farthest south cyanide has been detected on the west side of the WMA.

Contamination in the central part of the WMA is generally characterized by a low nitrate/technetium-99 ratio, indicative of tank-associated waste, moderate technetium-99 and nitrate levels, and high nitrite, not usually found in groundwater but present in tank waste at high levels. These characteristics and high uranium concentrations suggest this contamination may be residual metals waste from early WMA-related leaks, now settled into a structural low in the basalt surface. However with the recent discovery of perched water at well 299-E33-46 located in the BX tank farm, a vadose zone source must also be considered. Analyses of the groundwater from this well shows there is 2,410 pCi/L of technetium-99, 10.8  $\mu\text{g/L}$  of uranium and 58 mg/L of nitrate. The nitrate to technetium-99 ratio of 24 is very similar to the groundwater in this central part of the WMA. The presence of saturated zones in the lower part of the vadose zone suggests that water sources capable of remobilizing tank-associated waste may be the source for some of the contamination seen in the groundwater in this area.

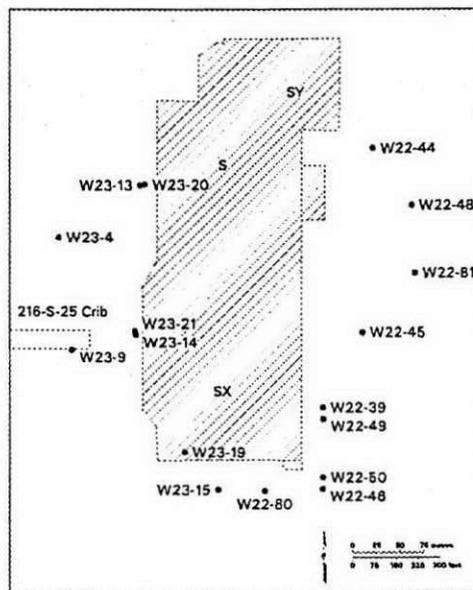
Uranium concentrations continued to rise in well 299-E33-9 (inside the BY tank farm) and on the east border of the farm in well 299-E33-44. The current level in well 299-E33-9 is 593  $\mu\text{g/L}$ , increasing from 515  $\mu\text{g/L}$  last quarter while the value in well 299-E33-44 is 390  $\mu\text{g/L}$ . South of these wells, the uranium has fallen back to 31  $\mu\text{g/L}$  from a maximum of 118  $\mu\text{g/L}$  last quarter in well 299-E33-41 (see Figure 1). In the BY cribs to the north, concentrations remained level at 117  $\mu\text{g/L}$  in well 299-E33-38 (114  $\mu\text{g/L}$  last quarter). One location where uranium is obviously increasing is on the west side of the BY tank farm in wells 299-E33-31 (79  $\mu\text{g/L}$ ) and 299-E33-42 (12  $\mu\text{g/L}$ ). This uranium may be from the same source as well 299-E33-9 given the proximity of the two wells or may be migrating in with the technetium-99, cyanide and cobalt-60 from the north. Cyanide and cobalt-60 concentrations in well 299-E33-31 are 21.1  $\mu\text{g/L}$  and 23.4  $\mu\text{g/L}$  respectively. Consequently the uranium may be associated with that in well 299-E33-38. A migration route from well 299-E33-38 to well 299-E33-31 would also agree with the flow direction determined using the colloidal borescope. The other area that displays a rising uranium trend is



at well 299-E33-26, located at the B-61 Crib. Uranium levels rose from 72.7  $\mu\text{g/L}$  to 88.8  $\mu\text{g/L}$  this quarter.

**Single-Shell Tanks WMA S-SX:** Groundwater beneath this WMA is contaminated with technetium-99, nitrate, and hexavalent chromium, primarily from sources assumed to be within the WMA. High concentrations of tritium and carbon tetrachloride are also present from upgradient sources. The water table elevation has continued to decline but the gradient is relatively stable. The inferred flow direction has gradually shifted from southeastward to a more eastward direction with the decline in water table.

The technetium-99 drinking water standard of 900 pCi/L continued to be exceeded in well 299-W23-19 located inside of the SX tank farm. This well has the highest concentration in WMA S-SX network wells (81,500 pCi/L in March). The well is located immediately adjacent to tank SX-115, where a leak occurred in the early 1960s. Concentrations have gradually increased since the well was first sampled in October 1999. The proximity of this well to a known source, and the occurrence of high technetium-99 in the vadose zone at this well location, indicates this area of the SX tank farm is the source of the observed groundwater contamination in well 299-W23-19. (The upgradient crib, 216-S-25, was ruled out as the source of the elevated technetium-99 in well 299-W23-19 because technetium-99 and gross beta measurements for three wells at the 216-S-25 crib were all less than 1,000 pCi/L for 1985 to the present). Technetium-99 concentrations also continued to exceed the standard in downgradient wells 299-W22-45, 299-W22-46, 299-W22-48 and 299-W22-50. The upward trend observed earlier in well 299-W22-45, which reached a maximum concentration in January 2000, has continued to slowly decline (Figure 2). Technetium-99 concentrations in new well 299-W22-48, on the other hand, have steadily increased to a maximum of 2,950 pCi/L in March.



Nitrate continued to exceed the 45-mg/L maximum contaminant level in upgradient wells 299-W23-9 and 299-W23-21 and in well 299-W23-19 (606 mg/L in March). Concentrations remained at or near the maximum contaminant level in downgradient well 299-W22-45 and 299-W22-48 (see Figure 2). The elevated nitrate in well 299-W23-19 is consistent with the high and increasing concentrations of technetium-99 in this well. The technetium-99/nitrate ratio is similar to the expected ratio for the contents of the single shell tanks adjacent to the well.

The maximum contaminant level (100  $\mu\text{g/L}$ ) for chromium was not exceeded in any of the downgradient network wells. However, the concentration in well 299-W23-19 (inside the SX tank farm) exceeded the maximum contaminant level for the second time in March (138  $\mu\text{g/L}$ ). Elevated chromium is expected in this well since it is one of the mobile tank waste contaminants.

The tritium drinking water standard of 20,000 pCi/L continued to be exceeded in both upgradient and downgradient wells. The highest concentrations for this quarter occurred in wells closest to and directly downgradient from the 216-S-25 crib. Concentrations in wells 299-W23-9, 299-W23-21 and 299-W23-19 were 155,000, 48,600 and 112,000 pCi/L, respectively. Concentrations were just above the drinking water standard in downgradient wells 299-W22-39, 299-W22-46, 299-W22-49 and 299-W22-50. The primary source of tritium in these wells is attributed to residual contamination from past-practice discharges to upgradient cribs (e.g. 216-S-25) as well as to tank leakage.

Carbon tetrachloride exceeded the 5- $\mu\text{g/L}$  maximum contaminant level in both upgradient and downgradient wells. During the quarter, the highest concentration, 190  $\mu\text{g/L}$ , occurred in downgradient well 299-W23-15. The highest concentration (150  $\mu\text{g/L}$ ) in network wells for the previous quarter occurred in upgradient well 299-W23-4. Carbon tetrachloride in groundwater beneath WMA S-SX is attributed to past-practice liquid waste disposal to various Plutonium Finishing Plant cribs, trenches and ponds. The specific location of the groundwater source area and pathway to WMA S-SX wells is unclear.

Uranium in well 299-W23-19 was 25.8  $\mu\text{g/L}$  in March. Uranium in the other downgradient wells for WMA S-SX ranged from 3 to 15  $\mu\text{g/L}$ , as compared to a mean natural background uranium concentration of 2.5  $\mu\text{g/L}$ . Most of the uranium in excess of the natural background level is attributed to upgradient, past-practice sources.

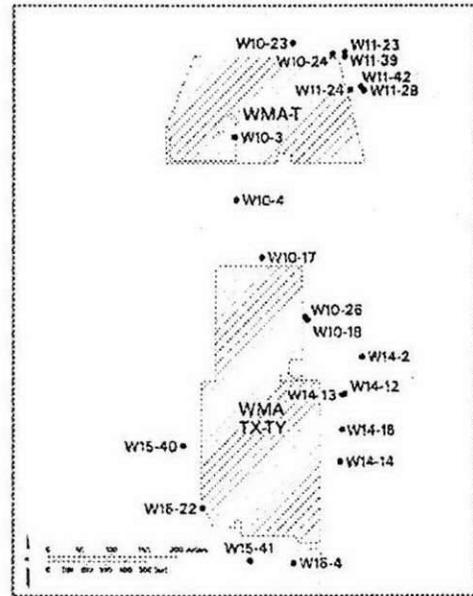
Iron exceeded the secondary maximum contaminant level of 50  $\mu\text{g/L}$  in well W23-19 (94  $\mu\text{g/L}$  in March) and in downgradient well 299-W22-39 (69  $\mu\text{g/L}$  in January). The iron concentration in March for well 299-W22-49 (the replacement for 299-W22-39) was 42  $\mu\text{g/L}$ . There were no exceedances for manganese and aluminum in network wells for this quarter.

**Single-Shell Tanks WMA T and TX-TY:** Water levels near these waste management areas continued to decline this quarter. While the water table has continued to drop, the gradient has changed little; therefore the rate and direction of groundwater flow have not changed during the quarter. As reported previously, groundwater flow directions have been affected by the 200-ZP-1 groundwater remediation. Groundwater flow is to the east or slightly north of east beneath T tank farm, to the east or east-southeast beneath TY tank farm, and to the south or south-southeast beneath the TX tank farm.

**WMA T.** Technetium-99 concentrations in well 299-W10-24 decreased from 1,770 pCi/L in December to 1,450 pCi/L in February. Ratio studies indicate that the groundwater sampled in this well is a mixture of high technetium-99 water, similar to that sampled in well 299-W11-27, and a low technetium, high nitrate water representative of the more transmissive aquifer in the lower portion of the screened interval. Well 299-W11-23, a non-RCRA well located ~30 meters east of 299-W10-24, could not be sampled in February. Technetium-99 concentration in this well was 4,470 pCi/L in December 2000 and the highest recorded technetium-99 value in this well was 8,540 pCi/L in November 1998. The technetium-99 concentration reported for replacement well 299-W11-39 in February was 4,370 pCi/L.

The nitrate concentration in well 299-W10-4, a non-RCRA well located south of WMA T, increased to 810 mg/L in February, down from a high of 1,049 mg/L in December 1999. Chromium increased slightly to 196  $\mu\text{g/L}$  and fluoride increased to 2,400  $\mu\text{g/L}$ . The probable origin of these contaminants is past waste disposal at facilities associated with the Plutonium Finishing Plant.

Nitrite concentrations in downgradient wells 299-W11-24 and 299-W11-28, on the east side of WMA T, continued to be high and variable. Nitrite is normally undetected in Hanford Site groundwater, but in February nitrite was reported at 10,200  $\mu\text{g/L}$  in well 299-W11-24 and 850  $\mu\text{g/L}$  in well 299-W11-28. The



concentration in well 299-W11-24 exceeds the maximum contaminant level of 3,300 µg/L. These wells consistently have elevated concentrations of iron, manganese, and nickel and relatively low concentrations of chromium and technetium-99. The high nitrite, iron, and manganese, coupled with low technetium-99 and chromium are indicative of very reducing conditions; however, the reason for this condition is unknown.

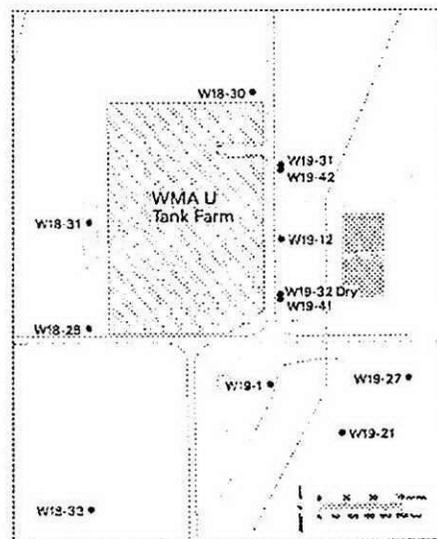
**WMA TX-TY.** Groundwater chemistry in well 299-W10-17 did not change significantly since the last sampling. Nitrate, which has been slowly increasing over the past several years, continued to exceed the maximum contaminant level and dropped slightly to 226 mg/L in February, while chromium, fluoride, and technetium-99 were below applicable standards. This was one of the wells that initially placed WMA TX-TY in assessment but it is no longer downgradient of the WMA. It apparently is intercepting part of the high nitrate plume also seen in well 299-W10-4 to the north.

Technetium-99 concentrations decreased to 3,360 pCi/L in well 299-W14-13. Well 299-W14-2 could not be sampled in February and will be replaced by a new RCRA well in late FY 2001 or early FY 2002. Nitrate (225 mg/L) and chromium (205 µg/L) also exceeded maximum contaminant levels in well 299-W14-13. Technetium-99 and chromium concentrations are similar to the contaminant signature initially detected in well 299-W14-12; however, the chromium/technetium-99 ratio seems to have increased, indicating that there may be more than one source location within the tank farms. Previous high values of technetium-99 and chromium were detected when groundwater flowed toward the northeast. Presently groundwater flow in the area around well 299-W14-13 is toward the southeast.

