unvalidated result, partially validated result, validated result, and result of reanalysis. (Note that these last four result types are most common in pre-closure data.) Before trends were calculated, for each well where this applied, these multiple results were winnowed to a single result representing each unique date. Factors evaluated in selecting the result for statistical use included the following:

- Filtration status
- Validation qualifiers
- Lab qualifiers
- Other U results from the well

Because groundwater samples for U analysis for many years have been field-filtered, where both sample results are provided, the filtered result is typically preferred for reasons of consistency. Similarly, where two very different results are presented, the value closer to other values from the same well is retained; if the two results are similar, the higher-concentration result is retained, to be conservative.

Data from original wells are grouped with those from replacement wells to form a data set on which the statistics are based. As additional data are collected from replacement wells (most of which were installed in 2005), this may prove to be inappropriate. The data populations from original and replacement wells may be discontinuous, suggesting that data from the original wells should be removed from statistical assessments of more recent groundwater data. This determination will be made as the post-closure data set becomes large enough to allow such an evaluation. Therefore, it should be stressed that trends for some locations may be misleading in that they might 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 evaluation parameters are greater than the corresponding Table 1 values (see Appendix D). Surface water at the eastern COU is monitored at WALPOC on Walnut Creek and WOMPOC on Woman Creek. During 2013, Walnut Creek was also monitored downstream at Indiana Street by POC GS03 through September 27, 2013. