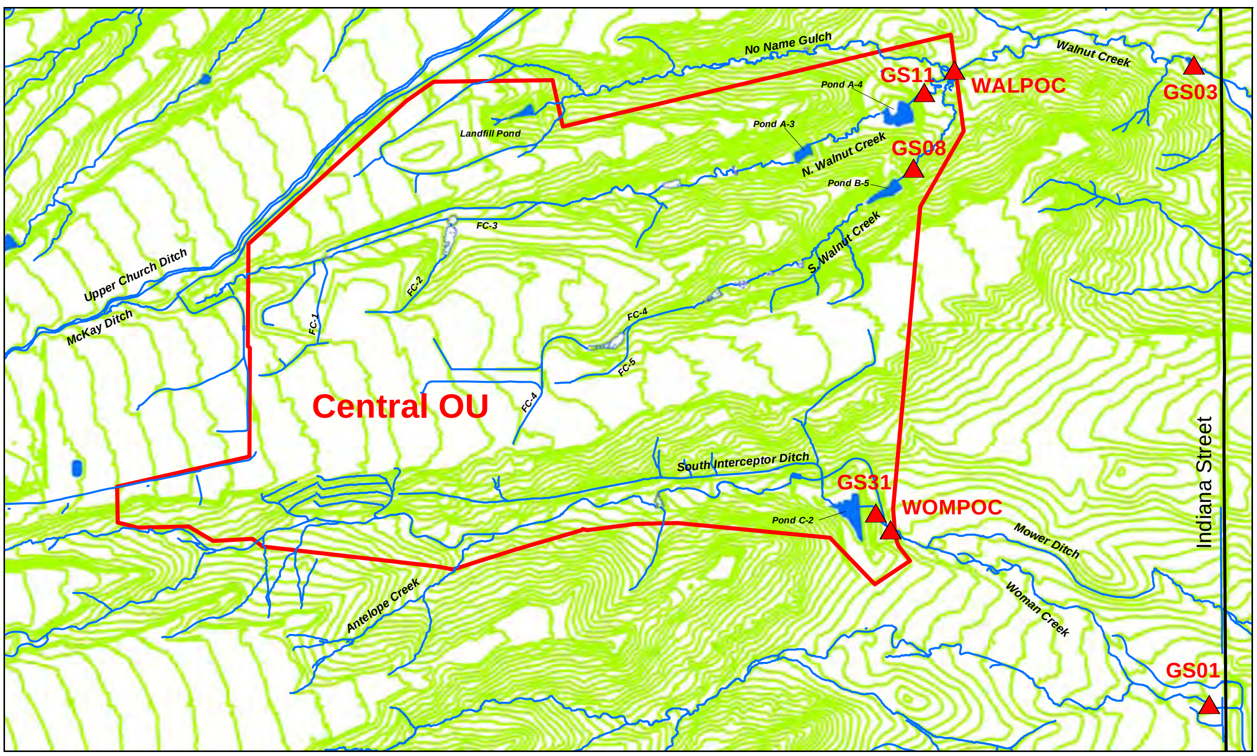
that they may be strongly affected by well replacement and do not reflect only groundwater geochemistry and hydrology.

3.1.2 Routine Monitoring

3.1.2.1 POC Monitoring

This objective deals with monitoring discharges from the Site into Woman and Walnut creeks and streamflow downstream at Indiana Street to demonstrate compliance with surface-water quality standards (Table 1 of RFLMA Attachment 2). Water-quality data at POCs are reportable under RFLMA when the applicable compliance parameters are greater than the corresponding Table 1 values (see Appendix D). Terminal pond discharges were formerly monitored by POCs GS11, GS08, and GS31. However, two new POCs at the eastern COU boundary replaced GS08, GS11, and GS31 in September 2011. WALPOC on Walnut Creek and WOMPOC on Woman Creek became operational on September 9, 2011, and September 28, 2011, respectively. Walnut Creek is monitored at Indiana Street by POC GS03. Woman Creek is monitored at Indiana Street by POC GS01. These locations are shown on Figure 4. Sampling and data evaluation protocols are summarized in Table 5.



Notes: WALPOC started operation as a POC on September 9, 2011; GS08 and GS11 ceased being POCs also on September 9, 2011. WOMPOC started operation as a POC on September 28, 2011; GS31 ceased being a POC also on September 28, 2011.

Figure 4. POC Monitoring Locations

Table 5. Sampling and Data Evaluation Protocols at POCs

Location Code	Location Description	Sample Types/Frequencies	Analytes	Data Evaluation
GS01	Woman Creek at Indiana Street	Continuous flow-paced composites; frequency varies (target is 25−30 per year)[a]	total Pu, Am, and U [TSS[d]]	See Figure 5 in Appendix D
GS03	Walnut Creek at Indiana Street	Continuous flow-paced composites; frequency varies (target is 25−30 per year)[a]	total Pu, Am, U, and nitrate[b, c] [TSS[d]]	See Figure 5 in Appendix D
WOMPOC[e]	Woman Creek at Eastern COU Boundary	Continuous flow-paced composites; frequency varies (target is 25−30 per year)[a]	total Pu, Am, and U [TSS[d]]	See Figure 5 in Appendix D
WALPOC[f]	Walnut Creek at Eastern COU Boundary	Continuous flow-paced composites; frequency varies (target is 25−30 per year)[a]	total Pu, Am, U, and nitrate[c] [TSS[d]]	See Figure 5 in Appendix D
GS08[f]	Pond B-5 Outlet	Continuous flow-paced composites; frequency varies (target is 0−14 per year)	total Pu, Am, U, and nitrate[b]	See Figure 5 in Appendix D
GS11[f]	Pond A-4 Outlet	Continuous flow-paced composites; frequency varies (target is 0−14 per year)	total Pu, Am, U, and nitrate[b]	See Figure 5 in Appendix D
GS31[e]	Pond C-2 Outlet	Continuous flow-paced composites; frequency varies (target is 0−7 per year)	total Pu, Am, and U	See Figure 5 in Appendix D

Notes: [a] Frequency depends on available flow; samples are segregated by water origin (baseflow only or including pond discharge). With the implementation of of flow-through operations in September 2011, samples are no longer segregated by water origin.

[b] Collected during batch pond discharges as daily grabs samples that are composited over 2–4 day periods (grab samples are collected instead of flow-paced composites to meet holding time and preservation requirements; nitrate is analyzed as nitrate+nitrite as nitrogen; this result is conservatively compared to the nitrate standard only).

[c.] Collected during flow-through pond discharge periods as grab samples collected at the start of each automated composite sample period. If there is no flow when the automated composite sample is started, then the nitrate grab is collected at the (nitrate is analyzed as nitrate+nitrite as nitrogen; this result is conservatively compared to the nitrate standard only).

[d] Total suspended solids (TSS) is analyzed when the composite sampling period is within TSS holding-time limits.

[e] GS31 was operated as a POC through September 27, 2011; once WOMPOC started operation as a POC on September 28, 2011, GS31 was no longer a POC.

[f] GS08 and GS11 were operated as POCs through September 8, 2011; once WALPOC started operation as a POC on September 9, 2011, GS08 and GS11 were no longer POCs.

The following sections include summary tables and plots showing the applicable 30-day and 12-month rolling averages for the POC analytes. The evaluations include all results that were not rejected through the data verification and validation process. Data are generally presented to decimal places as reported by the laboratories. Accuracy should not be inferred; minimum detectable concentrations, activities, and analytical errors are often greater than the precision presented. When a sample has a corresponding field duplicate, the value used in calculations is the arithmetic average of the “real” and “duplicate” values. When a sample has multiple “real” analyses (Site-requested “reruns”), the value used in calculations is the arithmetic average of the multiple “real” analyses.[5]

Refer to Appendix B, which contains the water-quality data, for further information.

Location GS01

Monitoring location GS01 is located on Woman Creek at Indiana Street (Figure 4). The Woman Creek headwaters, the southern portion of the COU, and Pond C-2 contribute flow to GS01.

Table 6 shows that all of the annual average Pu and Am activities were well below the RFLMA standard of 0.15 picocuries per liter (pCi/L). Additionally, the long-term Pu and Am averages (1997–2011) are well below 0.15 pCi/L. The average total U concentrations are all well below the RFLMA standard of 16.8 micrograms per liter (µg/L).

Table 6. Annual Volume-Weighted Average Radionuclide Activities at GS01 for 1997−2011

Calendar Year	Volume-Weighted Average		
	Am-241 (pCi/L)	**Pu-239,240 (pCi/L)**	**Total U (µg/L)**
1997	0.003	0.007	NA
1998	0.006	0.006	NA
1999	0.005	0.008	NA
2000	0.004	0.003	NA
2001	0.004	0.006	NA
2002	0.002	0.001	NA
2003	0.002	0.004	1.60
2004	0.003	0.002	4.58
2005	0.004	0.003	3.22
2006	0.012	0.003	6.06
2007	0.002	0.007	1.40
2008	0.002	0.003	5.74
2009	0.003	0.007	2.75
2010	0.005	0.010	2.39
2011	0.003	0.003	5.16
Total (1997−2011)	0.004	0.006	2.46

Notes: Collection of total U data began on February 3, 2003. NA = not applicable.

[5] Significant differences in values for a data pair are an indication of potential problems with sample preparation or analysis. Under these circumstances, an applicable value to be used for comparison cannot be determined with sufficient confidence to make compliance decisions. Thus, an evaluation of the relative error ratio (RER) or relative percent difference (RPD), depending on the analyte, is required to assess the representativeness of the sample and its usability for compliance decisions (see Section 11.2.3 of the RFSOG for discussion).

Figure 5 and Figure 6 show no occurrences of reportable 30-day averages for the year.

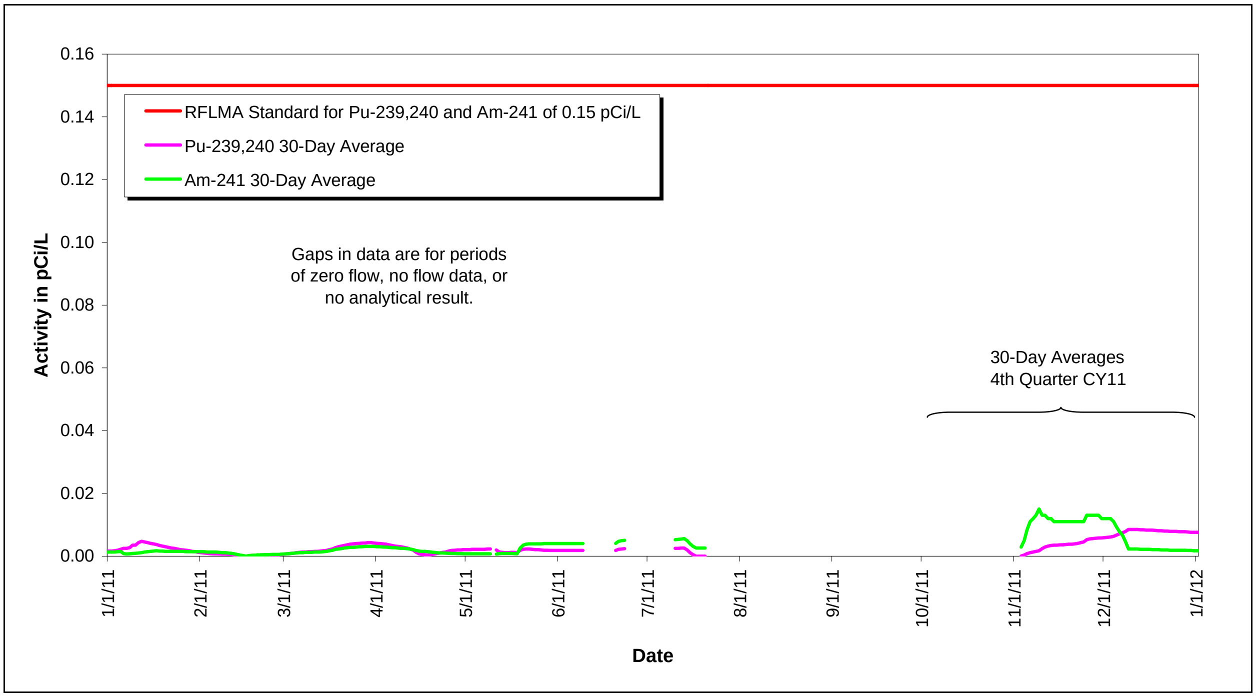


Figure 5. Volume-Weighted 30-Day Average Pu and Am Activities at GS01: Calendar Year Ending Fourth Quarter CY 2011

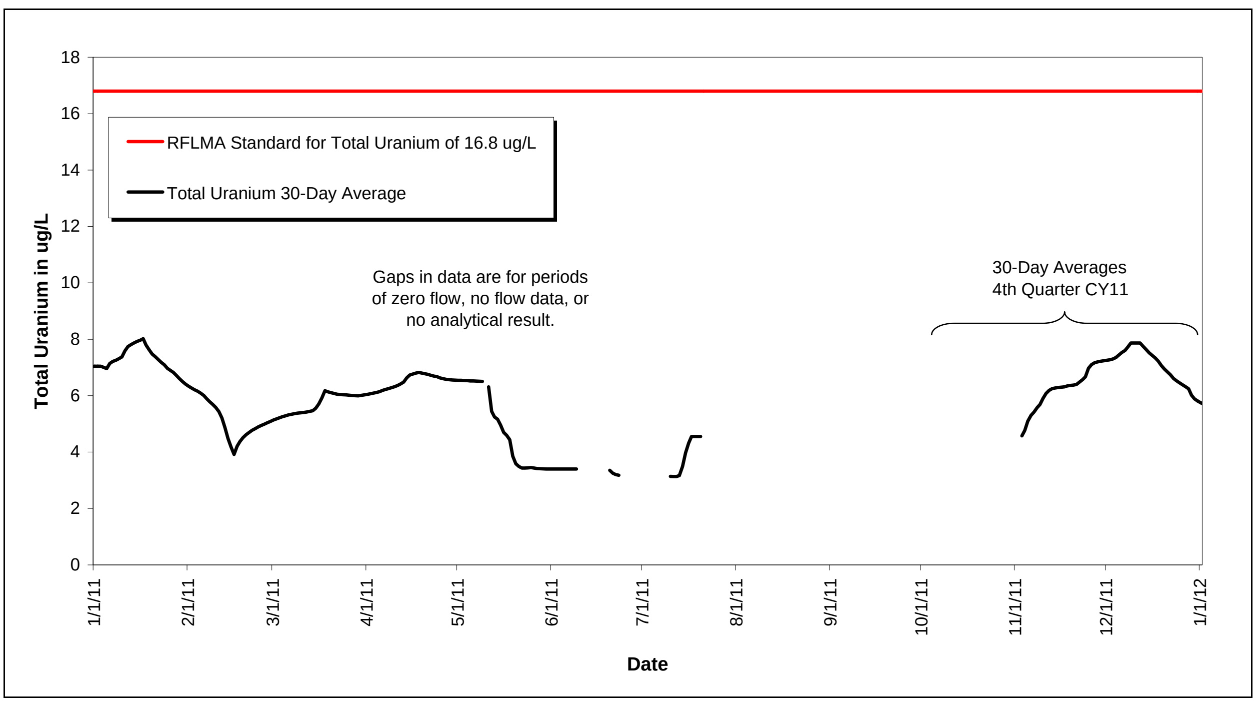


Figure 6. Volume-Weighted 30-Day Average Total U Concentrations at GS01: Calendar Year Ending Fourth Quarter CY 2011

Figure 7 and Figure 8 show similar data for the entire post-closure period.

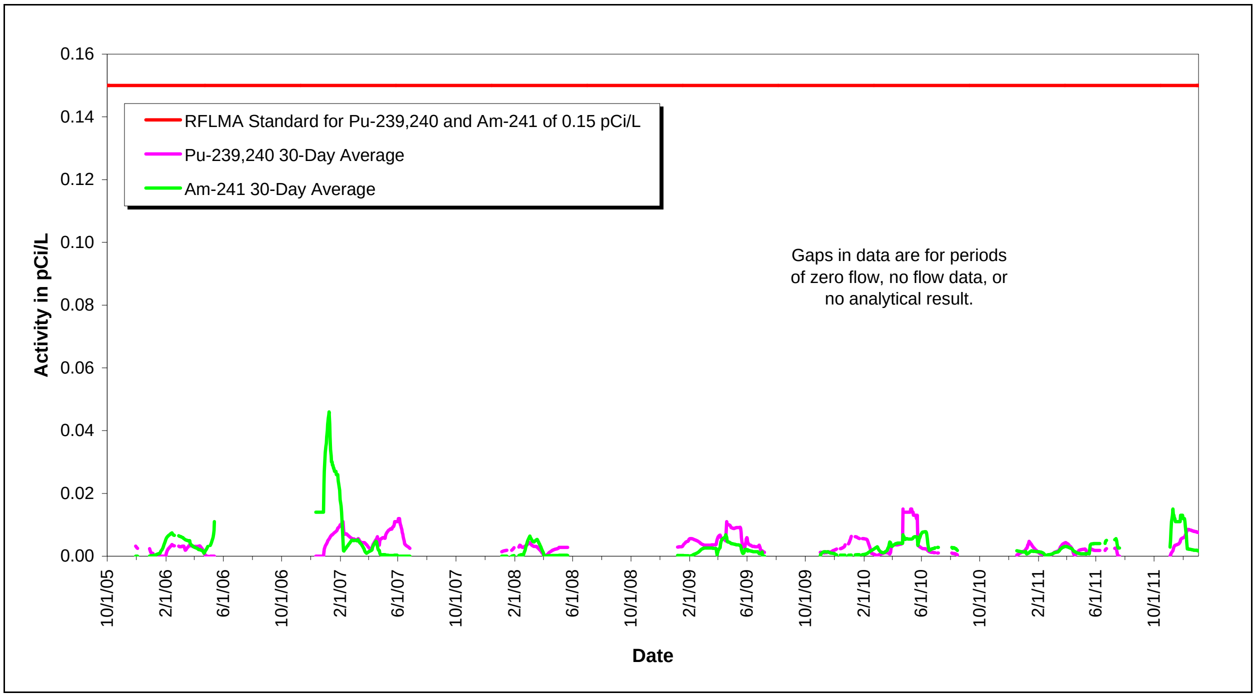


Figure 7. Volume-Weighted 30-Day Average Pu and Am Activities at GS01: Post-Closure Period

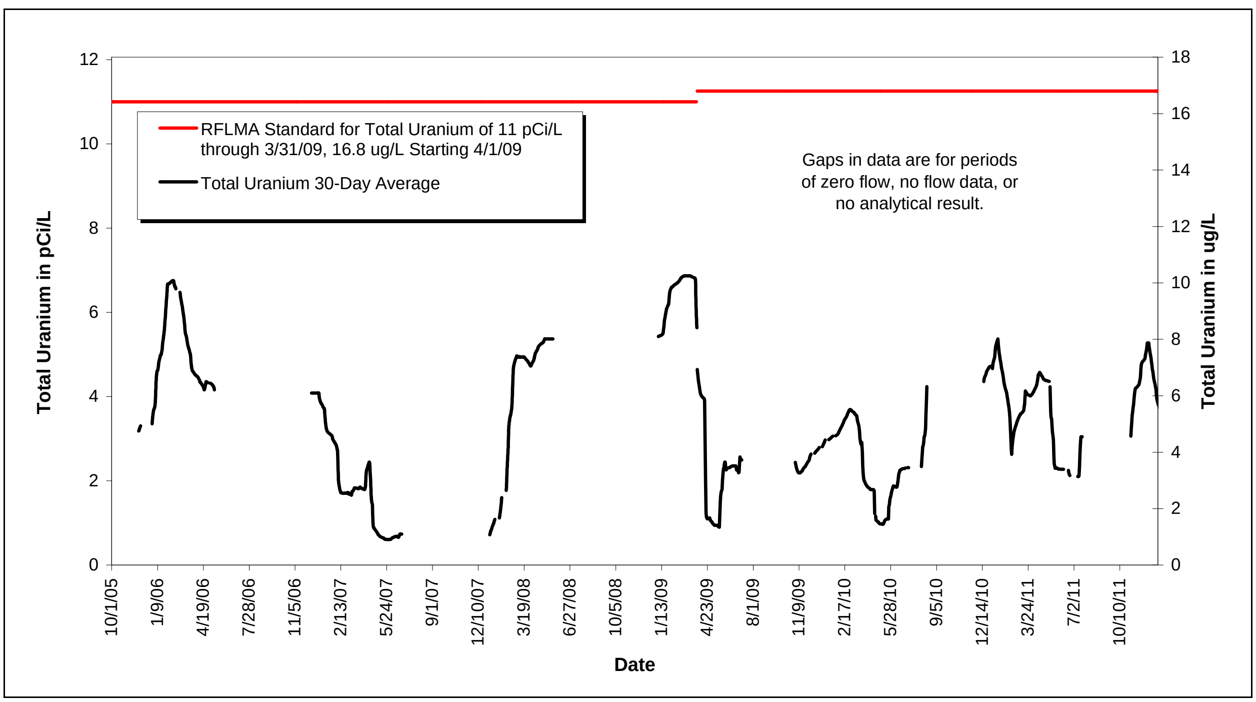


Figure 8. Volume-Weighted 30-Day Average Total U Concentrations at GS01: Post-Closure Period

Location GS03

Monitoring location GS03 is located on Walnut Creek at Indiana Street (Figure 4). The Walnut Creek headwaters, the majority of the COU, Pond A-4, and Pond B-5 contribute flow to GS03.

Table 7 shows that all of the annual average Pu and Am activities were well below the RFLMA standard of 0.15 pCi/L. Additionally, the long-term Pu and Am averages (1997–2011) are well below 0.15 pCi/L. The average total U and nitrate+nitrite as N concentrations are all well below the RFLMA standard of 16.8 µg/L and 10 milligrams per liter (mg/L), respectively.

Table 7. Annual Volume-Weighted Average Radionuclide Activities and Nitrate+Nitrite as Nitrogen Concentrations at GS03 for 1997−2011

Calendar Year	Volume-Weighted Average			
	Am-241 (pCi/L)	Pu-239,240 (pCi/L)	Total U (µg/L)	Nitrate+Nitrite as N (mg/L)[a]
1997	0.014	0.026	NA	NA
1998	0.010	0.014	NA	NA
1999	0.009	0.015	NA	NA
2000	0.007	0.005	NA	NA
2001	0.005	0.009	NA	NA
2002	0.006	0.012	NA	NA
2003	0.005	0.006	2.38	NA
2004	0.008	0.008	2.44	NA
2005	0.022	0.008	5.68	NA (no pond discharge after October 13, 2005)
2006	NA (no flow)	NA (no flow)	NA (no flow)	NA (no pond discharge)
2007	0.002	0.006	5.13	2.34
2008	NA (no flow)	NA (no flow)	NA (no flow)	NA (no pond discharge)
2009	0.003	0.004	4.29	0.34
2010	0.005	0.007	4.81	1.88
2011	0.003	0.002	6.72	0.05
Total (1997–2011)	0.008	0.011	3.88	1.43

Notes: Collection of total U data began on November 5, 2002. NA = not applicable.
[a] For pond discharge periods only; nitrate+nitrite as nitrogen sampling began on October 13, 2005.

Figure 9, Figure 10, and Figure 11 show no occurrences of reportable 30-day averages for the year.

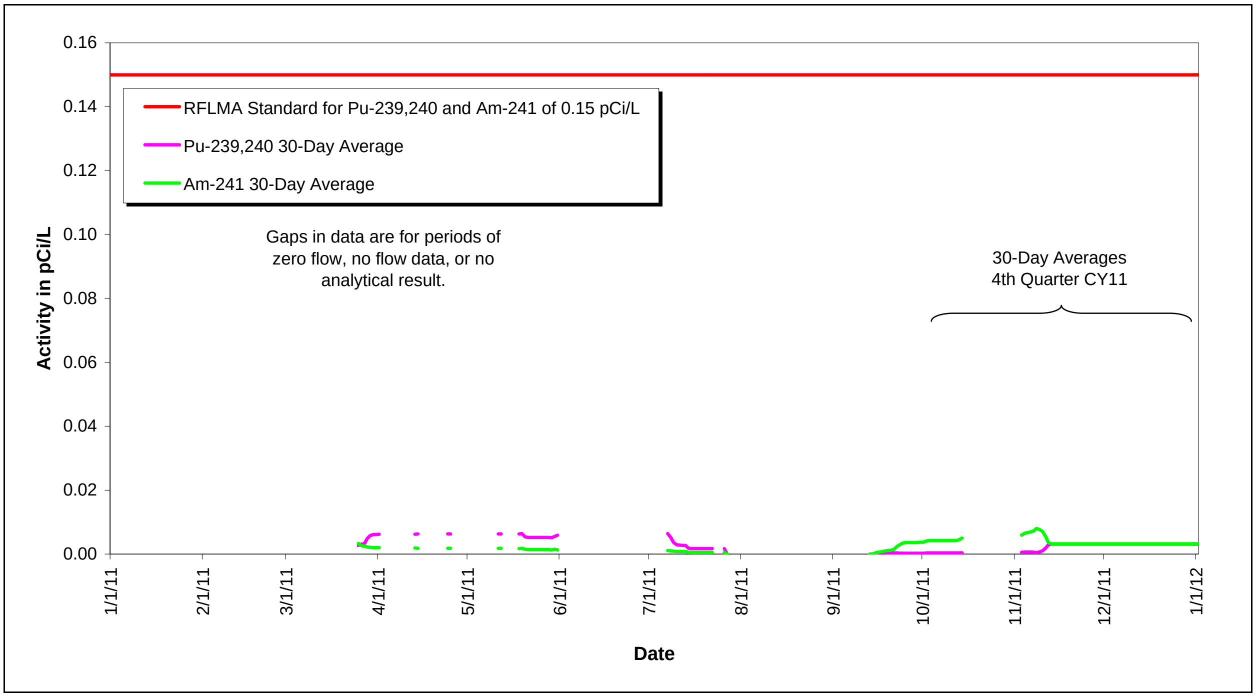


Figure 9. Volume-Weighted 30-Day Average Pu and Am Activities at GS03: Calendar Year Ending Fourth Quarter CY 2011

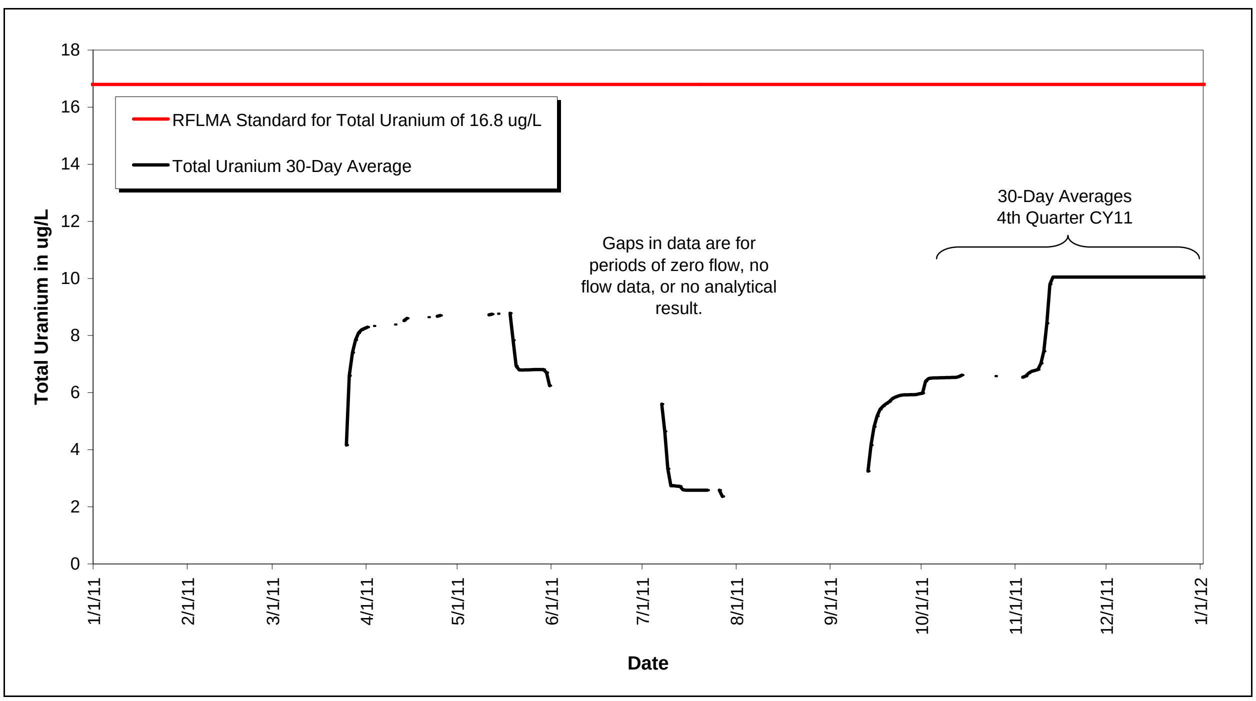


Figure 10. Volume-Weighted 30-Day Average Total U Concentrations at GS03: Calendar Year Ending Fourth Quarter CY 2011

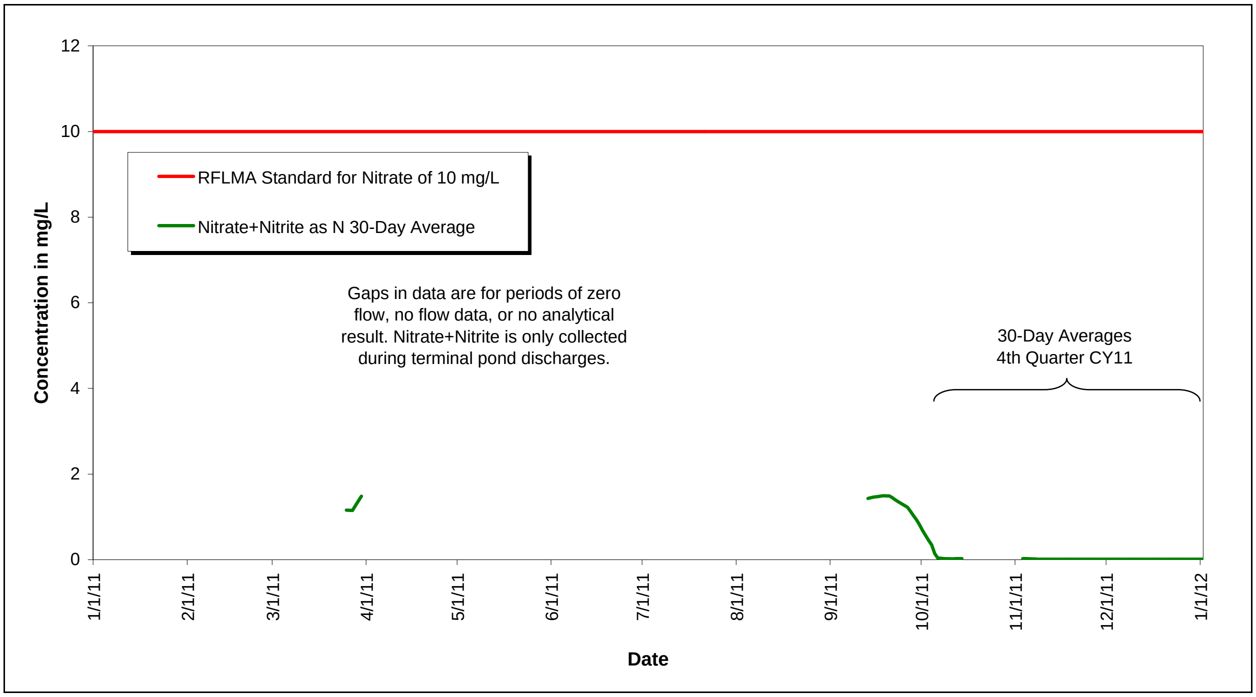


Figure 11. Volume-Weighted 30-Day Average Nitrate+Nitrite as N Concentrations at GS03: Calendar Year Ending Fourth Quarter CY 2011

Figure 12, Figure 13, and Figure 14 show similar data for the entire post-closure period.

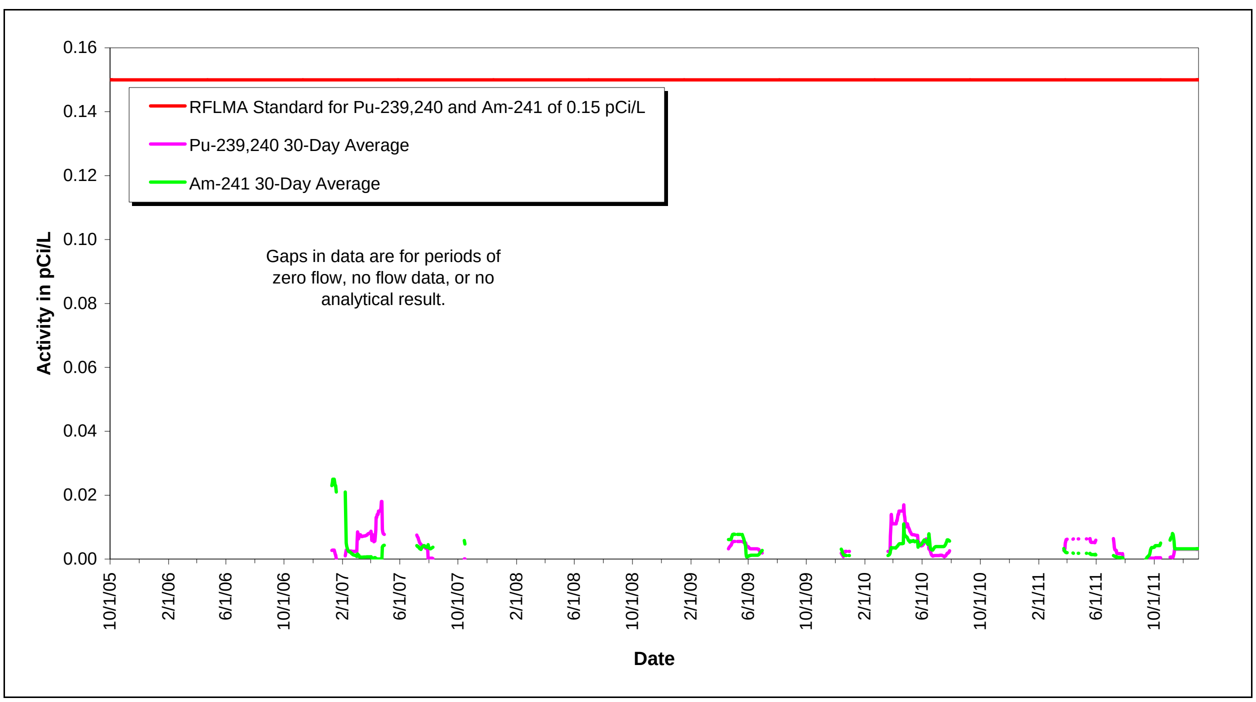


Figure 12. Volume-Weighted 30-Day Average Pu and Am Activities at GS03: Post-Closure Period

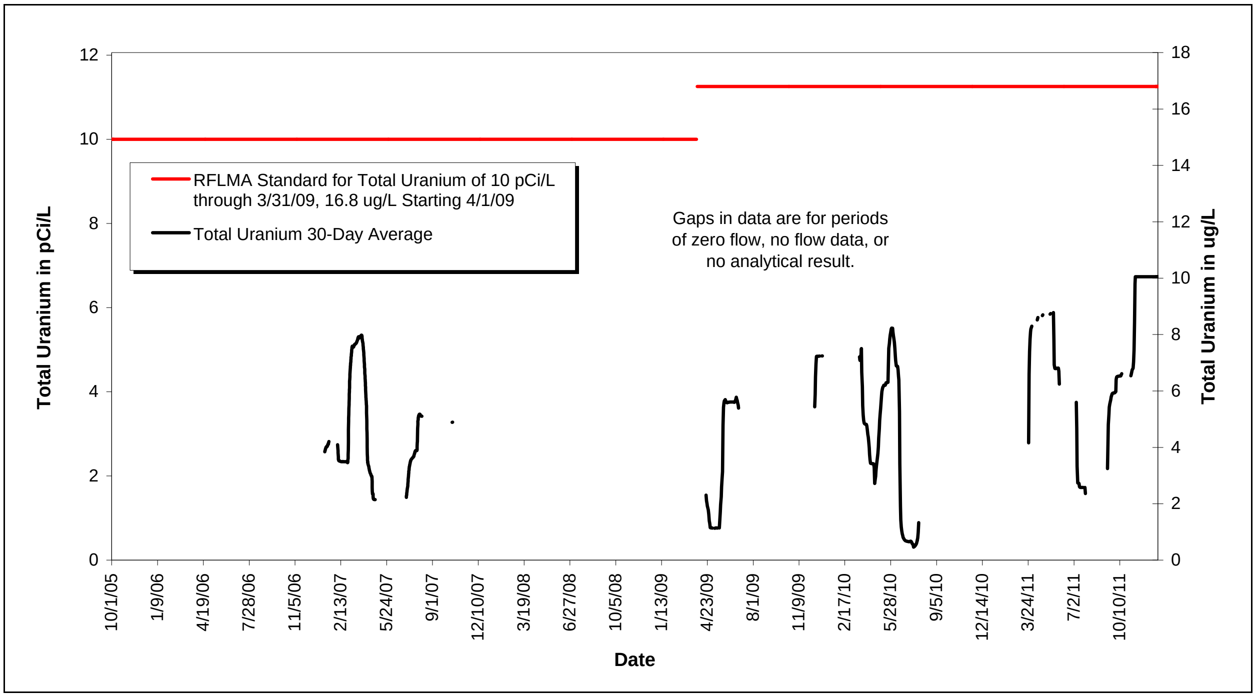


Figure 13. Volume-Weighted 30-Day Average Total U Concentrations at GS03: Post Closure-Period

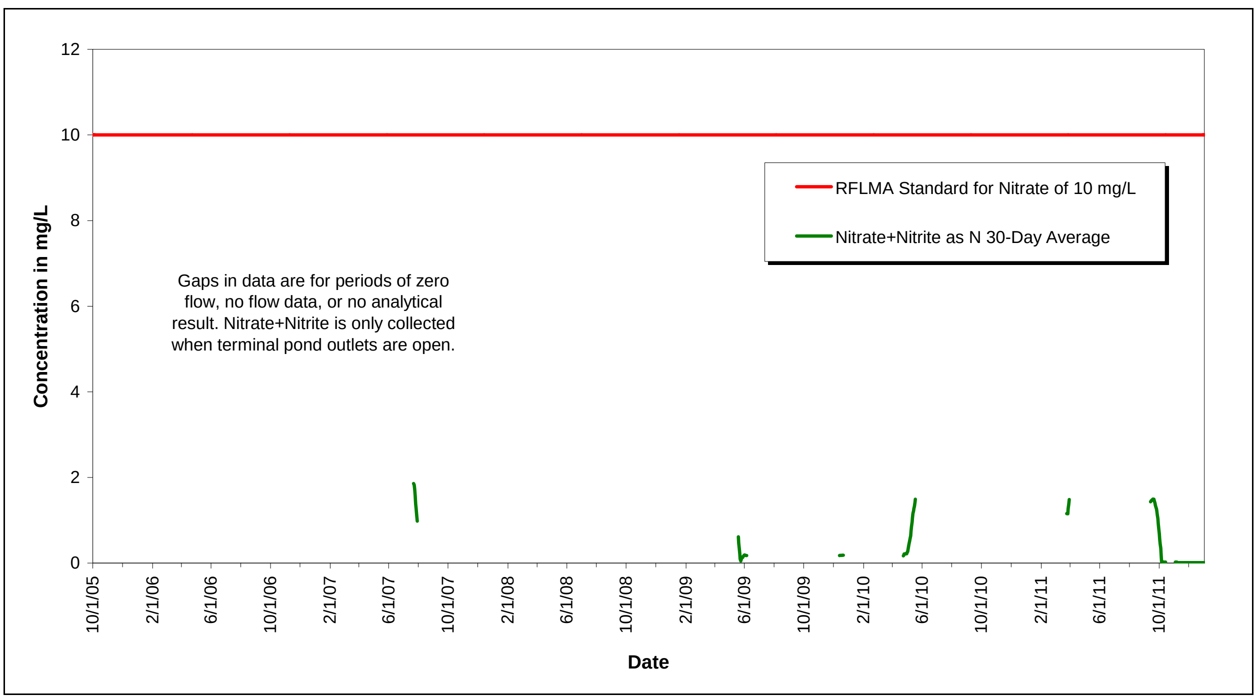


Figure 14. Volume-Weighted 30-Day Average Nitrate+Nitrite as N Concentrations at GS03: Post-Closure Period

Location WOMPOC

Monitoring location WOMPOC is located on Woman Creek at the eastern COU boundary (Figure 4). The Woman Creek headwaters, the southern portion of the COU, and Pond C-2 contribute flow to WOMPOC. OMPOC began operating as POC on September 28, 2011.

Table 8 shows that the CY 2011 Pu and Am activities were well below the RFLMA standard of 0.15 pCi/L. The CY 2011 total U concentrations are also well below the RFLMA standard of 16.8 μg/L.

Table 8. Annual Volume-Weighted Average Radionuclide Activities at WOMPOC for 2011

Calendar Year	**Volume-Weighted Average**		
	Am-241 (pCi/L)	**Pu-239,240 (pCi/L)**	**Total U (μg/L)**
2011 (partial year)	0.004	0.003	4.42
Total (2011)	0.004	0.003	4.42

Notes: WOMPOC began operating on September 28, 2011.

Figure 15 through Figure 18 show no occurrences of reportable 30-day or 12-month rolling averages for the year.

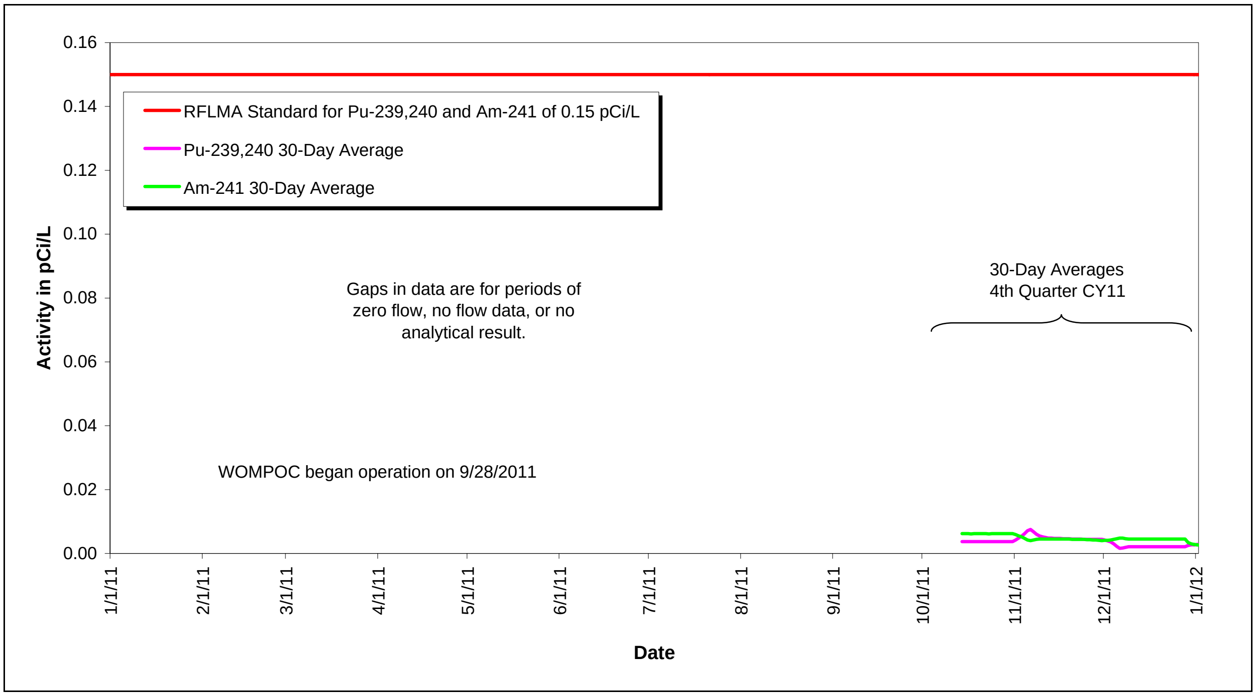


Figure 15. Volume-Weighted 30-Day Average Pu and Am Activities at WOMPOC: Calendar Year Ending Fourth Quarter CY 2011

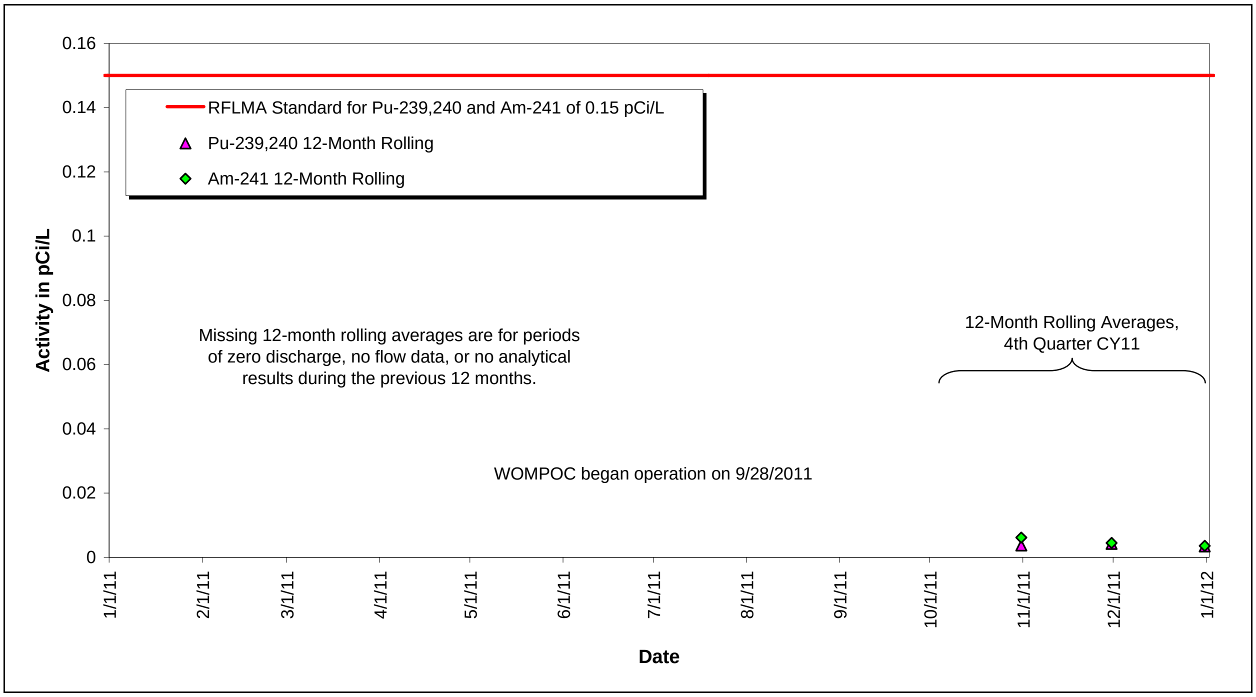


Figure 16. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at WOMPOC: Calendar Year Ending Fourth Quarter CY 2011

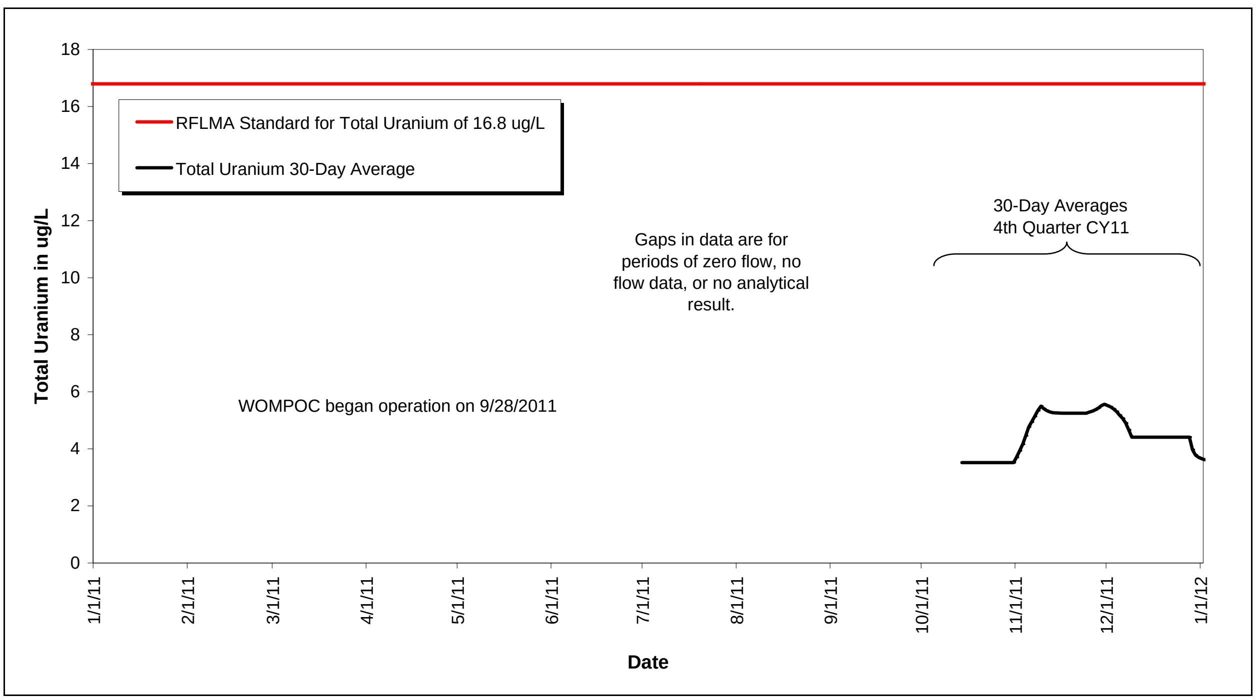


Figure 17. Volume-Weighted 30-Day Average Total U Concentrations at WOMPOC: Calendar Year Ending Fourth Quarter CY 2011

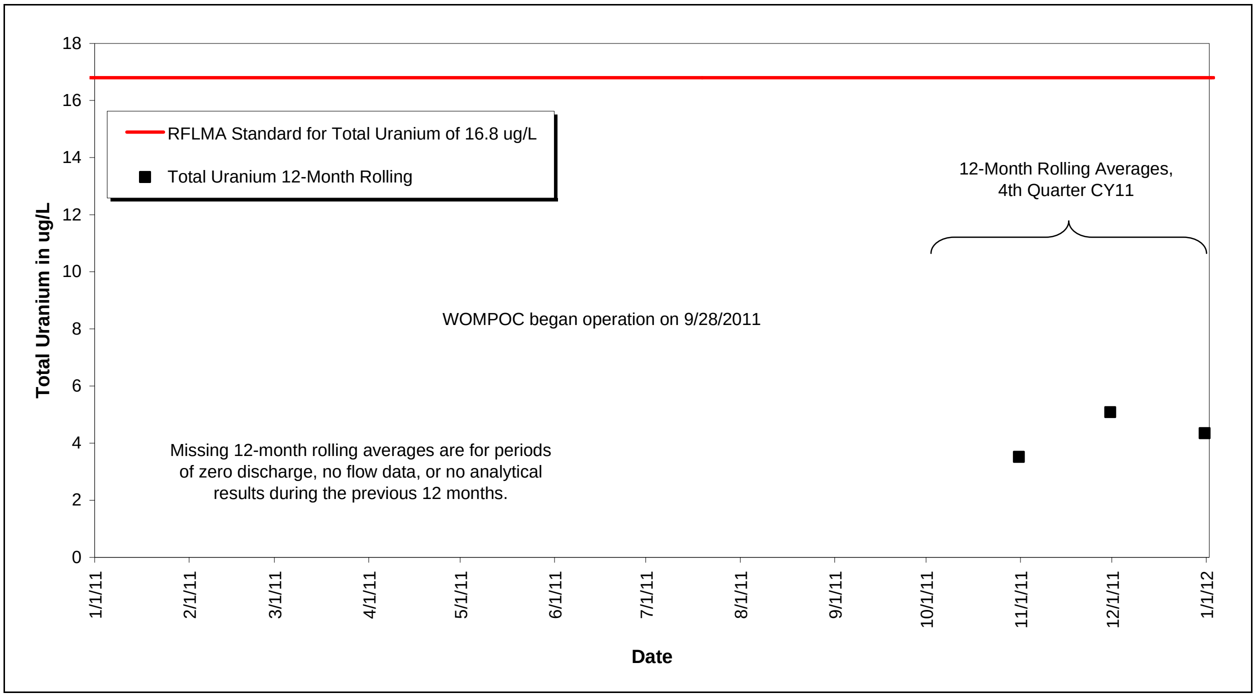


Figure 18. Volume-Weighted 12-Month Rolling Average Total U Concentrations at WOMPOC: Calendar Year Ending Fourth Quarter CY 2011

Location WALPOC

Monitoring location WALPOC is located on Walnut Creek at the eastern COU boundary (Figure 4). The Walnut Creek headwaters, the majority of the COU, No Name Gulch, Pond A-4, and Pond B-5 contribute flow to WALPOC. WALPOC began operating as a POC on September 9, 2011.

Table 9 shows that the CY 2011 Pu and Am activities were well below the RFLMA standard of 0.15 pCi/L. The CY 2011 total U and nitrate+nitrite as N concentrations are also below the RFLMA standards of 16.8 µg/L and 10 mg/L respectively.

Table 9. Annual Volume-Weighted Average Radionuclide Activities and Nitrate+Nitrite as Nitrogen Concentrations at WALPOC for 2011

Calendar Year	Volume-Weighted Average			
	Am-241 (pCi/L)	Pu-239,240 (pCi/L)	Total U (µg/L)	Nitrate+Nitrite as N (mg/L)[a]
2011	0.004	0.003	7.99	0.055
Total (2011)	0.004	0.003	7.99	0.055

Notes: WALPOC began operating on September 9, 2011.

Figure 19 through Figure 24 show no occurrences of reportable 30-day or 12-month rolling averages for the year.

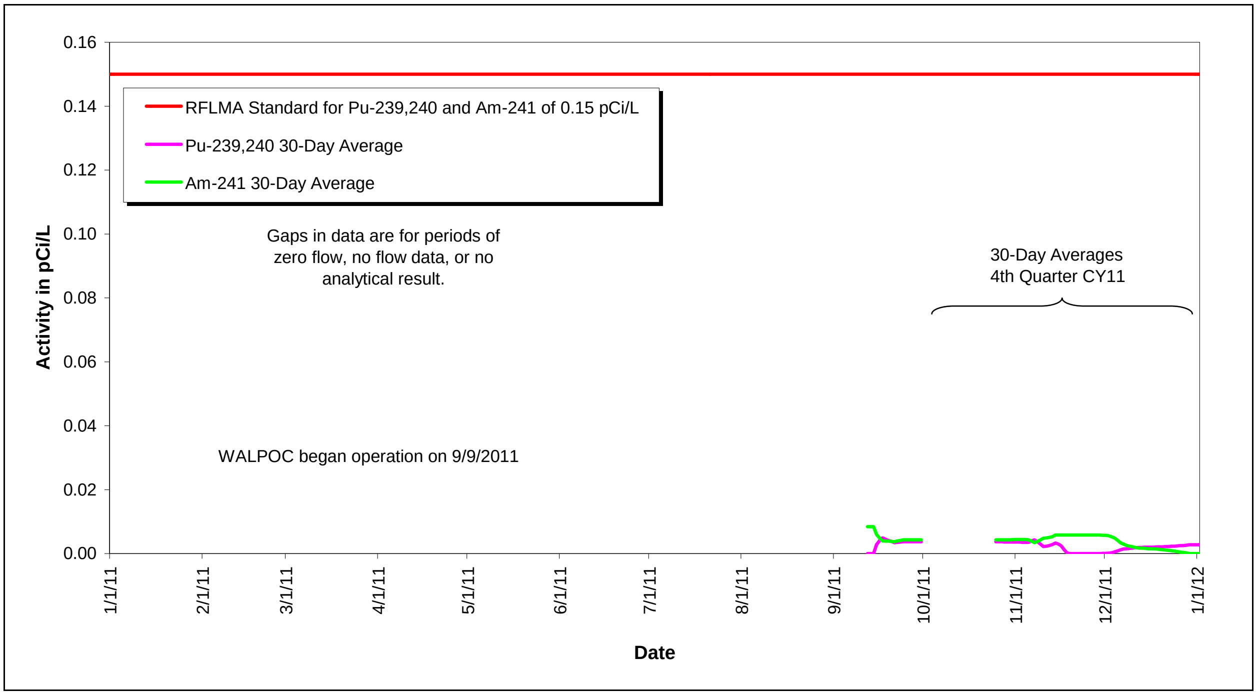


Figure 19. Volume-Weighted 30-Day Average Pu and Am Activities at WALPOC: Calendar Year Ending Fourth Quarter CY 2011

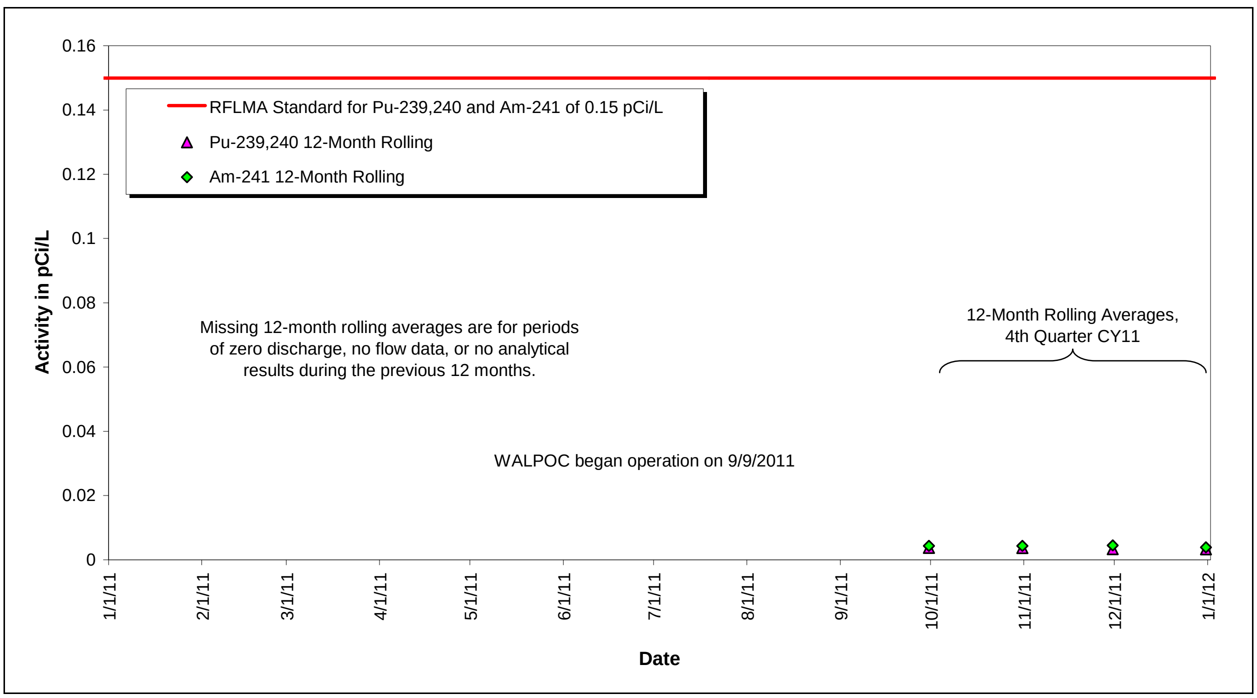


Figure 20. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at WALPOC: Calendar Year Ending Fourth Quarter CY 2011

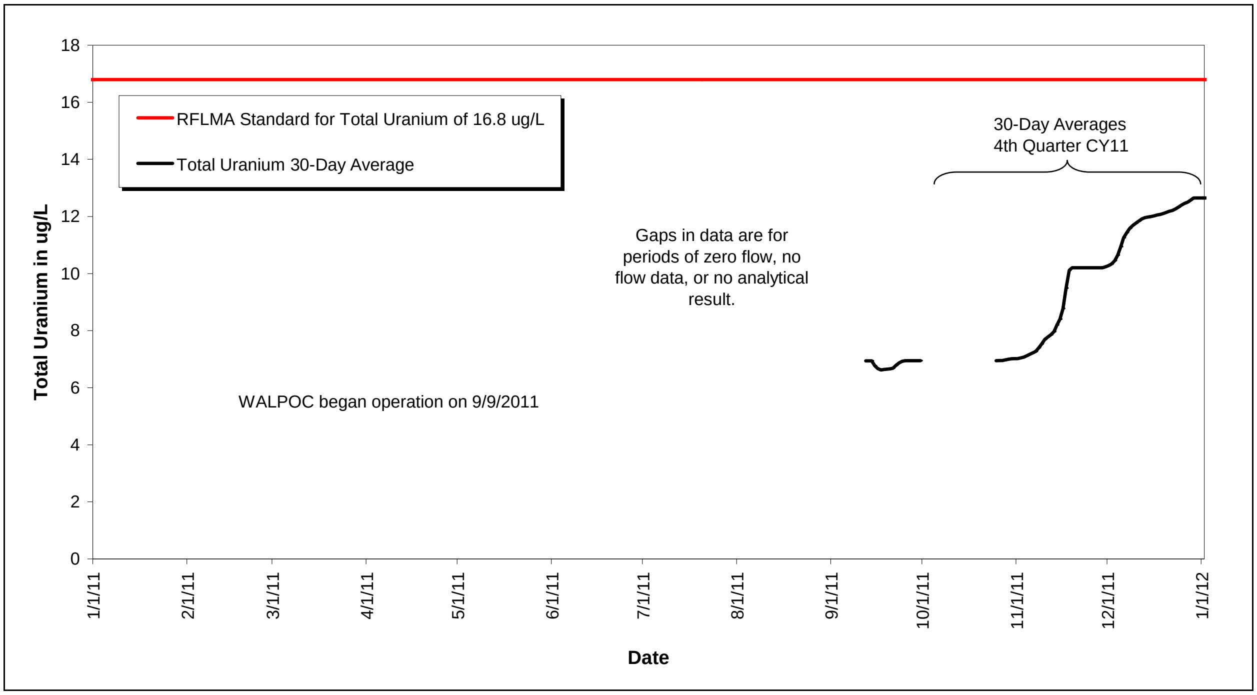


Figure 21. Volume-Weighted 30-Day Average Total U Concentrations at WALPOC: Calendar Year Ending Fourth Quarter CY 2011

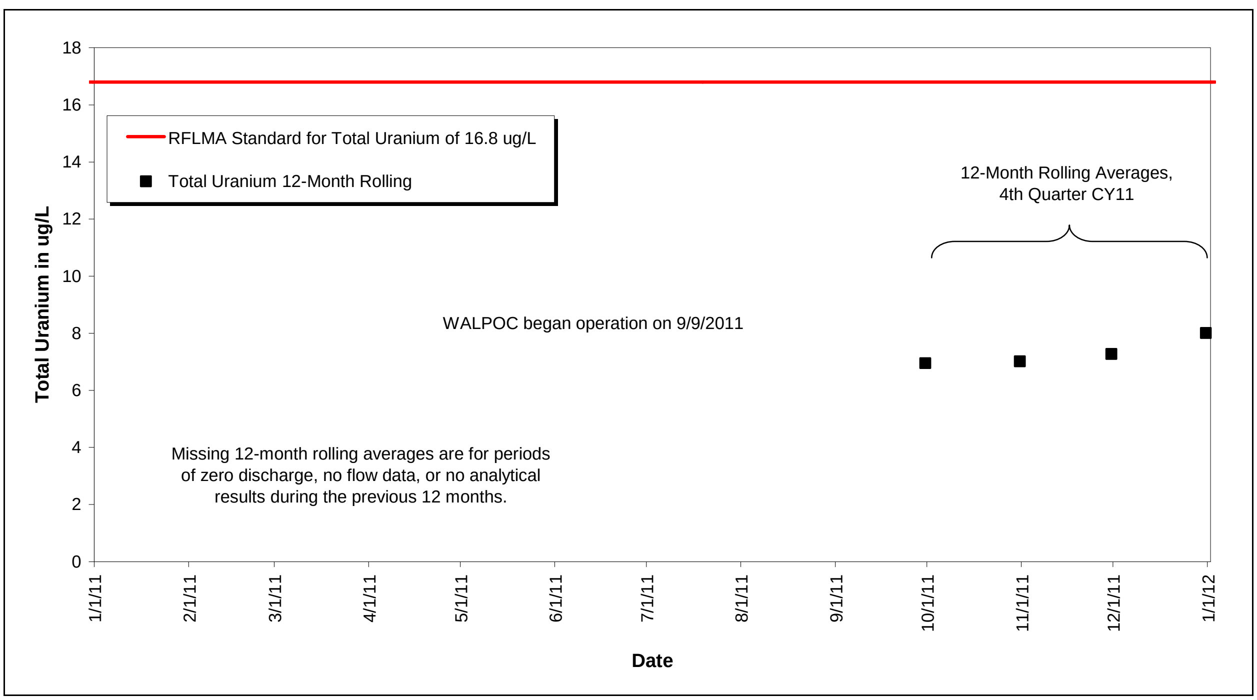


Figure 22. Volume-Weighted 12-Month Rolling Average Total U Concentrations at WALPOC: Calendar Year Ending Fourth Quarter CY 2011

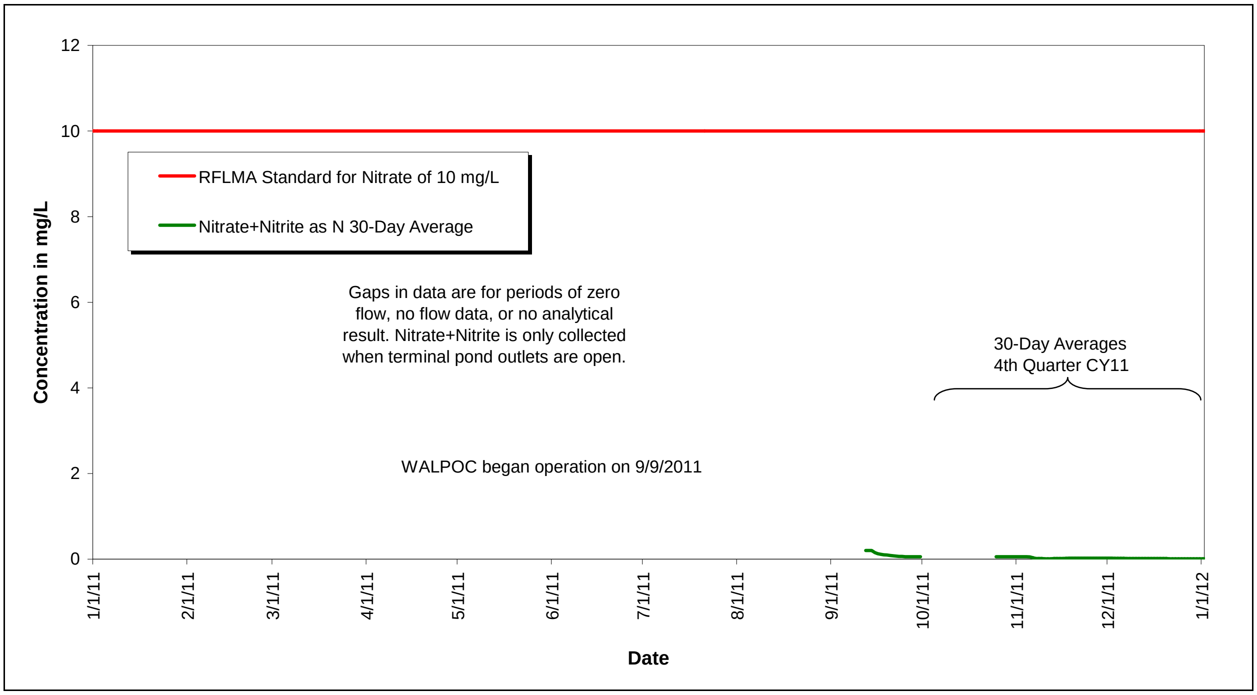


Figure 23. Volume-Weighted 30-Day Average Nitrate+Nitrite as N Concentrations at WALPOC: Calendar Year Ending Fourth Quarter CY 2011

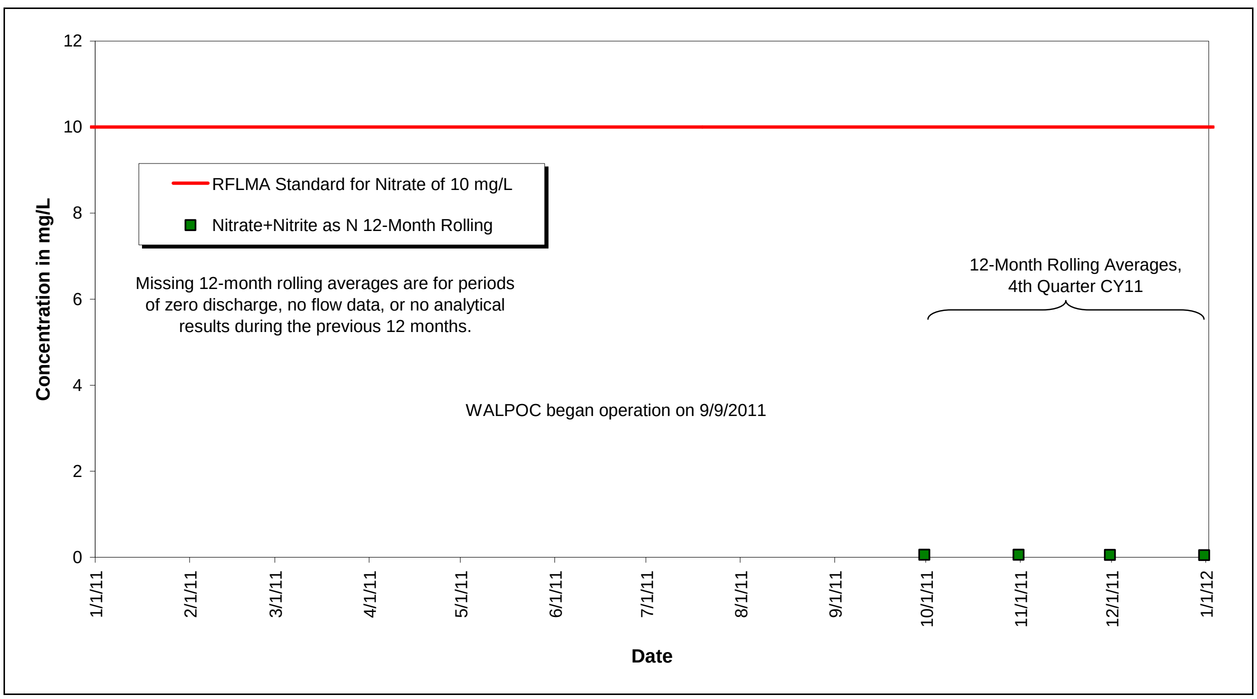


Figure 24. Volume-Weighted 12-Month Rolling Average Nitrate+Nitrite as N Concentrations at WALPOC: Calendar Year Ending Fourth Quarter CY 2011

Location GS08

Monitoring location GS08 is located on South Walnut Creek at the outlet of Pond B-5 (Figure 4). The central portion of the COU contributes flow to Pond B-5. Once WALPOC began operation as a POC on September 9, 2011, GS08 stopped being operated as a POC; GS08 continues operation under the Adaptive Management Plan (AMP).

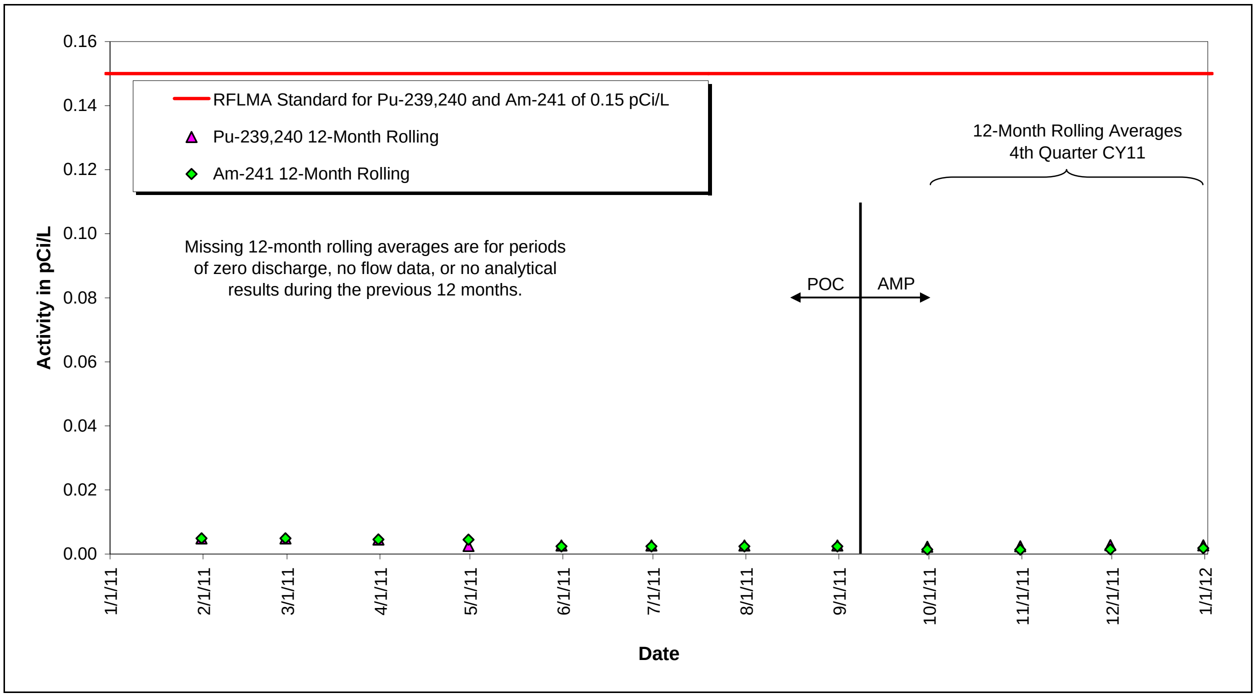
Table 10 shows that all of the annual average Pu and Am activities were well below the RFLMA standard of 0.15 pCi/L. Additionally, the long-term Pu and Am averages (1997–2011) are well below 0.15 pCi/L. The average total U concentrations have shown recent increases due to contributions from GS10 (see Section 3.1.2.2) but are all still below the RFLMA standard of 16.8 µg/L. Nitrate+nitrite as N concentrations are well below 10 mg/L.

Table 10. Annual Volume-Weighted Average Radionuclide Activities and Nitrate+Nitrite as Nitrogen Concentrations at GS08 for 1997−2011

Calendar Year	Volume-Weighted Average			
	Am-241 (pCi/L)	**Pu-239,240 (pCi/L)**	**Total U (µg/L)**	**Nitrate+Nitrite as N (mg/L)[a]**
1997	0.008	0.006	2.42	NA
1998	0.006	0.008	3.30	NA
1999	0.015	0.046	2.00	NA
2000	0.029	0.047	1.26	NA
2001	0.004	0.006	1.73	NA
2002	0.003	0.002	0.96	NA
2003	0.006	0.026	1.97	NA
2004	0.009	0.009	1.80	NA
2005	0.021	0.008	8.76	NA (no pond discharge after October 13, 2005)
2006	NA (no discharge)	NA (no discharge)	NA (no discharge)	NA (no discharge)
2007	0.002	0.003	12.0	0.38
2008	NA (no discharge)	NA (no discharge)	NA (no discharge)	NA (no discharge)
2009	0.001	0.004	6.74	0.01
2010	0.005	0.005	9.46	0.16
2011	0.002	0.003	6.96	0.10
Total (1997−2011)	0.011	0.020	2.81	0.17

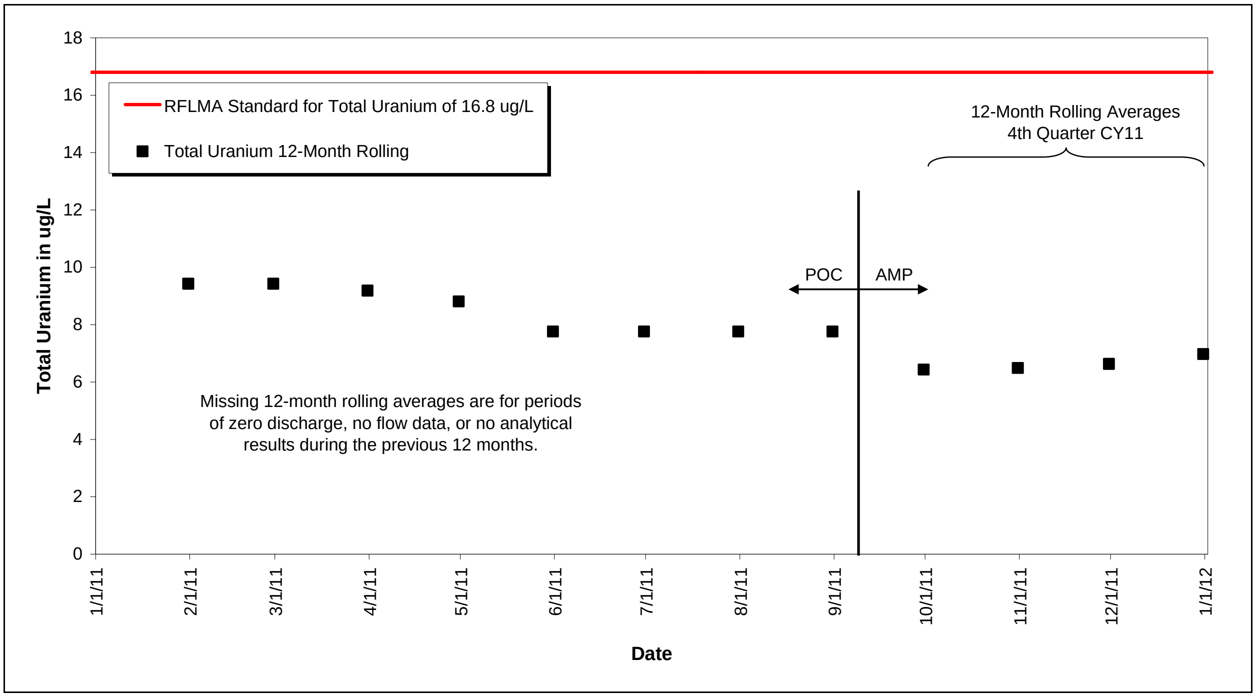
Notes: NA = not applicable.
[a] Nitrate+nitrite as nitrogen sampling began on October 13, 2005, and was discontinued on September 9, 2011.

Figure 25, Figure 26, and Figure 27 show no occurrences of reportable 12-month rolling averages for the year.



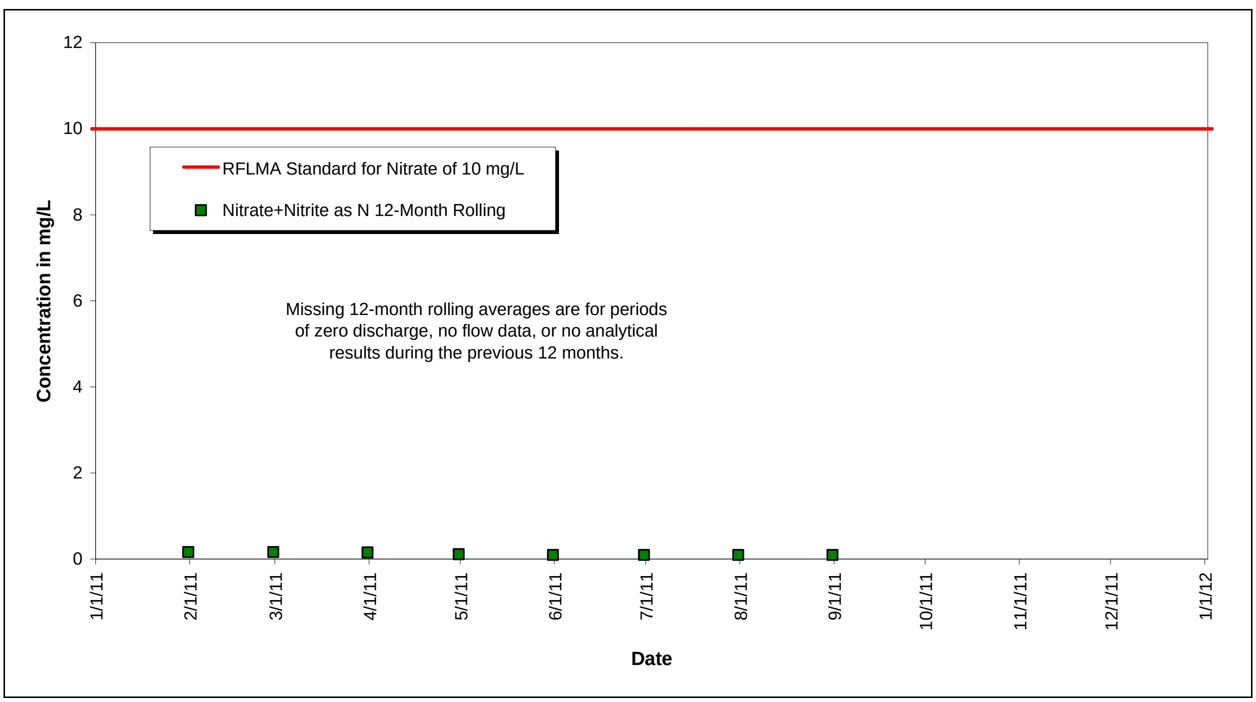
Note: GS08 stopped being operated as a POC on September 9, 2011; GS08 continues operation as an AMP monitoring location.

Figure 25. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at GS08: Calendar Year Ending Fourth Quarter CY 2011



Note: GS08 stopped being operated as a POC on September 9, 2011; GS08 continues operation as an AMP monitoring location.

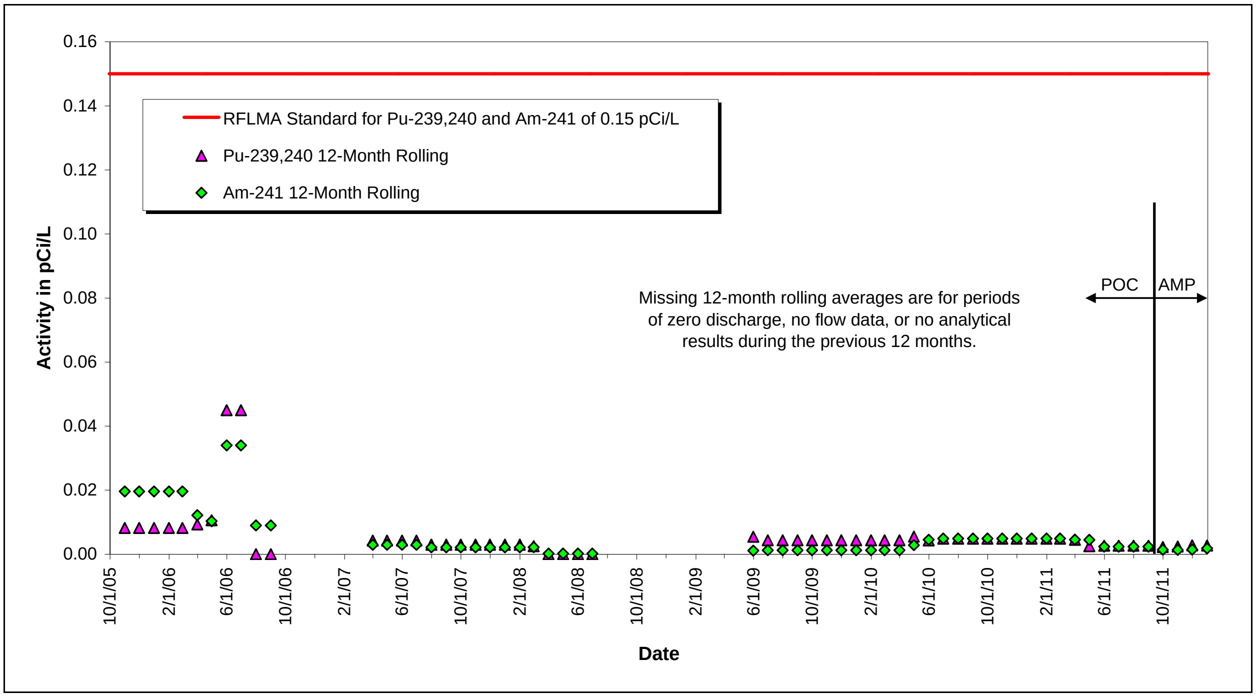
Figure 26. Volume-Weighted 12-Month Rolling Average Total U Concentrations at GS08: Calendar Year Ending Fourth Quarter CY 2011



Note: GS08 stopped being operated as a POC on September 9, 2011; GS08 continues operation as an AMP monitoring location. Nitrate+nitrite as nitrogen sampling was discontinued on September 9, 2011.

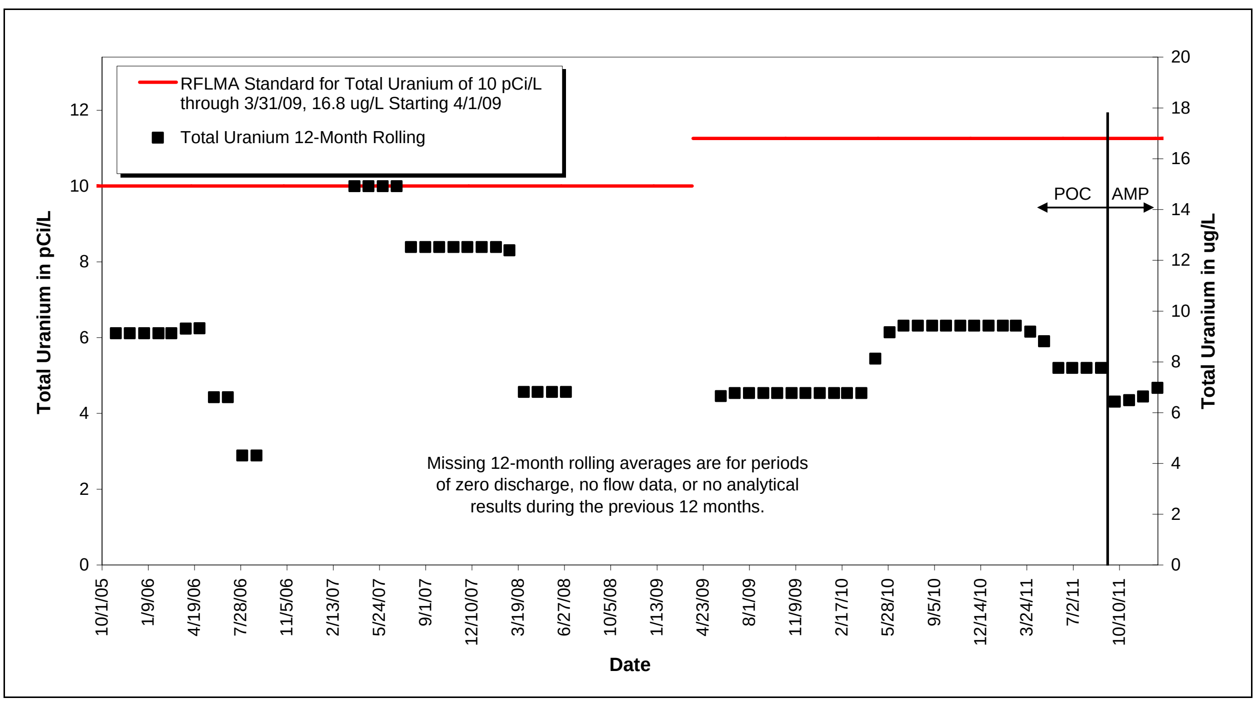
Figure 27. Volume-Weighted 12-Month Rolling Average Nitrate+Nitrite as N Concentrations at GS08: Calendar Year Ending Fourth Quarter CY 2011

Figure 28, Figure 29, and Figure 30 show data for the entire post-closure period.



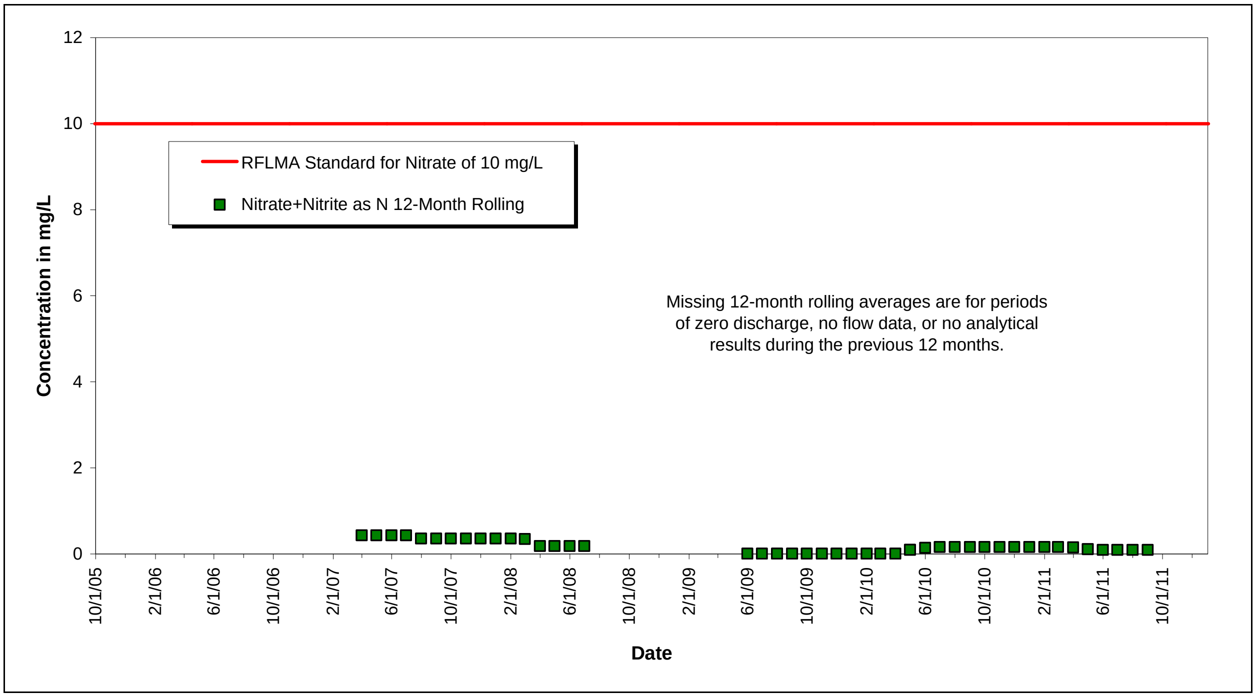
Note: GS08 stopped being operated as a POC on September 9, 2011; GS08 continues operation as an AMP monitoring location.

Figure 28. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at GS08: Post-Closure Period



Note: GS08 stopped being operated as a POC on September 9, 2011; GS08 continues operation as an AMP monitoring location.

Figure 29. Volume-Weighted 12-Month Rolling Average Total U Concentrations at GS08: Post-Closure Period



Note: GS08 stopped being operated as a POC on September 9, 2011; GS08 continues operation as an AMP monitoring location. Nitrate+nitrite as nitrogen sampling was discontinued on September 9, 2011.

Figure 30. Volume-Weighted 12-Month Rolling Average Nitrate+Nitrite as N Concentrations at GS08: Post-Closure Period

Location GS11

Monitoring location GS11 is located on North Walnut Creek at the outlet of Pond A-4 (Figure 4). The northern portion of the COU contributes flow to Pond A-4. Once WALPOC began operation as a POC on September 9, 2011, GS11 stopped being operated as a POC; GS11 continues operation under the AMP.

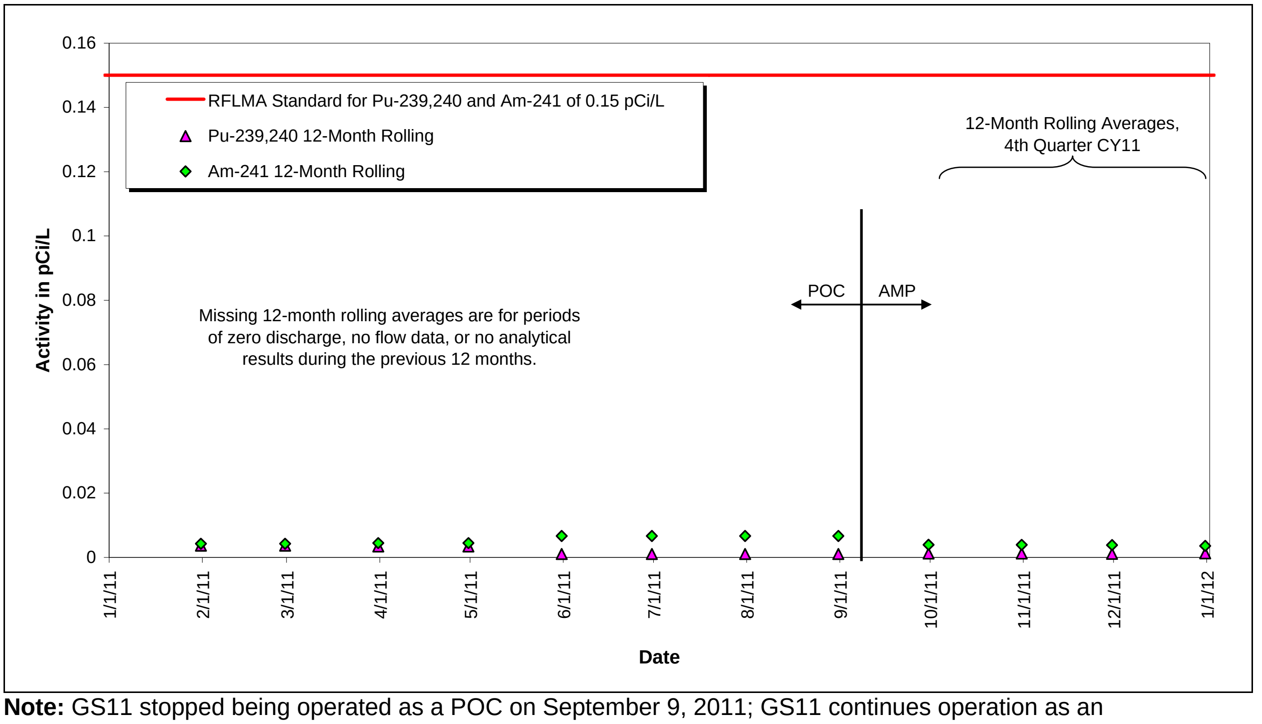
Table 11 shows that all of the annual average Pu and Am activities were well below the RFLMA standard of 0.15 pCi/L. Additionally, the long-term Pu and Am averages (1997–2011) are well below 0.15 pCi/L. The average total U and nitrate+nitrite as N concentrations are all below the RFLMA standards of 16.8 μg/L and 10 mg/L, respectively.

Table 11. Annual Volume-Weighted Average Radionuclide Activities and Nitrate+Nitrite as Nitrogen Concentrations at GS11 for 1997−2011

Calendar Year	Volume-Weighted Average Activity (pCi/L)			
	Am-241 (pCi/L)	Pu-239,240 (pCi/L)	Total U (µg/L)	Nitrate+Nitrite as N (mg/L)[a]
1997	0.005	0.008	2.70	NA
1998	0.011	0.004	3.23	NA
1999	0.003	0.007	2.60	NA
2000	0.001	0.018	3.51	NA
2001	0.003	0.002	4.14	NA
2002	0.003	0.000	3.29	NA
2003	0.003	0.002	3.98	NA
2004	0.006	0.002	3.63	NA
2005	0.022	0.002	2.43	NA (no pond discharge after October 13, 2005)
2006	NA (no discharge)	NA (no discharge)	NA (no discharge)	NA (no discharge)
2007	0.001	0.007	5.25	3.02
2008	NA (no discharge)	NA (no discharge)	NA (no discharge)	NA (no discharge)
2009	0.005	0.003	6.58	0.68
2010	0.004	0.004	9.76	4.70
2011	0.003	0.001	7.88	0.13
Total (1997−2011)	0.005	0.006	3.84	2.72

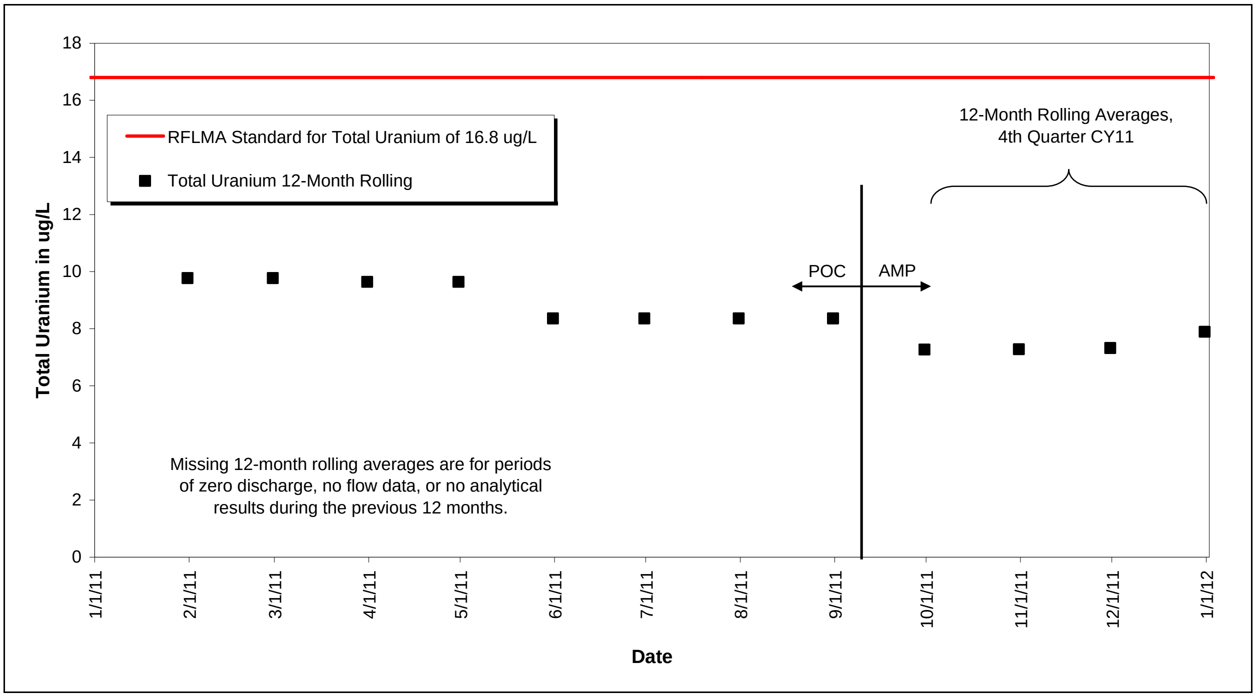
Notes: NA = not applicable.
[a] Nitrate+nitrite as nitrogen sampling began on October 13, 2005.

Figure 31, Figure 32, and Figure 33 show no occurrences of reportable 12-month rolling averages for the year.



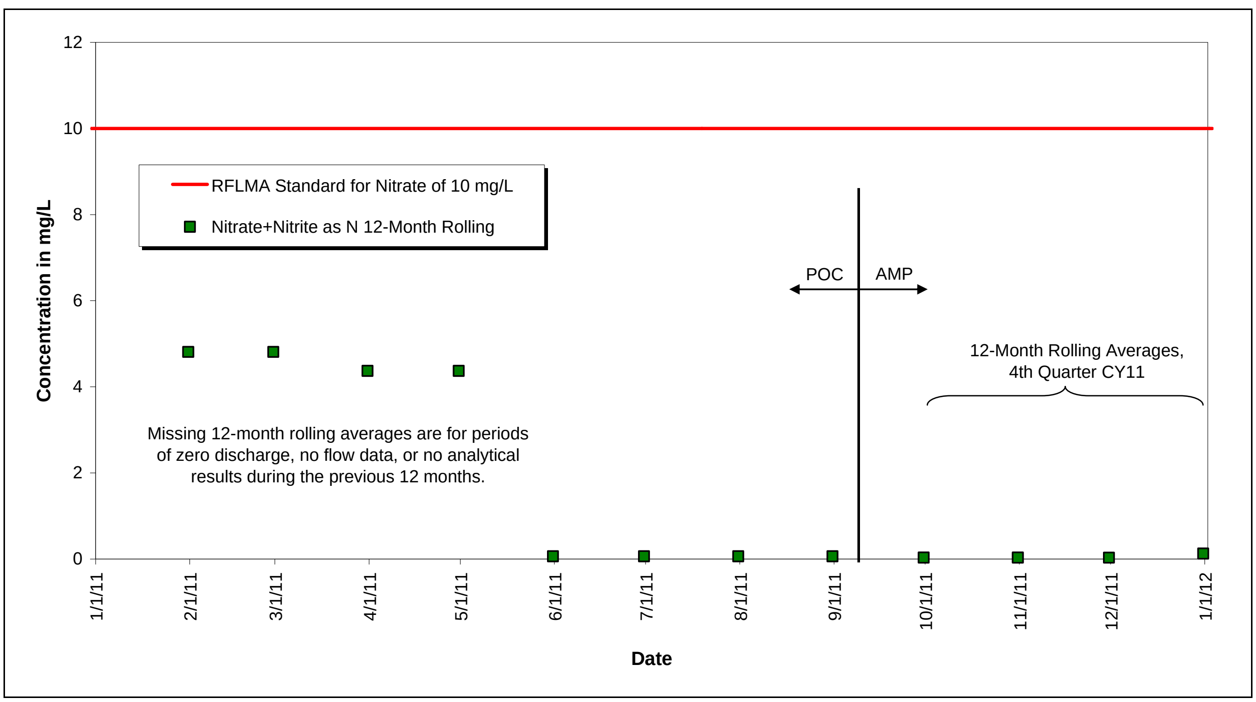
Note: GS11 stopped being operated as a POC on September 9, 2011; GS11 continues operation as an AMP monitoring location.

Figure 31. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at GS11: Calendar Year Ending Fourth Quarter CY 2011



Note: GS11 stopped being operated as a POC on September 9, 2011; GS11 continues operation as an AMP monitoring location.

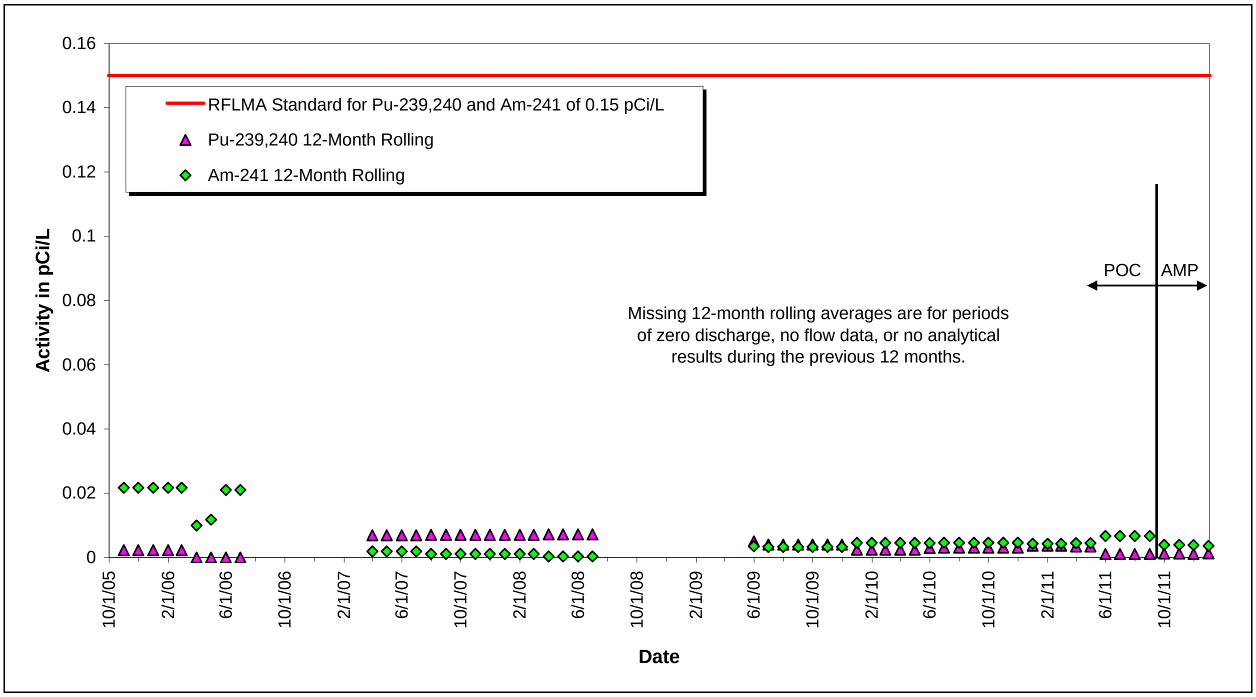
Figure 32. Volume-Weighted 12-Month Rolling Average Total U Concentrations at GS11: Calendar Year Ending Fourth Quarter CY 2011



Note: GS11 stopped being operated as a POC on September 9, 2011; GS11 continues operation as an AMP monitoring location.

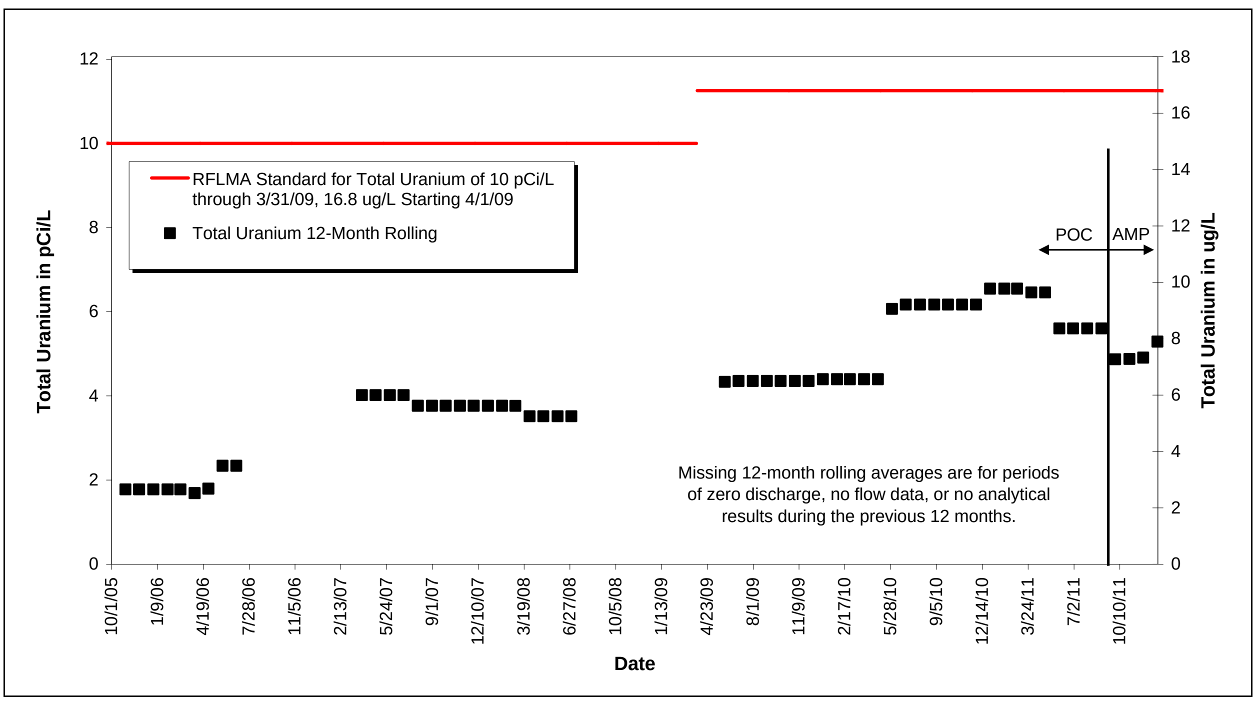
Figure 33. Volume-Weighted 12-Month Rolling Average Nitrate+Nitrite as N Concentrations at GS11: Calendar Year Ending Fourth Quarter CY 2011

Figure 34, Figure 35, and Figure 36 show similar data for the entire post-closure period.



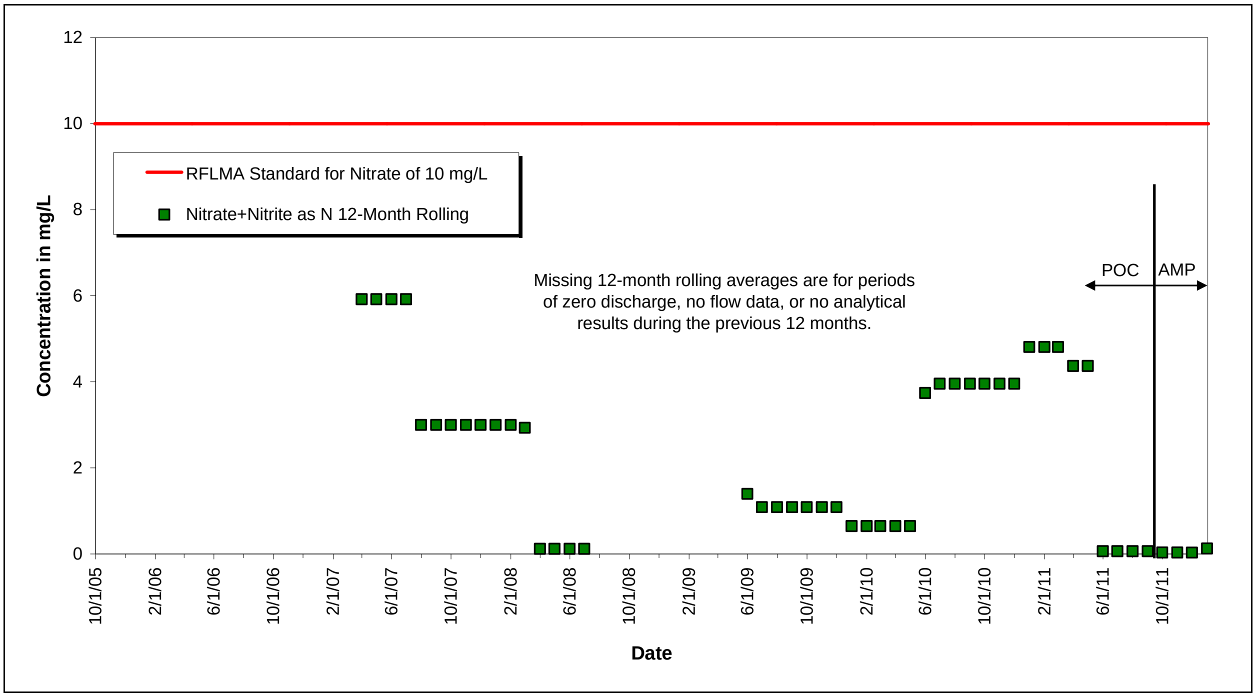
Note: GS11 stopped being operated as a POC on September 9, 2011; GS11 continues operation as an AMP monitoring location.

Figure 34. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at GS11: Post-Closure Period



Note: GS11 stopped being operated as a POC on September 9, 2011; GS11 continues operation as an AMP monitoring location.

Figure 35. Volume-Weighted 12-Month Rolling Average Total U Concentrations at GS11: Post-Closure Period



Note: GS11 stopped being operated as a POC on September 9, 2011; GS11 continues operation as an AMP monitoring location.

Figure 36. Volume-Weighted 12-Month Rolling Average Nitrate+Nitrite as N Concentrations at GS11: Post-Closure Period

Location GS31

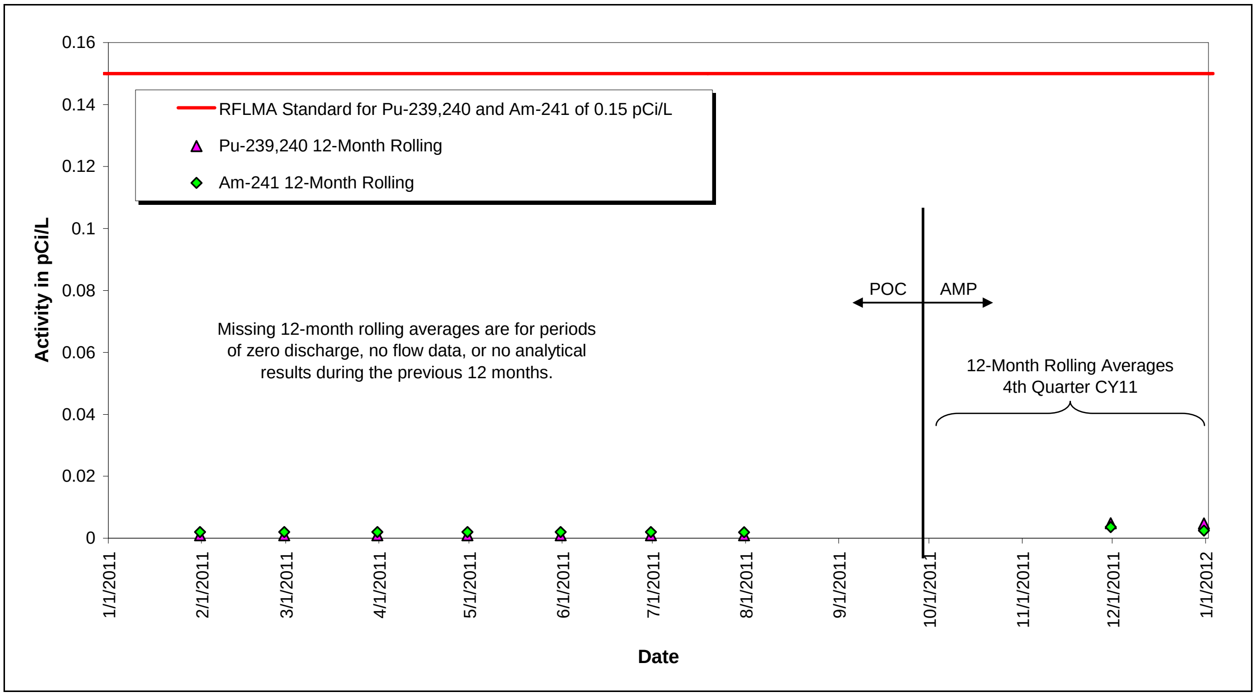
Monitoring location GS31 is located on Woman Creek at the outlet of Pond C-2 (Figure 4). The southern portion of the COU contributes flow to Pond C-2. Once WOMPOC began operation as a POC on September 28, 2011, GS31 stopped being operated as a POC; GS31 continues operation under the AMP.

Table 12 shows that the annual and long-term (1997–2011) average Pu and Am activities were all below the RFLMA standard of 0.15 pCi/L. Additionally, the annual and long-term total U concentrations were all below the RFLMA standard of 16.8 µg/L.

Table 12. Annual Volume-Weighted Average Radionuclide Activities at GS31 for 1997–2011

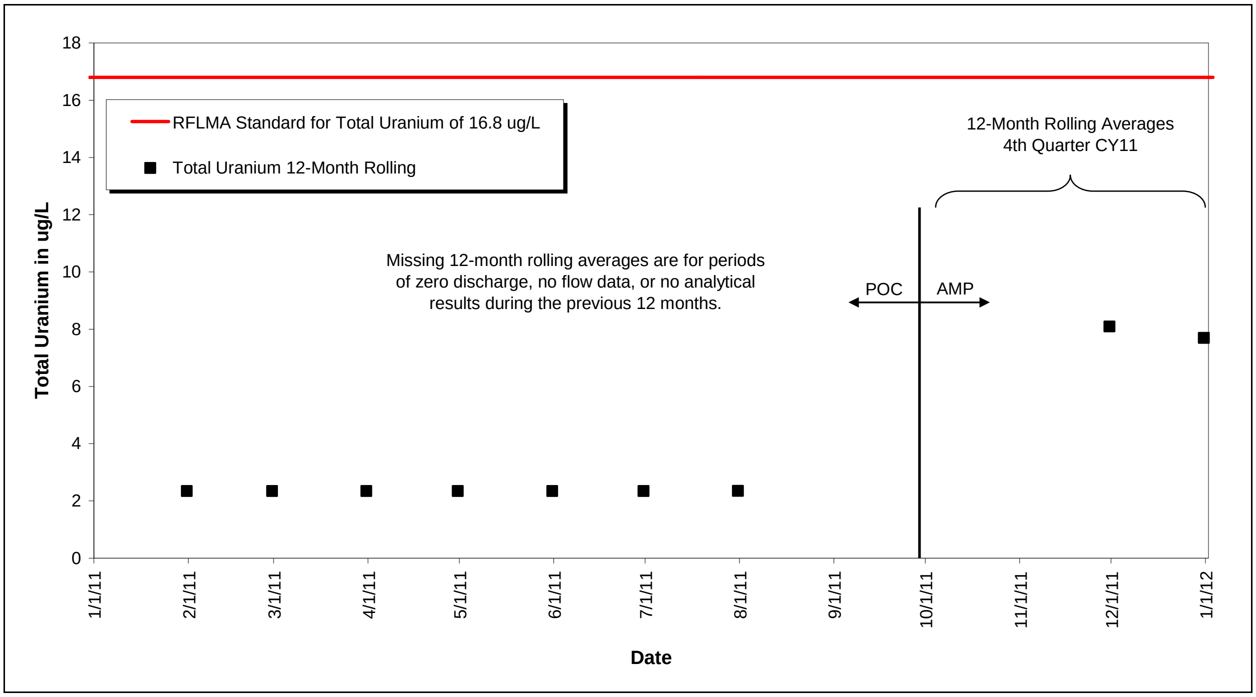
Calendar Year	Volume-Weighted Average Activity		
	Am-241 (pCi/L)	Pu-239,240 (pCi/L)	Total U (µg/L)
1997	0.008	0.017	3.32
1998	0.018	0.003	4.31
1999	0.010	0.043	4.22
2000	No C-2 discharge	No C-2 discharge	No C-2 discharge
2001	0.013	0.021	1.84
2002	0.015	0.089	3.54
2003	0.006	0.015	2.43
2004	0.010	0.021	2.36
2005	0.008	0.020	6.27
2006	No C-2 discharge	No C-2 discharge	No C-2 discharge
2007	No C-2 discharge	No C-2 discharge	No C-2 discharge
2008	No C-2 discharge	No C-2 discharge	No C-2 discharge
2009	0.006	0.016	5.17
2010	0.002	0.001	2.33
2011	0.002	0.005	7.68
Total (1997−2011)	0.009	0.017	3.51

Figure 37 and Figure 38 show no occurrences of reportable 12-month rolling averages for the year.



Note: GS31 stopped being operated as a POC on September 28, 2011; GS31 continues operation as an AMP monitoring location.

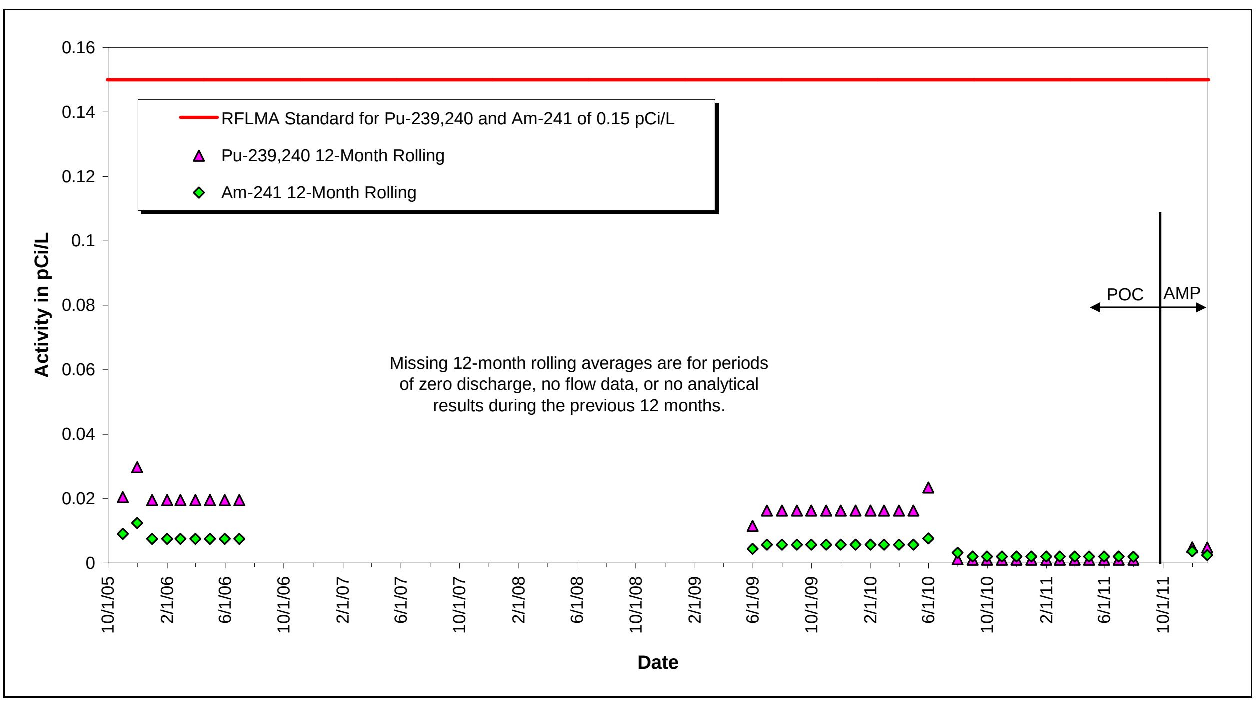
Figure 37. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at GS31: Calendar Year Ending Fourth Quarter CY 2011



Note: GS31 stopped being operated as a POC on September 28, 2011; GS31 continues operation as an AMP monitoring location.

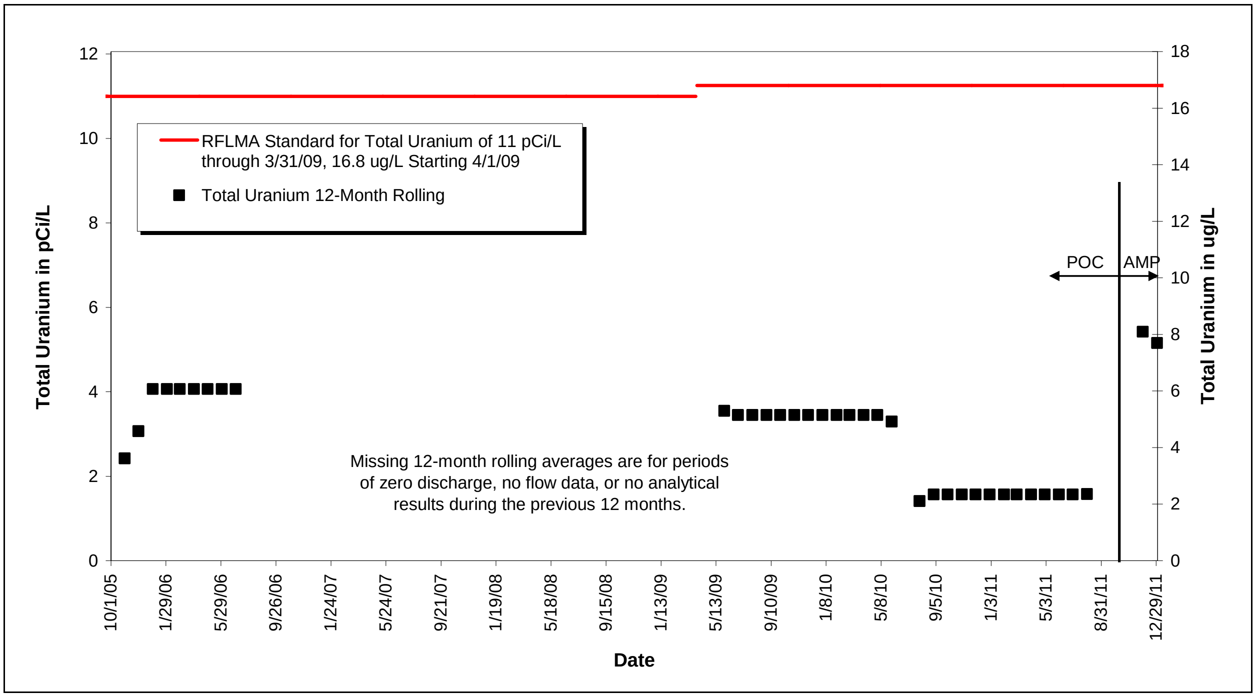
Figure 38. Volume-Weighted 12-Month Rolling Average Total U Concentrations at GS31: Calendar Year Ending Fourth Quarter CY 2011

Figure 39 and Figure 40 show similar data for the entire post-closure period.



Note: GS31 stopped being operated as a POC on September 28, 2011; GS31 continues operation as an AMP monitoring location.

Figure 39. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at GS31: Post-Closure Period



Note: GS31 stopped being operated as a POC on September 28, 2011; GS31 continues operation as an AMP monitoring location.

Figure 40. Volume-Weighted 12-Month Rolling Average Total U Concentrations at GS31: Post-Closure Period

3.1.2.2 POE Monitoring

This objective deals with monitoring runoff and baseflow from the interior of the COU to the A-, B-, and C-Series Ponds to demonstrate compliance with surface-water-quality standards (see Table 1 of RFLMA Attachment 2). Water quality data are reportable under RFLMA when the applicable compliance parameters are greater than the corresponding Table 1 values (see Appendix D). Surface water is monitored by POEs SW093, GS10, and SW027 on North Walnut Creek, South Walnut Creek, and the SID, respectively. These locations are shown on Figure 41. Sampling and data evaluation protocols are summarized in Table 13.

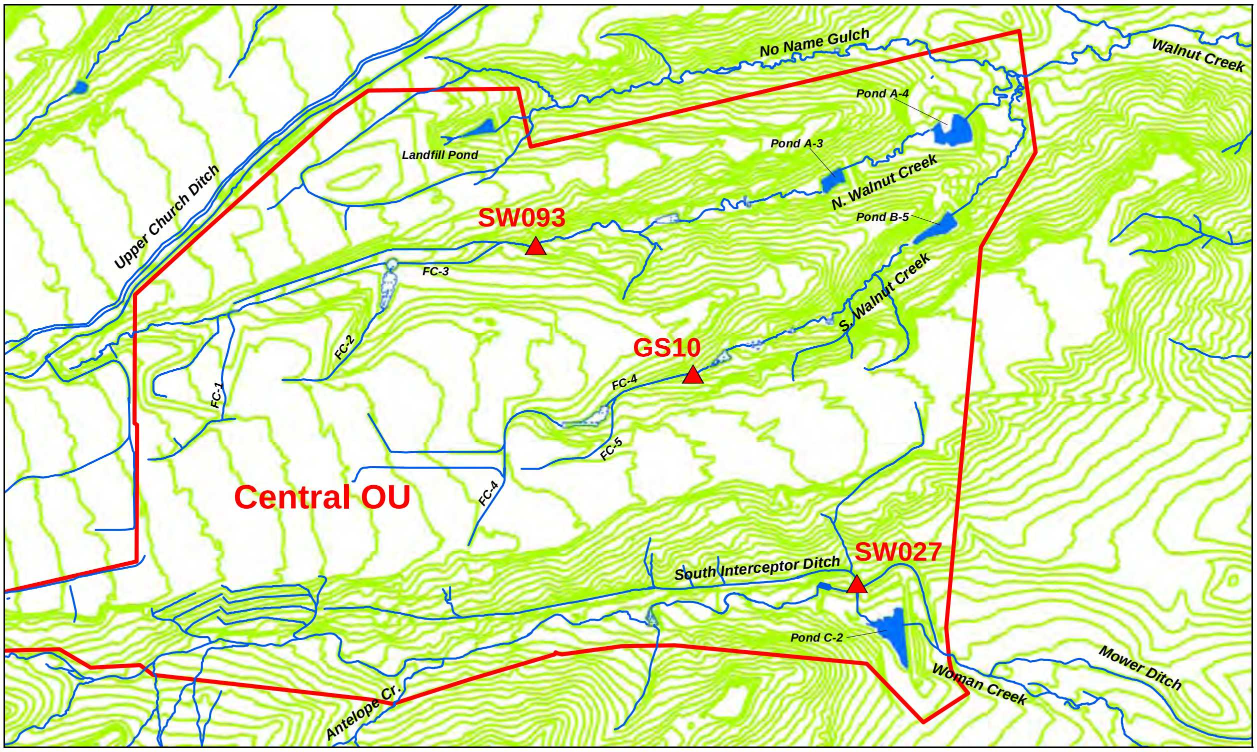


Figure 41. POE Monitoring Locations

Table 13. Sampling and Data Evaluation Protocols at POEs

Location Code	Location Description	Sample Types/Frequencies	Analytes	Data Evaluation
GS10	South Walnut Creek at Outfall of FC-4	Continuous flow-paced composites; frequency varies (target is 20 per year)[a]	Total hardness, Be, Cr, Pu, Am, and U; dissolved Ag and Cd; [TSS[b]]	See Figure 6 in Appendix D
SW027	SID at Pond C-2	Continuous flow-paced composites; frequency varies (target is 24 per year)[a]	Total hardness, Be, Cr, Pu, Am, and U; dissolved Ag and Cd; [TSS[b]]	See Figure 6 in Appendix D
SW093	North Walnut Creek at Outfall of FC-3	Continuous flow-paced composites; frequency varies (target is 18 per year)[a]	Total hardness, Be, Cr, Pu, Am, and U; dissolved Ag and Cd; [TSS[b]]	See Figure 6 in Appendix D

Notes: [a] Frequency depends on available flow.
[b] Total suspended solids (TSS) is analyzed when the composite sampling period is within TSS holding-time limits.
Ag = silver   Be = beryllium
Cd = cadmium   Cr = chromium

The following sections include summary tables and plots showing the applicable 30-day and 12-month rolling averages for the POE analytes. The evaluations include all results that were not rejected through the data verification and validation process. Data are generally presented to decimal places as reported by the laboratories. Accuracy should not be inferred; minimum detectable concentrations, activities, and analytical errors are often greater than the precision presented. When a sample has a corresponding field duplicate, the value used in calculations is the arithmetic average of the “real” and “duplicate” values. When a sample has multiple “real” analyses (Site-requested "reruns"), the value used in calculations is the arithmetic average of the multiple "real" analyses.[6]

Refer to Appendix B, which contains the water-quality data, for further information.

Location GS10

Monitoring location GS10 is located on South Walnut Creek just upstream of the B-Series Ponds (Figure 41). The central portion of the COU contributes flow to GS10 through FC-4 and FC-5.

Table 14 shows that many of the annual average Pu and Am activities at GS10 were greater than the RFLMA standard of 0.15 pCi/L during active Site closure. Although a significant reduction in both Pu and Am activities was observed through 2010, recent 2011 data show increased Pu and Am activities. Figure 42 shows that recent 12-month rolling averages for americium exceed the RFLMA standard of 0.15 pCi/L. Plutonium was not reportable as of the end of CY 2011, but increased Pu activities have also been observed.

Figure 44 shows that the 12-month rolling average for uranium exceeded the RFLMA standard of 16.8 µg/L during CY 2011.

An updated discussion of these reportable conditions is presented below.

The composite sampling results for plutonium, americium, and uranium from composite samples collected at GS10 during CY 2011–2012 are given below in Table 15. All other analytes were not reportable during CY 2011.

Table 14. Annual Volume-Weighted Average Radionuclide Activities at GS10 for 1997−2011

Calendar Year	**Volume-Weighted Average**		
	Am-241 (pCi/L)	**Pu-239,240 (pCi/L)**	**Total U (µg/L)**
1997	0.266	0.260	4.05
1998	0.109	0.158	4.28
1999	0.274	0.139	3.76
2000	0.421	0.195	3.20
2001	0.075	0.080	4.14
2002	0.087	0.061	4.03
2003	0.117	0.113	3.86
2004	0.136	0.314	3.64
2005	0.185	0.238	11.95
2006	0.010	0.014	19.31
2007	0.010	0.020	16.54
2008	0.025	0.020	22.87
2009	0.009	0.019	13.36
2010	0.007	0.012	14.38
2011	0.319	0.207	20.67
Total (1997−2011)	0.167	0.152	6.59

[6] Significant differences in values for a data pair are an indication of potential problems with sample preparation or analysis. Under these circumstances, an applicable value to be used for comparison cannot be determined with sufficient confidence to make compliance decisions. Therefore, an evaluation of the relative error ratio (RER) or relative percentage difference (RPD), depending on the analyte, is required to assess the representativeness of the sample and its usability for compliance decisions (see Section 11.2.3 of the RFSOG for discussion).

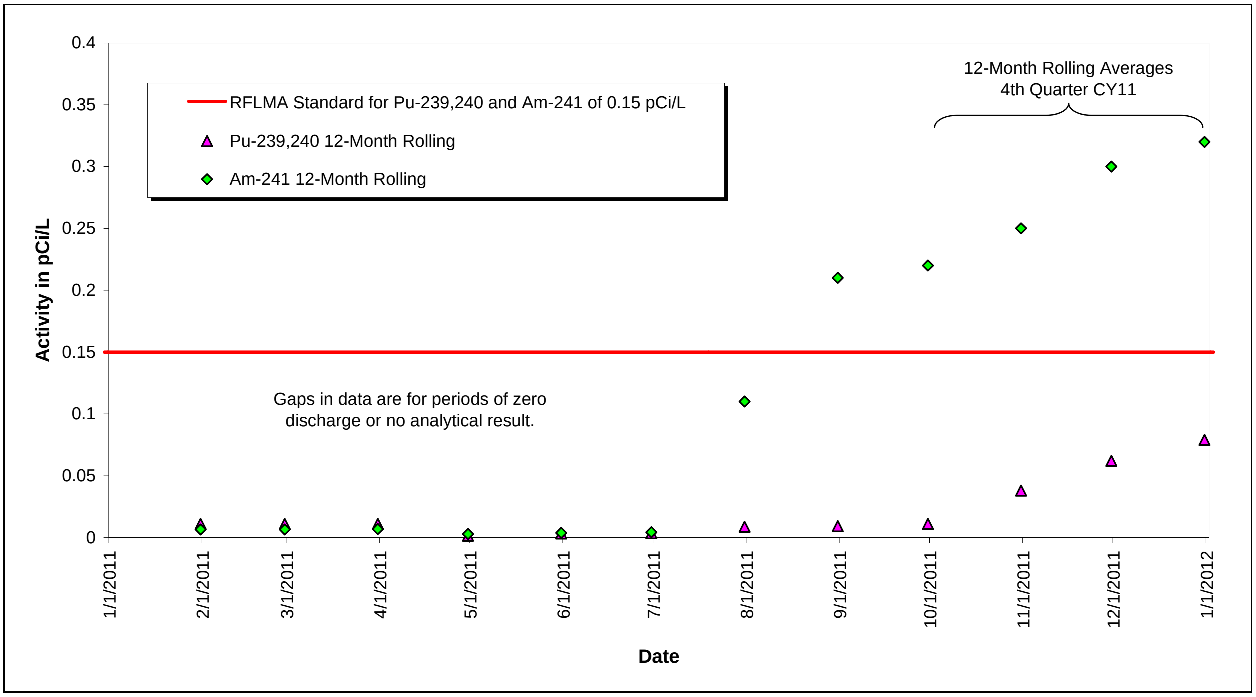


Figure 42. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at GS10: Calendar Year Ending Fourth Quarter CY 2011

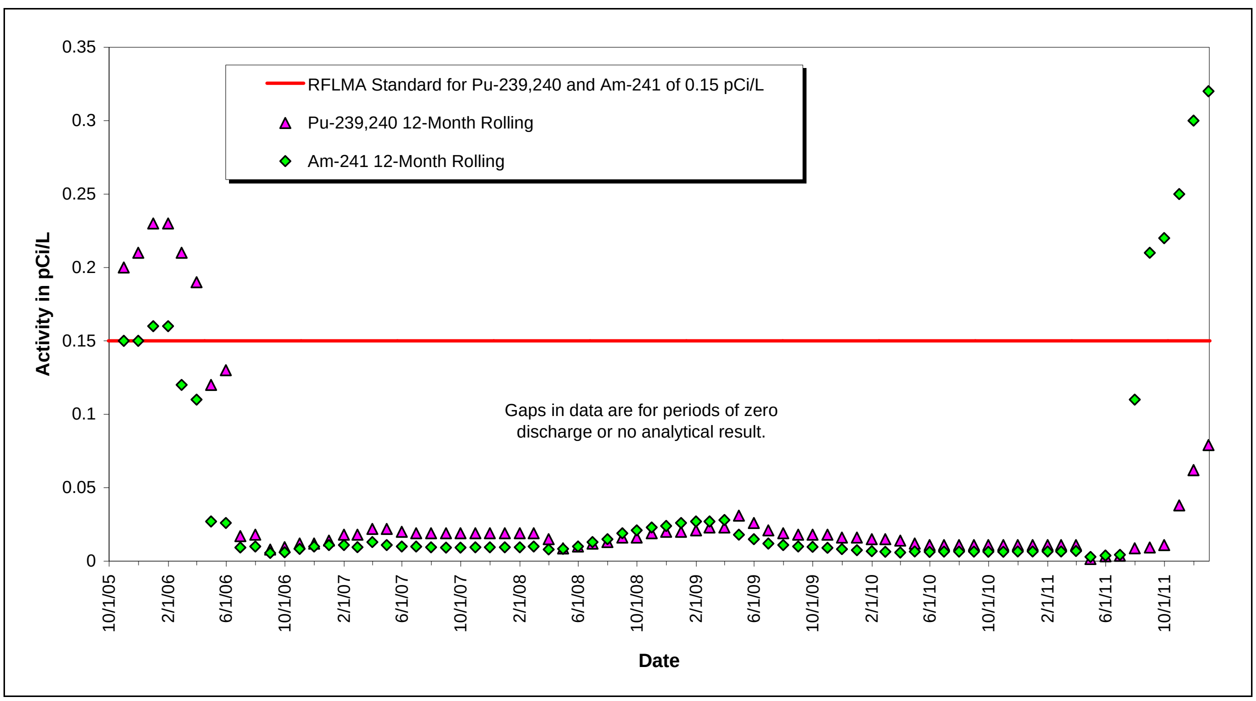


Figure 43. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at GS10: Post-Closure Period

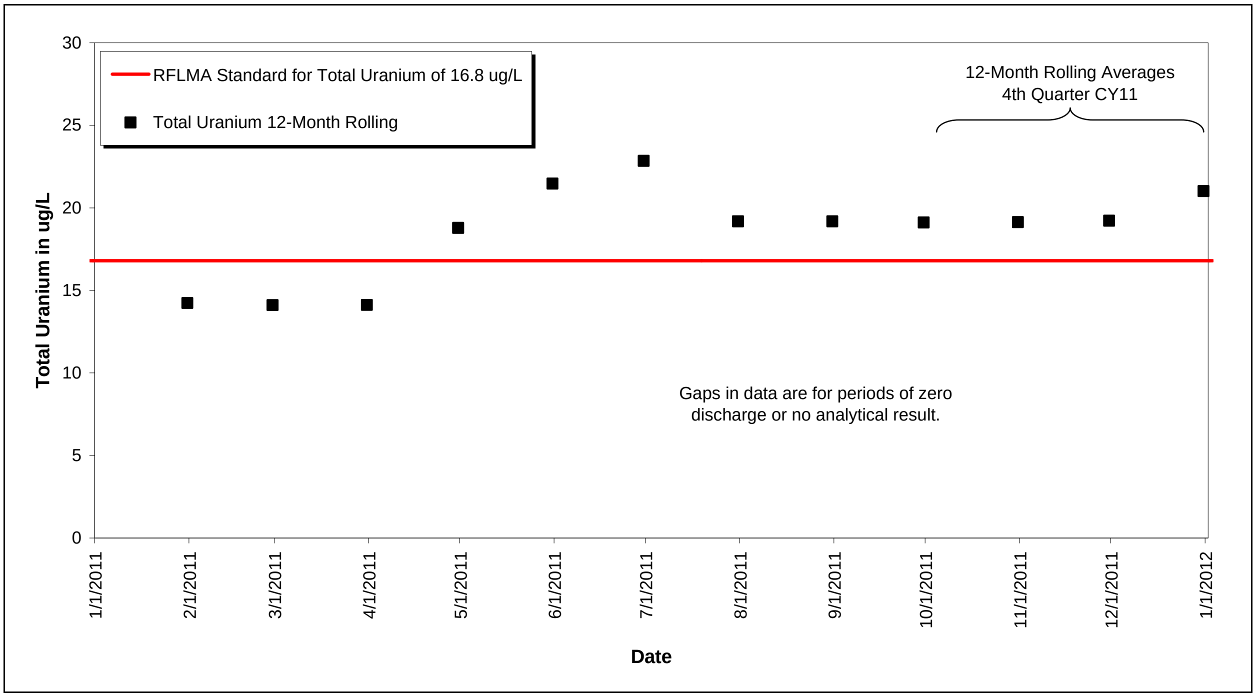


Figure 44. Volume-Weighted 12-Month Rolling Average Total U Concentrations at GS10: Calendar Year Ending Fourth Quarter CY 2011

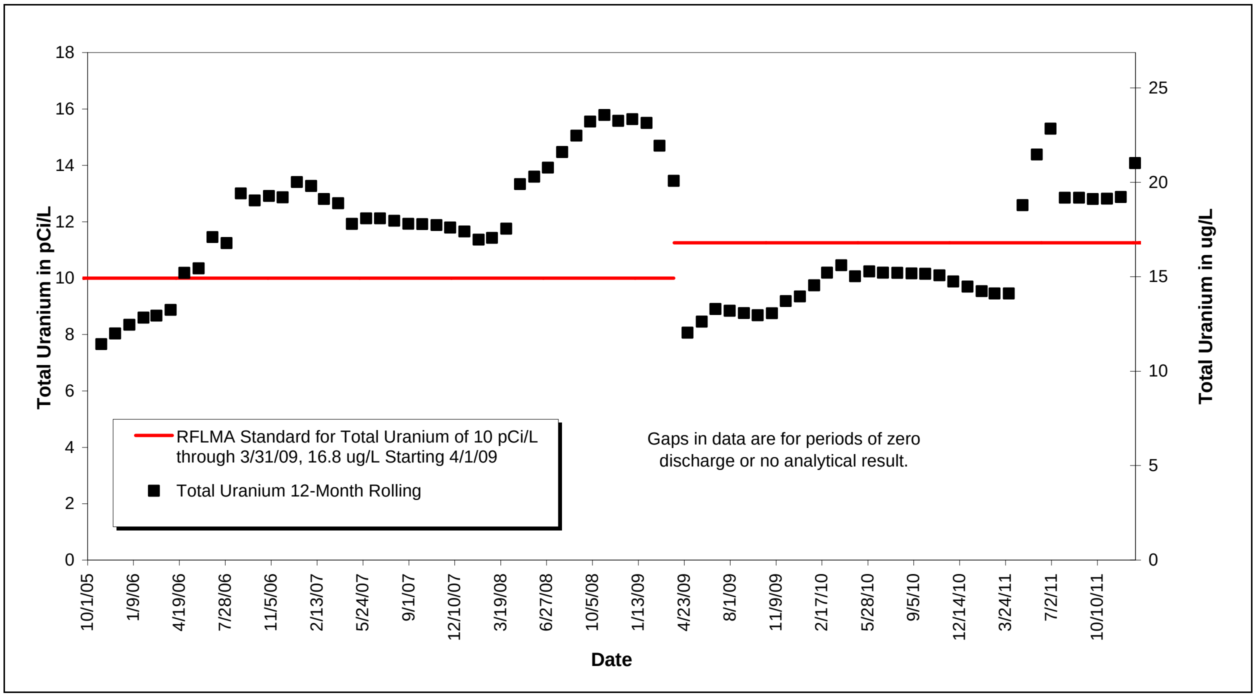


Figure 45. Volume-Weighted 12-Month Rolling Average Total U Concentrations at GS10: Post-Closure Period

Table 15. CY 2011–2012 Composite Sampling Results at GS10

Date-Time Start	Date-Time End	Am-241 Result (pCi/L)	Pu-239, 240 Result (pCi/L)	Uranium Result (µg/L)
1/3/2011–10:25	2/16/2011–9:47	0.000	0.000	21.8
2/16/2011–9:47	4/11/2011–10:50	0.000	0.013	89.2
4/11/2011–10:50	5/4/2011–11:39	0.023	0.021	71.0
5/4/2011–11:39	5/13/2011–12:25	0.019	0.017	46.5
5/13/2011–12:25	5/20/2011–12:03	0.003	0.007	18.6
5/20/2011–12:03	6/3/2011–10:56	0.004	0.001	35.8
6/3/2011–10:56	6/13/2011–10:22	0.015	0.000	20.1
6/13/2011–10:22	7/1/2011–9:00	0.010	0.004	10.6
7/1/2011–9:00	7/8/2011–11:08	0.008	0.008	7.75
7/8/2011–11:08	7/10/2011–11:05	0.015	0.005	4.36
7/10/2011–11:05	7/11/2011–10:59	0.020	0.011	6.06
7/11/2011–10:59	7/21/2011–8:56	0.058	0.037	11.3
7/21/2011–8:56	8/24/2011–9:41	3.490	[a]	7.82
8/24/2011–9:41	9/29/2011–12:35	0.044	0.020	8.16
9/29/2011–12:35	10/25/2011–10:27	0.877	0.658	8.24
10/25/2011–10:27	11/17/2011–10:40	0.904	0.405	16.5
11/17/2011–10:40	12/14/2011–12:17	0.349	0.189	16.4
12/14/2011–12:17	1/5/2012–13:19	0.435	0.238	44.5
1/5/2012–13:19	1/23/2012–10:43	1.140	0.735	49.7
1/23/2012–10:43	2/2/2012–12:36	0.037	0.021	38.3
2/2/2012–12:36	2/21/2012–11:18	0.776	0.466	49.0
2/21/2012–11:18	2/24/2012–9:34	0.214	0.267	25.1
2/24/2012–9:34	3/6/2012–12:04	0.074	0.05	33.9
3/6/2012–12:04	3/21/12–9:37	[b]	[b]	[b]
3/21/12–9:37	in progress	[c]	[c]	[c]

Notes: Recent results from 2012 are not yet validated and are subject to revision.
[a] Through data validation, results determined to be unusable
[b] Analysis pending
[c] Sample in progress

Table 16 shows that all of the annual average metals concentrations were less than the standards/PQLs. Additionally, the long-term metals averages (1997–2011) were all less than the RFLMA standards/PQLs. Figure 46 shows that none of the 85th percentile 30-day average metals concentrations were reportable for the year.

Table 16. Annual Volume-Weighted Average Hardness and Metals Concentrations at GS10 for 1997−2011

Calendar Year	Volume-Weighted Average Concentration (µg/L)				
	Hardness (mg/L)	Total Be	Dissolved Cd	Total Cr	Dissolved Ag
1997	138	0.50	0.09	4.05	0.11
1998	162	0.15	0.13	3.32	0.20
1999	139	0.16	0.07	4.08	0.15
2000	181	0.21	0.11	3.65	0.11
2001	222	0.32	0.11	5.95	0.11
2002	277	0.24	0.09	5.38	0.10
2003	228	0.22	0.10	6.91	0.12
2004	227	0.60	0.10	13.1	0.13
2005	401	0.88	0.06	17.5	0.15
2006	604	0.50	0.05	0.74	0.10
2007	383	0.50	0.10	0.89	0.10
2008	517	0.45	0.07	1.20	0.09
2009	351	0.50	0.06	1.69	0.10
2010	314	0.50	0.06	1.00	0.10
2011	395	0.50	0.06	0.80	0.10
Total (1997−2011)	234	0.37	0.09	5.45	0.13

Ag = silver
Be = beryllium
Cd = cadmium
Cr = chromium

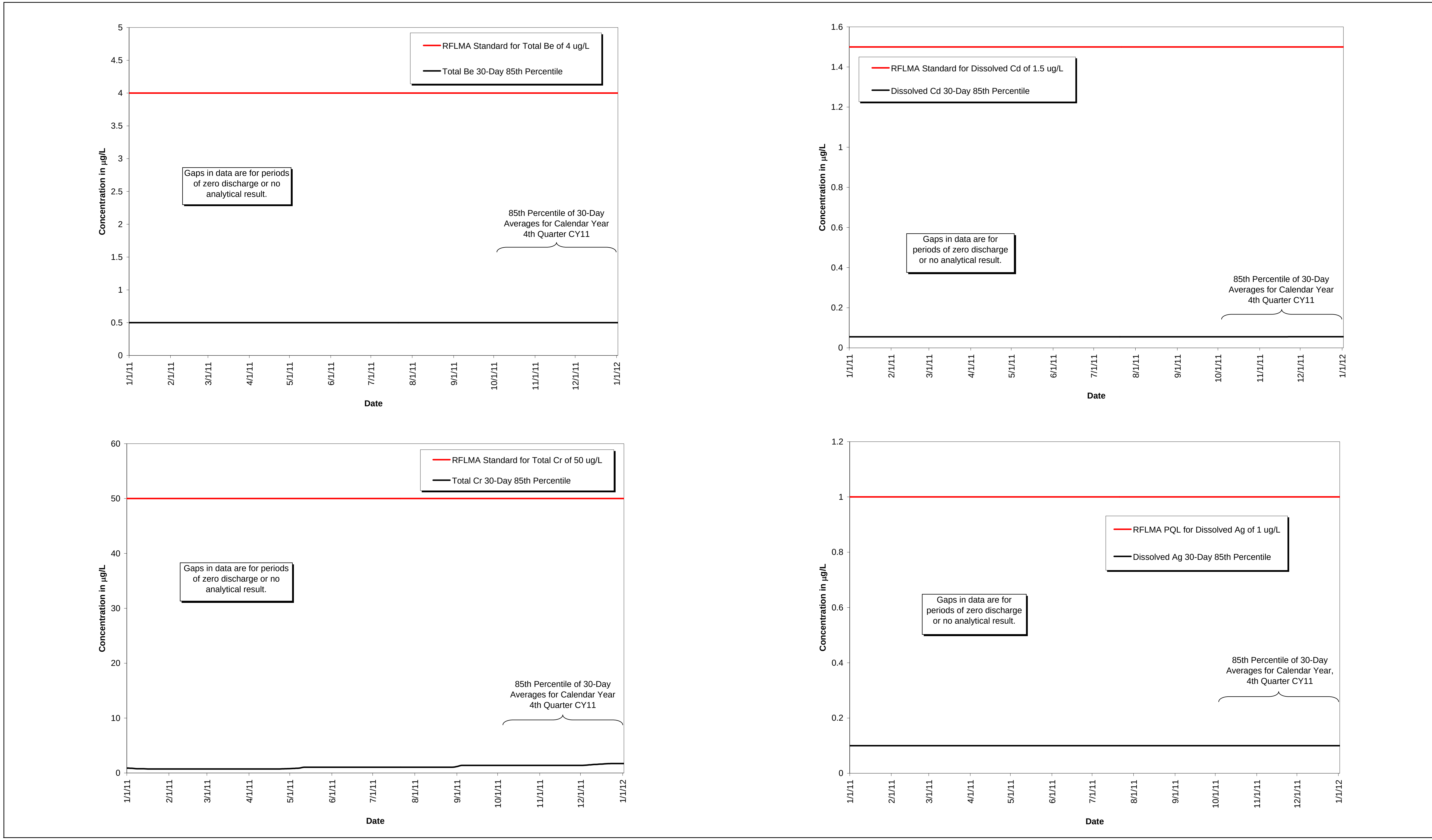


Figure 46. Volume-Weighted Average Metals Compliance Values at GS10: Calendar Year Ending Fourth Quarter CY 2011

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Reportable Americium Activities at GS10

Formal notification of a reportable condition for 12-month rolling average americium values at GS10 was made on December 12, 2011. The reportable condition was determined based on evaluation of recently available validated analytical results for americium (Am-241) from the composite samples collected during the period July 21, 2011–October 25, 2011. Following is a synopsis of the initial data that triggered the reportable condition:

- Composite July 21–August 24, 2011 (initial analysis; results validated November 2, 2011) Pu = 0.938 pCi/L, Am = 2.97 pCi/L
- Composite July 21-August 24, 2011 (laboratory re-analysis completed November 15, 2011; results validated November 22, 2011) Pu = 4.07 pCi/L, Am = 4.01 pCi/L
- Composite August 24–29, 2011 (results validated November 30, 2011) Pu = 0.020 pCi/L, Am = 0.044 pCi/L
- Composite September 29–October 25, 2011 (results validated November 22, 2011) Pu = 0.658 pCi/L, Am = 0.877 pCi/L

Under routine data validation protocols, the duplicate error ratio (DER) is used to evaluate data pairs (i.e., an initial analysis and a duplicate analysis). If the DER for a data pair is >3 and <=5, then the results are "J" qualified (estimated). If the DER for a data pair is >5, then the results are "R" qualified (unusable result). During validation of the July 21–August 24, 2011, analytical results, the Am results were determined to be "J" qualified, while the Pu results were determined to be "R" qualified. Therefore, the arithmetic average of the Am results is used in the calculation of the 12 month rolling average for Am; the Pu results were rejected and not included in calculation of the 12-month rolling average for Pu.

The above evaluation was performed in accordance with RFLMA Attachment 2, Figure 6, “Points of Evaluation,” which resulted in 12-month rolling average values for Am of 0.21 pCi/L on August 31, 2011, and 0.22 pCi/L on September 30, 2011. The applicable RFLMA Table 1 Standard for Am and Pu is 0.15 pCi/L. As of December 31, 2011, using validated data, the 12-month rolling average for Am remained above the standard at 0.32 pCi/L; using unvalidated data, americium is reportable through February 29, 2012. The 12-month rolling average for Pu remains below the standard.

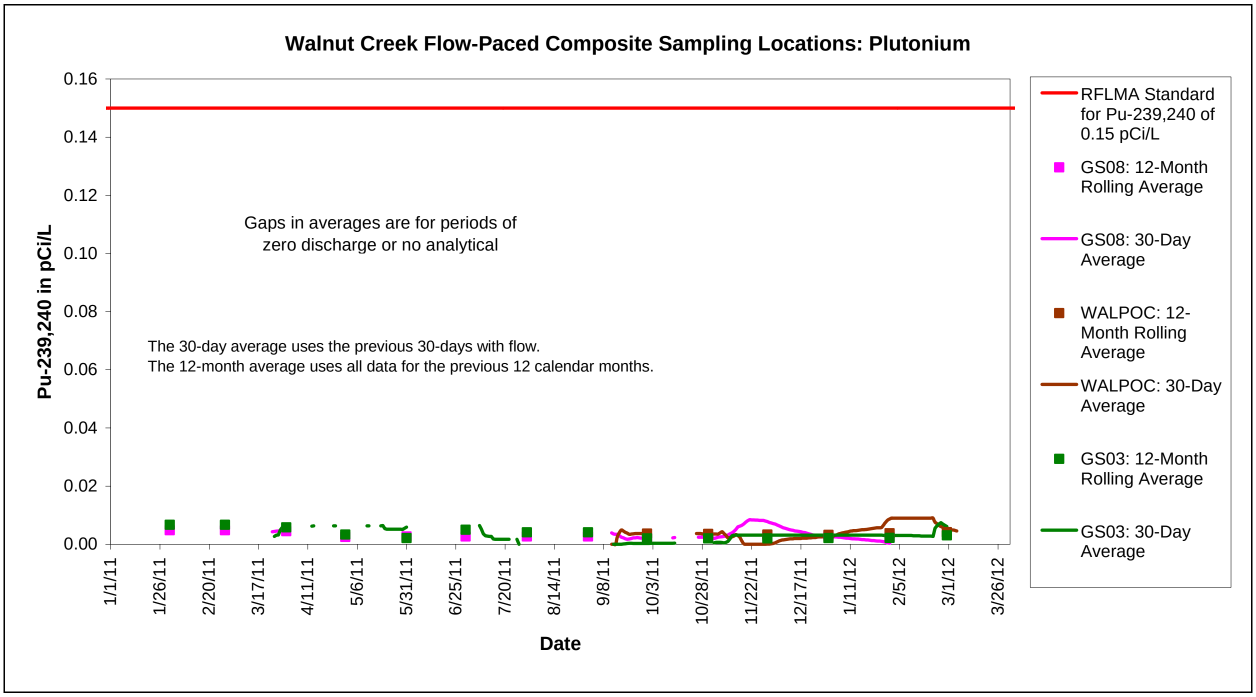
While the 12-month rolling average for Pu continues to be not reportable, the evaluation of the reportable Am values includes consideration of the Pu results.

Downstream monitoring at GS08, WALPOC, and GS03 continue to show Pu and Am activities well below the RFLMA standard of 0.15 pCi/L. Recent analytical results at downstream locations are given in Table 17. The latest available 12-month rolling and 30-day average Pu/Am activities calculated from flow-paced composite samples are shown on Figure 47 and Figure 48.

Table 17. Recent Pu and Am Flow-Paced Composite Sample Results

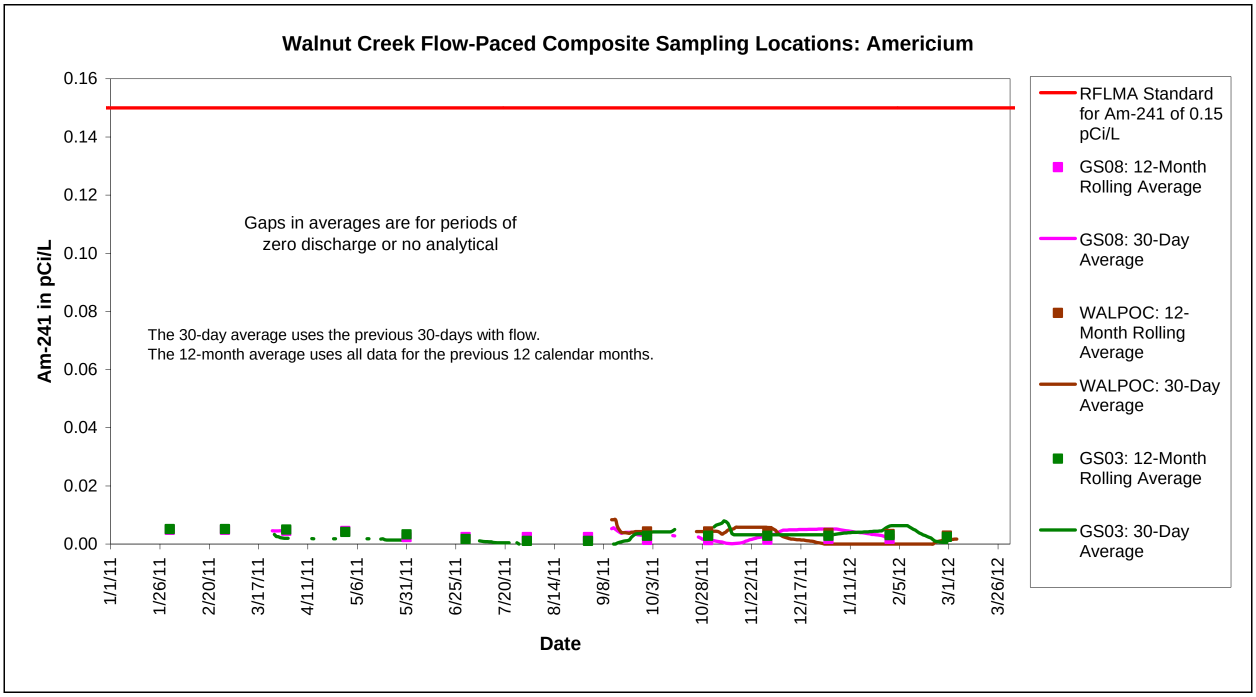
GS08		WALPOC		GS03	
Sample Period	**Result Am/Pu (pCi/L)**	**Sample Period**	**Result Am/Pu (pCi/L)**	**Sample Period**	**Result Am/Pu (pCi/L)**
3/24–3/26/11	0.002/0.003			3/24–3/26/11	0.0/0.002
3/26–3/28/11	0.002/0.004			3/26–3/28/11	0.002/0.003
3/28–3/30/11	0.003/0.0			3/28–3/31/11	0.001/0.011
				3/31–5/20/11	0.002/0.007
				5/20–9/12/11	0.0/0.0
9/12–9/15/11	0.002/0.002	9/12–9/15/11	0.008/0.0	9/12–9/15/11	0.0/0.0
9/15–9/18/11	0.001/0.0	9/15–9/18/11	0.0/0.009	9/15–9/18/11	0.002/0.0
9/18–9/21/11	0.0/0.0	9/18–9/22/11	0.003/0.0	9/18–9/22/11	0.003/0.001
9/21–9/27/11	0.0/0.005	9/22–9/27/11	0.006/0.004	9/22–9/27/11	0.009/0.0
9/27–11/9/11	0.0/0.009	9/27–11/30/11	0.006/0.0	9/27/11–1/3/12	0.003/0.003
11/9–11/29/11	0.005/0.008				
11/29/11–1/5/12	0.005/0.003	11/30/11–1/3/12	0.0/0.003		
1/5–2/1/12	0.001/0.0	1/3–2/23/12	0.0/0.009	1/3–2/10/12	0.006/0.003
2/1/12–	[b]			2/10–2/23/12	0.0/0.003
		2/23–3/6/12	0.003/0.001	2/23–2/27/12	0.0/0.012
				2/27–3/1/12	0.0/0.0
		3/6–3/21/12	[a]	3/1–3/15/12	
		3/21/12–	[b]	3/15/12–	

Notes: Some results are preliminary and subject to revision; negative results are set to zero
[a] Analysis pending
[b] Sample in progress



Note: Plot includes data that are preliminary and subject to revision.

Figure 47. Average Plutonium Activities at Locations Downstream of GS10



Note: Plot includes data that are preliminary and subject to revision.

Figure 48. Average Americium Activities at Locations Downstream of GS10

Although further evaluation and consultation is ongoing, the following list summarizes action to date:

- Rocky Flats staff walked down the GS10 drainage on November 16, 2011, to see if any obvious conditions were promoting potential soil erosion. Some thin vegetation spots were noted on the north side of the riprap upstream of GS10. Some reseeding/erosion matting could be applied in spots, and a map of the areas to be addressed will be prepared. A closer examination of the drainage to focus on seeps and former utility corridors was conducted on November 22, 2011; representatives from DOE and EPA were in attendance.
- Historical Pu and Am well data from wells in the drainage have been reviewed. The review gave no indication that additional well sampling would be informative at this stage.
- The previous GS10 evaluation reports are being reviewed for information that may aid this current evaluation.
- Several of the sampling locations already designated for the evaluation of the reportable condition for uranium at GS10 (FC4991, GS10, and B3OUTFLOW; Figure 49) were grab sampled on November 25, 2011. Several seep sampling locations (SEEP995, SEEP995A, SEEP995B, and SEEP995C; Figure 49) were also grab sampled on November 25, 2011. This Seep 995 area was chosen for sampling for the following reasons:
  - — GS10 samples with elevated Pu/Am were collected during low-flow conditions, not during high-flow conditions when soil/sediment would be expected to be transported.
  - — Visible surface flow from this seep was observed reaching FC-4.

— This seep, which has increased in size since closure, is in the same location of the former Wastewater Treatment Plant (WWTP) outfall and a former utility corridor that included Original Process Waste Lines.

The results in Table 18 suggest that the SEEP995 locations could be contributing Pu and Am to GS10. However, activities at GS10 for this grab sample are low.

Table 18. Grab Sampling Results Upstream of GS10: November 25, 2011

Location Code	SEEP995	SEEP995A	SEEP995B	SEEP995C
Pu [pCi/L]	0.096	0.156	0.157	0.105
Am [pCi/L]	0.066	0.127	0.035	0.052

	Upstream	➡	**Downstream**
Location Code	FC4991	GS10	B3OUTFLOW
Pu [pCi/L]	0.006	0.030	0.005
Am [pCi/L]	0.005	0.012	0.005

Note: The arrow from the upper table indicates the relative location of the SEEP995 locations along FC-4.

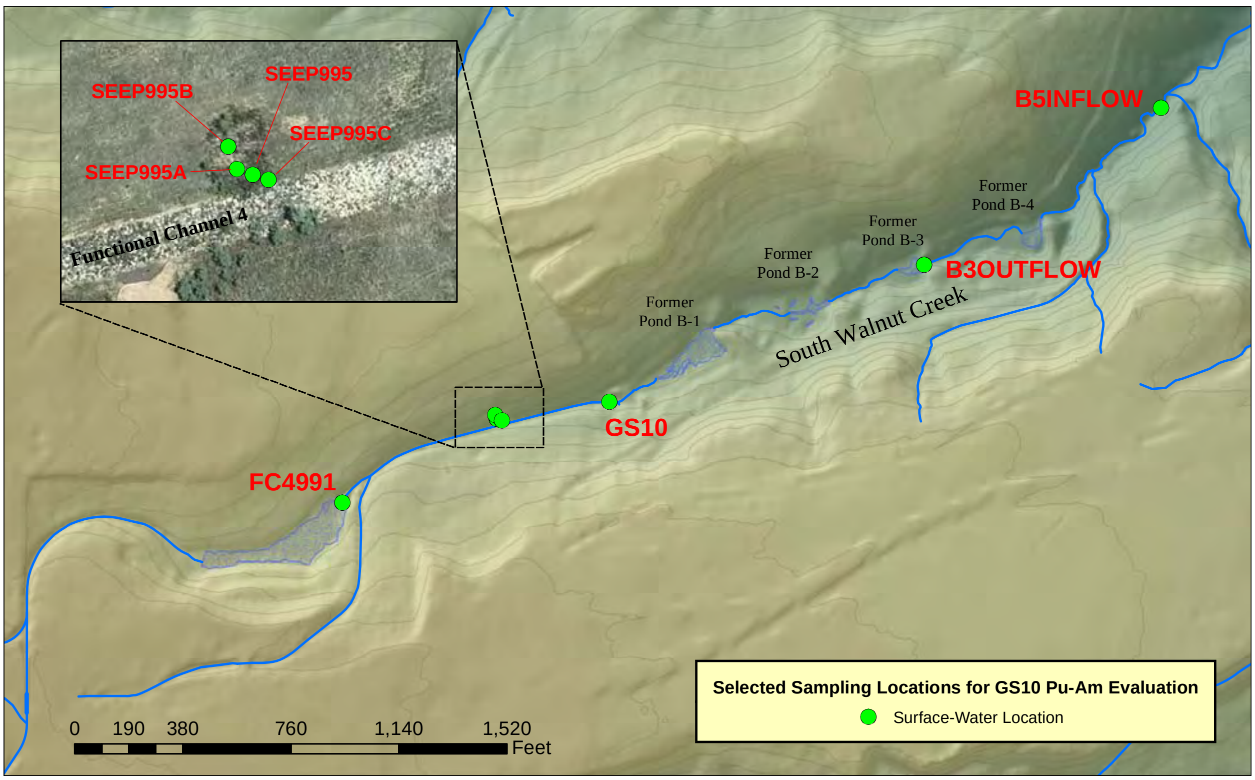


Figure 49. Pu/Am Evaluation Sampling Location Map for GS10 Drainage Area

- An aliquot from each flow-paced composite sample routinely being collected at B5INFLOW (supporting the GS10 uranium evaluation; Figure 49) is also being held for Pu and Am analysis if upstream sample results suggest analysis would inform the evaluation. To date, two Pu/Am results have been obtained and all results are well below the RFLMA standard of 0.15 pCi/L.
- Additional samples were subsequently collected at SEEP995A when water was available (i.e. unfrozen seep flow not affected by surface flow such as snowmelt). Samples were collected on January 6, 2012, and January 24, 2012. For the January 24 sample, analysis was performed for total Pu/Am (unfiltered) and also for filtered Pu/Am (sample filtered with 0.45 micron filter) to evaluate for the possibility of colloidal transport. Table 19 shows some activity for the January 6 sample. However, the low activities for the January 24 samples do not provide additional insight into the possibility of colloidal transport.

Table 19. Grab Sampling Results from SEEP995A: January 6, 2012, and January 24, 2012

SEEP995A	1/6/12 (total)	1/24/12 (total)	1/24/12 (filtered)
Pu [pCi/L]	0.079	0.007	0.000
Am [pCi/L]	0.052	0.000	0.000
U [ug/L]	12.3	13.7	NA

- To evaluate whether there could be other seep-related contributions along FC-4 that are not visible due to the thick riprap, several sampling locations were established along FC-4 where water could be reached between the rock (Figure 50). These locations were grab sampled on March 6, 2012, for both total and filtered analytes.

  Unfortunately, the results in Table 20 show low Pu and Am activities and no significant spatial trends in any of the analytes.

Table 20. Grab Sampling Results in FC-4 Upstream of GS10: March 6, 2012

Location Code	SEEP995A
Pu [pCi/L]	0.004
Am [pCi/L]	0.003
U [ug/L]	11.2
Alk as CaCO3 [mg/L]	143
Hardness as CaCO3 [mg/L]	384
pH	7.84@4.1C
TSS [mg/L]	6

	Upstream	➡	➡	**Downstream**
Location Code	FC4988	FC4995	FC4997	FC4EFF
Pu [pCi/L]	0.026	0.000	0.007	0.004
Am [pCi/L]	0.002	0.001	0.002	0.000
U [ug/L]	19.0	19.1	18.7	18.7
Alk as CaCO3 [mg/L]	261	256	246	246
Hardness as CaCO3 [mg/L]	478	468	464	462
pH	7.74@3.5C	7.62@3.2C	7.64@3.5C	7.71@3.7C
TSS [mg/L]	113	2	1	5

Note: The arrow from the upper table indicates the relative location of SEEP995A along FC-4.

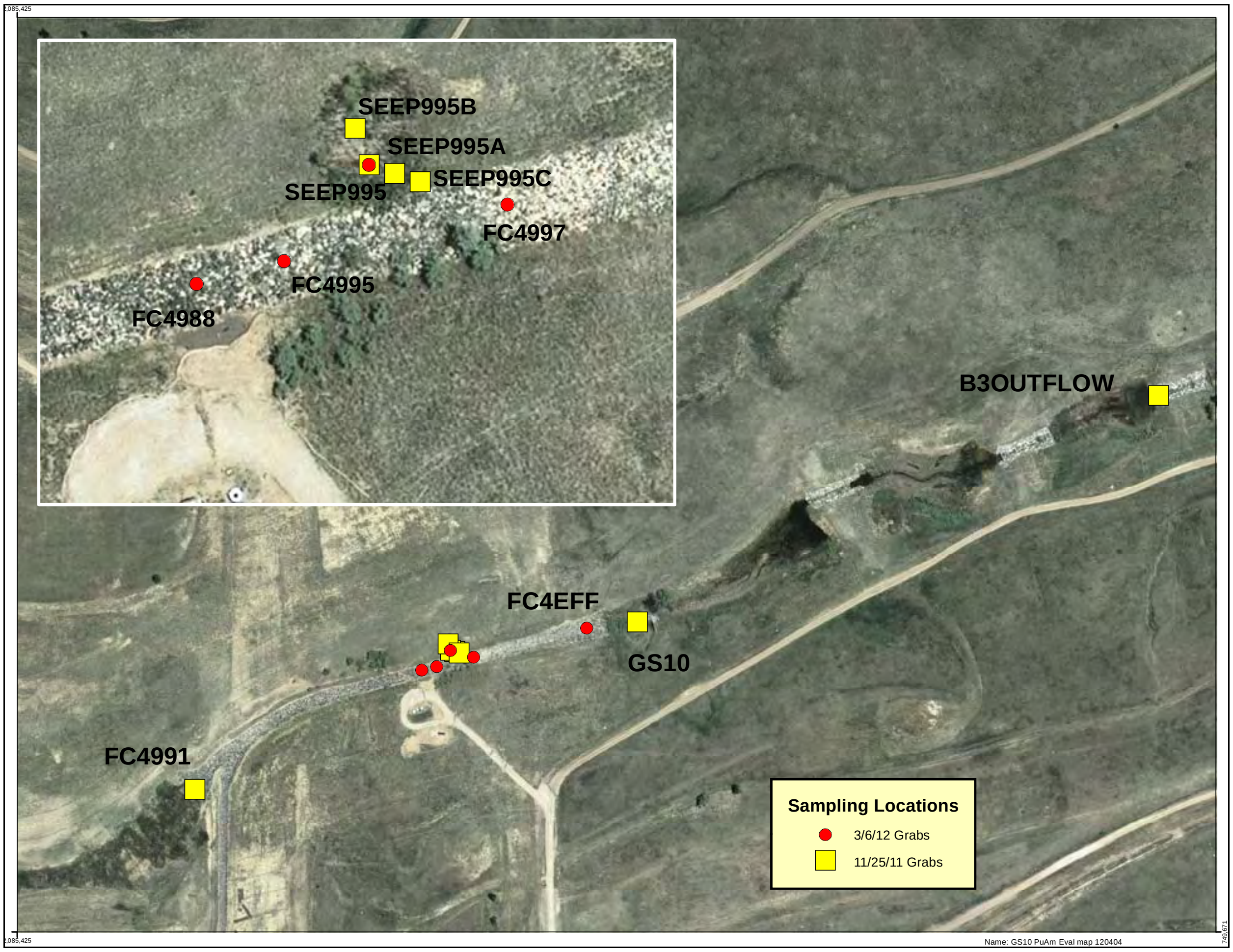


Figure 50. Pu/Am Evaluation Sampling Location Map in FC-4 Upstream of GS10.

- Flow-paced composite samples routinely being collected at WALPOC will continue to be requested to be analyzed on a 2-week turnaround. Analyses for flow-paced composite samples routinely being collected at GS10 and GS08 are also currently being requested to be analyzed on a 2-week turnaround.

Updates to the ongoing evaluation for GS10 will periodically be communicated through public meetings, routine reports, and contact records. For additional information go to http://www.lm.doe.gov/Rocky_Flats/ContactRecords.aspx.

Reportable Uranium Concentrations at GS10

The routine GS10 uranium data evaluation is performed in accordance with RFLMA Attachment 2, Figure 6, “Points of Evaluation,” which resulted in a calculated 12-month rolling average concentration for uranium on April 30, 2011, of 18.8 µg/L. More recent 12-month rolling averages using validated data through December 31, 2011, continue to exceed the RFLMA applicable Table 1 standard of 16.8 µg/L. Unvalidated data through February 29, 2012, continue to result in 12-month rolling averages above the standard.

Initial notification to the regulatory agencies and the public, in accordance with RFLMA Attachment 2, Figure 6, was made by e-mail on June 16, 2011. RFLMA Contact Record 2011-04

(July 8, 2011), “Reportable Condition for Uranium at Point of Evaluation GS10,” provides a discussion of the monitoring results and recaps the outcome of the RFLMA Parties consultation regarding the evaluation steps to be taken. RFLMA Contact Record 2011-05 (October 4, 2011), “Update for Reportable Condition for Uranium at Point of Evaluation GS10,” provides an update of the monitoring results and provides further discussion of the path forward. Both contact records are available on the Rocky Flats website, http://www.lm.doe.gov/Rocky_Flats/ContactRecords.aspx.

Figure 51 shows the locations sampled during CY 2011 in support of the uranium evaluation for GS10. GS03 is not shown, but is the current POC on Walnut Creek at Indiana Street.

The following bullets provide an update to the ongoing GS10 uranium evaluation:

- Downstream monitoring at B5INFLOW, GS08, WALPOC, and GS03 (Figure 51) continue to show uranium concentrations below 16.8 µg/L. Recent analytical results at downstream locations are given in Table 21. The latest available 12-month rolling and 30-day average uranium concentrations calculated from flow-paced composite samples are shown in Figure 52.
- Additional sampling and analysis for uranium within the GS10 drainage continues. Following the initial consultation, two temporary surface-water sample locations upstream of GS10 were established for biweekly uranium grab sampling (FC4991 and FC4750; Figure 51). Biweekly sampling at these locations was initiated on June 30, 2011.

  These new locations supplement GS10, B3OUTFLOW, B5INFLOW, and B5 POND (Figure 51), which have been sampled biweekly for uranium since January 27, 2010. Data from these six locations are summarized in Table 22. The averages are shown on Figure 53.
- As noted in previous RFLMA quarterly reports, the following samples were sent to Los Alamos National Laboratory (LANL) for isotopic analysis during the spring of 2011. LANL determines the percentages of natural and anthropogenic uranium to compare with percentages in pre-closure and post-closure samples previously analyzed by LANL. The locations described below are shown on Figure 51:
  - Flow-paced surface-water sample from GS10 for the period June 3 to June 13, 2011. (Historically, GS10 has shown approximately 70 percent natural uranium.)
  - Groundwater sample from upgradient well 99405. (Historically, 99405 has shown uranium concentrations that typically exceed 100 µg/L and have been 99.9 to 100 percent natural uranium.)

  The results of the LANL analysis have been reported by LANL to Stoller staff. The following highlights are noted:
  - The signature results for GS10 do not match the historical natural uranium percentage of approximately 70 percent. Natural uranium was reported as 50.6 percent. The uranium concentration was 21.6 µg/L. The previous LANL sample, taken on March 17, 2010, was 24.1 µg/L and 72.3 percent natural uranium.
  - The results for well 99405 were 411.1 µg/L uranium, with a 100 percent natural uranium signature. These results are consistent with historical data.