The high tritium groundwater plume first noted in well 299-W14-2 now includes well 299-W14-13, and possibly well 299-W14-15. This quarter tritium levels decreased to 1,110,000 pCi/L in well 299-W14-13, but increased to 19,100 pCi/L in well 299-W14-15. Iodine-129 concentrations also continued to be elevated in 299-W14-13, decreasing to 16 pCi/L. The source of the high tritium/iodine-129 component is unclear, but the most likely source is operational leaks from the nearby 242-T Evaporator, which was closed in the early 1970s. The increase in tritium in well 299-W14-15 may indicate that the tritium plume is migrating southward under the influence of the 200-ZP-1 pump-and-treat operation

In March 2000 the first sampling of new well 299-W15-41, located along the southern margin of WMA TX-TY, indicated a technetium-99 concentration of 1,980 pCi/L. The concentration decreased in May 2000, then increased, reaching 1,360 pCi/L in February 2001. Nearby dry well 299-W15-4 previously had concentrations up to 982 pCi/L.

**Single-Shell Tanks Waste Management Area U.** This WMA was placed into assessment after specific conductance in downgradient well 299-W19-41 exceeded the critical mean of 273 µg/L in August 1999. The assessment report concluded that the elevated specific conductance was from the WMA and due to elevated concentrations of non-hazardous constituents calcium, magnesium, chloride, and sulfate. Nitrate and technetium-99 were present as co-contaminants and they have increased over the past several years, though concentrations are well below their respective drinking water standards. Chromium concentrations in downgradient wells generally have exceeded background levels, but similar levels were also observed in upgradient well 299-W18-25 in early 2000 before it went dry.

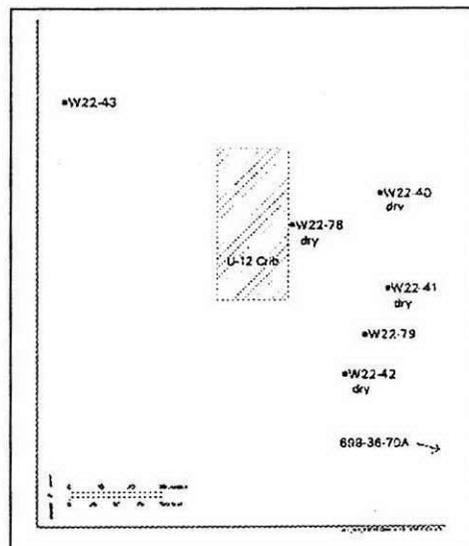


Overall there was little change in groundwater chemistry from

previous quarters. During the quarter, specific conductance in downgradient wells 299-W18-30, 299-W19-12, and 299-W19-41 exceeded the critical mean value indicating that the WMA is still affecting groundwater quality. Major non-hazardous constituents reported previously continue to be the cause of the elevated specific conductance levels. Nitrate and technetium-99 remain as co-contaminants in downgradient wells 299-W19-12 and 299-W19-41. Nitrate has continued to increase in concentration in the two wells to about 25 mg/L. Nitrate has also continued to rise in upgradient well 299-W18-31, but at only 20% of the level found in the downgradient wells. Therefore, the increasing nitrate concentrations downgradient of the WMA can be attributed to the WMA. Technetium-99 remained elevated in both downgradient wells but at levels less than the maximum contaminant level.

200-ZP-1 pumping well 299-W15-37, located approximately 70 meters northwest of WMA U, was shut down on January 17. Weekly water level measurements in nearby wells, initiated last year, and data from pressure transducers installed in wells 299-W18-31 and 299-W19-42 were used to evaluate groundwater flow directions and effects of shutting off the pumping well. The assessment indicated that all of the wells in the immediate vicinity of the WMA behave identically with a distinct and nearly equal gradient between upgradient and downgradient wells across the WMA. These data showed that groundwater flow varies between 5° to 12° north of east in the north and south halves of the WMA. Transducer data were used to show that the pumping well had an effect on groundwater beneath the WMA, but the effect was small and equal across the WMA.

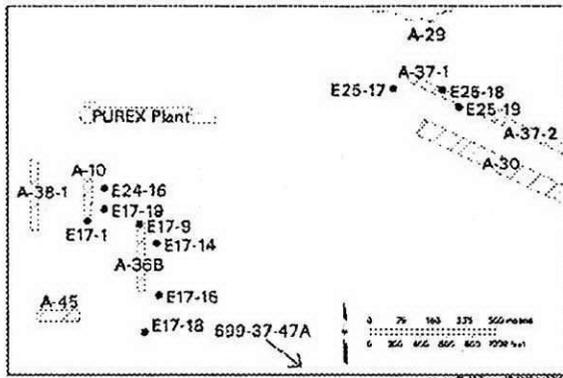
**216-U-12 Crib:** The current groundwater assessment monitoring network for the 216-U-12 Crib consists of only two downgradient wells (299-W22-79 and 699-36-70A). The wells were sampled in mid-March 2001. Concentrations for the contaminants were varied; some declining and some increasing slightly during the quarter, but all are expected to continue to decline. Water levels were not reported for this quarter. Previous data from the last sample event in December 2000 indicated that the downgradient two-well network is still monitoring releases from the 216-U-12 Crib. The groundwater flow direction beneath the crib is toward the east-southeast.



Specific conductance in both downgradient wells continued to decline. Specific conductance in downgradient well 299-W22-79 was 310  $\mu\text{S}/\text{cm}$ , which is below the critical mean (457.8  $\mu\text{S}/\text{cm}$ ). Specific conductance in downgradient well 699-36-70A is 555  $\mu\text{S}/\text{cm}$ . The nitrate concentration in well 299-W22-79 declined to 37 mg/L, below the 45 mg/L maximum contaminant level. The nitrate concentration in 699-36-70A continued to exceed the maximum contaminant level; the March result was 104 mg/L, a slight increase from the previous quarter. Technetium-99 results were essentially unchanged and far below the drinking water standard in well 299-W22-79. In well 699-36-70A technetium-99 increased to 92 pCi/L from a previous concentration of 60 pCi/L.

Tritium and iodine-129, regional contaminants not associated with the 216-U-12 crib, were not analyzed this quarter for well 299-W22-79. Only iodine-129 was analyzed in 699-36-70A this quarter; results for March were up to 16.7 pCi/L from 13.3 pCi/L during December.

**PUREX Cribs (216-A-10, 216-A-36B, and 216-A-37-1):** One well near each of the three cribs was sampled during January 2001. The wells are 299-E17-14 near the 216-A-36B crib, 299-E24-16 near the 216-A-10 crib, and 299-E25-19 near the 216-A-37-1 crib.



Manganese, nitrate, gross beta, strontium-90, iodine-129, and tritium continued to exceed drinking water standards during the quarter at near-field wells of the PUREX Cribs monitoring well network. Far-field wells are sampled annually to once every three years for tritium, nitrate, and iodine-129, and the results are reported in the annual Hanford Site groundwater-monitoring report.

Beneath the PUREX Cribs, the differences in water table elevations from well to well are very small.

Typically the elevation difference between the lowest and highest water levels are about 0.2 m. Therefore, the water table gradient is too low to determine groundwater flow rate or flow direction reliability. However, groundwater flow directions determined from the movement of groundwater contaminant plumes indicate that the regional flow is toward the southeast.

Manganese concentrations in filtered samples from well 299-E25-19 have been generally increasing since 1997 (Figure 3). A January 2001 sample had a concentration of 52  $\mu\text{g/L}$ , just above the drinking water standard of 50  $\mu\text{g/L}$ . It is not clear whether the elevated manganese is due to a released from the 216-A-37-1 crib or whether it is from corrosion of the carbon steel casing (the well is not compliant with WAC 173-160).

The nitrate concentration at well 299-E17-14 near the 216-A-36B crib continued to exceed the maximum contaminant level (45 mg/L). The concentration was 105 mg/L in January 2001. Since 1998 the trend has been decreasing gradually.

Strontium-90 remained above the drinking water standard (8 pCi/L) at well 299-E17-14 near 216-A-36B crib. In January 2001 the concentration was 17 pCi/L. The trend is steady to slightly rising. Because strontium-90 is a beta-emitter, the strontium-90 results are associated with elevated gross beta levels, which were  $\sim 50$  pCi/L in January.

Iodine-129 concentrations remained above the 1 pCi/L drinking water standard at the two wells near the 216-A-36B and 216-A-10 cribs. Well 299-E17-14 near the 216-A-36B crib had 9 pCi/L of iodine-129 in January. The short-term trend is variable but remains fairly steady with greater time. Well 299-E24-16 near the 216-A-10 crib had an iodine-129 concentration of 8 pCi/L in January 2001, part of a steady trend.

Tritium concentrations remained above the drinking water standard (20,000 pCi/L) at all three wells sampled in January 2001. The trend generally was decreasing until approximately 1998 when concentrations tended to stabilize except for well 299-E17-14 near the 216-A-36B crib where the trend continued to decline (see Figure 3). The highest concentration in January was in well 299-E17-14 where duplicates measured 758,000 and 754,000 pCi/L.

### Quality Control

Results of the RCRA quality control program for the January-March quarter are discussed in the Appendix. Quality control data that are not available in HEIS are available in electronic form upon request. The quality control program indicated that the data were acceptable for use in the statistical comparisons discussed above.

References:

(1) John G. Morse, RL, to Jane Hedges, Ecology. "Notification of Specific Conductance Exceedance at the Non-Radioactive Dangerous Waste Landfill (NRDWL)," May 21, 2001, 01-GWVZ-023.

(2) John G. Morse, RL, to Jane Hedges, Ecology. "Results of Assessment at the Non-Radioactive Dangerous Waste Landfill (NRDWL)," June 7, 2001.

Table 1. Status of RCRA Sites, January-March, 2001.

Site	Routine sampling Jan-Mar 2001	Statistical exceedance
Indicator Evaluation Sites [40 CFR 265.93(b)] (sampled semiannually)		
1301-N Facility	Yes	No
1325-N Facility	Yes	Yes <sup>a</sup>
1324-N/NA Site	Yes	Yes <sup>a</sup>
B-Pond	Yes	No
A-29 Ditch	No	Not applicable
B-63 Trench	No	Not applicable
S-10 Pond and Ditch	Yes	No
LERF	No	Not applicable
LLBG WMA 1	No	Not applicable
LLBG WMA 2	No	Not applicable
LLBG WMA 3	Yes	No
LLBG WMA 4	Yes	Yes <sup>a</sup>
SST WMA A-AX	No	Not applicable
SST WMA C	Yes <sup>b</sup>	No
NRDWL	Yes	Yes <sup>a</sup>
Groundwater Quality Assessment Sites [40 CFR 265.93(d)] (sampled quarterly)		
Seven sites <sup>c</sup>	Yes	Not required
Final Status Sites (WAC 173-303-645)		
300 Area Process Trenches	Yes	Yes <sup>d</sup>
183-H Basins	No	Not applicable <sup>d</sup>

LERF = Liquid Effluent Retention Facility

LLBG = Low-Level Burial Grounds

NRDWL = Nonradioactive Dangerous Waste Landfill

SST = Single-Shell Tanks

WMA = Waste Management Area

<sup>a</sup> No indication of hazardous waste contamination from facility; see text for explanation.

<sup>b</sup> Due to scheduling error, no quadruplicate samples were collected in December 2000. March 2001 data were statistically evaluated, except for TOC data which were invalid.

<sup>c</sup> U-12 Crib, PUREX Cribs, SST WMAs B-BX-BY, S-SX, T, TX-TY, and U.

<sup>d</sup> Site has entered corrective action because of previous exceedances.