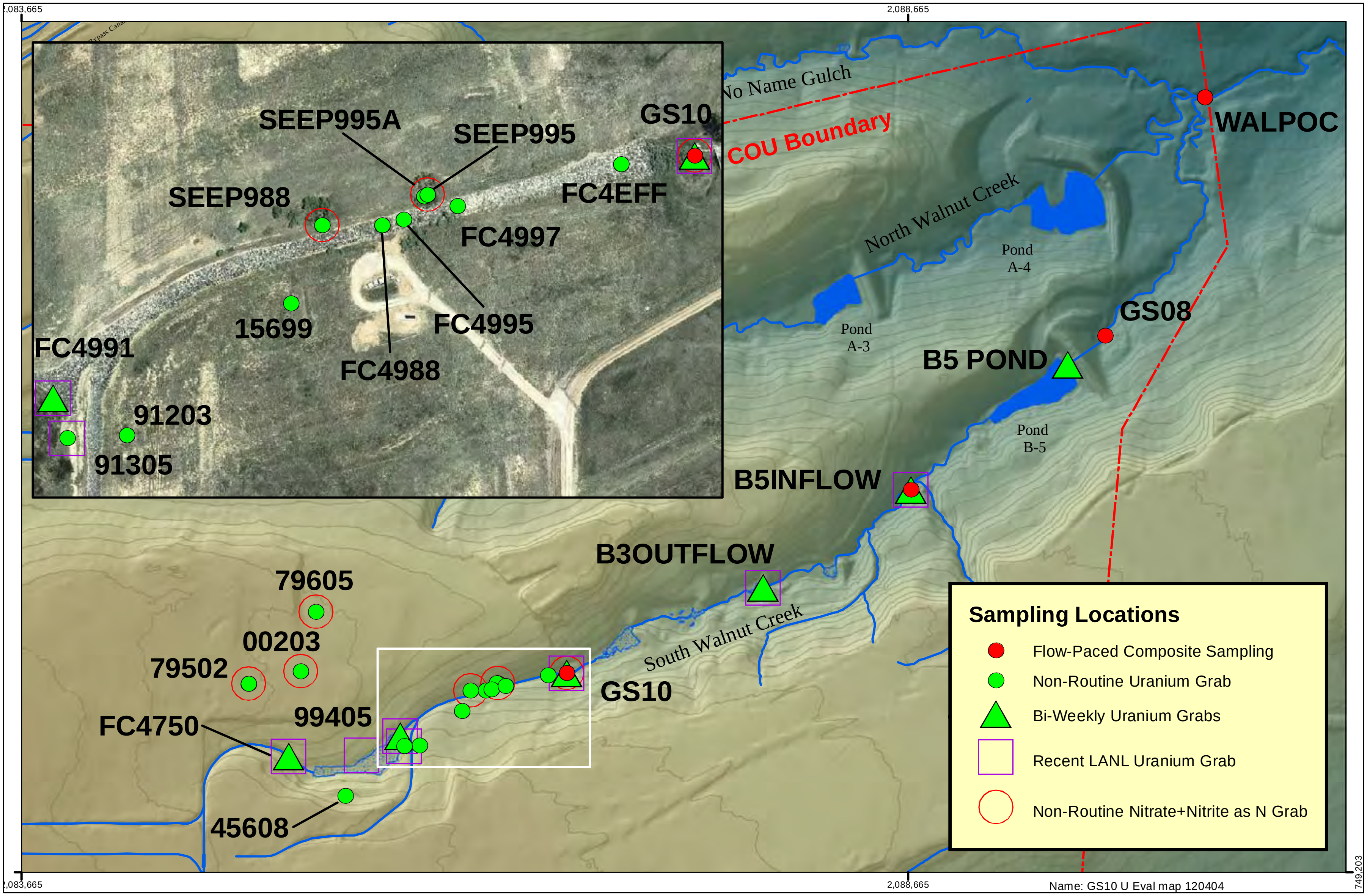
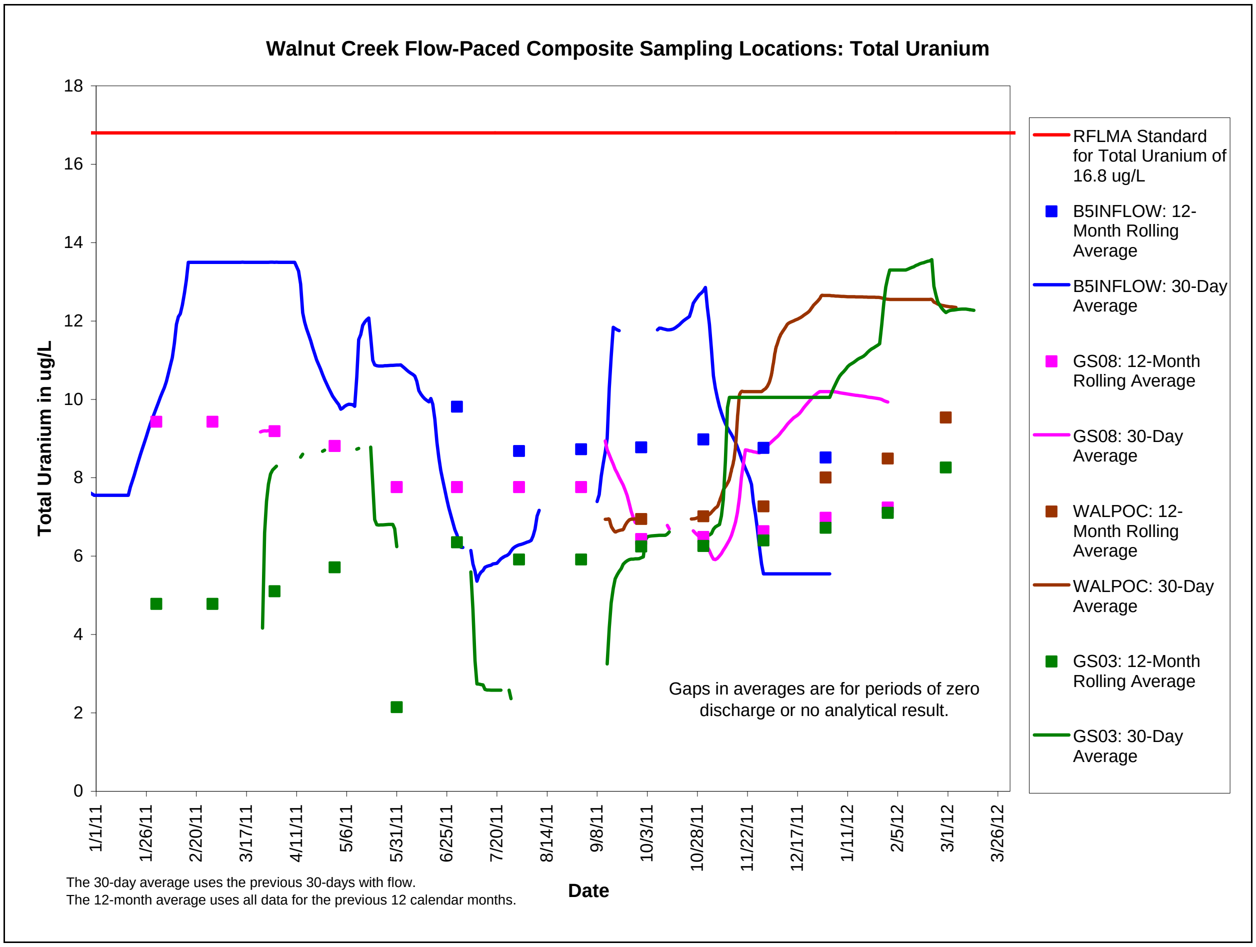


Figure 51. Uranium Evaluation Sampling Location Map for GS10 Drainage Area

Table 21. Recent Uranium Flow-Paced Composite Sample Results

B5INFLOW		GS08		WALPOC		GS03	
Sample Period	Result (µg/L)	Sample Period	Result (µg/L)	Sample Period	Result (µg/L)	Sample Period	Result (µg/L)
1/18–4/11/11	13.5	3/24–3/26/11	7.9			3/24–3/26/11	8.0
4/11–5/4/11	9.1	3/26–3/28/11	7.5			3/26–3/28/11	9.1
5/4–5/13/11	14.6	3/28–3/30/11	7.9			3/28–3/31/11	9.2
5/13–5/18/11	11.9					3/31–5/20/11	3.3
5/18–5/19/11	8.0					5/20–9/12/11	2.4
5/19–5/20/11	10.3						
5/20–6/3/11	10.5						
6/3–7/1/11	6.2						
7/1–7/10/11	5.3						
7/10–7/11/11	4.7						
7/11–7/21/11	6.2						
7/21–8/24/11	12.2						
8/24–9/29/11	11.2	9/12–9/15/11	5.6	9/12–9/15/11	6.9	9/12–9/15/11	6.1
		9/15–9/18/11	5.4	9/15–9/18/11	6.3	9/15–9/18/11	6.9
		9/18–9/21/11	5.7	9/18–9/22/11	6.8	9/18–9/22/11	6.7
		9/21–9/27/11	6.0	9/22–9/27/11	7.6	9/22–9/27/11	6.2
9/29–11/1/11	13.3	9/27–11/9/11	8.8	9/27–11/30/11	10.2	9/27/11–1/3/12	10.1
11/1/11–1/3/12	5.6	11/9–11/29/11	8.5				
		11/29/11–1/5/12	10.2	11/30/11–1/3/12	12.7		
1/3–3/6/12	[a]	1/5–2/1/12	9.9	1/3–2/23/12	12.6	1/3–2/10/12	13.3
		2/1–4/4/12	[a]			2/10–2/23/12	13.7
				2/23–3/6/12	12.2	2/23–2/27/12	11.2
						2/27–3/1/12	11.4
3/6–3/23/12	[a]			3/6–3/21/12	[a]	3/1–3/15/12	13.1
3/23/12-	[b]			3/21/12-	[b]	3/15–4/4/12	[a]
		4/4/12-	[b]			4/4/12-	[b]

Notes: Some results are preliminary and subject to revision.
[a] Analysis pending
[b] Sample in progress

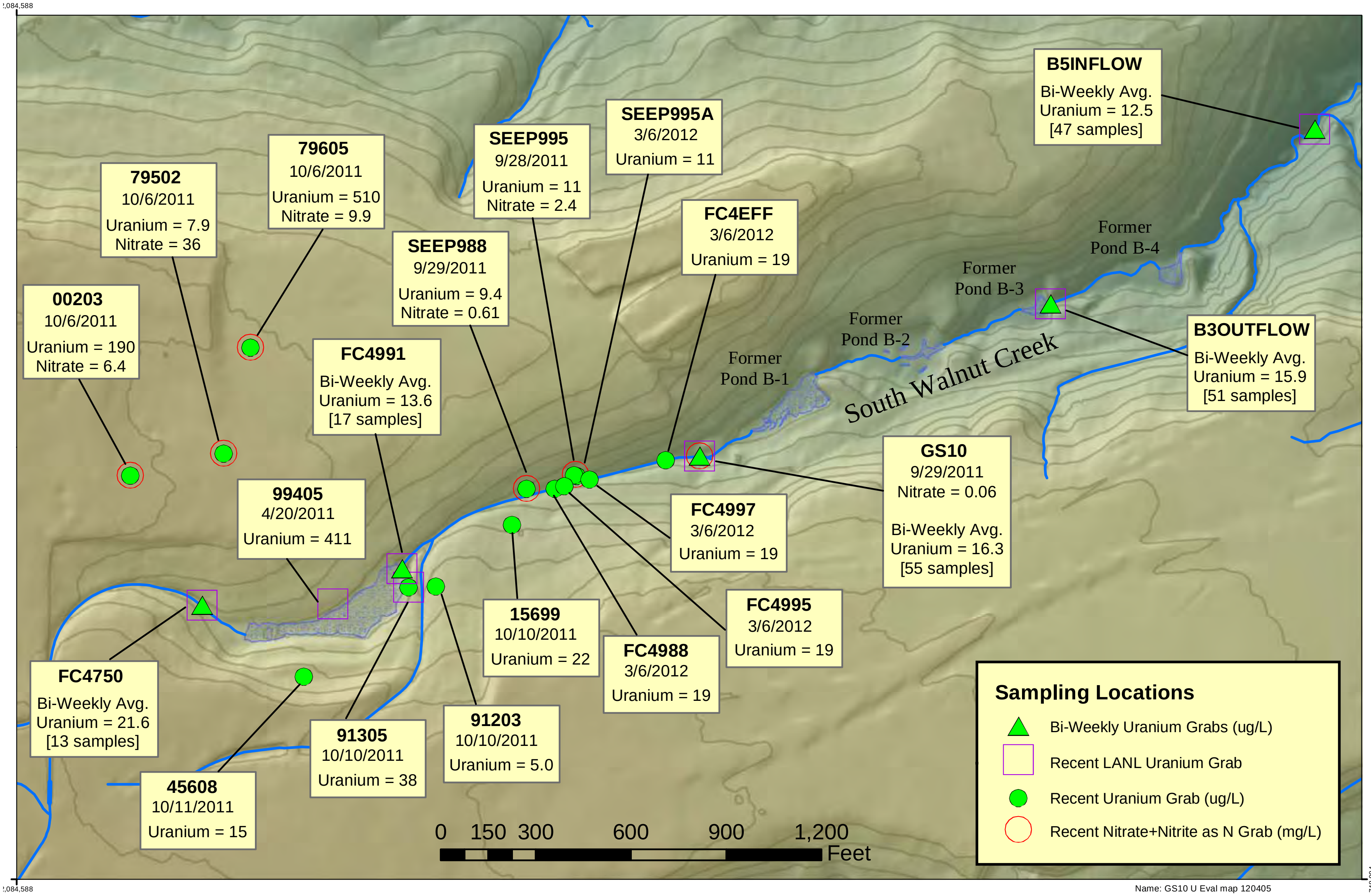


Note: Plot includes unvalidated analytical data that are preliminary and subject to revision.

Figure 52. Average Uranium Concentrations at Locations Downstream of GS10

Table 22. Summary of Biweekly Uranium Grab Sampling in South Walnut Creek

		Uranium (ug/L)			
	Location Code	**Average**	**Sample Count**	**85th Percentile**	**50th Percentile**
Upstream	FC4750	21.6	13	24.2	18.0
⬇	FC4991	13.6	17	23.6	10.5
⬇	GS10	16.3	55	22.9	15.0
⬇	B3OUTFLOW	15.9	51	23.0	17.0
⬇	B5INFLOW	12.5	47	18.1	11.0
Downstream	B5 POND	8.52	57	10.6	7.30



Name: GS10 U Eval map 120405

Figure 53. Uranium and Nitrate+Nitrite as N Results for Grab Samples Collected in South Walnut Creek

- Based on the above LANL results for GS10, the following additional samples were collected in the fall of 2011 and sent to LANL for isotopic analysis. The locations are shown on Figure 51.

  — Water from the routine flow-paced composite sample collected at GS10 during the period August 24–September 29, 2011, to help confirm the previous sample results.

  — Grab samples at FC4750 and FC4991 collected on September 28, 2011.

  — Water from the routine flow-paced composite sample collected at B5INFLOW during the period August 24–September 29, 2011. This location does not have previous LANL results.

  — A grab sample at B3OUTFLOW collected on September 27, 2011. One post-closure LANL sample has been collected at B3OUTFLOW. The result was a 74.7 percent natural uranium signature.

  — A grab sample at well 91305, which is upgradient of GS10, collected on October 10, 2011.

  The results of the LANL analysis have been reported by LANL to Stoller staff. The following highlights are noted:

  — The signature results for GS10 have returned to the historical natural uranium percentage of approximately 70 percent. Natural uranium was reported as 70.2 percent. The uranium concentration was 8.9 µg/L.

  — The results for all of the other locations show natural uranium signatures between 70.9 and 90.8 percent. These results are consistent with historical data.

- Additional nonroutine grab samples have been collected to assist in the possible identification of a source that may have contributed to elevated uranium levels at GS10. The results are shown on Figure 53.

  — Wells 15699, 45608, 91305, and 91203 were grab sampled for uranium on October 10–October 11, 2011.

  — Wells 00203, 79502, and 79605 were grab sampled for uranium and nitrate+nitrite as N on October 6, 2011.

  — GS10 and hillside seep locations SEEP988 and SEEP995 were also grab sampled for uranium and nitrate+nitrite as N on September 28–September 29, 2011.

Updates to the ongoing evaluation for GS10 will periodically be communicated through public meetings, routine reports, and contact records. For additional information go to http://www.lm.doe.gov/Rocky_Flats/ContactRecords.aspx.

Location SW027

Monitoring location SW027 is located at the end of the SID at the inlet to Pond C-2 (Figure 41). The southern portion of the COU contributes flow to SW027 through the SID.

Table 23 shows that the majority of the annual average Pu and Am activities are less than the RFLMA standard of 0.15 pCi/L. The significant increase in 2004 was the result of increased solids transport from disturbed areas associated with the 903 Pad/Lip accelerated actions. However, a measurable reduction in both Pu and Am activities has been observed following completion of accelerated actions in the drainage. With the completion of the 903 Pad/Lip actions, implementation of enhanced erosion controls, revegetation, soil stabilization, and lack of substantial runoff, transport of Pu and Am has been significantly reduced. The total U annual average concentrations are well below the RFLMA standard of 16.8 µg/L.

Table 23. Annual Volume-Weighted Average Radionuclide Activities at SW027 for 1997−2011

Calendar Year	**Volume-Weighted Average**		
	Am-241 (pCi/L)	**Pu-239,240 (pCi/L)**	**Total U (µg/L)**
1997	0.008	0.036	2.46
1998	0.021	0.156	5.99
1999	0.019	0.066	3.15
2000	0.060	0.348	1.62
2001	0.006	0.025	2.17
2002	0.001	0.003	0.87
2003	0.011	0.080	2.80
2004	0.413	2.273	1.55
2005	0.022	0.156	3.91
2006	NA (no flow)	NA (no flow)	NA (no flow)
2007	0.040	0.092	2.78
2008	NA (no flow)	NA (no flow)	NA (no flow)
2009	0.015	0.092	3.07
2010	0.027	0.155	4.73
2011	NA (no analytical data)[a]	NA (no analytical data)[a]	NA (no analytical data)[a]
Total (1997−2011)	0.056	0.305	3.11

Note: NA = not applicable.
[a] During CY 2011, only 4,033 gallons of flow were observed at SW027 (less than 0.3% of the post-closure average). Therefore, the automated sampler collected an insufficient volume of water for laboratory analysis.

Figure 54 shows that the 12-month rolling average for plutonium exceeded the RFLMA standard of 0.15 pCi/L during CY 2011. By the end of CY 2011, Pu was no longer reportable at SW027. Further discussion is presented later in this section (see “Reportable Plutonium Activities at SW027” below). The composite sampling results for plutonium at SW027 collected during 2010 and 2011 are given in Table 24. All other analytes were not reportable during the fourth quarter of CY 2011.

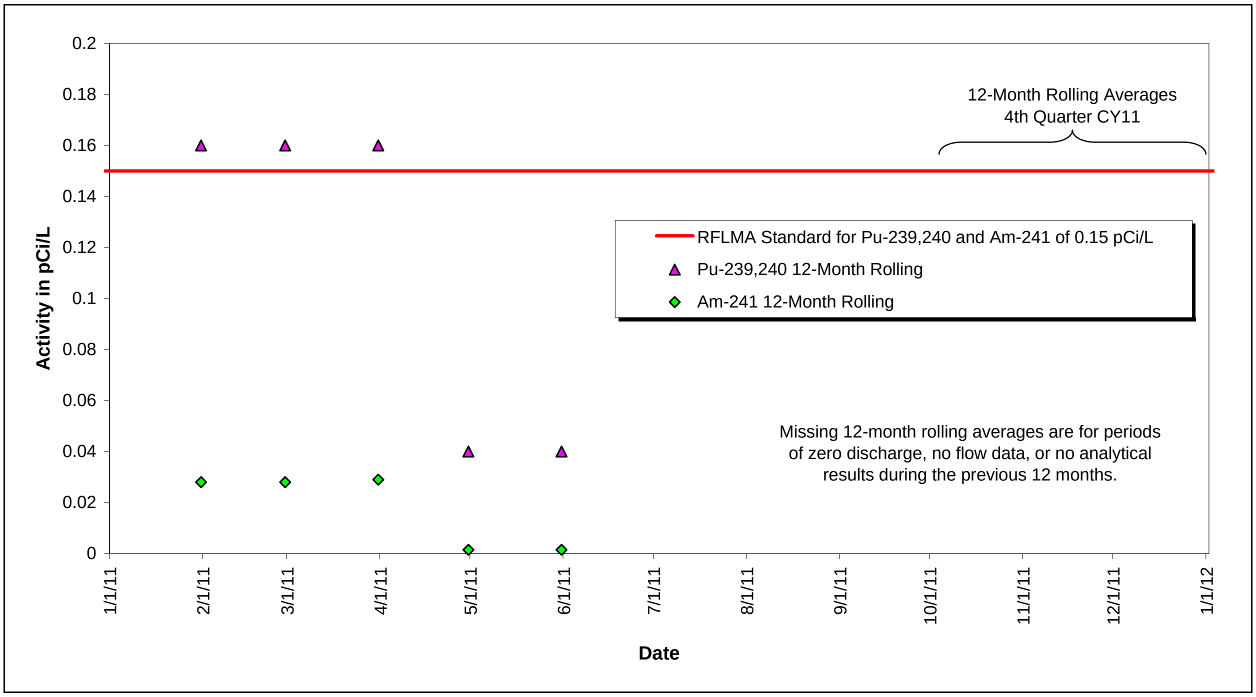


Figure 54. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at SW027: Calendar Year Ending Fourth Quarter CY 2011

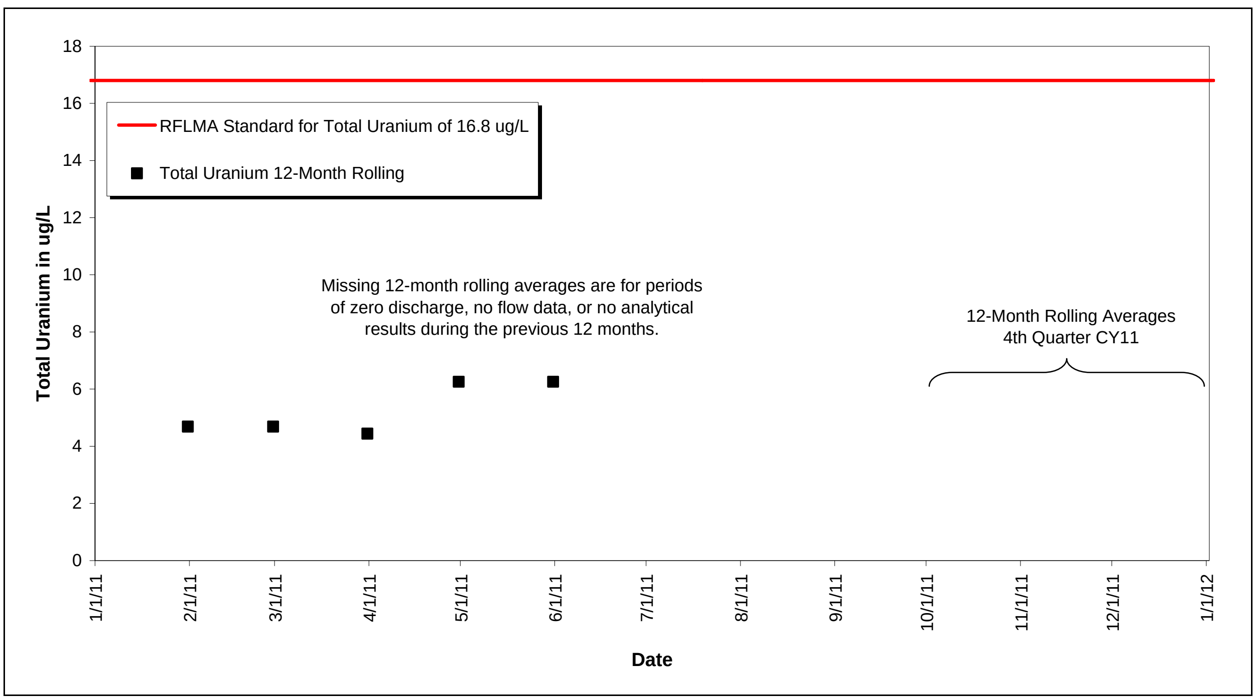


Figure 55. Volume-Weighted 12-Month Rolling Average Total U Concentrations at SW027: Calendar Year Ending Fourth Quarter CY 2011

Table 24. CY 2010–2011 Composite Sampling Results for Plutonium at SW027

Date-Time Start	Date-Time End	Plutonium Result (pCi/L)	Flow Volume (gallons)
4/24/09—11:30	1/13/10—11:11	NA; NSQ (2 grabs)	9,963
1/13/10—11:11	3/29/10—11:55	0.122	441,780
3/29/10—11:55	4/23/10—11:11	0.300	244,624
4/23/10—11:11	4/23/10—19:12	0.294	1,449,207
4/23/10—19:12	4/27/10—12:07	0.029	1,626,578
4/27/10—12:07	10/4/10—12:39	0.040	150,999
10/4/10—12:39	2/17/11—9:23	NA; No Flow	0
2/17/11—9:23	1/9/12—10:47	NA; NSQ (1 grab)	4,033
1/9/12—10:47	In Progress	NA	NA

Note: pCi/L = picocuries per liter
NSQ = non-sufficient quantity for analysis
NA = not available

Figure 56 and Figure 57 show similar data for the entire post-closure period.

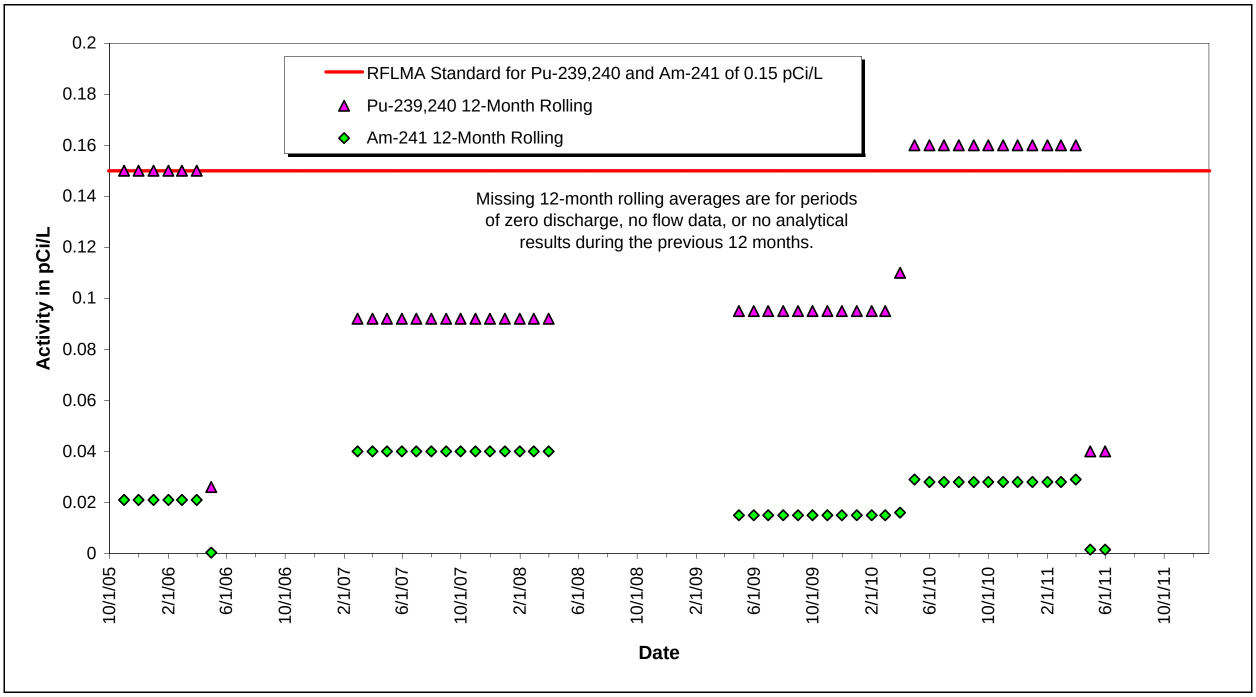


Figure 56. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at SW027: Post-Closure Period

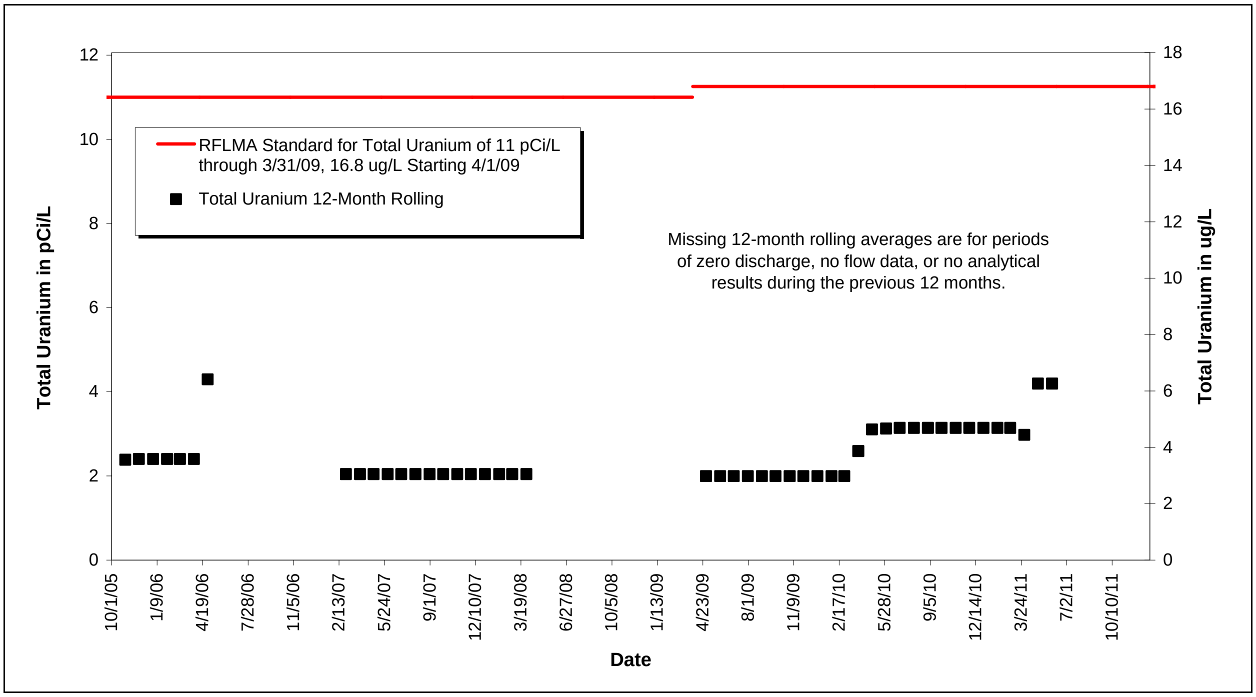


Figure 57. Volume-Weighted 12-Month Rolling Average Total U Concentrations at SW027: Post-Closure Period

Table 25 shows that all of the annual average metals concentrations are less than the standards/PQLs. Additionally, the long-term metals averages (1997–2011) are less than the standards/PQLs.

Table 25. Annual Volume-Weighted Average Hardness and Metals Concentrations at SW027 for 1997−2011

Calendar Year	Volume-Weighted Average Concentration (µg/L)				
	Hardness (mg/L)	**Total Be**	**Dissolved Cd**	**Total Cr**	**Dissolved Ag**
1997	108	0.44	0.09	1.71	0.10
1998	152	0.14	0.15	0.91	0.21
1999	111	0.03	0.10	1.55	0.24
2000	150	0.27	0.05	4.14	0.09
2001	145	0.23	0.07	1.82	0.12
2002	114	0.12	0.05	2.88	0.11
2003	148	0.06	0.06	1.75	0.15
2004	133	0.32	0.06	7.36	0.19
2005	236	0.08	0.07	2.03	0.19
2006	NA (no flow)	NA (no flow)	NA (no flow)	NA (no flow)	NA (no flow)
2007	133	0.50	0.05	0.50	0.10
2008	NA (no flow)	NA (no flow)	NA (no flow)	NA (no flow)	NA (no flow)
2009	139	0.50	0.06	1.15	0.10
2010	154	0.50	0.06	1.16	0.10
2011	NA (no analytical data)[a]	NA (no analytical data)[a]	NA (no analytical data)[a]	NA (no analytical data)[a]	NA (no analytical data)[a]
Total (1997−2011)	138	0.23	0.08	2.19	0.16

NA = not applicable.

[a] During CY 2011, only 4,033 gallons of flow were observed at SW027 (less than 0.3% of the post-closure average). Therefore, the automated sampler collected an insufficient volume of water for laboratory analysis.

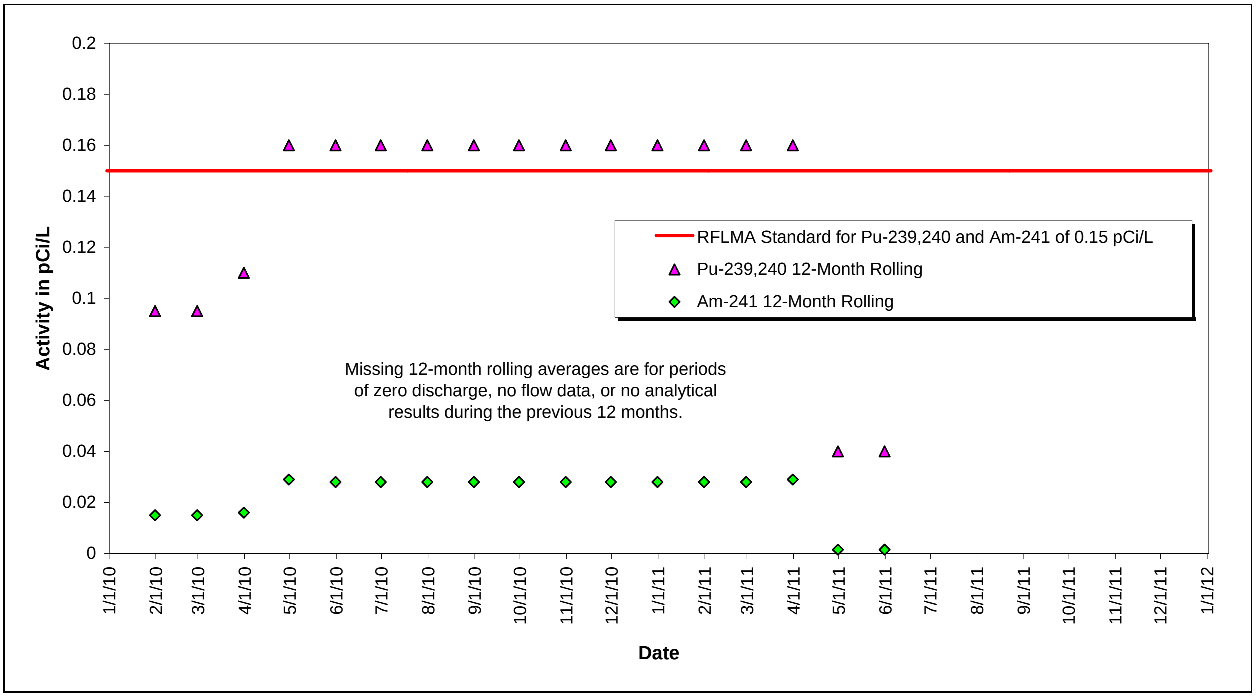
Ag = silver Be = beryllium Cd = cadmium Cr = chromium

Reportable Plutonium Activities at SW027

Pu initially became reportable at SW027 with the calculation of the April 30, 2010, 12-month rolling average value (see Figure 58). This calculation was performed when the analytical results for the April 27–October 4, 2010, composite sample were received in November 2010. While the 12-month rolling average values could not be formally calculated until November 2010, DOE initiated preemptive consultation with CDPHE on June 2, 2010, based on available sample results. RFLMA Contact Record 2010-06, "Monitoring Results at Surface Water Point of Evaluation (POE) SW027," provides a discussion of the monitoring results and recaps the outcome of the RFLMA Parties' consultation regarding steps to be taken to evaluate the SW027 drainage area. Contact Record 2010-06 is available on the Rocky Flats website, http://www.lm.doe.gov/Rocky_Flats/ContactRecords.aspx.

Subsequent to Contact Record 2010-06, the *Report of Steps Taken Regarding Monitoring Results at Surface Water Point of Evaluation (POE) SW027* was completed on August 31, 2010. This report provided data evaluation and an update on the steps taken in accordance with Contact Record 2010-06. Recommendations beyond the actions already taken and discussed in the contact record are also provided. This report is also available on the Rocky Flats website, http://www.lm.doe.gov/Rocky_Flats/ContactRecords.aspx.

The recommendations in the evaluation included installing additional erosion control wattles in locations along the hillside north of the SID, installing permanent erosion blankets, and reseeding three areas in the SID. This work was successfully completed on December 20, 2010. Approximately 2,560 linear feet of Filtrexx wattles and 8,452 square feet of permanent erosion matting were installed (see Figure 59).



Note: pCi/L = picocuries per liter

Figure 58. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at SW027: Calendar Years 2010–2011

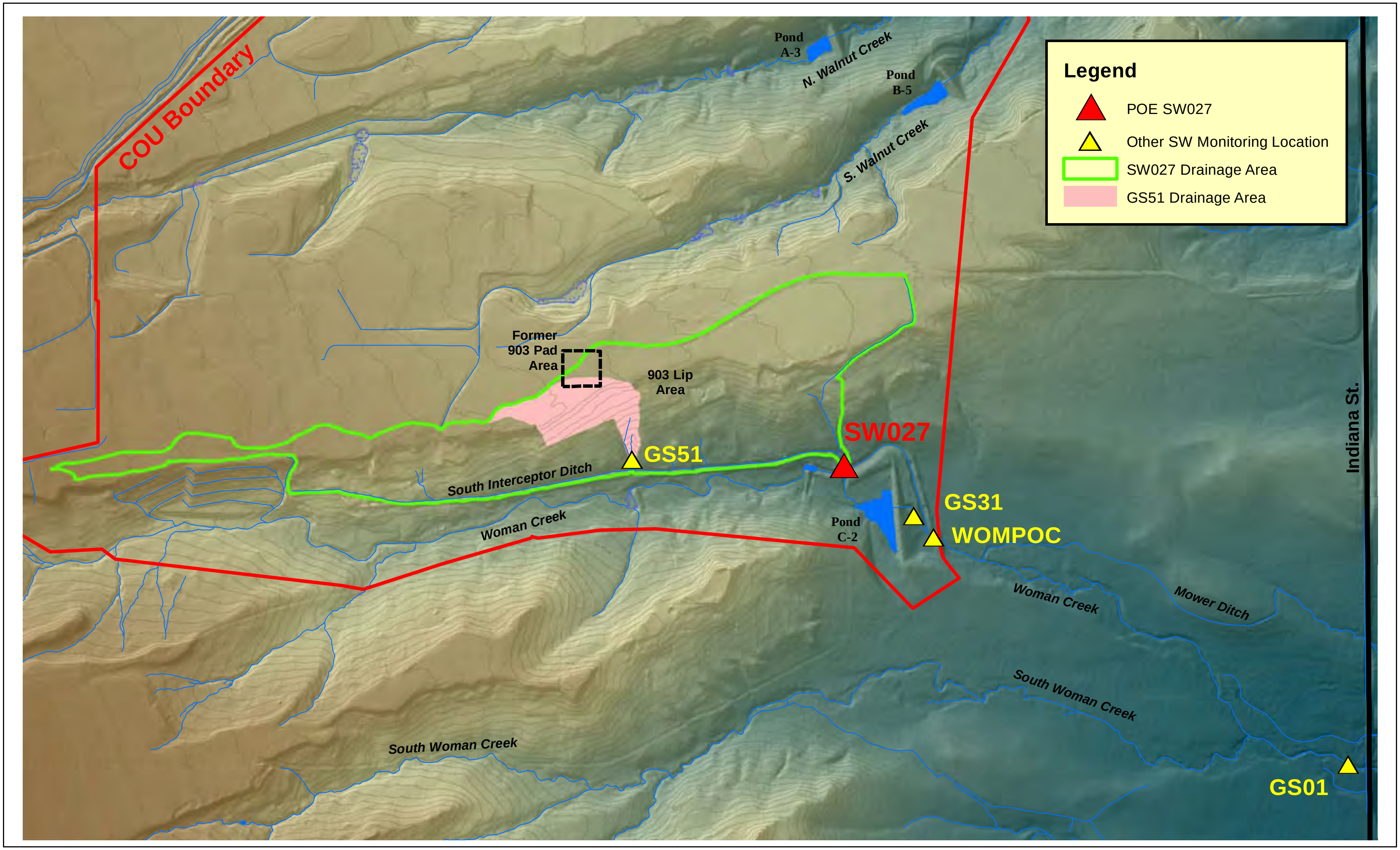


Figure 59. Woman Creek/SID Drainage Areas and Monitoring Locations

Figure 58 shows the 12-month rolling averages for Pu during CYs 2010 and 2011. Pu initially became reportable in April 2010, continued to be reportable into CY 2011, and was no longer reportable as of April 30, 2011. The following is an explanation of the plotted values:

- The period of the reportable Pu values begins on April 30, 2010. This value includes flow and analytical data going back to May 1, 2009. It is important to note that the flow on April 23, 2010 alone represents approximately 61 percent of the total flow during the 12-month period. Similarly, the month of April 2010 represents approximately 87 percent of the total flow. Therefore, since the 12-month rolling average is volume-weighted, April 2010 has more influence on the 12-month rolling average values than all of the other months combined.
- Progressing forward in time, it can be seen that there is essentially no variation in the 12-month rolling average. This is due to the fact that as the 12-month 'window' moves forward in time, the days that are no longer included and the days that begin to be included, have essentially no affect on the average.
- As of January 5, 2012, the most recent composite sample started on February 17, 2011 (Table 24) was still in progress and only a single 200 ml grab (collected May 29, 2011 15:58) had been deposited in the composite carboy. On January 5, 2012, in consultation with the RFLMA Parties, the decision was made to discard the single grab and start a new composite period. The new composite was started on January 9, 2012 at a slightly reduced pace (ft^3 per grab).
- Once the February 17, 2011–January 9, 2012, composite was discarded, and therefore no analytical results would be forthcoming, the 12-month rolling averages could be calculated for the period February 28–December 31, 2011.
  - For February 28, 2011, and March 3, 2011, no change is calculated as described above.
  - For April 30, 2011, and May 31, 2011, the values drop below 0.15 pCi/L and SW027 is no longer reportable for plutonium.
  - For June 30–December 31, 2011, there was either no flow and/or no analytical results for the preceding 12 months. Therefore, no 12-month rolling average values are calculated.

Downstream Monitoring

Once SID flows are monitored at SW027, the water then flows under Woman Creek to Pond C-2 (there is no commingling of SID flows with Woman Creek upstream of Pond C-2). Prior to the recent initiation of flow-through operations at Pond C-2, water was normally retained in Pond C-2 for eventual batch discharge. Since SID flow volumes entering Pond C-2 are small relative to its storage capacity, the pond did not require frequent discharge; Pond C-2 has been batch discharged twice since completion of site closure in 2005.

To implement the operational conversion from batch-mode to flow-through at Pond C-2, a final batch discharge was needed to lower the pool level down to the outlet valve elevation in a controlled manner. Predischarge samples for Pond C-2 were collected on September 15, 2011. All results indicated that RFLMA water quality standards would be met at downstream POC locations WALPOC and GS01 during discharge. The predischarge sample result for Pu-239,240 was reported as 0.0172 pCi/L, which is below the laboratory detection limit. The predischarge sample report is available at the Rocky Flats website at http://www.lm.doe.gov/Rocky_Flats/Sites.aspx?view=5.

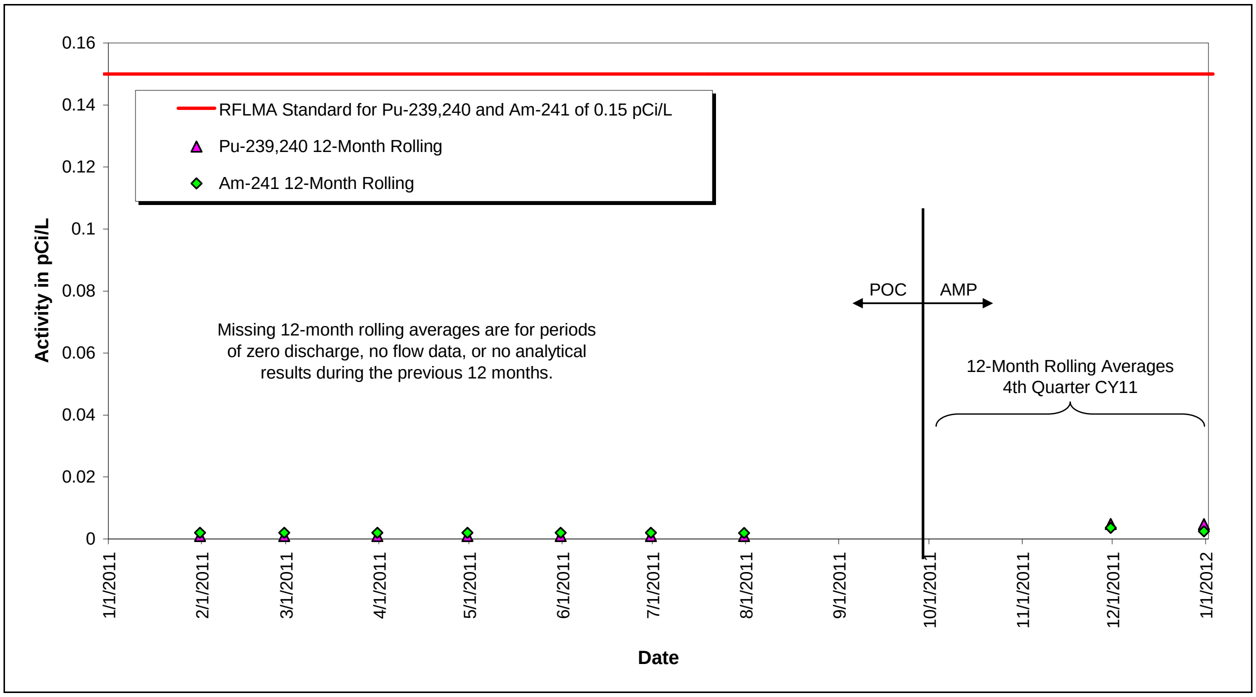
Discharge of Pond C-2 using the outlet works to Woman Creek through GS31 began on November 7, 2011, with the pool level reaching the outlet valve elevation on November 13, 2011. Since November 13, 2011, Pond C-2 has been operated in a flow-through configuration with the valve completely open.

Water discharging from Pond C-2 is monitored 130 feet downstream of the outlet at AMP monitoring location GS31. After passing GS31, water joins Woman Creek 230 feet further downstream. Immediately downstream of this confluence and just inside the COU boundary, water is monitored by POC WOMPOC. After leaving the Site, Woman Creek flows continue downstream and commingle with water from other Woman Creek tributaries (most significantly South Woman Creek) before being subsequently sampled at POC GS01 (Woman Creek at Indiana Street). The available results from these locations for samples collected around the time Pond C-2 began discharging in November 2011 are given in Table 26. Plots of 30-day and 12-month rolling averages are shown in Figure 60 through Figure 63. The data clearly show both Pu and Am well below the RFLMA standards.