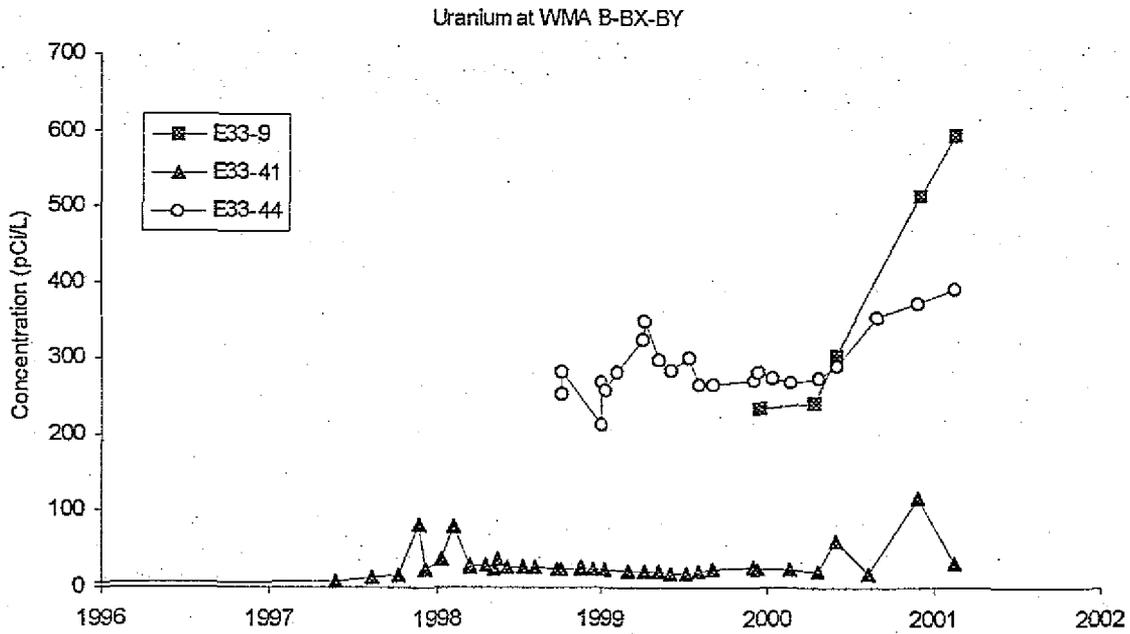
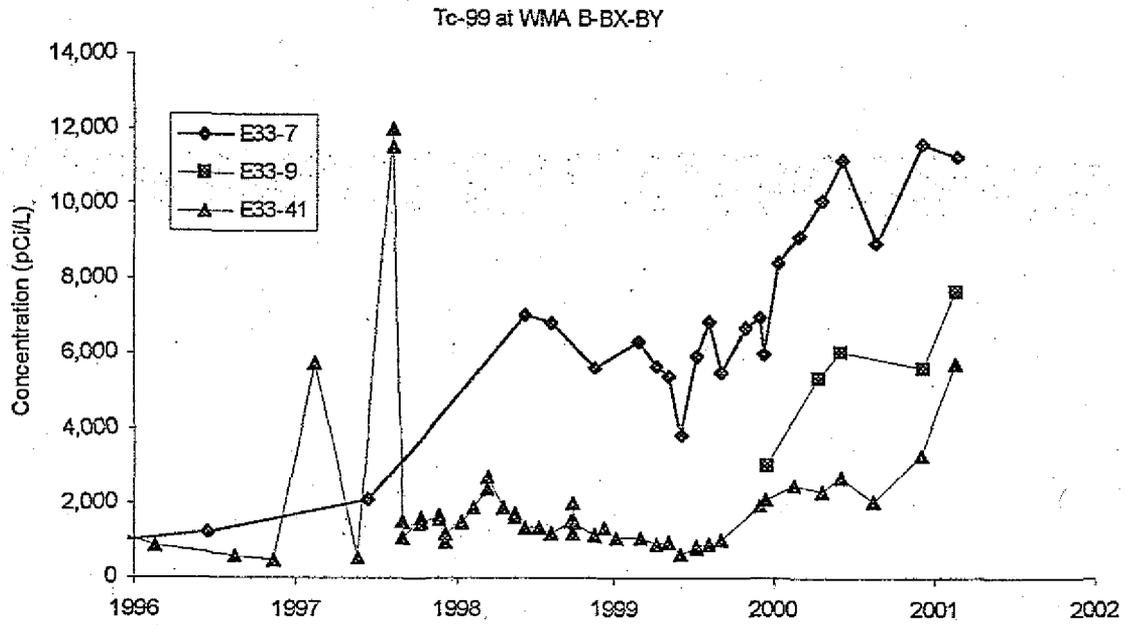


Figure 1. Technetium-99 and Uranium at Waste Management Area B-BX-BY.

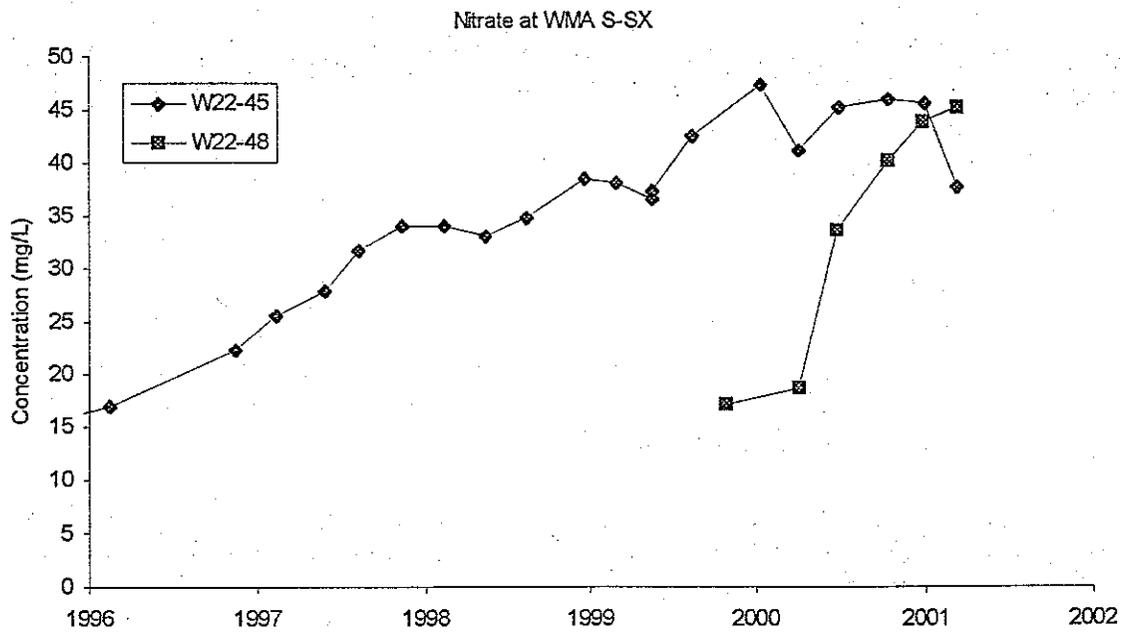
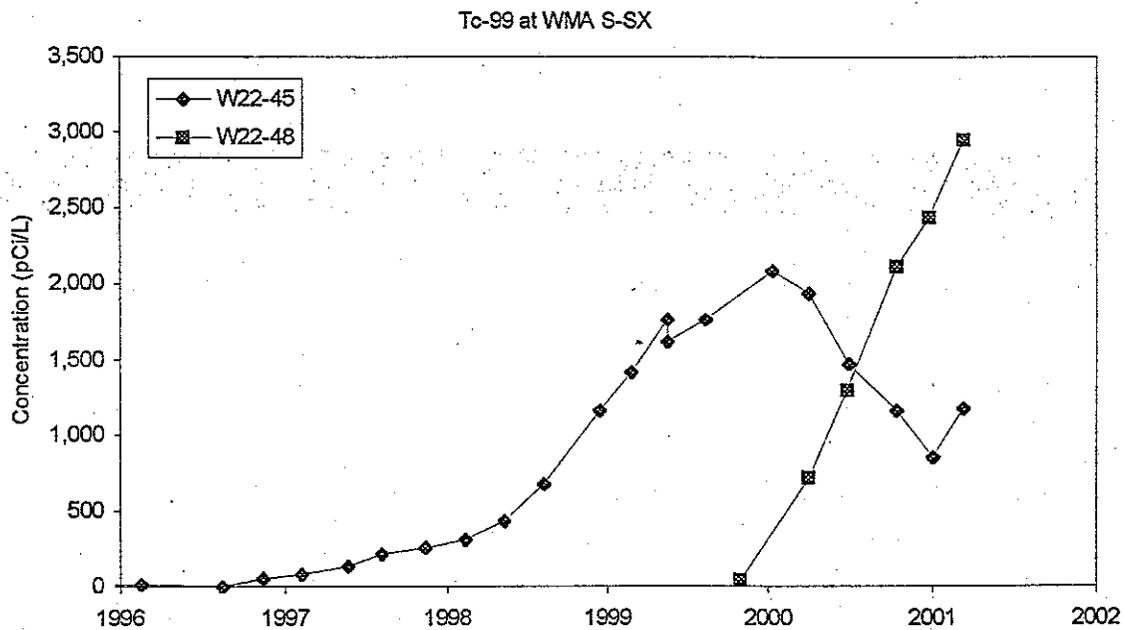


Figure 2. Technetium-99 and Nitrate at Waste Management Area S-SX.

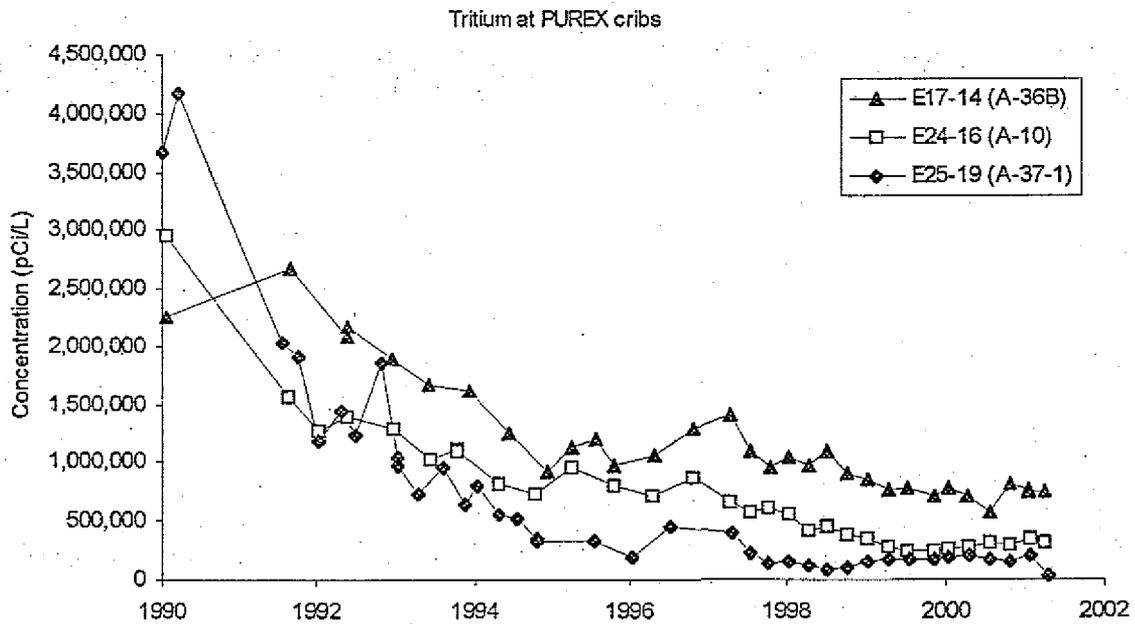
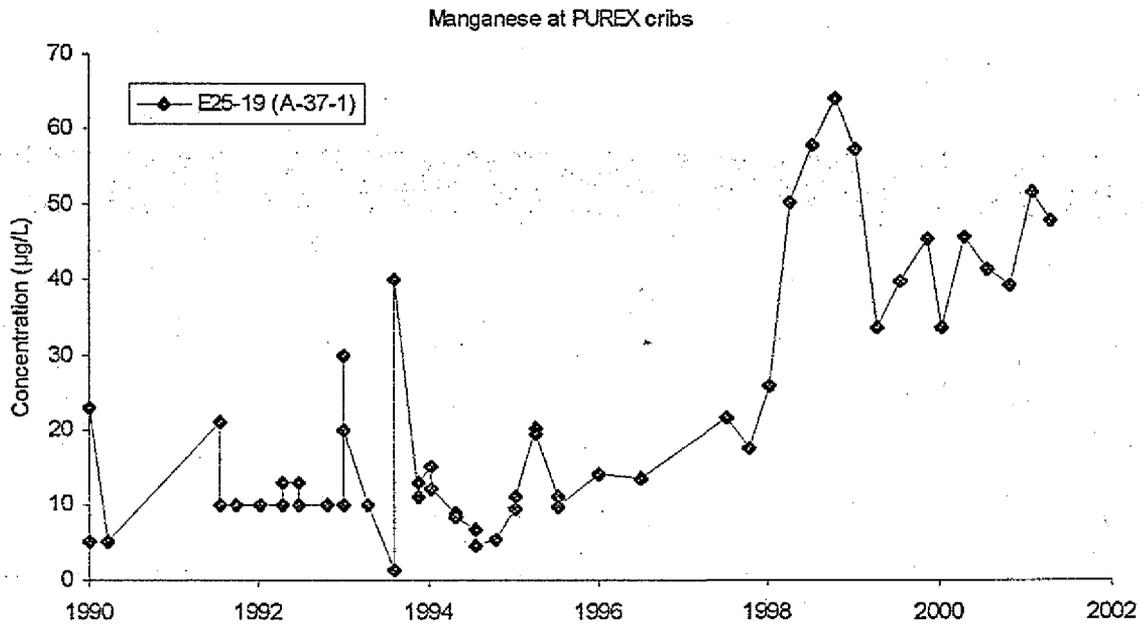


Figure 3. Manganese and Tritium at PUREX Cribs.

## Appendix: Quality Control Results, January-March, 2001.

This quality control (QC) report presents information on laboratory performance and field QC sample results for the fourth quarter of calendar year 2000.

**Completeness.** 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 data that have not been flagged with a Y, R, Q, or H, or qualified to indicate laboratory blank contamination. Ninety-one percent of the 1<sup>st</sup> quarter's 16,065 results were considered valid. This fraction is approximately the same as the overall percentage from last year. Roughly 85% of the 1<sup>st</sup> quarter flags resulted from detection of anions, metals, and total organic carbon 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.

The method used to evaluate exceeded holding times was changed slightly this quarter. In the past, holding times were tracked based on the exact time each sample was collected and analyzed. For example, if a sample with a 7-day holding time was collected on a Monday at 10:00:00 a.m. and analyzed the following Monday at 10:00:01 a.m., the result would have been flagged with an H to signify an exceeded holding time. This approach is probably stricter than it needs to be. Holding times greater than 72 hours are always specified in units of days with no decimal point. Therefore, a common practice adopted by commercial laboratories is to track holding times to the nearest time unit (e.g., hours or days) that is used to specify the holding time for a given method. Using this criterion, the holding time for the above example would not be missed until the beginning of "calendar" day 8 (i.e., Tuesday). By adopting this approach, the application of H flags will be more focused, and the flags should be slightly more useful for identifying samples that could have been affected by a delayed analysis.