Table 26. Recent Woman Creek Flow-Paced Composite Sample Results: Pu-239,240

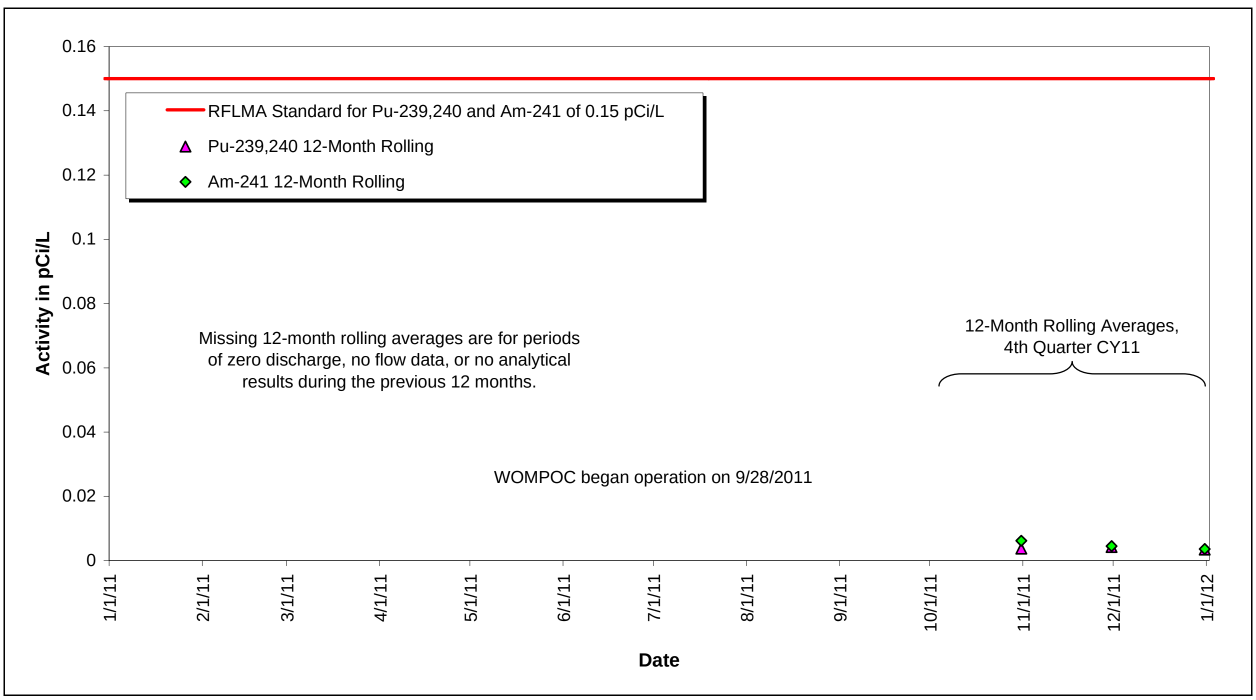
Locations (upstream → downstream)	GS31		WOMPOC		GS01	
	Sample Period	Result (pCi/L)	Sample Period	Result (pCi/L)	Sample Period	Result (pCi/L)
			9/28–11/1/11	0.004	8/17–11/10/11	0.003
			11/1–11/7/11	0.012		
	11/7–11/10/11	0.010	11/7–11/10/11	0.000		
	11/10–11/16/11	0.000	11/10–12/29/11	0.002	11/10–12/13/11	0.008
	11/16–12/29/11	0.005				
	12/29/11–1/6/12	0.000	12/29/11–1/3/12	0.004	12/13/11–1/3/12	0.007
	1/6–2/16/12	0.001	1/3–2/2/12	0.004	1/3–1/19/12	0.003
	2/16/12-	[b]	2/2–2/23/12	0.007	1/19–2/13/12	0.005
					2/13–2/23/12	0.002
			2/23–3/6/12	0.000	2/23–3/1/12	0.001
			3/6–3/21/12	[a]	3/1–3/15/12	0.000
			3/21/12-	[b]	3/15–3/29/12	[a]
					3/29/12-	[b]

Notes: Some results are preliminary and subject to revision.
[a] Analysis pending
[b] Sample in progress



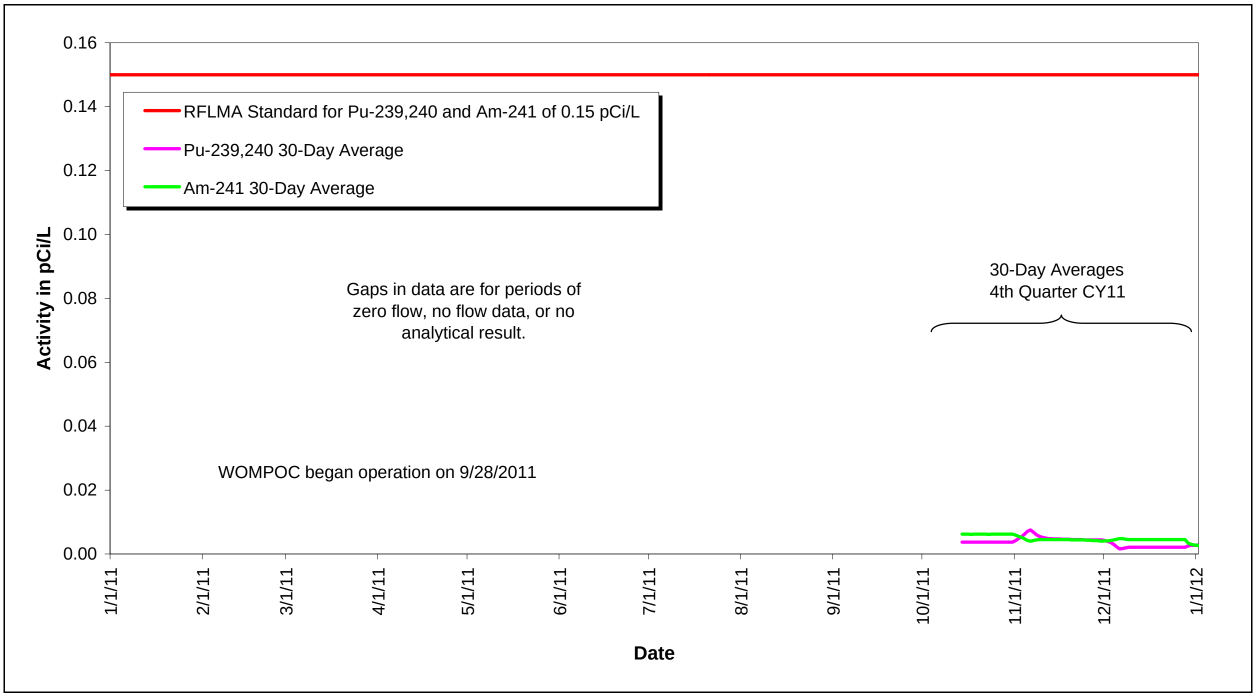
Note: GS31 stopped being operated as a POC on September 28, 2011; GS31 continues operation as an AMP monitoring location.

Figure 60. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at GS31: Calendar Year 2011



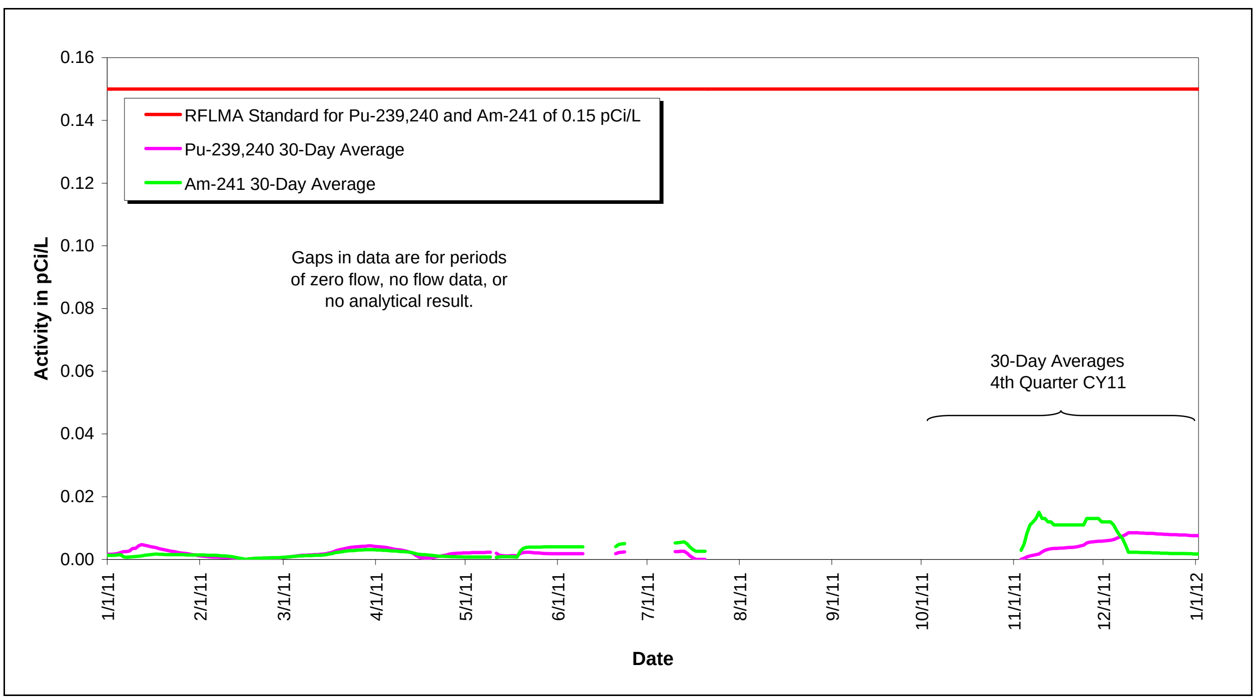
Note: pCi/L = picocuries per liter

Figure 61. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at WOMPOC: Calendar Year 2011



Note: pCi/L = picocuries per liter

Figure 62. Volume-Weighted 30-Day Average Pu and Am Activities at WOMPOC: Calendar Year 2011



Note: pCi/L = picocuries per liter

Figure 63. Volume-Weighted 30-Day Average Pu and Am Activities at GS01: Calendar Year 2011

Upstream Monitoring

The SW027 drainage area covers approximately 180 acres within the southern portion of the COU (Figure 59). The most significant potential source area for residual Pu contamination within the SW027 drainage is the 903 Pad/Lip Area. Unlike the former 903 Pad, no imported soil was used to fill, contour, and revegetate the 903 Lip Area after surface soil removal.

Only one automated upstream monitoring location is currently operated in the SW027 drainage. GS51, originally installed in 2001 in support of 903 Pad and Lip accelerated actions, monitors runoff from an approximately 16-acre drainage swale south of the former 903 Pad.

The composite sampling results for plutonium at GS51 collected during 2010 and 2011 are given in Table 27.

Table 27. CY 2010–2011 Composite Sampling Results for Pu at GS51

Date-Time Start	Date-Time End	Plutonium Result (pCi/L)	Flow Volume (gallons)
6/3/09—9:10	1/13/10—11:22	NA; NSQ (8 grabs)	5,084
1/13/10—11:22	3/30/10—8:03	8.9	82,430
3/30/10—8:03	4/23/10—11:02	4.58	86,935
4/23/10—11:02	4/23/10—19:05	6.07	133,043
4/23/10—19:05	5/11/10—10:55	6.87	83,321
5/11/10—10:55	5/13/10—10:20	0.76	51,114
5/13/10—10:20	6/11/10—22:25	0.286	35,636
6/11/10—22:25	6/14/10—11:58	0.231	76,135
6/14/10—11:58	2/17/11—9:12	NA; NSQ (2 grabs)	736
2/17/11—9:12	1/9/12—10:53	NA; NSQ (9 grabs)	6,119
1/9/12—10:53	In Progress	NA	

Note: NSQ = non-sufficient quantity for analysis
NA = not available

Erosion Controls/Vegetation Evaluation

The primary mechanism by which Pu moves in surface water is well understood. Since Pu in the environment is predominantly associated with soils and sediments, if these solids were to become suspended in runoff (through mechanical processes like raindrop/hail impact, and hydraulic forces due to concentrated runoff), then the Pu could be transported within the resulting stream flow.

The water-monitoring data collected at GS51 (Table 27) clearly indicate that the GS51 drainage is a source of Pu transport to the SID.

The SID channel is covered with areas of riprap, vegetation, and vegetation debris, which limit movement of sediment within the SID. Site personnel inspected areas of the SID in June 2010 and conducted an additional walkdown of the SID area on August 23, 2010. It was noted that the SID channel banks had good stands of vegetation, and there were no conditions that indicate significant erosion, such as gullying or washouts, or conditions that are precursors to significant erosion on the channel banks. Much of the litter and the riprap, which has litter in the spaces between the rocks, appear to form natural erosion matting. However, the generally reduced flow of water in the SID relative to pre-closure conditions was apparent in areas that previously supported wetland-type vegetation. The wetland plants were no longer thriving, and dead stands and litter occupied these locations.

Using environmental monitoring data, there are several relationships that can be evaluated to indicate the effectiveness of erosion controls:

- **Flow rate vs. Rainfall.** Effective erosion controls reduce runoff flow rates by reducing the rate at which sheet flow concentrates into runoff, promoting infiltration and evapotranspiration, and attenuating peak flow rates as flow moves down a drainage.
- **Total suspended solids (TSS) vs Rainfall/Flow Rate.** Effective erosion controls reduce TSS by reducing flow rates and the resulting scour energy, reducing raindrop/hail impact, and encouraging the settling of suspended solids as flow moves down a drainage.
- **Pu vs Rainfall/Flow Rate.** Since Pu tends to be transported in association with TSS, then a reduction in Pu transport would also be expected after the implementation of effective erosion controls.

By evaluating these types of relationships using data from both before and after the implementation of erosion controls, it is often possible to assess the effectiveness of the controls. However, no water-quality data has been collected since implementation of the erosion controls in the SW027 drainage and the SID.

The simple fact that there has been very little flow measured at either GS51 or SW027 is, in some measure, an indication that the erosion controls have been effective. The rate at which runoff is produced is dependent on the condition of land surface, which can be directly influenced by erosion controls such as the following:

- Wattle placement can essentially modify slope angles
- The promotion of pooling and water distribution can enhance infiltration
- Wattles and other drainage features can simply detain runoff
- Increased vegetation and vegetation litter will enhance evapotranspiration

Climate-driven factors such as soil-moisture conditions, rainfall intensity, rainfall frequency, and precipitation type (e.g., snow, hail, rain) can also affect the generation of runoff. Therefore, it is often difficult to determine if changes in runoff production are due to erosion controls or to variation in climate conditions. Regardless, Figure 64 clearly shows that CY 2011 was one of the wetter post-closure year to date, but flow volumes at GS51 were minimal.

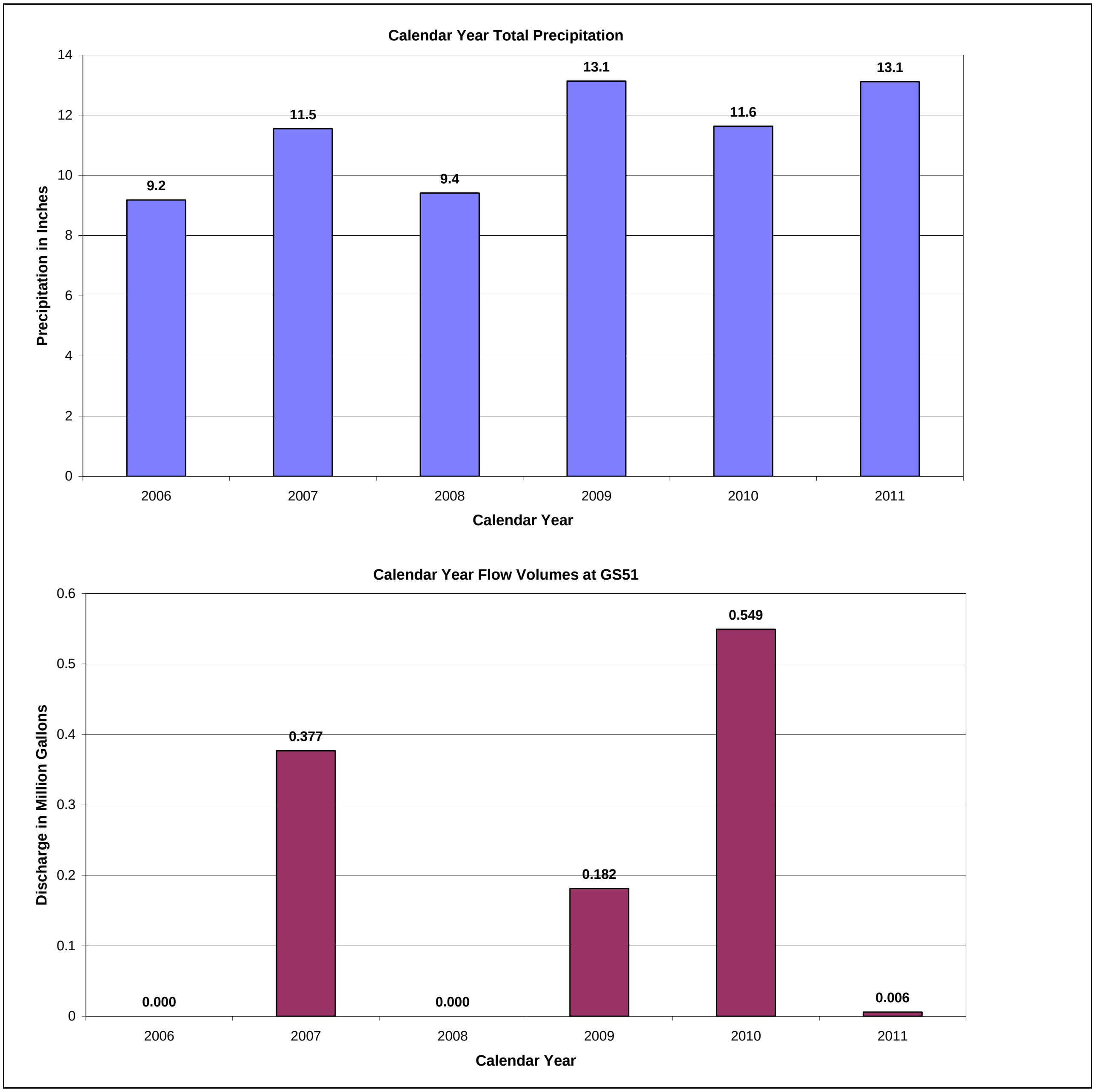


Figure 64. Site Precipitation and GS51 Flow Volume: Post-Closure Calendar Years

Location SW093

Monitoring location SW093 is located on North Walnut Creek 1,300 feet upstream of the A-Series Ponds (Figure 41). The northern portion of the COU contributes flow to SW093 through FC-2 and FC-3.

Table 28 shows that the majority of the annual average Pu and Am activities are below the RFLMA standard of 0.15 pCi/L. Additionally, the long-term Pu and Am averages (1997–2011) are below 0.15 pCi/L. The total U annual average concentrations are well below the RFLMA standard of 16.8 µg/L.

Table 28 indicates an increase in Pu and Am activities during 2004. However, a significant reduction in both Pu and Am activities has been observed following Site closure. With the completion of the FCs, implementation of enhanced erosion controls, revegetation, soil stabilization, and lack of substantial runoff, transport of Pu and Am has been virtually eliminated. Figure 65 and Figure 66 show no reportable Pu, Am, or total U values during the year.

Table 28. Annual Volume-Weighted Average Radionuclide Activities at SW093 for 1997−2011

Calendar Year	Volume-Weighted Average		
	Am-241 (pCi/L)	**Pu-239,240 (pCi/L)**	**Total U (μg/L)**
1997	0.035	0.052	3.84
1998	0.020	0.022	3.51
1999	0.025	0.038	3.02
2000	0.022	0.040	3.12
2001	0.011	0.015	3.12
2002	0.017	0.006	4.24
2003	0.039	0.056	3.19
2004	0.622	0.603	3.67
2005	0.029	0.022	5.55
2006	0.004	0.008	8.00
2007	0.009	0.011	4.85
2008	0.034	0.061	10.06
2009	0.007	0.016	5.67
2010	0.008	0.008	7.28
2011	0.003	0.004	5.20
Total (1997−2011)	0.066	0.072	4.14

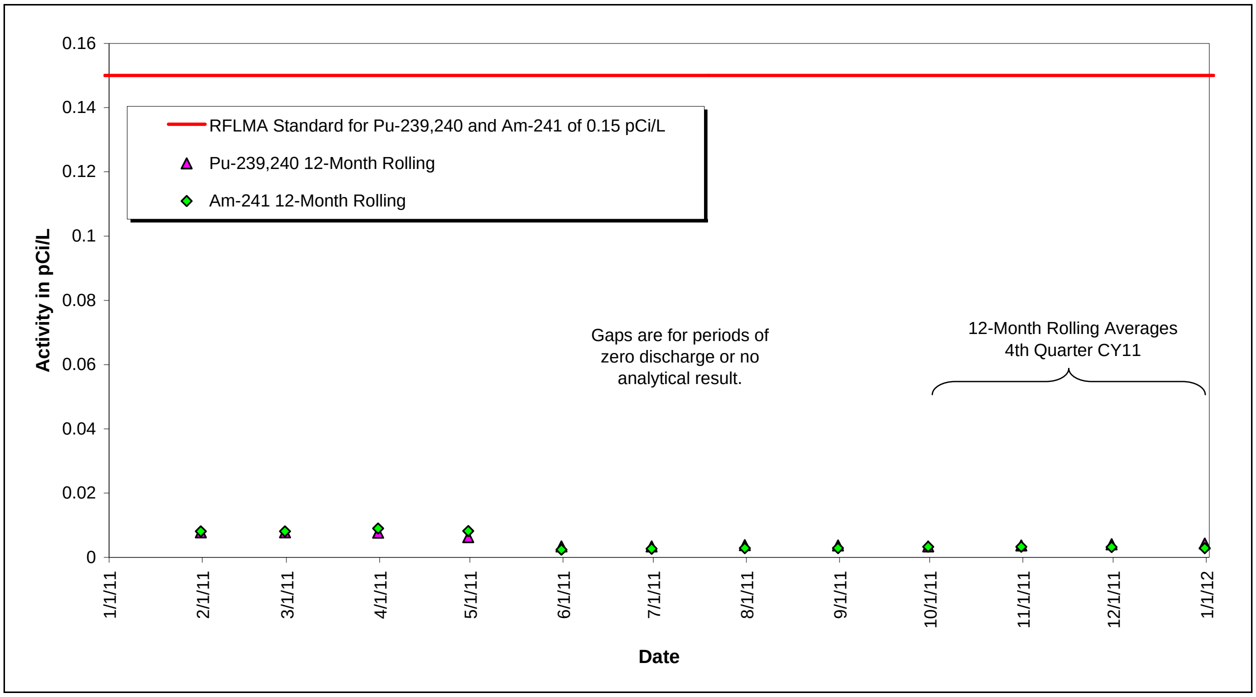


Figure 65. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at SW093: Calendar Year Ending Fourth Quarter CY 2011

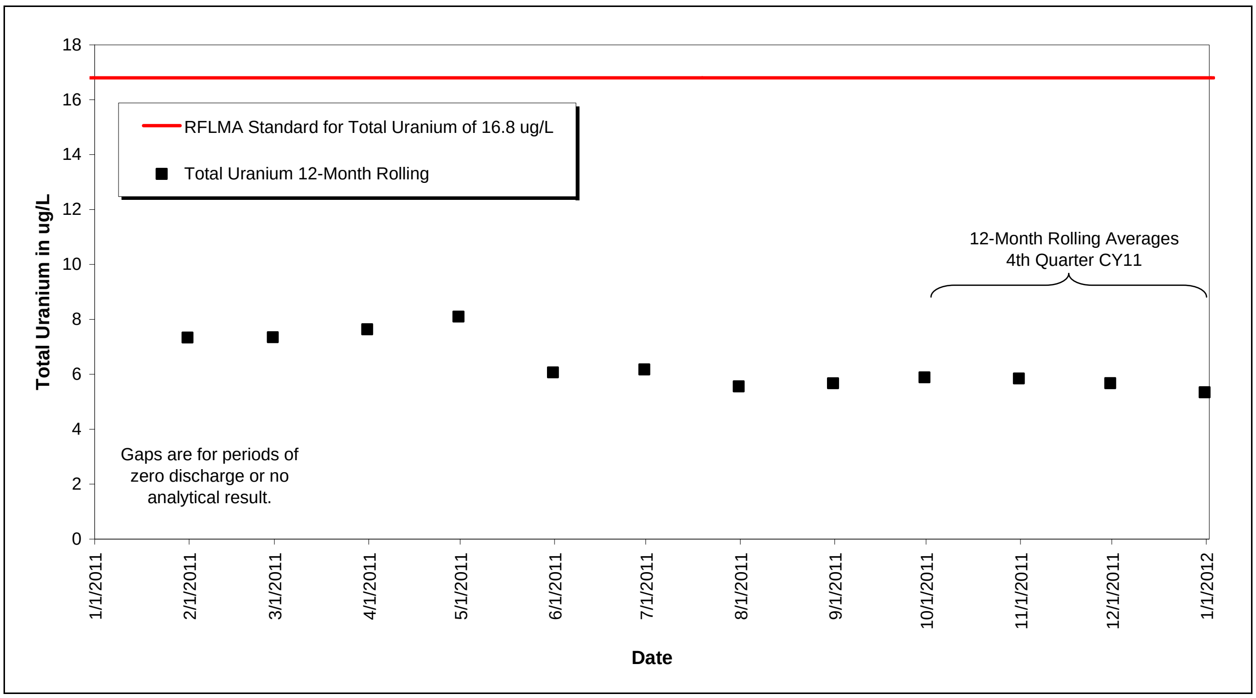


Figure 66. Volume-Weighted 12-Month Rolling Average Total U Concentrations at SW093: Calendar Year Ending Fourth Quarter CY 2011

Figure 67 and Figure 68 show similar data for the entire post-closure period.

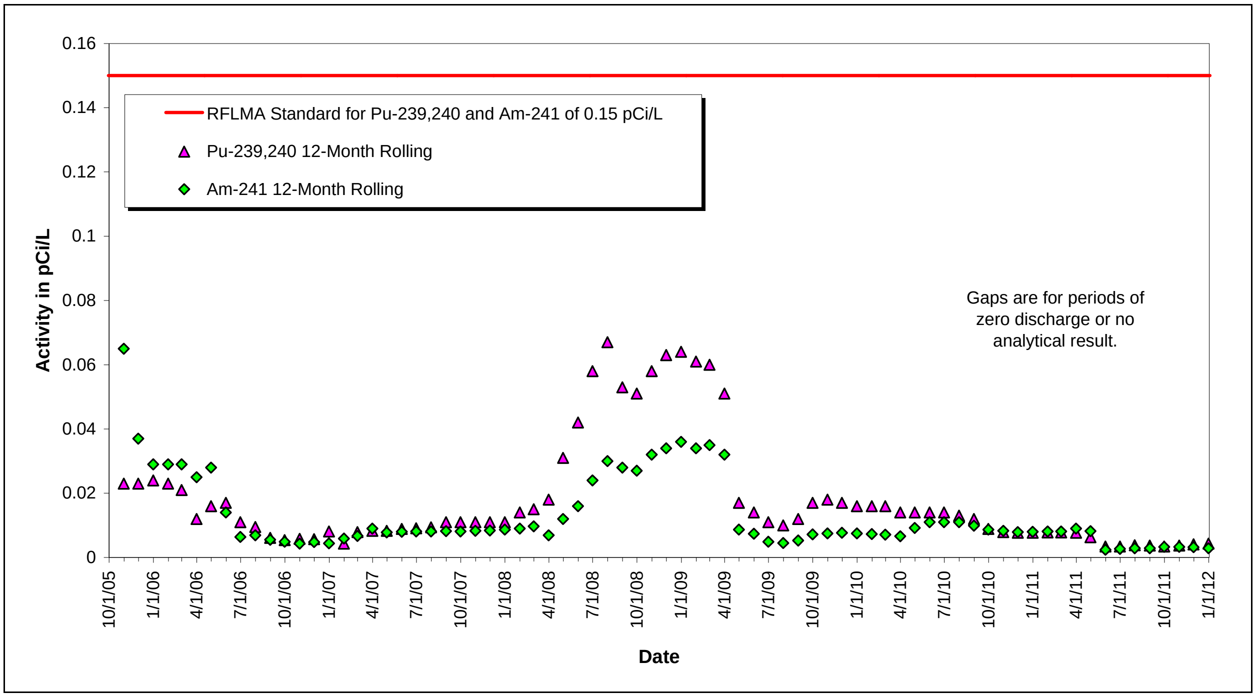


Figure 67. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at SW093: Post-Closure Period

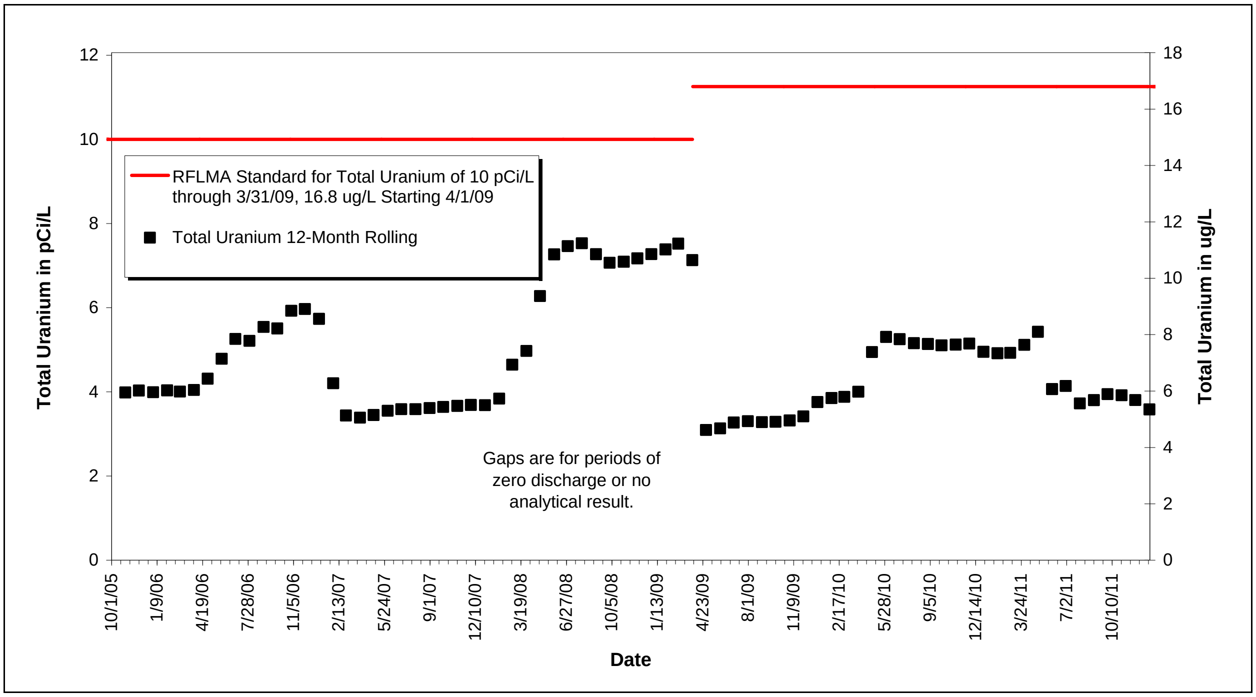


Figure 68. Volume-Weighted 12-Month Rolling Average Total U Concentrations at SW093: Post-Closure Period

Table 29 shows that all of the annual average metals concentrations are less than the standards/PQLs. Additionally, the long-term metals averages (1997–2011) are less than the standards/PQLs. Figure 69 shows that none of the 85th percentile 30-day average metals concentrations were reportable for the year.

Table 29. Annual Volume-Weighted Average Hardness and Metals Concentrations at SW093 for 1997–2011

Calendar Year	**Volume-Weighted Average Concentration (µg/L)**				
	Hardness (mg/L)	**Total Be**	**Dissolved Cd**	**Total Cr**	**Dissolved Ag**
1997	168	0.43	0.07	2.36	0.12
1998	184	0.14	0.23	2.22	0.22
1999	152	0.20	0.13	5.08	0.16
2000	231	0.21	0.08	3.94	0.11
2001	247	0.36	0.07	6.49	0.11
2002	365	0.30	0.08	5.95	0.11
2003	257	0.29	0.09	6.88	0.16
2004	315	0.57	0.09	12.05	0.12
2005	337	0.11	0.05	1.92	0.11
2006	564	0.50	0.05	0.82	0.10
2007	287	0.50	0.06	0.82	0.10
2008	552	0.50	0.07	1.84	0.10
2009	295	0.50	0.06	2.23	0.10
2010	237	0.50	0.06	1.15	0.10
2011	343	0.50	0.06	1.15	0.10
Total (1997−2011)	249	0.34	0.10	4.25	0.13

Notes: Ag = silver Cd = cadmium Be = beryllium Cr = chromium

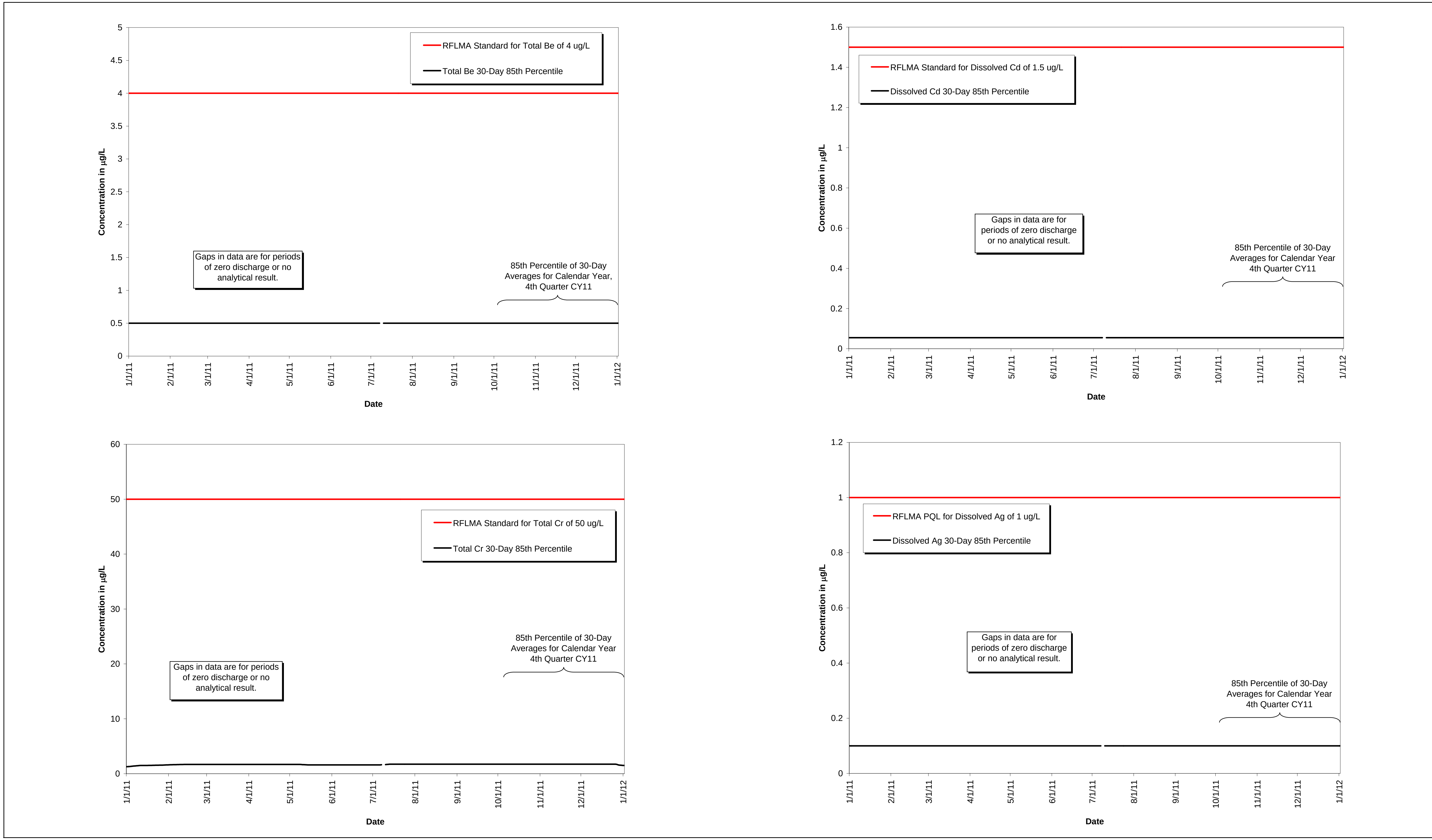


Figure 69. Volume-Weighted Average Metals Compliance Values at SW093: Calendar Year Ending Fourth Quarter CY 2011

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3.1.2.3 AOC Wells and SW018

AOC wells (Table 30 and Figure 70) are located to evaluate potential groundwater impacts to surface water. Surface Water Support location SW018 is located to assess groundwater impacts from specific source areas on surface water. Impacts are based on a minimum of two routinely scheduled sampling events in a row, not on a single data point. Analytical results from AOC wells are compared directly against the appropriate surface-water standards in Table 1 of RFLMA Attachment 2 or the RFLMA U groundwater threshold value of 120 µg/L. Analytical data from surface-water performance location SW018, where grab samples for VOCs are collected to support groundwater objectives, are assessed in a manner similar to data from AOC wells.

Table 30. Sampling and Data Evaluation Protocols at AOC Wells and SW018

Location Code	Location Description	Sample Types/Frequencies	Analytes[a]	Data Evaluation
00193	Woman Creek upstream of Pond C-2	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U	See Figure 7 in Appendix D
00997	South Walnut Creek upstream of Pond B-5	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate	See Figure 7 in Appendix D
10304	Southeast of 903 Pad/Ryan's Pit Plume at Woman Creek	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate	See Figure 7 in Appendix D
10594	North Walnut Creek downstream of Pond A-1	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate	See Figure 7 in Appendix D
11104	Downgradient, downstream	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U	See Figure 7 in Appendix D
4087	Below Landfill Pond	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate	See Figure 7 in Appendix D
42505	Terminus of FC-2	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 7 in Appendix D
89104	Downgradient at Woman Creek	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 7 in Appendix D
B206989	Below Landfill Pond	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate	See Figure 7 in Appendix D
SW018	FC-2 west of former Building 771 area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 7 in Appendix D

Notes: [a] Samples for the analysis of U are field-filtered using a 0.45-micrometer in-line filter.
Nitrate is analyzed as nitrate+nitrite as nitrogen; this result is conservatively compared to the nitrate standard only (standard is also nitrate+nitrite as N).

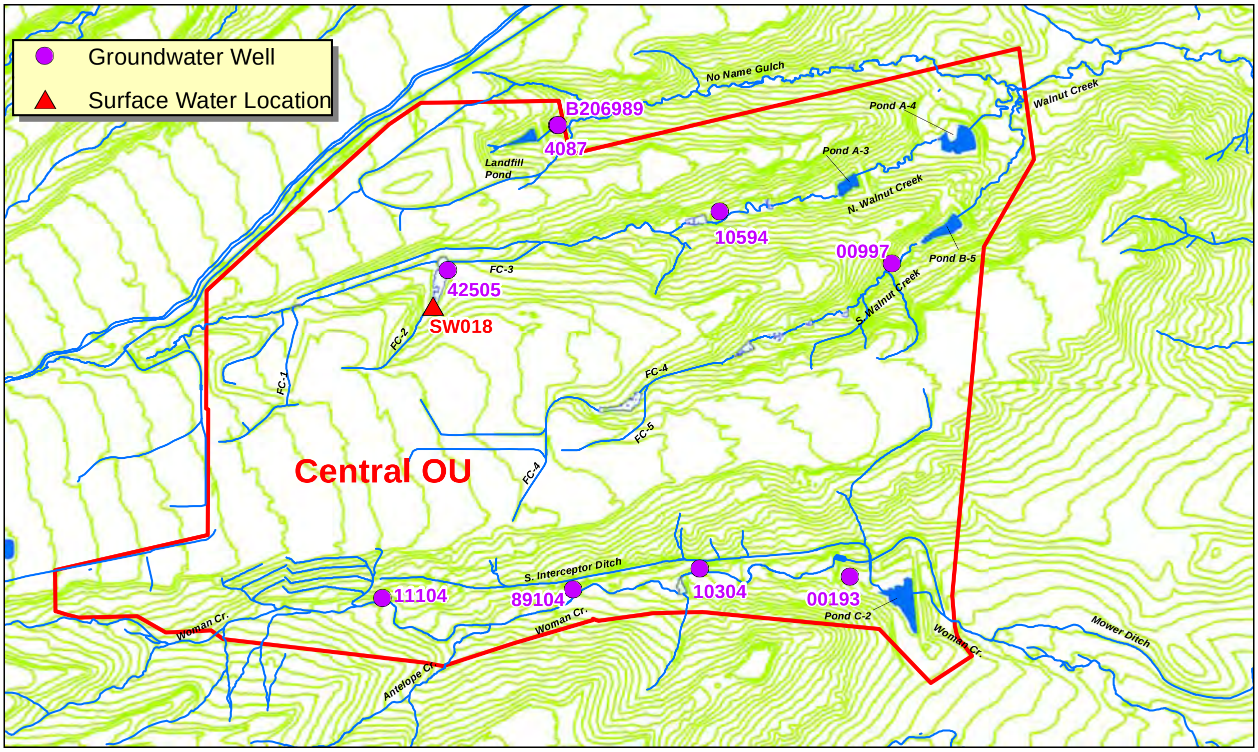


Figure 70. AOC Well and SW018 Locations

Data Evaluation

All AOC wells and SW018 were scheduled for routine monitoring in the fourth quarter of CY 2011. No decision criteria were triggered by the associated analytical results (Appendix B), which were generally consistent with previous data save for the exception discussed below for well B206989. Monitoring will continue as prescribed in RFLMA (DOE 2007a).

A reportable condition was encountered for AOC well B206989 in August 2007 (see corresponding RFLMA Contact Record 2007-06) due to elevated concentrations of nitrate in groundwater samples from this well. The fourth-quarter 2011 result was 3.87 mg/L. Each of the last three nitrate results, representing the fourth quarter of 2010 and the second and fourth quarters of 2011, was below the associated 10 mg/L standard. Updated S-K trend calculations for this well are provided in Appendix B and summarized in Section 3.1.5.3. Consistent with the results obtained in 2009 and 2010, the 2011 analytical data continue to support a decreasing trend in nitrate concentrations at well B206989 that has a 95 percent level of significance. Refer to Section 3.1.5.3 for additional discussion.

3.1.2.4 Boundary Wells

The Boundary wells (Table 31 and Figure 71) were removed from the RFLMA monitoring network in the second quarter of 2011. These wells are located at the Walnut Creek/Indiana Street and Woman Creek/Indiana Street intersections, far from contaminant source areas and well outside the actual Site (as defined by the COU). They met no technical monitoring objectives, nor were they required by the original or 2011 update to the CAD/ROD. The final results from these wells were reported in the second quarter 2011 report (DOE 2011f). These wells are scheduled to be abandoned in the near future.

Table 31. Sampling and Data Evaluation Protocols at Boundary Wells

Location Code	Location Description	Sample Types/Frequencies	Analytes	Data Evaluation
10394	Woman Creek at Indiana Street	N/A (Previously, annual grabs; second calendar quarter)	N/A (Previously, VOCs, U, nitrate)	N/A
41691	Walnut Creek at Indiana Street	N/A (Previously, annual grabs; second calendar quarter)	N/A (Previously, VOCs, U, nitrate)	N/A

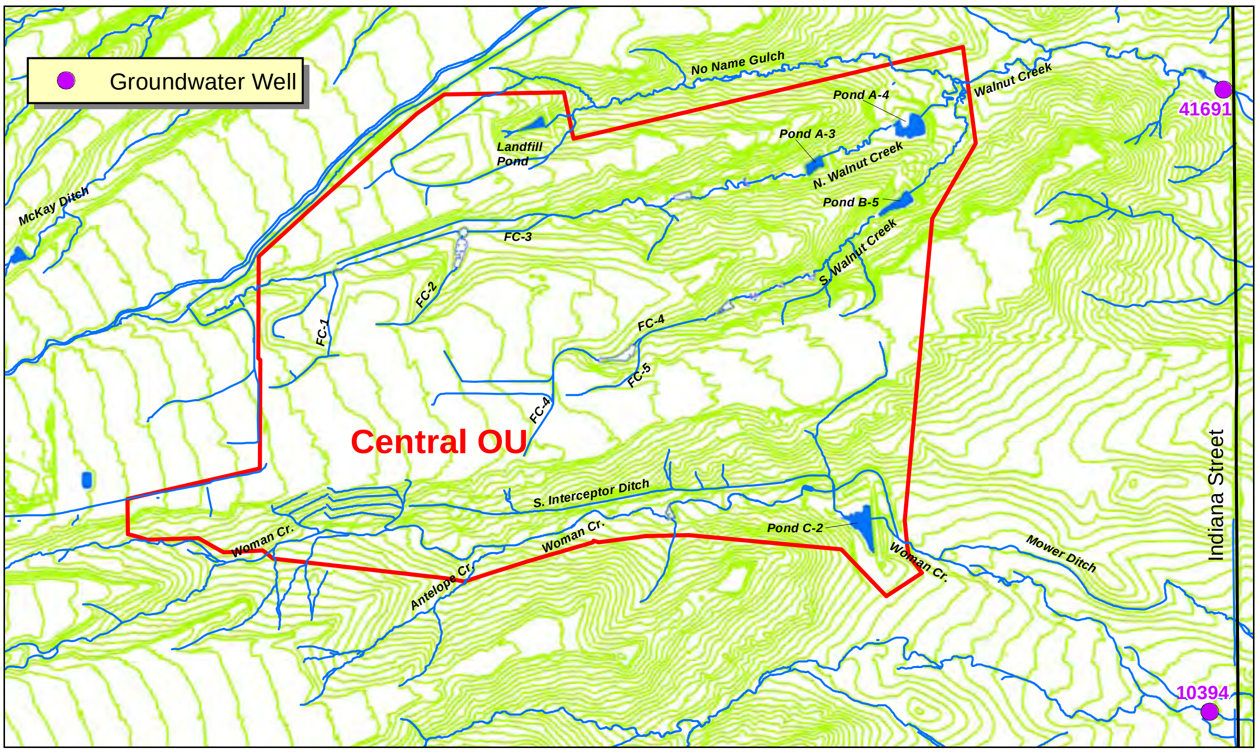


Figure 71. Locations of Former Boundary Wells

Data Evaluation

Boundary wells were removed from the network in early 2011 and therefore were not scheduled for sampling in the fourth quarter of CY 2011.

3.1.2.5 Sentinel Wells

Sentinel wells (Table 32 and Figure 72) are located near downgradient edges of contaminant plumes, in drainages, at groundwater treatment systems, and along contaminant pathways to surface water. These wells are monitored to determine whether concentrations of contaminants are increasing, thereby providing advance warning of potential groundwater-quality impacts to the downgradient AOC wells. Confirmation of a potential impact to downgradient wells will require an analytical record that consistently indicates an impact, not a single data point that indicates that a contaminant has been detected.

Sentinel wells are used to monitor the performance of an accelerated action (including soil and source removals, in situ contaminant plume treatment, groundwater intercept components of treatment systems, and facility demolitions) and assess contaminant trends at important locations. Data from Sentinel wells are supplemented by those from Evaluation wells and are used to determine when monitoring may cease or additional remedial work should be considered.