One hundred ninety of the 1<sup>st</sup> quarter results were flagged with an H, based on the new criteria. Most of the flags were associated with anions (24%) and volatile organic compounds (48%), but some results for coliform, cyanide, pH, phenols, total dissolved solids, total organic carbon, and total organic halides were also flagged. Several problems contributed to the missed holding times: shipping delays, instrument failures (total organic carbon and volatile organic compounds), reanalyses triggered by unacceptable laboratory QC data, and a special request for a pH analysis (pH has a 1 day holding time). Groundwater project staff are working with the laboratory to correct these problems and reduce the number of missed holding times in the future.

### 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 1<sup>st</sup> quarter of 2001 included full trip blanks, field transfer blanks, and equipment 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 pumps or as needed for special projects. Split samples are also collected on an as-needed basis. Results from each type of QC sample are summarized below.

**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 5 times

the method detection limit or minimum detectable activity must have RPDs less than 20% to be considered acceptable. Duplicates with RPDs outside this range are flagged with a Q in the database.

Nineteen field duplicates were collected and analyzed during the 1<sup>st</sup> quarter of 2001 to produce 604 pairs of results. Overall, the results demonstrate good sampling and analysis precision. Ten pairs of qualifying duplicate results had relative percent differences greater than 20%. However, after reviewing the raw data for the results that were out of trend, it was determined that a reporting error and swapped samples at the laboratory accounted for the poor precision in 5 pairs of results (alkalinity, chloride [2 pairs], nitrate, and sulfate). In addition, acceptable precision was obtained for one of the out-of-limit result pairs after a reanalysis was performed on a sample with an out-of-trend lead result. The variability in the remaining results was slightly high but was not unusual for the analytical methods at the given concentrations.

**TOC and TOX Quadruplicates.** Samples for total organic carbon and total organic halides analyses are normally collected in quadruplicate in accordance with 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 5 times the method detection limit was considered to have poor precision. For the 1<sup>st</sup> quarter, 2 out of 71 total organic carbon quadruplicates and 5 out of 71 total organic halide quadruplicates failed to meet the evaluation criteria. Most of the quadruplicates with poor precision contained one anomalous result. Removing the outliers drops the RSDs to less than 20% in all cases except for total organic carbon for one well. The outliers' raw data was reviewed, and, although no errors were identified, the replicate precision associated with the strange total organic halide result was very poor, and the sample should have been reanalyzed. Swapped samples may be responsible for some of the other anomalous results.

**Field Blanks.** Full trip blanks, field transfer blanks, and equipment blanks are used to check for contamination resulting from field activities or bottle preparation. In general, the QC limit for blank results is 2 times the method detection limit or instrument detection limit for chemistry methods and 2 times the total propagated error for radiochemistry methods. For common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the QC limit is 5 times the method detection limit. 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 1,615 results were produced from the 1<sup>st</sup> quarter field blank samples. Approximately 2% of the results (i.e., 33 results) exceeded the QC limits for field blanks. The relative number of out-of-limit results is approximately the same as the percentage from last quarter. Most of the flagged results were for chloride and total organic carbon; however, results were also flagged for fluoride, iron, manganese, nitrate, potassium, sodium, trichloroethene, tritium, and zinc. The potential impacts on the data are minor in most cases. Chloride, fluoride, nitrate, and sodium had field blank results that were greater than the QC limits, but the values were significantly lower than the concentrations of these constituents in most 1<sup>st</sup> quarter groundwater samples. Some additional observations about the field blanks are noted below.

Eight out of 25 field blank results for total organic carbon exceeded the QC limits. All of the out-of-limit results were relatively low in concentration (i.e., within a factor of 3 of the method detection limit), but the values are disturbing due to the importance of total organic carbon for detection monitoring. Unfortunately, the reason for the field blank detections is difficult to determine. As noted last quarter, the samplers began using a new deionized water system in December. The water used to prepare the field

blanks could have been contaminated with low levels of organic carbon from the new water system. However, one of the quarter's laboratory method blank results was 640 µg/L, suggesting that the elevated results may also be related to a laboratory problem.

Unlike previous quarters, only one field blank result for volatile organic compounds exceeded the QC limits. A trace amount of trichloroethene was detected in a field transfer blank. Similar levels of trichloroethene have been detected in field blanks in the past. The absence of chloroform in this quarter's field blanks may indicate that the sampler's new deionized water system is more effective at removing chloroform from tap water than the previous water-purification system.

A relatively high tritium result of 138 pCi/L was obtained for a full-trip blank collected on March 21. Tritium may have been present in the source water used to prepare the blank. Nevertheless, the three tritium results associated with the high blank result should be viewed as suspect and were flagged in the database.

**Blind Standards.** Double-blind standards containing known amounts of selected anions, metals, organic compounds, and radionuclides were prepared and submitted to Severn Trent in February. Two special sets of standards were included in the group issued to the St. Louis laboratory. The first contained low concentrations of arsenic, antimony, cadmium, lead, selenium, and thallium for evaluating the laboratory's trace ICP capability. The second set included standards for gross alpha, gross beta, and uranium for evaluating the St. Louis laboratory's performance on frequently requested radiochemical methods. Duplicates of the total organic carbon, total organic halides, and gross beta standards were submitted to Lionville Laboratory and Eberline Services. All of the standards except those for cyanide were prepared using groundwater from background wells. Cyanide standards were prepared in deionized water. Standards for indicator analyses were spiked using the following constituents: potassium hydrogen phthalate was used to prepare total organic carbon standards, 2,4,6-trichlorophenol was used to prepare TOX-phenol standards, and TOX-VOA standards were prepared using a mixture of carbon tetrachloride and trichloroethene. Gross alpha and gross beta standards were spiked with plutonium-239 and strontium-90, respectively.

The acceptance limits for blind standard recoveries are generally 75 – 125% except for specific radionuclides, which have a ± 30% acceptance range. The majority of the 1<sup>st</sup> quarter results were acceptable, indicating good analytical performance overall. However, Severn Trent Richland had one out-of-limit result for gross beta and technetium-99. Additionally, the St. Louis laboratory had high, out-of-limit recoveries for total organic carbon and low-biased results for cadmium, cyanide, and total organic halides. Lionville Laboratory also had unacceptable results for total organic halides. Severn Trent's out-of-limit results for cyanide, gross beta, and technetium-99 appear to have resulted from isolated instances of poor accuracy and/or precision; most of the results for these analytes were acceptable. The other out-of-limit results are briefly discussed below.

Two of Severn Trent St. Louis' results for total organic carbon were out of limits, and all of the results were biased high. Laboratory staff reanalyzed the samples with unacceptable results, but the results confirmed the original values. The reasons for the elevated results are unknown, but the apparent bias may explain why some of the field blank results were also out of limits. These results, along with the elevated field blank results, will be shared and discussed with the laboratory to help troubleshoot this problem.

The total organic halide results for Severn Trent St. Louis and Lionville Laboratory were similar to those from last quarter. Both laboratories had low recoveries for the standards spiked with volatile organic compounds. Since the St. Louis laboratory's results for the trichlorophenol standards were acceptable, the reason for the low bias appears to be volatilization or weak retention of the volatile

analytes on the charcoal cartridges used in the analysis. This is a recurring problem that appears to be inherent with the method when volatile analytes are analyzed. An additional problem appeared to affect Lionville Laboratory's results, because the trichlorophenol standards also had low recoveries. This is the fourth quarter in a row that Recra/Lionville Laboratory has had unacceptable results for the trichlorophenol standards. Since data rechecks and reanalyses have failed to resolve the problems with the results, no additional total organic halide standards are planned for Lionville Laboratory.

Overall, Severn Trent St. Louis performed well on the trace-ICP standards. With the exception of cadmium, all of the results were within the acceptance limits. The cadmium recoveries were approximately 40%, and reanalyses of the samples produced non-detected results. These results are somewhat surprising, since the standards were prepared using a certified standard, and the spiked concentrations were approximately 8 times greater than the laboratory's detection limit. Additional standards containing low levels of cadmium will be submitted to the St. Louis laboratory during the 3<sup>rd</sup> quarter to further investigate the situation. For the other metals included in the standards, the trace-ICP analysis appears to be a viable alternative to traditional graphite furnace atomic absorption spectroscopy, which tends to be plagued by poor precision.

All of the results for the radiological standards submitted to the St. Louis laboratory were within the acceptance limits, although one of the samples for gross beta required reanalysis before an acceptable value was reported. These results suggest that the St. Louis laboratory may be able to serve as another reliable backup laboratory for some of the more common radiochemical analysis methods. Additional blind standards for regular (i.e., not trace-level) tritium analyses are planned for the St. Louis laboratory for the 4<sup>th</sup> quarter.

#### Laboratory QC Data

**ERA Water Supply/Water Pollution Programs.** Severn Trent-St. Louis (STL-St. Louis) and Lionville Laboratory participate in the EPA sanctioned Water Supply/Water Pollution (WS/WP) Performance Evaluation studies conducted by New York State (Environmental Laboratory Approval Program (ELAP)) and Environmental Resources Associates (ERA), respectively. 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. 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.

For the two ELAP studies received from STL-St. Louis this quarter (ELAP-237 and ELAP-240), the percentages of acceptable results were 92% and 94%, respectively. Of the 17 constituents with unacceptable results, none were out of limits more than once. Two of the 17 constituents, BOD and Kjeldahl nitrogen, were not reported. Three others (dicamba, isopropylbenzene, and p-isopropyltoluene) were incorrect because of reporting errors. The total dissolved solids result was high; laboratory staff think this was caused either by a dilution error or a reporting error. Dichlorodifluoromethane and vinyl chloride results were both high as a result of a calibration bias; laboratory staff believe this was probably caused by degradation of the compounds in the calibration standard. Carbon tetrachloride also had a high result associated with a calibration bias. Mercury results were low, possibly because of sample instability. No cause or corrective action was reported for the low results for total organic carbon, ammonia, 2-chloroethylvinyl ether, endosulfan sulfate, or total hardness. No cause or corrective action was reported for the high results for alkalinity or specific conductance.

**Mixed Analyte Performance Evaluation Program.** The Mixed Analyte Performance Evaluation Program (MAPEP) is conducted by the Department of Energy. In this program, samples containing metals, volatile and semivolatile organic compounds, and radionuclides are sent to participating laboratories in January and July. New MAPEP results for aqueous samples were not available this quarter.

**InterLaB RadChem Proficiency Testing Program Studies.** The InterLaB RadChem Proficiency Testing Program, conducted by Environmental Resource Associates (ERA), is a replacement for the EPA's National Exposure Research Laboratory performance evaluation studies. Control limits are based on the National Standards for Water Proficiency Testing Studies Criteria Document, December 1998.

The results from four RadChem studies were received from STL-Richland this quarter (RAD-32, 34, 35, 36). No unacceptable results were reported. The following were analyzed with acceptable results: iodine-131, radium-226, radium-228, strontium-89, strontium-90, tritium, and uranium (natural). Eberline Services does not participate in the RadChem performance evaluation studies.

**Department of Energy Quality Assessment Program.** This program is conducted by the Environmental Measurements Laboratory 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 historic data distributions from data collected from 1982 to 1992. Acceptable results should fall within the 15<sup>th</sup> and 85<sup>th</sup> percentile of the cumulative normalized distribution. Results are within warning limits if they fall between the 5<sup>th</sup> and 15<sup>th</sup> percentile or the 85<sup>th</sup> and 95<sup>th</sup> percentile. Results less than the 5<sup>th</sup> percentile or greater than the 95<sup>th</sup> percentile are "not acceptable." Preliminary results were reported for QAP 54. All of the results for STL-Richland were acceptable, although americium-241, uranium-234, and uranium-238 were within the warning limits. One result from Eberline Services was not acceptable, viz., gross alpha. The other results for Eberline were acceptable, but uranium was within the warning limits.

**Laboratory QC Data from STL.** 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 method detection limit or instrument detection limit for chemical constituents and two times the total propagated error 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 method detection limit. Results for laboratory control samples, matrix spikes, and surrogates are evaluated by comparing the actual percentages recovered with minimum and maximum control limits. For matrix duplicates, only those samples with values five times greater than the method detection limit or total propagated error are considered. Quantifiable matrix duplicates are evaluated by comparing the relative percent difference with an acceptable 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 80-120%, significantly out-of-limits would mean less than 70% or greater than 130%).

Most of the first quarter laboratory QC results were within acceptance limits, suggesting that the analyses were in control and reliable data were generated. Some of the more significant findings from the laboratory QC data include the following:

- Several method blank results exceeded the QC limits for conductivity, chloride, cyanide, beryllium, cadmium, and tritium.
- For most of the constituents with method blanks that were significantly out of limits, (i.e., cyanide, nitrogen in nitrate, methylene chloride, beryllium, cadmium, iron, and tritium), a number of Hanford groundwater sample results were less than five times the blank values.
- Cyanide, phenol, and uranium-235 had laboratory control sample results that were significantly out of limits. Some phenol results were significantly out of limits last quarter as well.
- For ammonia and anions and for radiochemistry parameters, the percentages of matrix spikes and matrix spike duplicates that were out of limits this quarter were lower than for last quarter. Ammonia and anions and radiochemistry parameters had several constituents with results that were significantly out of limits. Trichloroethene, phenol and 4-nitrophenol also had some results that were significantly out of limits.
- Matrix spike duplicates were significantly out of limits for two anions, chloride and cyanide, and for several radiochemistry parameters, viz., gross beta, iodine-129, and uranium. The number of results that were significantly out of limits was lower than the total for last quarter.

**Laboratory QC Data from Eberline Services and Lionville Laboratory.** First quarter QC data from Eberline are limited to gross beta. All the QC data except the matrix duplicate were within limits. First quarter QC data from Lionville Laboratory are limited to total organic carbon and total organic halides. All the associated laboratory QC data were within limits.