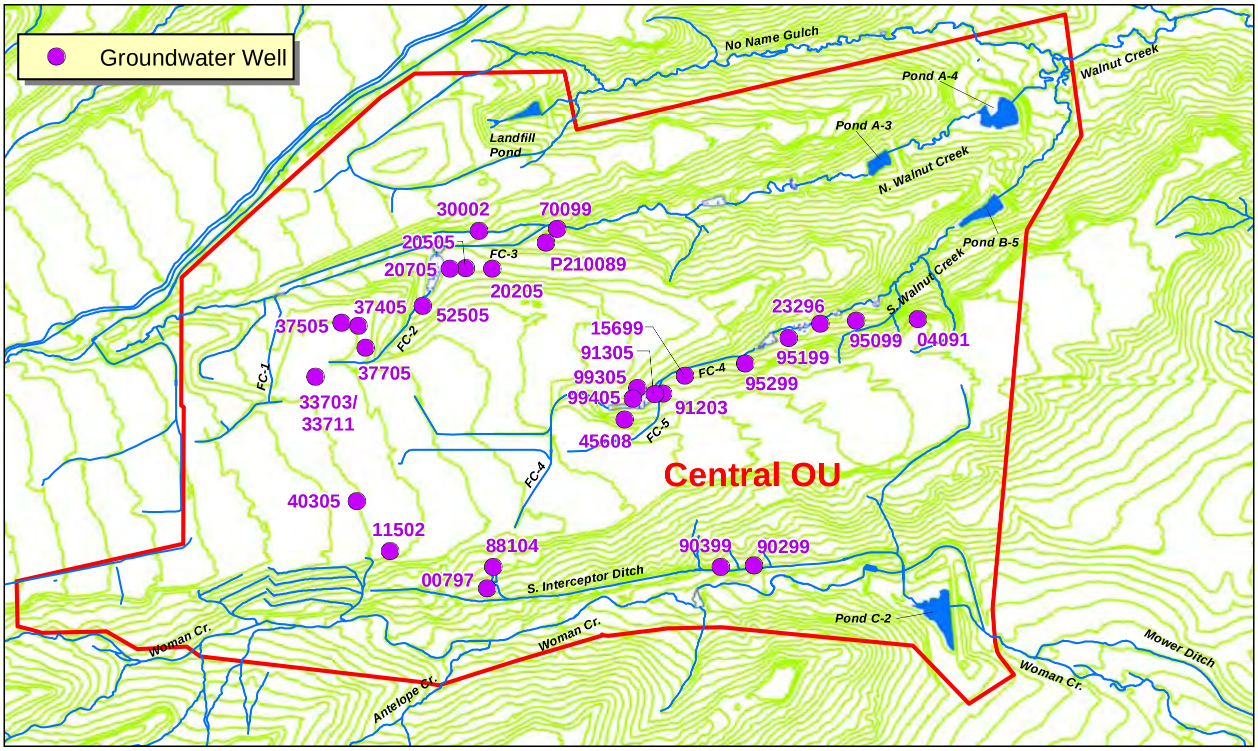
Table 32. Sampling and Data Evaluation Protocols at Sentinel Wells

Location Code	Location Description	Sample Types/Frequencies	Analytes[a]	Data Evaluation
00797	South of former Building 881 (B881) area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U	See Figure 8 in Appendix D
04091	East of source area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
11502	Southeast of former B444 area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U	See Figure 8 in Appendix D
15699	Downgradient of MSPTS intercept trench	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
20205	North/northeast of former B771/774 area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, Pu, Am	See Figure 8 in Appendix D
20505	North of former B771/774 area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, Pu, Am	See Figure 8 in Appendix D
20705	North/northwest of former B771 area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate, Pu, Am	See Figure 8 in Appendix D
23296	Downgradient of ETPTS intercept trench	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U	See Figure 8 in Appendix D
30002	Downgradient at North Walnut Creek	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
33711	Downgradient of source area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
37405	North/northeast part of former B371/374 area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate, Pu, Am	See Figure 8 in Appendix D
37505	North part of former B371 area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate	See Figure 8 in Appendix D
37705	East/southeast of former B371/374 area at foundation drain confluence	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate, Pu, Am	See Figure 8 in Appendix D
40305	East part of former B444 area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U	See Figure 8 in Appendix D

Table 32 (continued). Sampling and Data Evaluation Protocols at Sentinel Wells

Location Code	Location Description	Sample Types/Frequencies	Analytes[a]	Data Evaluation
45608	Adjacent to remnants of SW056 French drain and drain interruption	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
52505	West of former IHSS 118.1 area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
70099	Northwest (side-gradient) of SPPTS intercept trench	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	U, nitrate	See Figure 8 in Appendix D
88104	South part of former B881 area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U	See Figure 8 in Appendix D
90299	Southeast part of 903 Pad/Ryan's Pit Plume at SID	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
90399	Southeast part of 903 Pad/Ryan's Pit Plume at SID	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
91203	Downgradient of Oil Burn Pit (OBP) #2 source area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
91305	South of confluence of FC-4 and FC-5	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate	See Figure 8 in Appendix D
95099	Downgradient of ETPTS intercept trench	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
95199	Downgradient of ETPTS intercept trench	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
95299	Downgradient of ETPTS intercept trench	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
99305	East part of former B991 area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate	See Figure 8 in Appendix D
99405	Southeast part of former B991 area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate	See Figure 8 in Appendix D
P210089	Downgradient (north) portion of SPP	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs, U, nitrate	See Figure 8 in Appendix D

Notes: [a] Samples for the analysis of U, Pu, and Am are field-filtered using a 0.45-micrometer in-line filter. Nitrate is analyzed as nitrate+nitrite as nitrogen; this result is conservatively compared to the nitrate standard only.
IHSS = Individual Hazardous Substance Site



Note: Well 33711 replaces damaged well 37703, which was abandoned in March 2011.

Figure 72. Sentinel Well Locations

Data Evaluation

All Sentinel wells were monitored in the fourth quarter of CY 2011 (refer to Appendix B for analytical results). Analytical data are generally consistent with previous results, but data from a few locations warrant special mention. Concentrations of VOCs in samples from well 91203, located a short distance north-northwest of the Oil Burn Pit #2 source area, continued to decrease following the higher than normal levels reported in the fourth quarter of 2010 (DOE 2011d). For example, carbon tetrachloride, which had been as high as 570 µg/L in fourth quarter 2010, was approximately half that one year later (280 µg/L); the magnitude of decreases reported for concentrations of tetrachloroethene (PCE) and trichloroethene (TCE) were even greater.

Concentrations of several VOCs in fourth-quarter 2011 samples from well 33711 (which replaced 33703 in March 2011, and monitors the Vinyl Chloride Plume south of former Building 371) decreased with respect to the levels reported in the samples collected in the second quarter of 2011 and the follow-up sample collected in the early third quarter. For example, the concentration of *cis*-1,2-DCE in the fourth quarter 2011 sample was reported as 22 µg/L; in the sample collected in June 2011, the concentration was reported at 680 µg/L, and in the July 2011 sample it was 320 µg/L.

Concentrations of several VOCs in samples from well 15699, located immediately downgradient of the groundwater intercept trench supporting the MSPTS, increased in the sample collected in the fourth quarter 2011. The levels of PCE and TCE appeared anomalous, being an order of magnitude higher than in the second quarter of 2011. Confirmatory samples were collected approximately one month later and were significantly lower. For example, the concentration of TCE in the second quarter 2011 was reported as 54 µg/L; in the October 2011 sample TCE was reported at 560 µg/L, and in the November 2011 sample it was reported at 24 µg/L.

The pattern of VOC distribution in samples from well 23296 continues to suggest biodegradation of parent VOCs is affecting the water quality at this location, as discussed in previous reports (e.g., DOE 2008c and DOE 2011d).

Refer to Section 3.1.5.3 for additional discussion of these and other Sentinel well data, including statistical results, and Appendix B for trend plots.

3.1.2.6 Evaluation Wells

Evaluation wells (Table 33 and Figure 73) are located within groundwater contaminant plumes and near plume source areas, and within the interior of the COU at the Site. As such, they may monitor the effects of accelerated actions that have been performed (e.g., source removal and in situ treatment). Data from these Evaluation wells are therefore appropriate to determine whether the monitoring of a particular plume and source area may cease, and to support the determination of whether corresponding groundwater plume treatment systems may be decommissioned. In addition, Evaluation wells are used to support any groundwater evaluations that may be needed as a result of changing contaminant characteristics in downgradient Sentinel or AOC wells. Data from these wells also assist evaluations of predictions made through groundwater modeling efforts.

Table 33. Sampling and Data Evaluation Protocols at Evaluation Wells

Location Code	Location Description	Sample Types/Frequencies	Analytes[a]	Data Evaluation
00191	East of former 903 Pad area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
00203	Downgradient (south) portion of SPP	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U	See Figure 9 in Appendix D
00491	Southeast of former 903 Pad area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
00897	Mound Site source area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
3687	East Trenches source area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
03991	East of East Trenches source area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
05691	East Trenches source area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
07391	Ryan's Pit source area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
18199	North of former IHSS 118.1 source area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
20902	Northwest of former IHSS 118.1 source area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
21505	West of former B776/777 area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
22205	Downgradient (north) portion of SPP	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U	See Figure 9 in Appendix D

Table 33 (continued). Sampling and Data Evaluation Protocols at Evaluation Wells

Location Code	Location Description	Sample Types/Frequencies	Analytes[a]	Data Evaluation
22996	East/northeast part of former B886 area	Biennial grabs; second calendar quarter (high-water conditions)	U, nitrate	See Figure 9 in Appendix D
30900	PU&D Yard Plume source area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U, nitrate	See Figure 9 in Appendix D
33502	OBP#1 source area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U, nitrate	See Figure 9 in Appendix D
33604	OBP#1 source area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U, nitrate	See Figure 9 in Appendix D
33905	North of former 231 Tanks area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
40005	West part of former B444 area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
40205	South part of former B444 end	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U	See Figure 9 in Appendix D
50299	East of former 903 Pad area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
51605	Downgradient, adjacent to GS13	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U	See Figure 9 in Appendix D
55905	North part of former B559 area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
56305	West part of former B559 area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
70705	East part of former B707 area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
79102	SPP source area—north	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U, nitrate	See Figure 9 in Appendix D
79202	SPP source area—north	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U, nitrate	See Figure 9 in Appendix D
79302	SPP source area—northeast	Biennial grabs; second calendar quarter (high-water conditions)	U, nitrate	See Figure 9 in Appendix D
79402	SPP source area—northeast	Biennial grabs; second calendar quarter (high-water conditions)	U, nitrate	See Figure 9 in Appendix D
79502	SPP source area—east	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U, nitrate	See Figure 9 in Appendix D
79605	SPP source area—east	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
88205	South part of former B881 area	Biennial grabs; second calendar quarter (high-water conditions)	U, nitrate	See Figure 9 in Appendix D
891WEL	OU 1 Plume source area	Biennial grabs; second calendar quarter (high-water conditions)	U, nitrate	See Figure 9 in Appendix D
90402	Southeast of former 903 Pad area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U	See Figure 9 in Appendix D
90804	Southeast part of 903 Pad/Ryan's Pit Plume	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
91105	OBP#2 source area	Biennial grabs; second calendar quarter (high-water conditions)	U, nitrate	See Figure 9 in Appendix D
B210489	Downgradient of SPPTS	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U	See Figure 9 in Appendix D
P114689	Southwest of former B559 area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U	See Figure 9 in Appendix D
P115589	West part of former B551 Warehouse area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U	See Figure 9 in Appendix D

Table 33 (continued). Sampling and Data Evaluation Protocols at Evaluation Wells

Location Code	Location Description	Sample Types/Frequencies	Analytes[a]	Data Evaluation
P208989	SPP source area—north	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U, nitrate	See Figure 9 in Appendix D
P210189	SEP-area VOC plume source area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U, nitrate	See Figure 9 in Appendix D
P416889	Southeast of former B444 area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
P419689	Southeast of former B444 area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D

Notes: [a] Samples for the analysis of U are field-filtered using a 0.45-micrometer in-line filter.
Nitrate is analyzed as nitrate+nitrite as nitrogen; this result is conservatively compared to the nitrate standard only.
IHSS = Individual Hazardous Substance Site
OBP = Oil Burn Pit
PU&D = Property Utilization and Disposal
SEP = Solar Evaporation Pond

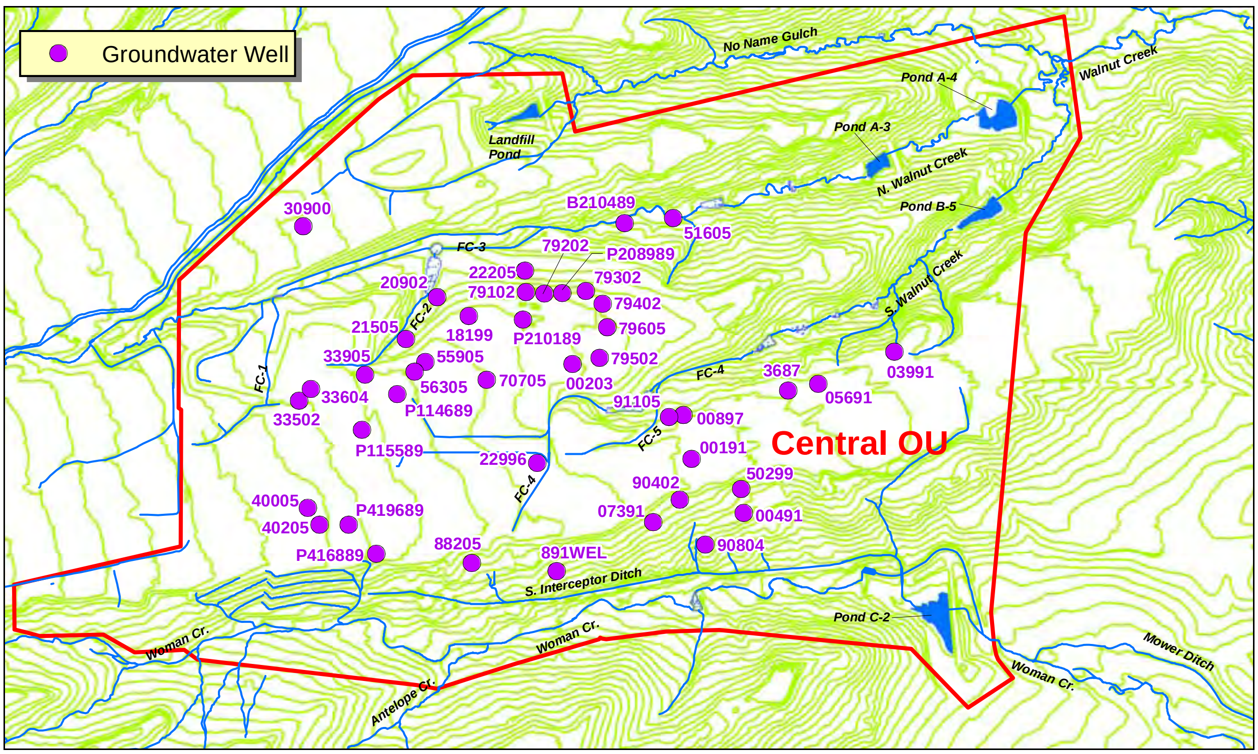


Figure 73. Evaluation Well Locations

Data Evaluation

Evaluation wells were not scheduled for in the fourth quarter of 2011.

3.1.2.7 Investigative Monitoring

When RFLMA reportable conditions are identified based on RFLMA analyte surface-water concentrations measured at POEs or POCs, additional monitoring may be required to identify the source and evaluate whether any mitigating action may be necessary. The objectives of any investigative monitoring are determined through the RFLMA consultative process and are intended to inform the evaluation of the reportable condition. Data collection is generally limited to RFLMA-required POE and POC analytes and is intended to be discontinued once the evaluation is complete or the data no longer supports the objective.

Data collection during CY 2011 was implemented at the locations listed in Table 34 and shown on Figure 74. Some of these locations are sampled primarily to satisfy other monitoring objectives, though the data are used for this investigative objective. The CY 2011 locations were all chosen in response to a specific source evaluation objective. Any future data collection upstream of POEs and POCs, subject to the RFLMA consultative process, is not limited to the locations in Table 34. The RFLMA Parties may also elect to collect data using other methods, subject to the characteristics of the reportable water quality values and through the RFLMA consultative process.

Table 34. CY 2011 Sampling Protocols and Objectives for Investigative Monitoring Locations

Location Code	Location Description	Sample Types	Analytes	Objective
GS51	Drainage area tributary to the SID and south of former 903 Pad/Lip	Continuous flow-paced composites	Pu, Am, U, TSS[a]	POE SW027 plutonium evaluation
B5INFLOW	South Walnut Creek upstream of Pond B-5	Continuous flow-paced composites	Pu, Am	POE GS10 americium evaluation
FC4750	FC-4 downstream of former 750 Pad	Grabs	U	POE GS10 uranium evaluation
FC4991	FC-4 downstream of former B991	Grabs	Pu, Am, U	POE GS10 americium and uranium evaluations
SEEP988	Hillside seep area south of former B988	Grabs	U, NO3+NO2 as N	POE GS10 uranium evaluation
SEEP995	Hillside seep area at former B995 outfall	Grabs	Pu, Am, U, NO3+NO2 as N	POE GS10 americium and uranium evaluations
SEEP995A	Hillside seep area at former B995 outfall	Grabs	Pu, Am	POE GS10 americium evaluation
SEEP995B	Hillside seep area at former B995 outfall	Grabs	Pu, Am	POE GS10 americium evaluation
SEEP995C	Hillside seep area at former B995 outfall	Grabs	Pu, Am	POE GS10 americium evaluation

Notes: [a] TSS is analyzed when the composite sampling period is within TSS holding-time limits.
FC-4 = Functional Channel 4.

As investigative monitoring continues, limited data evaluation related to the investigative objective is presented in this report. Refer to Appendix B, which contains the water-quality data, for additional information. The completion of the evaluations for RFLMA reportable conditions, the need for and details of any required mitigating actions, and the schedule for such actions will be contained in RFLMA contact records or subsequent RFLMA quarterly or annual reports or other correspondence, as appropriate.

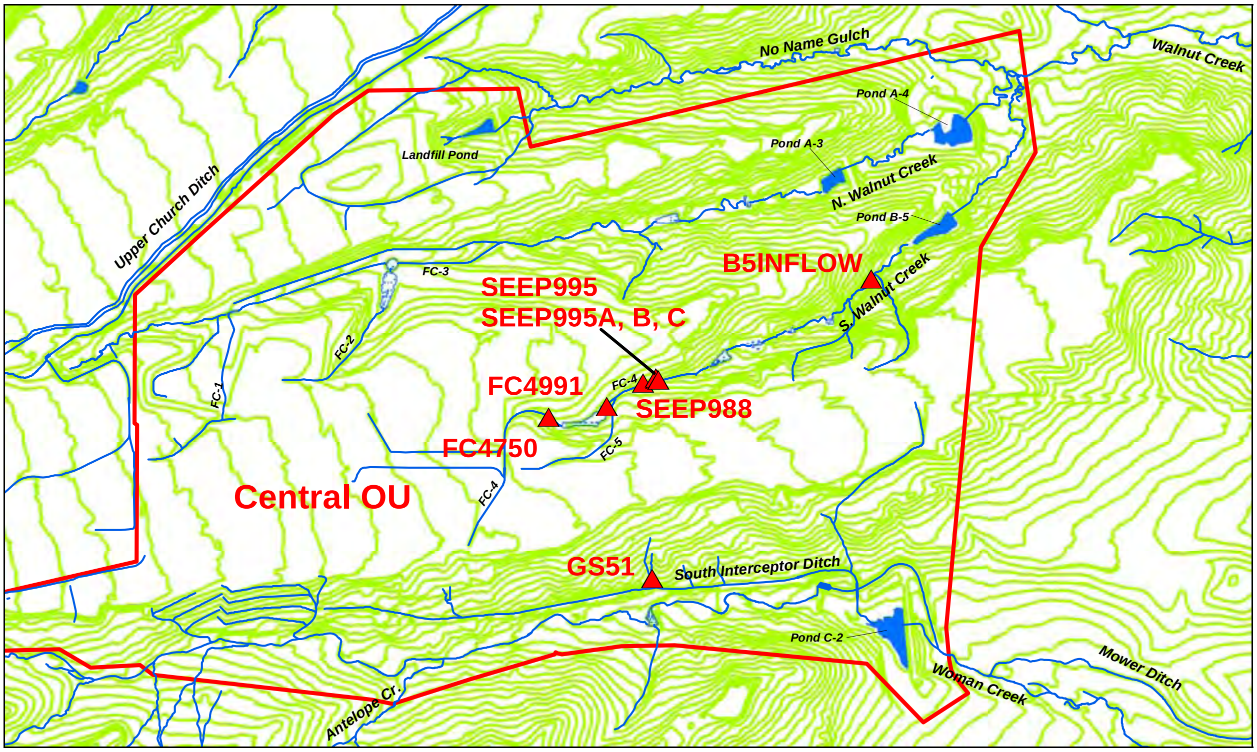


Figure 74. Investigative Monitoring Locations

Data Evaluation

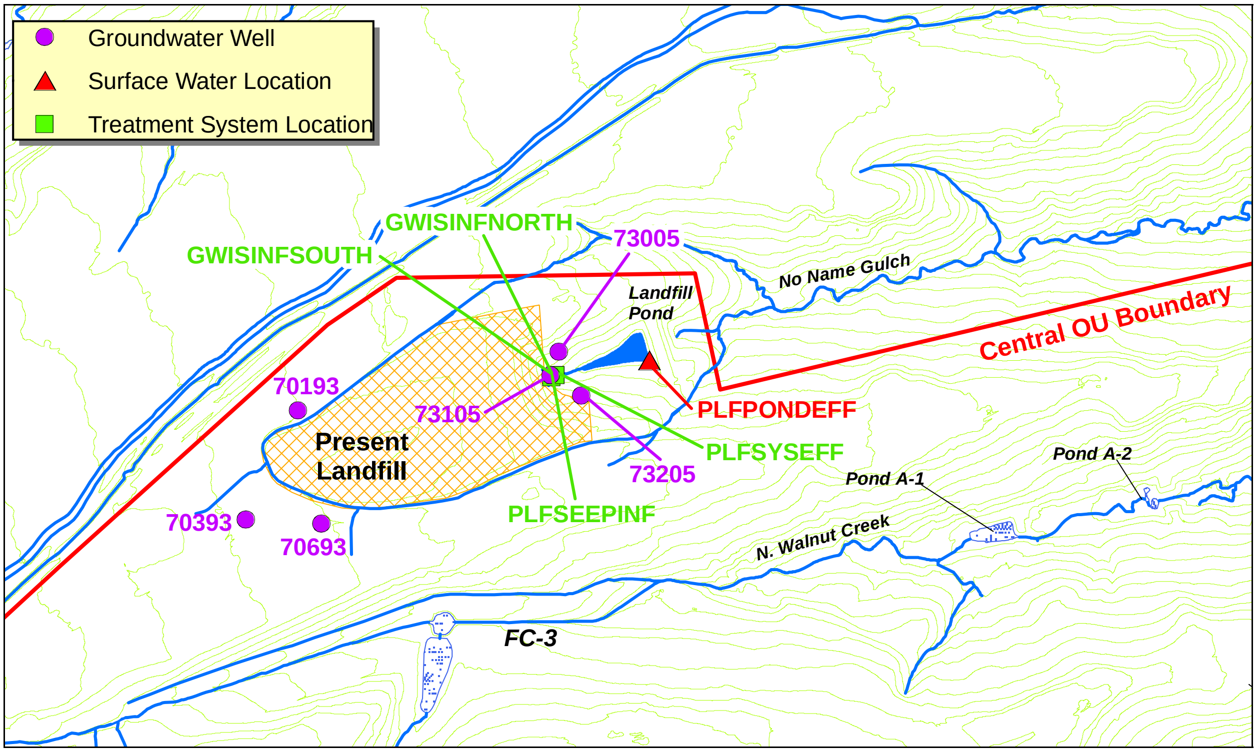
No routine data evaluation for the investigative objective is presented in this report. Refer to Appendix B, which contains the water-quality data, for additional information.

3.1.2.8 PLF Monitoring

The PLF is located in the COU just north of the former IA. This objective deals with monitoring surface water and groundwater at the PLF to determine the short- and long-term effectiveness of the remedy. These requirements were initially identified in the *Final Interim Measures/Interim Remedial Action for IHSS 114 and RCRA Closure of the RFETS Present Landfill*, Appendix B, "Post-Accelerated Action Monitoring and Long-Term Surveillance and Monitoring Considerations" (DOE 2004), and finalized in the PLF M&M Plan (DOE 2008a).

Water monitoring locations for the PLF are shown on Figure 75. The surface-water and treatment system monitoring requirements deal specifically with the PLFTS and are discussed in detail in Section 3.1.2.10. Details regarding general groundwater monitoring are provided below.

The RCRA monitoring network at the PLF comprises six wells: three are located upgradient of the landfill, and three are downgradient of the landfill but upgradient of the Landfill Pond. The RCRA wells are monitored in accordance with RFLMA. Decision rules are also set forth in that document; see Appendix D for the RFLMA decision flowcharts. Additional monitoring wells are present in the general vicinity of the PLF; however, they do not contribute to the RCRA monitoring of the landfill and are discussed in other sections of this report.



Note: PLFSYSEFF serves as both the treatment system effluent monitoring location and a performance surface-water location.

Figure 75. PLF Monitoring Locations

Sampling and data evaluation protocols for the RCRA wells at the PLF are provided in Table 35.

Table 35. Sampling and Data Evaluation Protocols at PLF RCRA Monitoring Wells

Location Code	Location Description	Sample Types/ Frequencies	Analytes[a]	Data Evaluation
70193	Upgradient (northwest) of the upgradient end of the PLF	Quarterly each calendar quarter	VOCs, metals	See Figure 10 in Appendix D
70393	Upgradient (west/southwest) of the upgradient end of the PLF	Quarterly each calendar quarter	VOCs, metals	See Figure 10 in Appendix D
70693	Upgradient (southwest) of the upgradient end of the PLF	Quarterly each calendar quarter	VOCs, metals	See Figure 10 in Appendix D
73005	Downgradient (northeast) of the downgradient end of the PLF	Quarterly each calendar quarter	VOCs, metals	See Figure 10 in Appendix D
73105	Downgradient (east) of the downgradient end of the PLF at the PLFTS	Quarterly each calendar quarter	VOCs, metals	See Figure 10 in Appendix D
73205	Downgradient (southeast) of the downgradient end of the PLF	Quarterly each calendar quarter	VOCs, metals	See Figure 10 in Appendix D

Notes: [a] Samples for the analysis of metals are field-filtered using a 0.45-micrometer in-line filter. Laboratory analytes are limited to those based on the analytical methods listed in the PLF M&M Plan.

Data Evaluation

All RCRA wells at the PLF were sampled in the fourth quarter of CY 2011. Results are included in Appendix B.

This section presents the evaluation of the PLF groundwater quality data for all of CY 2011. Monitoring performed in 2011 at the PLF RCRA wells is summarized in Table 36.

Table 36. RCRA Groundwater Sampling Performed in 2011 at the PLF

Well	Location	Q1	Q2	Q3	Q4
70193	Upgradient	VOCs, metals	VOCs, metals	VOCs, metals	VOCs, metals
70393	Upgradient	VOCs, metals	VOCs, metals	VOCs, metals	VOCs, metals
70693	Upgradient	VOCs, metals	VOCs, metals	VOCs, metals	VOCs, metals
73005	Downgradient	VOCs, metals	VOCs, metals	VOCs, metals	VOCs, metals
73105	Downgradient	VOCs, metals	VOCs, metals	VOCs, metals	VOCs, metals
73205	Downgradient	VOCs, metals	VOCs, metals	VOCs, metals	VOCs, metals

Notes: Q = quarter. Metals include U. Only RFLMA-defined (DOE 2007a) RCRA wells supporting the PLF are listed; other wells in the area (such as Sentinel and Evaluation wells) are omitted because they are not part of the RCRA monitoring network.

Downgradient water quality (as represented by analytical data from wells 73005, 73105, and 73205) was statistically compared against upgradient water quality (as represented by analytical data from wells 70193, 70393, and 70693). Generally, water quality in the upgradient wells continues to be more impacted than that in the downgradient wells, because upgradient wells 70393 and 70693 are within the margins of the Property Utilization and Disposal (PU&D) Yard Plume, an area of groundwater contaminated with VOCs. (This plume is discussed separately later in this report.)

Statistical evaluation of the analytical data from the PLF was performed using all nonrejected (i.e., valid) data for upgradient and downgradient RCRA wells. An interwell comparison was made (i.e., comparing upgradient wells against downgradient wells) in accordance with RFLMA and the PLF M&M Plan, using the Analysis of Variance (ANOVA) procedure as performed using the Sanitas software package (Sanitas Technologies 2011). The data were also assessed for trends, again using Sanitas and the S-K trending method in keeping with the findings of previous studies indicating this method to be most appropriate for Rocky Flats groundwater data (K-H 2004a).

The ANOVA evaluation of the groundwater analytical data from PLF RCRA wells indicates that groundwater sample results from one or more of the downgradient wells are statistically higher in the concentration of certain constituents, all metals. As summarized in Table 37, one or more downgradient wells produce groundwater samples with statistically significant higher concentrations of boron (B), chromium (Cr), copper (Cu), nickel (Ni), selenium (Se), uranium (U), or zinc (Zn) than upgradient wells. This 2011 statistical result is the same as that reported for 2010 (DOE 2011d) for B, Se, U, and—in well 73105—Zn; it is also the same as that determined for the 2009 Annual Report (DOE 2010d) with respect to the B, Se, U, and Zn results. However, the 2011 ANOVA results find insufficient evidence for the higher downgradient concentration of cadmium (Cd) in well 73205 and Zn in well 73005 that was determined for 2010 (DOE 2011d).

It is important to note that the analytical data sets compiled for the downgradient RCRA wells include many nondetects for Cr in samples from well 73005, Cu in samples from well 73205, and Ni in samples from both well 73105 and 73205. In addition, the data sets for Se in samples from well 73005 and Zn in samples from 73105 both contain numerous estimated results. In fact, for the entire combined dataset of the six ANOVA-identified constituents at the respective wells—nearly 150 analytical results total—only four of the results (all for Se in samples from well 73005) are not qualified. Therefore, because of this abundance of nondetects and estimated concentrations, the results of statistical calculations utilizing these data may not be valid. Additional data will be required to evaluate the validity of these ANOVA determinations.

Table 37. Results of Groundwater ANOVA Evaluation for 2011 at the PLF

Analyte	73005	73105	73205
B	x	x	x
Cr	x (U)		
Cu			x (U)
Ni		x (U, est)	x (U)
Se	x (est)		x
U	x	x	x
Zn		x (est)	

Note: x = analyte is present in groundwater at a statistically significant higher concentration in the indicated downgradient well compared to upgradient wells. This notation is assigned the qualifier (U) if the dataset contains at least 25% nondetects, and (est) if it contains at least 25% estimated values.

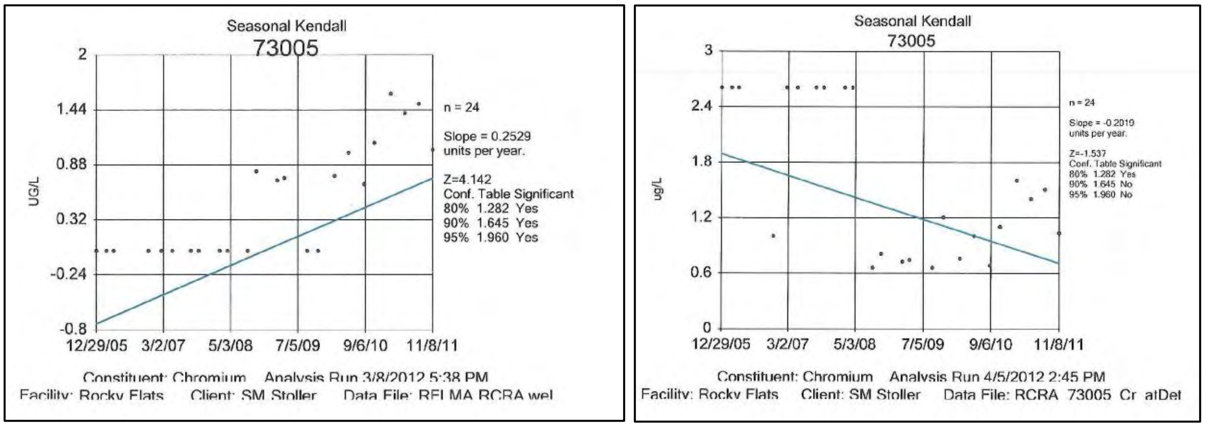
Section 3.1.5.3 provides a more detailed discussion of statistical trend testing using the S-K method, results of which are summarized below in Table 38. Increasing trends having a 95 percentlevel of confidence are calculated for B in groundwater at well 73105, and for both Cr (discussed separately in the next paragraph) and Se in groundwater at well 73005. (Additional information and summary results of trend testing are provided in subsequent sections of this report; see also Appendix B–3 for statistical output, including trend plots.)

Table 38. Results of Groundwater S-K Trend Testing for 2011 at the PLF

Analyte	73005	73105	73205
B		x	
Cr	x (U)		
Se	x (est)		

Note: x = analyte is on an increasing trend, with a statistical significance of 95%, in the indicated downgradient well. This notation is assigned the qualifier (U) if the dataset contains at least 25% nondetects, and (est) if it contains at least 25% estimated values.

The increasing trend calculated for Cr at well 73005 is strongly affected by data replacement. As explained in Section 3.1.1.2, due to the extreme variability of detection limits a convention was adopted in the years prior to Site closure to replace nondetects with a very low, non-zero number (at the Site, this number is 0.001). This can lead to a suggestion of trends that may not be real, as may the common practice of replacing nondetects with half the detection limit. In fact, use of this data-replacement practice leads to the calculation of an increasing trend, with 95 percent confidence, in concentrations of Cr at well 73005; conversely, using the reported U-qualified results at face value (i.e., at concentrations equal to the detection limits) leads to the calculation of a <u>decreasing</u> trend of lesser statistical significance. Both results are depicted below in Figure 76. Therefore, as cautioned above, the calculated trend for Cr may not be viable, and the same may apply to other calculated statistical trends based on data sets that contain numerous nondetects.



Notes: Left plot utilizes data replacement wherein all nondetects are replaced with a value of 0.001. Right plot incorporates reported data at face value, regardless of qualifier; nondetects are therefore plotted at the associated detection limits.

Figure 76. Effects of Data Replacement on Statistical Trends Calculated for Cr at PLF Well 73005

Concentrations of B in samples from well 73105 remain well under the RFLMA Table 1 standard of 750 µg/L; the highest concentration observed in 2011 was 148 µg/L in the sample collected in November. This well consistently produces samples with the highest concentrations of B, though they are well below the RFLMA standard of 750 µg/L.

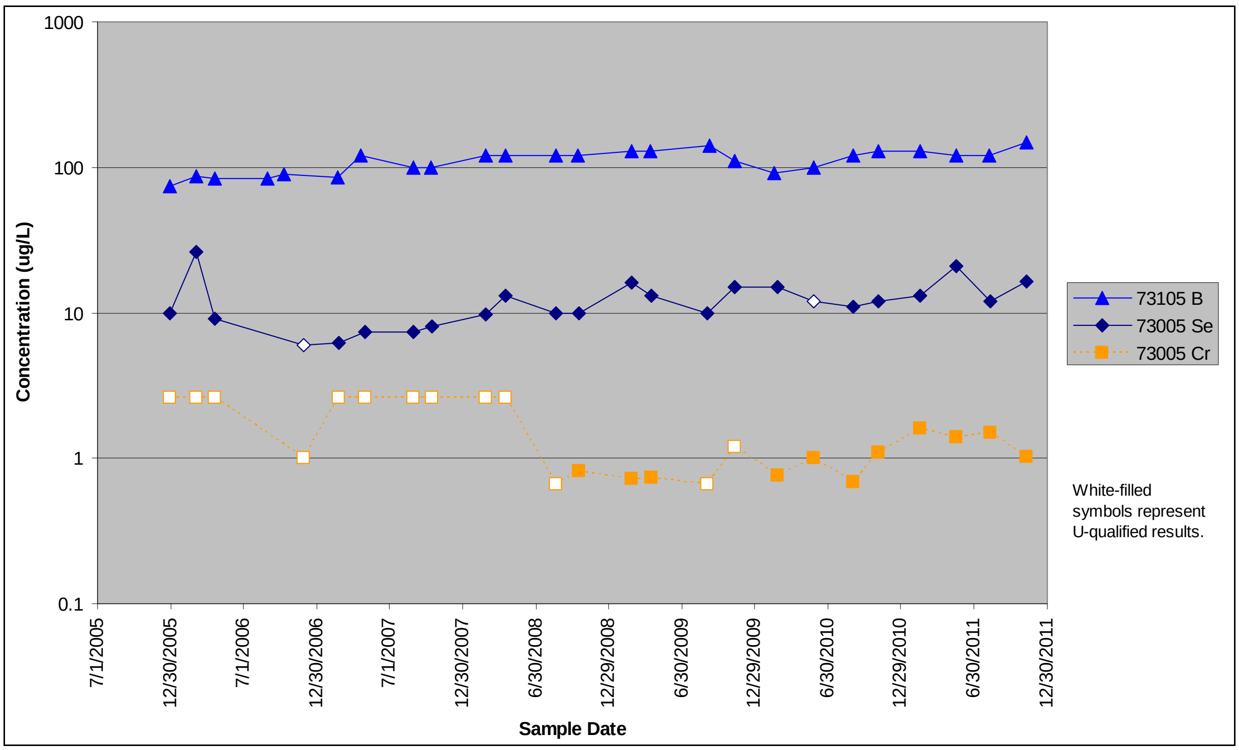
The highest concentration of Cr detected in samples from well 73005 was estimated at 1.6 µg/L in February. The RFLMA standard for the more toxic Cr-VI is 20 µg/L (PQL, applies to dissolved Cr-VI), while that for the more environmentally-typical Cr-III is 50 µg/L (applies to total recoverable Cr-III). Although the speciation of the Cr reported in groundwater from downgradient PLF wells is not certain, the reported concentrations are well below either of these RFLMA standards.

The highest concentration of Se reported in 2011 at well 73005 was 21 µg/L in the sample collected in February. This result was not qualified, indicating the value is reliable. Although the reported concentrations of Se in groundwater samples from this well are usually qualified, they consistently exceed the 4.6 µg/L RFLMA standard. Similarly, as in previous years, concentrations of Se in samples from well 73205 are consistently above the corresponding standard, ranging in 2011 from 290 µg/L to 410 µg/L, but were not found to be on an increasing trend.

Although all three downgradient wells produce samples with concentrations of U that are statistically higher than in upgradient wells, only well 73205 produces samples with concentrations that are close to the U threshold of 120 µg/L. To date, U data from this well include two results—one collected in 2006, and the second from the fourth quarter of 2011—

exceeding that concentration. Samples collected in 2011 had concentrations of U ranging from 93 µg/L to 124 µg/L. These concentrations are consistent with conditions in previous years. The other downgradient wells produce groundwater samples with U concentrations that are much lower than the threshold.

Figure 77 provides time-series plots of the constituents that are ANOVA-identified (per Table 37) and on an increasing trend (Table 38). Note the frequent nondetects reported for Cr in samples from well 73005. While increasing trends in B in well 73105 and Se in well 73005 may be visually apparent, that is not the case for Cr. Concentrations of Cr in well 73005 may be relatively constant, increasing, or decreasing; the prevalence of nondetects in the dataset obscures any trend. Additional data will be required to confirm any concentration trend.



Notes: Constituents and corresponding RFLMA standards (DOE 2007a): B = boron, 750 µg/L; Se = selenium, 4.6 µg/L; Cr = chromium, 50 µg/L (as total recoverable Cr-III). Only those analyte-well combinations that were both (1) identified in the ANOVA evaluation of PLF groundwater data as having statistically significant higher concentrations in downgradient RCRA wells (as listed in Table 37), and (2) on an increasing concentration trend at the 95% level of significance (Table 38) are shown. In addition to the nondetects, numerous other results were qualified but are not shown differently for the sake of simplicity. Note logarithmic concentration scales.

Figure 77. Constituents Meeting Both ANOVA and Trending Decision Criteria at the PLF

No VOCs were detected in samples from downgradient wells in 2011.

The constituents identified via the ANOVA statistical evaluation are all found in natural settings, and the statistical results summarized above may not reflect the presence of contaminants related to the PLF. For example, B is incorporated in evaporite minerals (such as ulexite, or “TV rock,” and the more common borax), metamorphic minerals (such as tourmaline), and perhaps most notably in coals and similar deposits of carbonaceous fossilized organic matter. Two of the upgradient wells are screened in alluvial materials, and one is screened in weathered bedrock. The three downgradient wells are all screened in the weathered bedrock, and lithologic logs from these wells note the presence of fossilized organics (i.e., substances akin to lignite or coal) at the depth corresponding to the screened interval. Thus, these wells may produce waters with higher concentrations of B as an artifact of the geology and variations in screened materials.

Similarly, the presence of Se at elevated concentrations may be related to regional mineralization and the prevalence of coals and organic-rich sediments, clays, and iron oxides in the geologic intervals screened by PLF wells (and most monitoring wells at Rocky Flats). The sulfide mineralization that drew prospectors to Colorado and is evident in the mountains west of the Site would be a source of Se, as might shales that are closer to the Site. Se would be liberated as those rocks and minerals weather. Clays, coals, and iron oxides could then act to sorb the mobile Se and may be present in the screened interval of these wells.

According to RFLMA, consultation with the regulators is required if both of two conditions are true of PLF groundwater: (1) concentration of a RFLMA constituent is statistically higher in downgradient than upgradient groundwater (per ANOVA results), and (2) the constituent is also calculated to be on an increasing trend. As indicated by the ANOVA statistics summarized in Table 37 and the summary of statistically-significant increasing trends in Table 38), both of these conditions were true in 2011 for B in groundwater from well 73105, and for Cr and Se in groundwater from well 73005.

The same condition for B at well 73105 was also reported following the statistical evaluation of 2009 and 2010 data, as discussed in the associated annual reports (DOE 2010d and DOE 2011d). The consultative process was initiated in response to that determination and is summarized in Contact Record 2010-05. Also, an increasing trend for Cr in downgradient well 73005 was identified in the 2010 Annual Report (DOE 2011d), but at the time Cr was not identified as being present at higher concentrations in groundwater from downgradient wells than from upgradient wells. Conversely, the ANOVA results calculated for 2010 determined that Se at well 73005 was elevated with respect to upgradient concentrations, but the increasing trend in Se that was calculated at well 73005 did not rise to the 95 percent level of significance (DOE 2011d). The results for 2011 have therefore been hinted at in past years.

Consultation was conducted in April 2012 on the statistical results for these downgradient PLF RCRA wells. This regulatory consultation concluded that no response action is required, and no modification of RFLMA monitoring is needed. Subsequent RFLMA monitoring results will further inform the evaluation.

According to RFLMA, calculated 85th percentile concentrations from downgradient PLF wells are also to be compared to the corresponding standards to support the exit strategy. However, the data to be used in this comparison are from the previous two periodic (i.e., CERCLA) reviews. These downgradient PLF wells were installed in 2005, and consequently were represented by only about 6 years of data as of the end of 2011. Therefore, such a comparison cannot be completed at this time.

Groundwater quality at the PLF is impacted on the upgradient side by VOCs from the PU&D Yard Plume. (Refer to the separate discussion of this plume in Section 3.1.5.3.) As noted above, data from the downgradient RCRA wells in 2011 showed no detections of VOCs.

Groundwater flow at the PLF is strongly affected by the GWIS, which diverts groundwater around the perimeter of the PLF rather than through the landfill wastes. The GWIS includes a slurry wall and perforated drain around the upgradient and side-gradient perimeter of the PLF and acts to isolate groundwater within the PLF from that outside the PLF. (Refer to the previously published reports referenced earlier in this section for more detail on the GWIS and related discussions.) Previous RCRA and groundwater annual reports have confirmed the effectiveness of this isolation. Because the GWIS is located between the upgradient PLF RCRA wells and the downgradient PLF RCRA wells, estimating seepage velocities as discussed in Section 3.1.3.5 between those sets of wells is not appropriate.

3.1.2.9 OLF Monitoring

The OLF is located in the COU just south of the former IA. This objective addresses monitoring surface water and groundwater at the OLF to determine the short- and long-term effectiveness of the remedy. These requirements were initially identified in the *Final Interim Measure/Interim Remedial Action for the Original Landfill (Including IHSS Group SW-2; IHSS 115, Original Landfill and IHSS 196, Filter Backwash Pond)*, Appendix B, “Post-Accelerated Action Monitoring and Long-Term Surveillance and Maintenance Considerations” (DOE 2005a), and finalized in the OLF M&M Plan (DOE 2009a).

Four groundwater monitoring wells monitor the OLF and are classified as RCRA wells in RFLMA; three of these wells were installed in 2005. One of the OLF RCRA wells is located upgradient of the landfill, and three are downgradient of the landfill but upgradient of Woman Creek. The RCRA wells are monitored in accordance with RFLMA. Decision rules are also set forth in that document; see Appendix D for the RFLMA decision flowcharts. Additional monitoring wells are present in the general vicinity of the OLF; however, they do not contribute to the RCRA monitoring of the facility and are therefore discussed in other sections of this report.

Surface-water and RCRA groundwater monitoring locations for the OLF are shown on Figure 78. Sampling and data evaluation protocols are summarized in Table 39 and Figure 78.

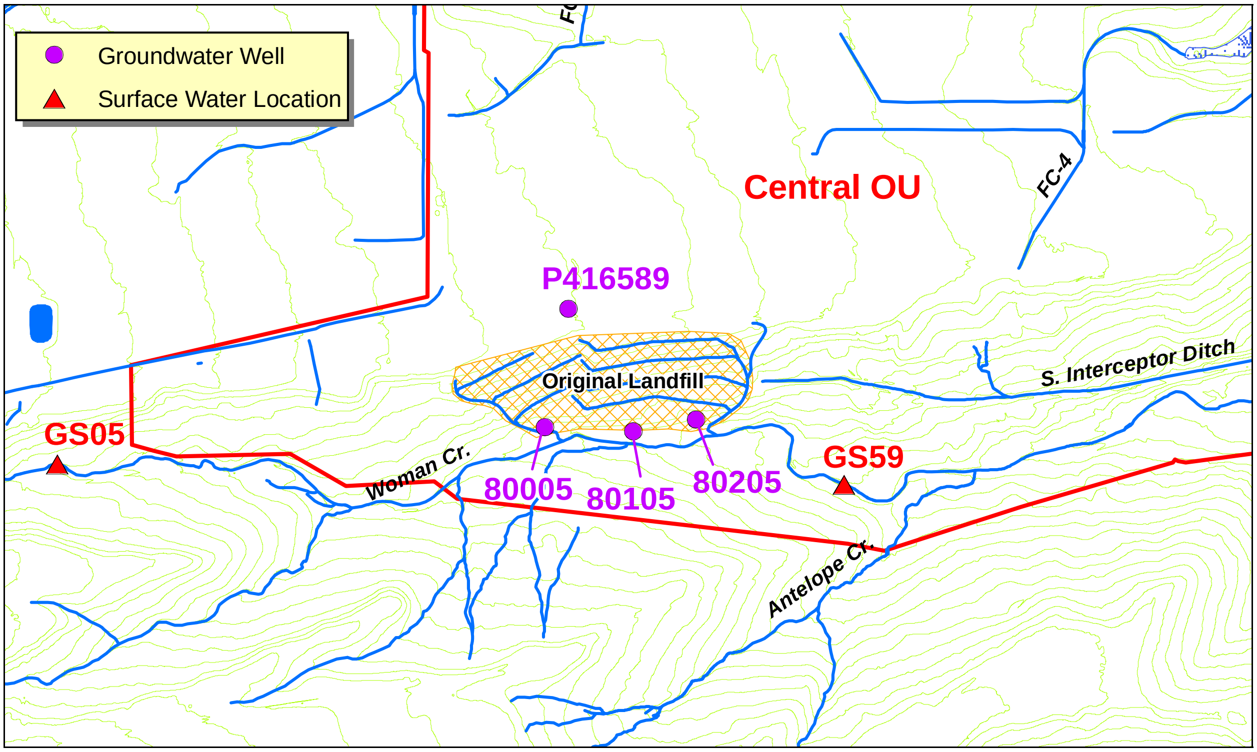


Figure 78. OLF Monitoring Locations

Table 39. Sampling and Data Evaluation Protocols at OLF Surface-Water Monitoring Locations

Location Code	Location Description	Sample Types/ Frequencies	Analytes[b]	Data Evaluation
GS05; upgradient	Woman Creek at west POU fenceline	Quarterly grab samples[a]	Total U; dissolved and total metals; VOCs; mercury	See Figure 12 in Appendix D
GS59; downgradient	Woman Creek 800 feet downstream of OLF	Quarterly grab samples[a]	Total U; dissolved and total metals; VOCs; mercury	See Figure 12 in Appendix D

Notes: [a] Samples for total U and metals are currently collected as continuous flow-paced composites in conjunction with the Investigative monitoring objective; decisions specifically for the OLF monitoring objective only require quarterly grabs.

[b] Laboratory analytes are limited to those based on the analytical methods listed in the OLF M&M Plan.

Table 40. Sampling and Data Evaluation Protocols at OLF RCRA Monitoring Wells

Location Code	Location Description	Sample Types/ Frequencies	Analytes[a]	Data Evaluation
P416589	Upgradient (north) of the OLF	Quarterly each calendar quarter	VOCs, SVOCs, metals	See Figure 10 in Appendix D
80005	Downgradient (south) of the western portion of the OLF	Quarterly each calendar quarter	VOCs, SVOCs, metals	See Figure 10 in Appendix D
80105	Downgradient (south) of the central portion of the OLF	Quarterly each calendar quarter	VOCs, SVOCs, metals	See Figure 10 in Appendix D
80205	Downgradient (south) of the eastern portion of the OLF	Quarterly each calendar quarter	VOCs, SVOCs, metals	See Figure 10 in Appendix D

Notes: [a] Samples for the analysis of metals are field-filtered using a 0.45-micrometer in-line filter.Laboratory analytes are limited to those based on the analytical methods listed in the OLF M&M Plan.
SVOCs = semivolatile organic compounds

Data Evaluation

Analytical results for GS59 and GS05 are compared, according to Figure 12 in Appendix D, to the appropriate surface-water standard in Table 1 of RFLMA Attachment 2. During CY 2011, there were two instances where analytes were detected above the applicable standards:

- Dissolved silver was measured at 1.04 µg/L in the GS59 composite sample collected during the period March 10–April 7, 2011. The RFLMA Table 1 standard is 1.0 µg/L. This result triggered increased sampling frequency (monthly). However, for the next composite sample collected during the period April 7–April 25, 2011, dissolved silver was not detected
- Selenium was measured at 7.79 µg/L in the GS59 composite sample collected during the period October 5–November 1, 2011. The RFLMA Table 1 standard is 4.6 µg/L. This result triggered increased sampling frequency (monthly). However, for the next composite sample collected during the period November 1, 2011–January 5, 2012, selenium was not detected

All RCRA wells at the OLF were sampled in the fourth quarter of CY 2011. Results are included in Appendix B.

This section presents the evaluation of the CY 2011 groundwater quality data for the OLF, previously known as OU 5. All RCRA wells are monitored quarterly. Monitoring performed in 2011 is summarized in Table 41.

Table 41. RCRA Groundwater Sampling Performed in 2010 at the OLF

Well	Location	Q1	Q2	Q3	Q4
P416589	Upgradient	VOCs, metals, SVOCs	VOCs, metals, SVOCs	VOCs, metals, SVOCs	VOCs, metals, SVOCs
80005	Downgradient	VOCs, metals, SVOCs	VOCs, metals, SVOCs	VOCs, metals, SVOCs	VOCs, metals, SVOCs
80105	Downgradient	VOCs, metals, SVOCs	VOCs, metals, SVOCs	VOCs, metals, SVOCs	VOCs, metals, SVOCs
80205	Downgradient	VOCs, metals, SVOCs	VOCs, metals, SVOCs	VOCs, metals, SVOCs	VOCs, metals, SVOCs

Notes: Q = quarter. SVOCs = semivolatile organic compounds. Metals include U. Only RCRA wells supporting the OLF are listed; other wells in the area (such as AOC, Sentinel, and Evaluation wells) are omitted because they are not part of the RCRA monitoring network.

In addition to being monitored and evaluated similarly to RCRA wells (i.e., sampled quarterly, and resulting analytical data evaluated by upgradient-downgradient comparisons), the three downgradient wells are also monitored and evaluated in the manner of Sentinel wells. Specifically, data from these wells are statistically evaluated using 85th percentile concentrations to compare against surface-water standards, and data trends are constructed as warranted to determine a need for action.

As with the PLF, statistical evaluation of the analytical data from the OLF was performed using all nonrejected data for upgradient and downgradient RCRA wells. An interwell comparison was made (i.e., comparing the upgradient well against downgradient wells) in accordance with RFLMA and the OLF M&M Plan (DOE 2009a), using the ANOVA procedure as performed with the Sanitas software package (Sanitas Technologies 2011). The data were also evaluated for statistical trends, again using Sanitas and the S-K trending method in keeping with the findings of previous studies indicating this method to be most appropriate for Rocky Flats groundwater data (K-H 2004a).

RFLMA-required consultation with the regulators is required if either of two conditions is true of OLF groundwater: (1) concentrations of certain constituents are statistically higher in downgradient than upgradient groundwater (per ANOVA results); or (2) concentrations of constituents in a downgradient well are on an increasing trend meeting the 95 percent level of significance. In 2011, condition (1) was true for B in all three downgradient wells and uranium in downgradient well 80205, but condition (2) did not apply because no such increasing trends were calculated. These statistical conclusions are identical to those determined for the 2010 Annual Report (DOE 2011d), for which consultation was conducted in early 2011 as reported in a contact record issued in early 2011. (Note that this same outcome was also the result of the statistical evaluations performed for the 2009 Annual Report, as reported in Contact Record 2010-05 and the 2009 Annual Report [DOE 2010d].) These groundwater conditions and statistical evaluations are described in greater detail below.

ANOVA evaluation of the groundwater analytical data from OLF RCRA wells indicates that groundwater samples from the downgradient wells are statistically higher in the concentration of certain constituents. No VOCs were found in downgradient wells at statistically higher concentrations than in upgradient wells, but the concentrations of two metals are statistically higher in one or more downgradient wells. These results are summarized in Table 42. A similar tabulation of increasing statistical trends in downgradient wells, such as that provided for the

PLF as Table 38, is not included for the OLF because no increasing trends were defined at the 95 percent statistical significance.

Table 42. Results of Groundwater ANOVA Evaluation for 2011 at the OLF

Analyte	80005	80105	80205
B	x	x	x
U			x

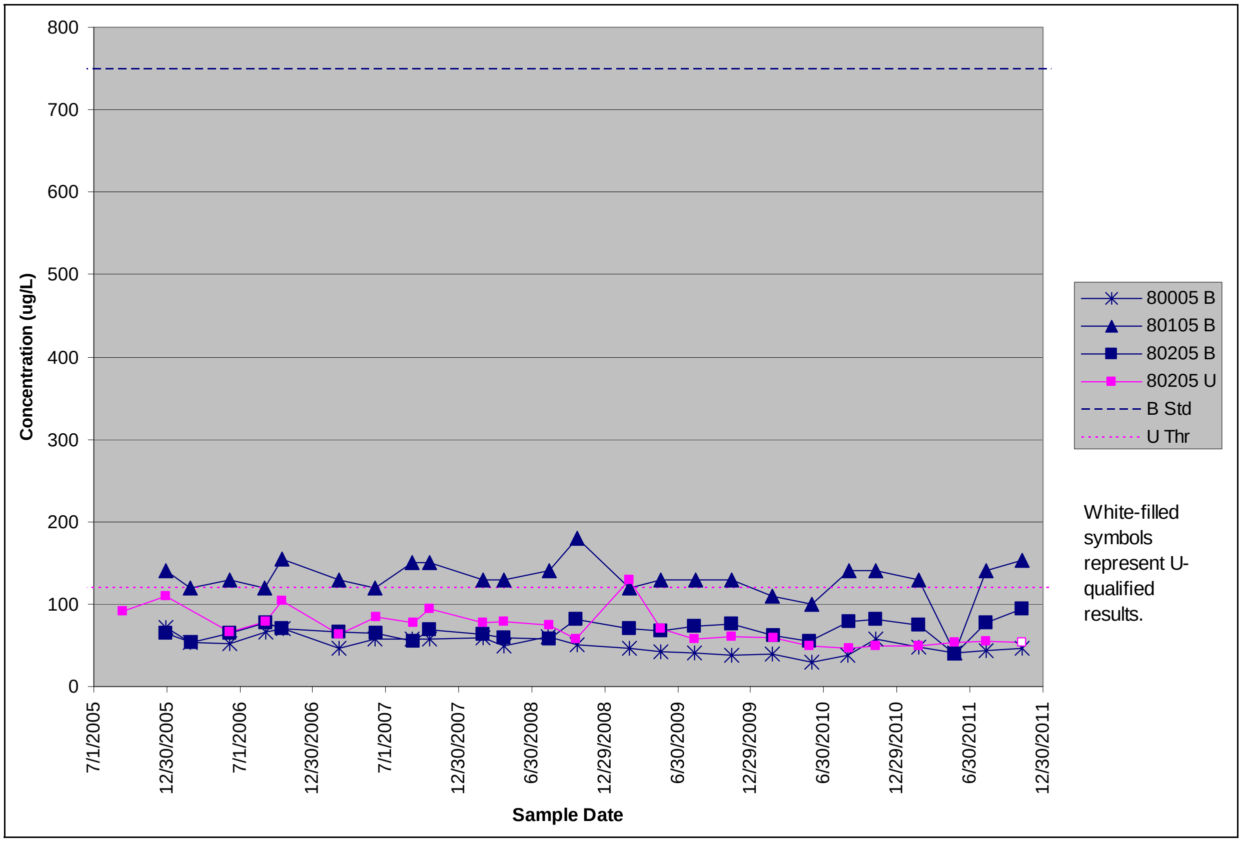
Note: x = analyte is present in groundwater at a statistically significant higher concentration in the indicated downgradient well compared to upgradient wells.

RFLMA instructs that if concentrations in downgradient wells are found to be significantly higher than in upgradient, the consultative process is initiated to determine the appropriate response. All three downgradient wells produce groundwater samples with statistically higher concentrations of B than the upgradient well, and the same applies to concentrations of U in well 80205. This is identical to ANOVA results reported in the 2007, 2008, 2009, and 2010 Annual Reports (DOE 2008c, 2009d, 2010d, and 2011d). Consistent with conditions reported above for the PLF, consultation was conducted in April 2012 on the statistical results for these downgradient OLF RCRA wells. This regulatory consultation concluded that no response action is required, and no modification of RFLMA monitoring is needed. Subsequent RFLMA monitoring results will further inform the evaluation.

Also as noted above in the discussion of the PLF groundwater results, these findings may be due to natural geological and geochemical conditions.

Figure 79 provides time-series plots of reported B and U concentrations in groundwater from the wells listed in Table 42. As this figure indicates, concentrations of B in downgradient groundwater are uniformly well under the RFLMA Table 1 standard of 750 µg/L; the highest concentration reported in 2011 was 153 µg/L in the November 2011 sample collected from well 80105. The surface-water quality reported at downstream OLF location GS59 does not indicate that B concentrations in downgradient OLF groundwater represent a threat.

Concentrations of U in samples from downgradient well 80205 (Figure 79) were consistently below the U threshold in 2011. Given that only one result has been reported above that value (in March 2009), it follows that the 85th percentile concentration of U in samples from well 80205 also does not exceed this threshold (as described in the Sentinel well decision rules that also apply to downgradient OLF RCRA wells). Including the 2011 results, the 85th percentile concentration of U in samples from well 80205 is 92.8 µg/L, slightly lower than the 94 µg/L reported in 2010 and the 100 µg/L value reported in 2009 (DOE 2010d, 2011d). Consistent with this steadily-decreasing 85th-percentile value, a decreasing trend in U concentrations is found to be 95 percent significant for well 80206. In addition, groundwater from this well was analyzed for anthropogenic content in late 2007 and found to be 100 percent natural (DOE 2008c). As with B, the surface water monitored at location GS59 has not indicated that U concentrations in downgradient OLF groundwater represent a threat to surface-water quality.



Notes: Only those analyte-well combinations identified in the ANOVA evaluation of OLF groundwater data as having statistically significant higher concentrations in downgradient RCRA wells are shown. Illustrated RFLMA action levels (DOE 2007a): B, 750 µg/L; U threshold, 120 µg/L. Several detections were qualified but for simplicity are not shown differently. Note logarithmic concentration scale.

Figure 79. B and U in Downgradient Groundwater from OLF RCRA Wells Identified in 2011 ANOVA Data Evaluations

Data reported in 2011 from downgradient RCRA wells at the OLF include one VOC detection and no detections of semivolatile organic compounds (SVOCs). This is reduced relative to conditions reported for 2010 (DOE 2011d), which included two VOC and three SVOC detections (one of which exceeded the corresponding standard). The 2011 data include a detection of 1,1-DCE at an estimated (J-qualified) concentration of 0.48 µg/L in May 2011 at well 80105; the RFLMA standard for this constituent is 7 µg/L. This represents the first detection of this constituent in the downgradient OLF RCRA wells.

Table 43. VOCs and SVOCs Detected in 2011 in Downgradient Wells at the OLF

Well	Sample Date	Analyte	Result	Units	Lab Qualifier
80105	5/25/2011	1,1-dichloroethene	0.48	µg/L	J

Note: J = analyte detected, result is estimated. Applicable RFLMA standard is 7 µg/L.

According to RFLMA, downgradient OLF wells are also assessed in a manner consistent with that used for Sentinel wells (DOE 2007a); concentrations are evaluated for statistically-significant (95 percent) trends, and 85th percentile concentrations are assessed in comparison with the applicable RFLMA standards or threshold. As stated above, there were no increasing trends meeting the 95 percent level of significance for the downgradient wells, but a decreasing trend of this significance is calculated for U at well 80205. In addition, a decreasing trend of the same significance is calculated for B concentrations in samples from well 80005. Both of these decreasing trends are identical to the findings reported for 2010 (DOE 2011d). Trending results are provided in Appendix B.

RFLMA instructs that calculated 85th percentile concentrations from downgradient OLF wells are to be compared against the corresponding standards to support the exit strategy. However, as with downgradient RCRA wells at the PLF, the data to be used in this comparison are from the previous two CERCLA reviews. These downgradient OLF wells were installed in 2005, and consequently were represented by only about six years of data as of the end of 2011. Therefore, such a comparison cannot be completed at this time.

Groundwater flow at the OLF is not affected by controls such as the GWIS at the PLF. Groundwater flows beneath the pediment surface on the north side of the OLF in a general west-to-east direction. As it nears the southern edge of the pediment, closest to the OLF, groundwater is diverted to a more south-southeasterly direction. This latter general flow direction applies to groundwater moving through the OLF.

Groundwater flow velocities were calculated (see Section 3.1.3.5) for OLF well pair P416589 (the upgradient well) and 80105 (the middle downgradient well). The resulting estimates for the travel time from the upgradient to downgradient well based on water level data collected in 2011 are approximately 3 years. Note that this calculated velocity is simplistic and applies only to pure water; the migration of contaminants would be retarded to varying degrees.

Seeps are also present at the OLF and have been observed in this area for decades (as well as being suggested on aerial photographs taken before the Rocky Flats Plant came into existence in the 1950s). Additional discussion of seeps at the OLF is provided in Section 2.4.2; included in that discussion are analytical results from grab samples collected in 2011 from selected seeps on the OLF.

3.1.2.10 Groundwater Treatment System Monitoring

Contaminated groundwater is intercepted and treated in four areas of the Site. Three of these systems (MSPTS, ETPTS, and SPPTS) include a groundwater intercept trench (collection trench), which is similar to a French drain with an impermeable membrane on the downgradient side. Groundwater entering the trench is routed through a drain pipe into one or more treatment cells, where it is treated and then discharged to the subsurface, and eventually reaches surface water. The fourth system (PLFTS) treats water from the north and south components of the GWIS and flow from the PLF seep.

Water monitoring at the MSPTS, ETPTS, and SPPTS includes a minimum of three sample-collection points: untreated influent entering the treatment system, treated effluent exiting the system, and a surface-water performance location. At the PLFTS, the treated effluent and surface-water sampling locations are typically the same; this is discussed in further detail below.

The fundamental questions at each system are whether (1) influent-water quality indicates that treatment is still necessary, (2) effluent-water quality indicates that system maintenance is required, and (3) surface-water quality suggests impacts from inadequate treatment of influent.

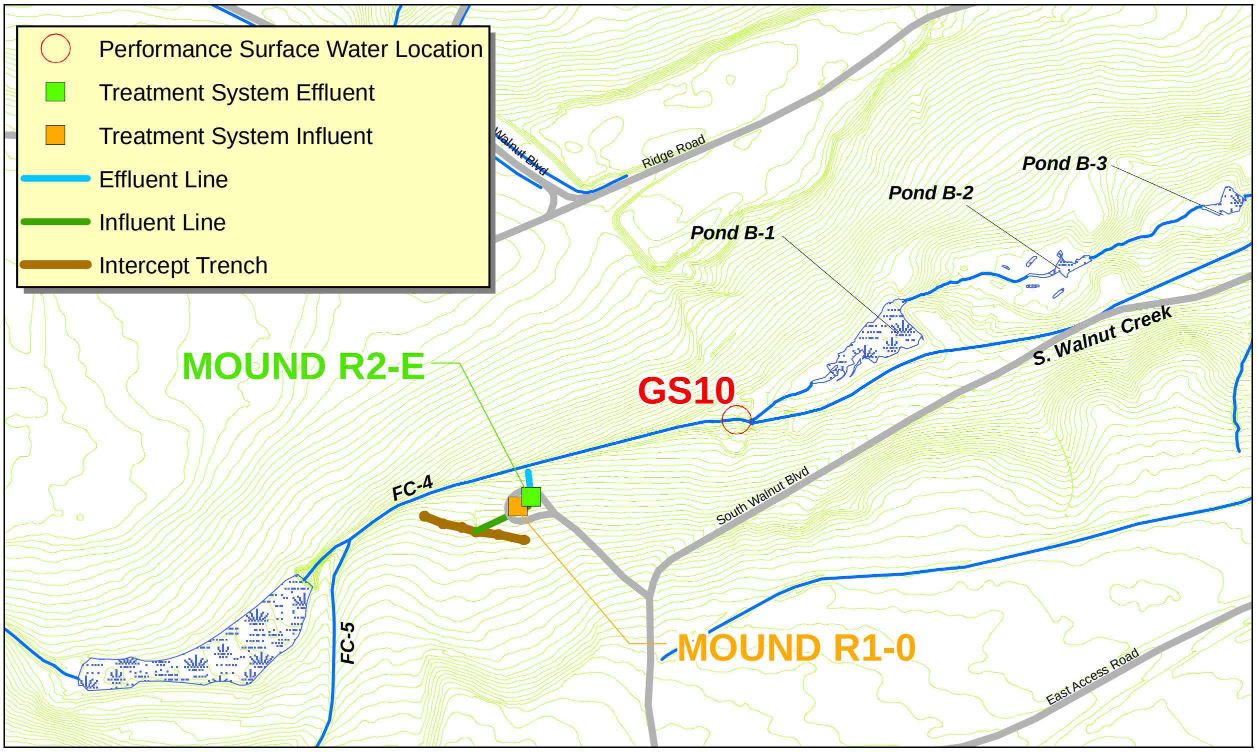
Note that groundwater monitoring wells also support the MSPTS, ETPTS, and SPPTS. (Wells are also present in the vicinity of the PLFTS, but their objectives differ as they directly support the PLF as RCRA wells.) These locations are discussed in the sections that correspond to their respective objectives (i.e., text describing Sentinel and Evaluation wells) and that discuss groundwater plume characteristics.

Mound Site Plume Treatment System

RFMLA monitoring locations specific to the MSPTS are shown on Figure 80. Sampling and data evaluation protocols are summarized in Table 44. In addition to the monitoring locations shown, one well is monitored as a Sentinel well (see related text above), and several piezometers are present within the collection trench. The piezometers are retained for troubleshooting purposes.

Table 44. RFLMA Sampling and Data Evaluation Protocols at MSPTS Monitoring Locations

Location Code	Location Description	Sample Types/Frequencies	Analytes	Data Evaluation
MOUND R1-0	Influent sampling location	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 11 in Appendix D
MOUND R2-E	Effluent sampling location	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 11 in Appendix D
GS10	Downgradient surface-water performance location	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 11 in Appendix D



Note: The intercept trench also captures water from a former 72-inch storm drain utility corridor (not shown) that previously emptied to South Walnut Creek (shown here as FC-4). This corridor runs from south to north, approximately parallel to the dominant trend of FC-5 shown here. It was backfilled and tied into the western portion of the intercept trench during Site closure activities. See the 2006 Annual Report (DOE 2007c) for additional discussion, and subsequent sections of this 2010 report for water quality updates.

Figure 80. RFLMA MSPTS Monitoring Locations

Data Evaluation

All MSPTS locations listed above were scheduled for routine monitoring in the fourth quarter of CY 2011. Results are provided in Appendix B and are discussed in Section 3.1.5.3.

In addition to the RFLMA locations, locations associated with the air stripper (the effluent polishing component housed within the effluent manhole) were sampled in the fourth quarter to continue optimization efforts focusing on this component. This is also discussed in Section 3.1.5.3 and Appendix F.

East Trenches Plume Treatment System

RFMLA monitoring locations specific to the ETPTS are shown on Figure 81. Sampling and data evaluation protocols are summarized in Table 45. In addition to the monitoring locations shown, several monitoring wells are present, and several piezometers are present within the collection trench. Each of the wells is monitored as a Sentinel well (see related text above). The piezometers are retained for troubleshooting purposes.

Table 45. RFLMA Sampling and Data Evaluation Protocols at ETPTS Monitoring Locations

Location Code	Location Description	Sample Types/Frequencies	Analytes	Data Evaluation
ET INFLUENT	Influent sampling location	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 11 in Appendix D
ET EFFLUENT	Effluent sampling location	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 11 in Appendix D
POM2	Downgradient surface-water performance location	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 11 in Appendix D

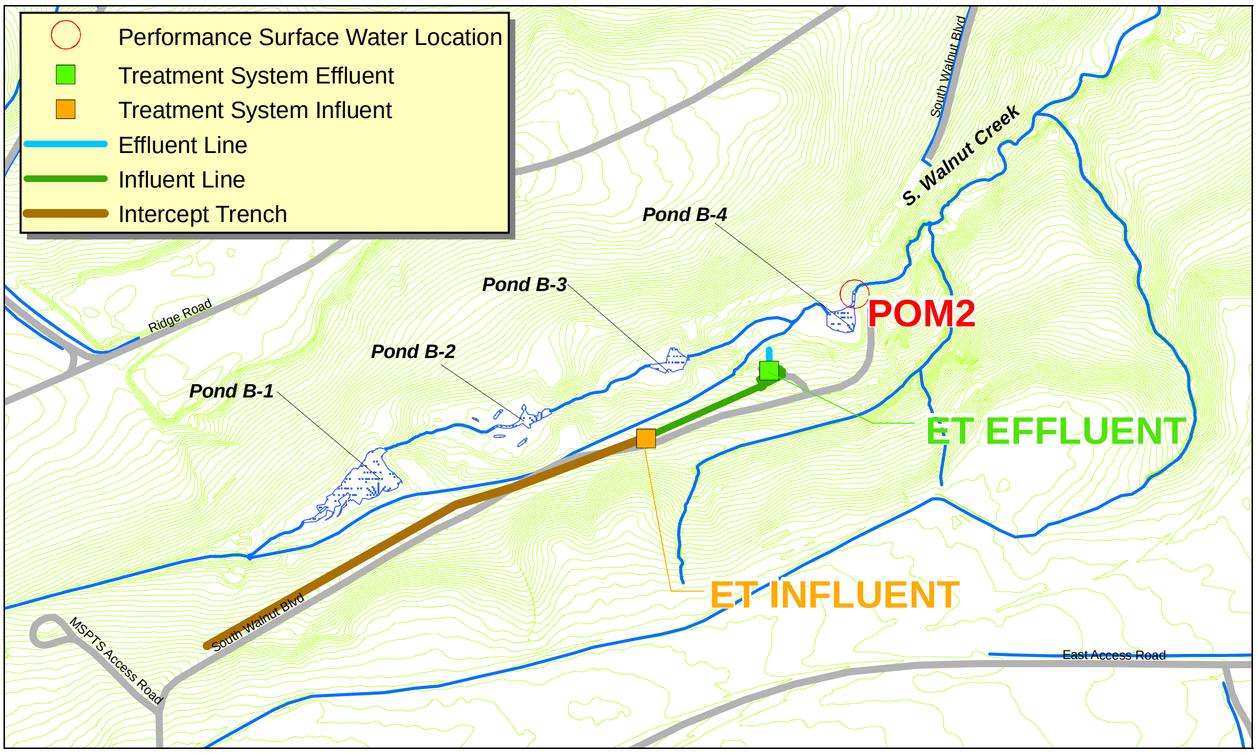


Figure 81. RFLMA ETPTS Monitoring Locations

Data Evaluation

All ETPTS locations listed above were scheduled for routine monitoring in the fourth quarter of CY 2011. Results are provided in Appendix B and are discussed in Section 3.1.5.3. These results included anomalously high effluent concentrations of some VOCs, most notably TCE, which drove collection of a confirmatory sample in November, a month after the initial sample was collected. Concentrations in this later sample remained elevated; in early 2012 flow through the system was reconfigured to series, with upflow through Cell 1 and then downflow through Cell 2. Subsequent samples showed treatment levels had been restored. This topic is discussed further in Section 3.1.5.3.

Solar Ponds Plume Treatment System

RFLMA monitoring locations specific to the SPPTS are presented on Figure 82. Sampling and data evaluation protocols are summarized in Table 46. In addition to the monitoring locations shown, several monitoring wells are present, and several piezometers are present within the collection trench. The wells are monitored as either Sentinel wells or Evaluation wells (see related text above). The piezometers are retained for troubleshooting purposes.

Table 46. RFLMA Sampling and Data Evaluation Protocols at SPPTS Monitoring Locations

Location Code	Location Description	Sample Types/Frequencies	Analytes	Data Evaluation
SPIN	Influent sampling location	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	U, nitrate	See Figure 11 in Appendix D
SPOUT[a]	Effluent sampling location	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	U, nitrate	See Figure 11 in Appendix D
GS13[b]	Downgradient surface-water performance location	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	U, nitrate	See Figure 11 in Appendix D

Notes: [a] The effluent monitoring location was changed from SPPMM01 to SPOUT in 2008, as described in Contact Record 2008-09, following several rounds of sampling that showed water quality at the two locations to be equivalent.
[b] Samples collected for U at GS13 are typically flow-paced and unfiltered. U data at GS13 support other monitoring objectives that are not addressed here.
Nitrate is analyzed as nitrate+nitrite as nitrogen; this result is conservatively compared to the nitrate standard only.

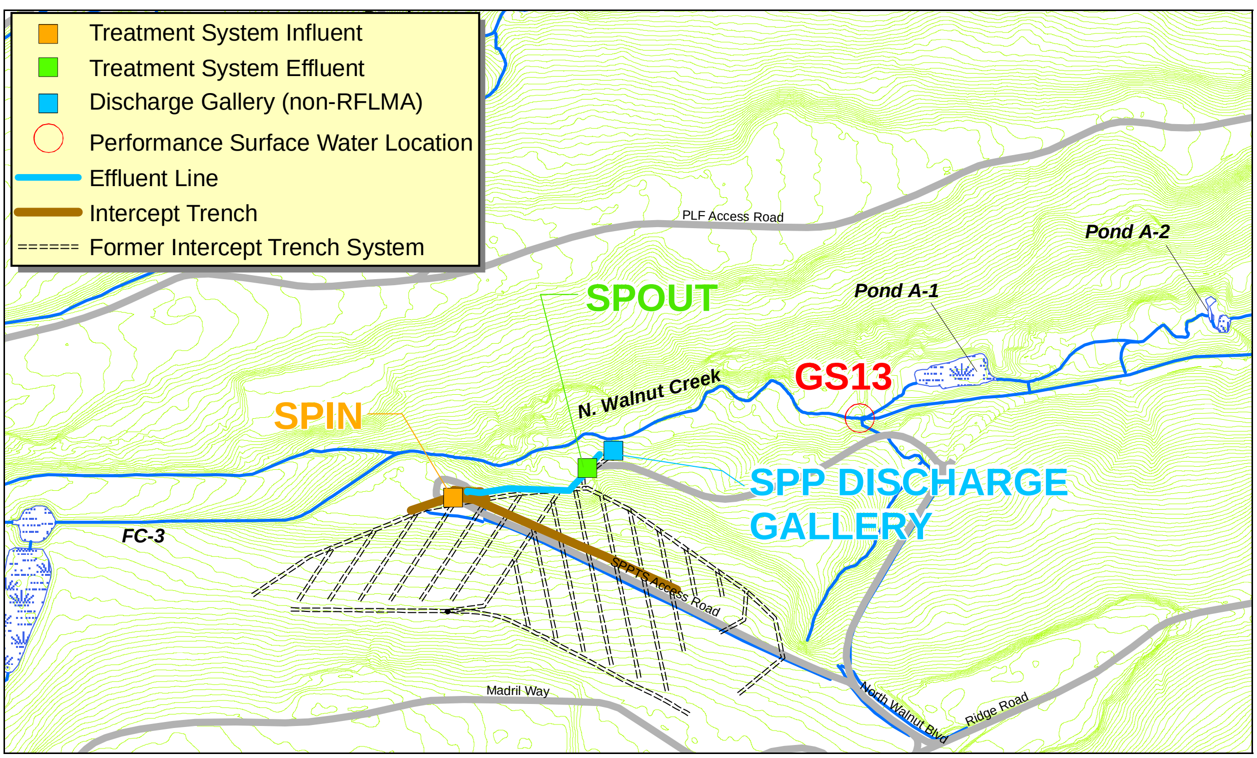


Figure 82. RFLMA SPPTS Monitoring Locations

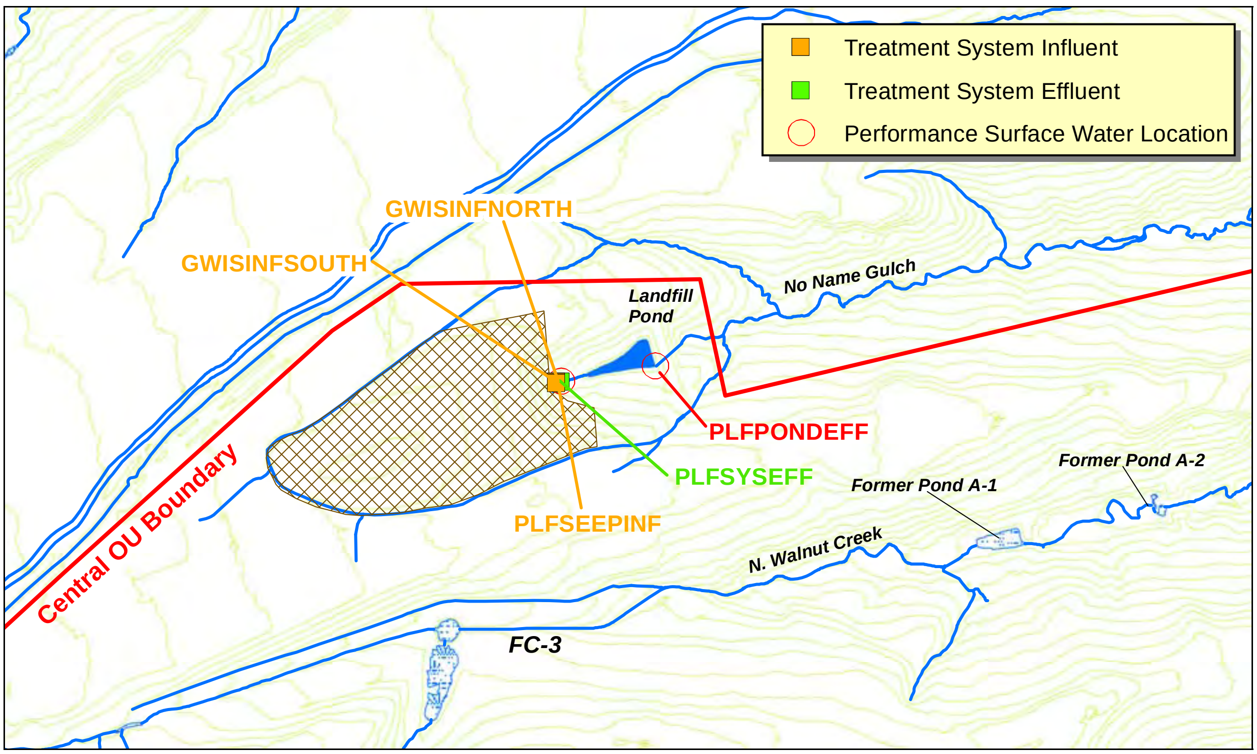
Data Evaluation

All SPPTS locations listed above were scheduled for routine monitoring in the fourth quarter of CY 2011. Results are included in Appendix B; see Section 3.1.5.3 for discussion.

In addition to the RFLMA locations, in the fourth quarter the Solar Ponds Plume (SPP) Discharge Gallery was sampled according to the RFSOG, and extra samples were collected from SPOUT to support system operation, optimization, and performance (see Section 3.1.5.3) as well as the ongoing AMP requirements.

PLF Treatment System

Water monitoring locations for the PLF are shown on Figure 83. The general groundwater monitoring requirements deal specifically with the RCRA wells and are discussed in detail in Section 3.1.2.8. Details regarding surface-water and treatment system monitoring are provided below.



Note: PLFSYSEFF serves as both the treatment system effluent monitoring location and a performance surface-water monitoring location.

Figure 83. PLFTS Monitoring Locations

As part of PLF closure, a passive seep interception and treatment system was installed to treat landfill seep water and GWIS water. There are three sources of influent to the treatment system: two GWIS pipes and the PLF seep. Effluent for the treatment system eventually flows to the Present Landfill Pond. This section presents the monitoring data for the treatment system effluent as well as the Landfill Pond if the treatment system effluent exceeds surface-water standards. Details regarding PLFTS monitoring can be found in the PLF M&M Plan.

Monitoring locations for the PLFTS are shown on Figure 83. Sampling and data evaluation protocols are summarized in Table 47. As of December 21, 2007, collection of samples at the GWIS locations (GWISINFNORTH and GWISINFSOUTH) has been discontinued. This action has been taken subsequent to the consultative process in accordance with the Groundwater Treatment Systems flowchart (Appendix D) and documented in Contact Record 2007-08.

Table 47. Sampling and Data Evaluation Protocols at PLFTS Monitoring Locations

Location Code	Location Description	Sample Types/ Frequencies	Analytes	Data Evaluation
GWISINFNORTH	Northern GWIS influent to the treatment system	Discontinued	VOCs, total U, total and dissolved metals, nitrate[a]	See Figure 11 in Appendix D
GWISINFSOUTH	Southern GWIS influent to the treatment system	Discontinued	VOCs, total U, total and dissolved metals, nitrate[a]	See Figure 11 in Appendix D
PLFSEEPINF	Landfill seep influent to the treatment system	Quarterly grabs	VOCs, total U, total and dissolved metals	See Figure 11 in Appendix D
PLFSYSEFF	Effluent from the treatment system	Quarterly grabs	VOCs, total U, total and dissolved metals, SVOCs	See Figure 11 in Appendix D
PLFPONDEFF	Landfill Pond at the downstream (east) end	As needed; triggered by data evaluation	As needed; determined by decision rule	See Figure 11 in Appendix D

Notes: [a] Nitrate is analyzed as nitrate+nitrite as nitrogen.
GWISINFNORTH and GWISINFSOUTH may still be periodically sampled for investigative purposes only.

Data Evaluation

Analytical results for the treatment system effluent (PLFSYSEFF) are compared to the appropriate surface-water standards listed in Table 1 of RFLMA Attachment 2. During CY 2011, there were two analytes detected above the applicable standards:

- Arsenic was measured at 23.5 µg/L in routine quarterly grab sample collected on July 26, 2011. The RFLMA Table 1 standard is 10 µg/L. This result triggered increased sampling frequency (monthly). However, for the next grab sample collected on August 24, 2011, arsenic was not detected
- Selenium was not detected in the July 26, 2011, routine quarterly grab sample but was detected at 6.9 µg/L in the duplicate. The normal protocol is to average the ‘real’ result with the ‘duplicate’ result. In this case the average is 4.675 µg/L (average of 4.9/2 µg/L [half the detection limit] and 6.9 µg/L). The RFLMA Table 1 standard is 4.6 µg/L. This result triggered increased sampling frequency (monthly). However, for the next grab sample collected on August 24, 2011, selenium was not detected
- Arsenic was measured at 24.0 µg/L in routine quarterly grab sample collected on October 19, 2011. The RFLMA Table 1 standard is 10 µg/L. This result triggered increased sampling frequency (monthly). The next sample collected on November 16, 2011, was above the standard at 16 µg/L; increased sampling was therefore continued. However, for the next grab sample collected on December 21, 2011, arsenic was not detected

3.1.2.11 Predischarge Monitoring

This monitoring objective deals with predischarge sampling of Ponds A-4, B-5, and C-2, or any other upstream pond functioning as a terminal pond, as a BMP to suggest compliance with surface-water-quality standards (see Table 1 of RFLMA Attachment 2) at the downstream POCs. Predischarge samples are collected at Ponds A-4, B-5, and C-2 on North Walnut Creek, South Walnut Creek, and Woman Creek, respectively. These locations are shown on Figure 84. Sampling and data evaluation protocols are summarized in Table 48.

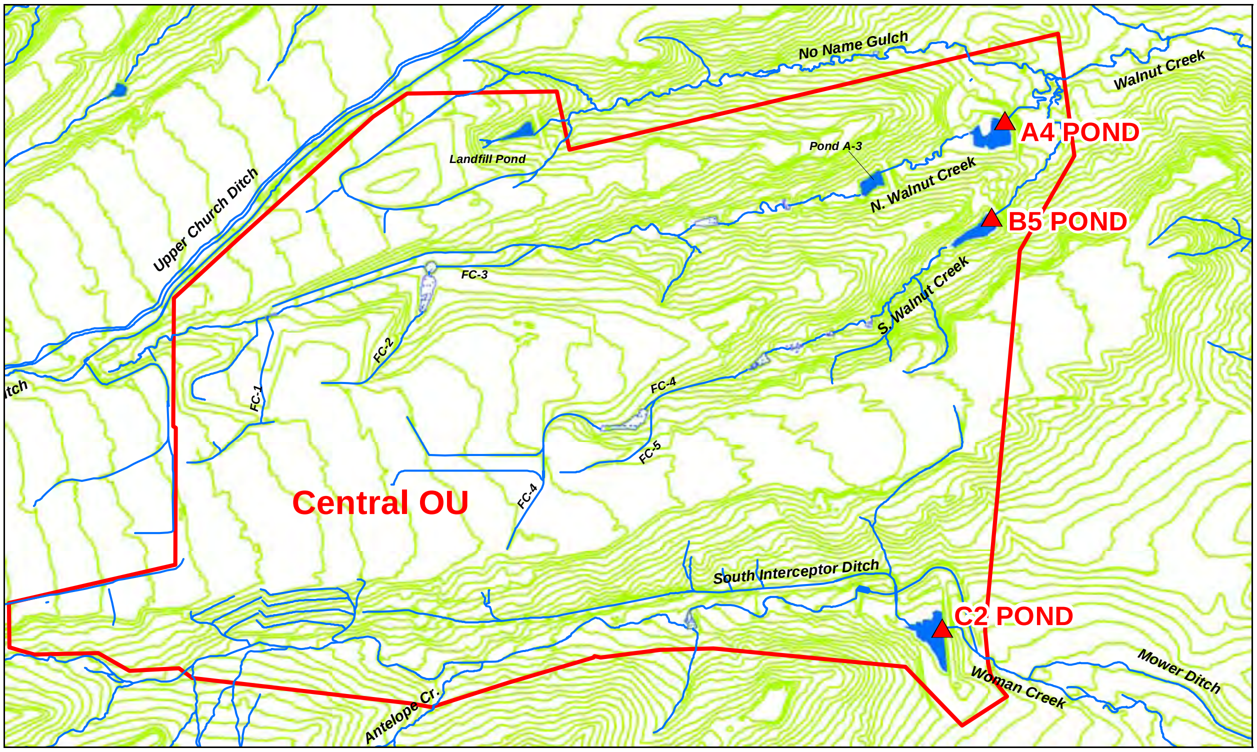


Figure 84. Predischarge Sampling Locations

Table 48. Sampling and Data Evaluation Protocols at Predischarge Monitoring Locations

Location Code	Location Description	Sample Types/ Frequencies	Analytes	Data Evaluation
A4 POND	Pond A-4 at east end of pond near outlet works	Prior to opening outlet valve	Pu, Am, total U, nitrate[a]	Review with regulators prior to initiating discharge
B5 POND	Pond B-5 at east end of pond near outlet works	Prior to opening outlet valve	Pu, Am, total U, nitrate[a]	Review with regulators prior to initiating discharge
C2 POND	Pond C-2 at east end of pond near outlet works	Prior to opening outlet valve	Pu, Am, total U	Review with regulators prior to initiating discharge

Notes: [a] Nitrate is analyzed as nitrate+nitrite as nitrogen; the nitrate+nitrite result is conservatively compared to the nitrate standard only.

Data Evaluation

During CY 2011, predischarge samples were collected during at Ponds A-4, B-5, and C-2 prior to opening the outlet valve to initiate discharge. All predischarge sample results indicated that water quality was acceptable for discharge. Subsequent POC sampling during discharge also indicated acceptable water quality for the discharged water.

3.1.3 Rocky Flats Hydrology

The following section provides information for all automated surface-water monitoring and precipitation gage locations at the Site that operated during CY 2011. For locations with continuous flow measurement, graphical discharge summaries are provided. Graphical summaries are also provided for all precipitation gage locations. Numerical discharge and precipitation values are included in the tables in Appendix A.

Groundwater hydrology is also addressed. This includes a discussion of groundwater levels in various areas of interest via the preparation of hydrographs and potentiometric surface maps. Flow velocities are also calculated. Hydrographs for monitoring wells are included in Appendix A.

3.1.3.1 General Hydrologic Setting

Streams and seeps at the Site are largely ephemeral, with stream reaches gaining or losing flow, depending on the season and precipitation amounts. Section 3.1.3.6 discusses the 2011 efforts to document observed seeps at the site. Surface-water flow across the Site is primarily from west to east, with three major drainages traversing the Site. In 2011, five ponds within the COU collected and managed surface-water runoff.[7] The Site drainages and ponds, including their respective pertinence to this report, are described below and shown on Figure 85.

The major stream drainages leading out of the Refuge, from north to south, are Rock Creek, Walnut Creek, and Woman Creek. North Walnut Creek flows through the A-3 and A-4 Ponds, and South Walnut Creek flows through the B-5 Pond; both are tributaries to Walnut Creek. The hydrologic routing diagram (as of December 31, 2011) for the locations included in this report is shown on Figure 86.

The groundwater hydrology is generally characterized by relatively thin, shallow, saturated materials (in the COU, typically on the order of a few dozen feet thick or less, and less than 50 feet deep). This shallow saturated interval occurs within the unconsolidated Rocky Flats Alluvium, hillslope colluvium, valley-fill alluvium, artificial fill, and the weathered portion of the underlying bedrock. Collectively, these materials are referred to as the upper hydrostratigraphic unit (UHSU). Regionally, groundwater flows from west to east within the UHSU of the pediment surfaces, except where locally diverted toward the generally east-west trending drainages that bisect these pediments. Groundwater typically discharges at seeps and

[7] Former Dams A-1, A-2, B-1, B-2, B-3, and B-4 were breached during 2008−2009.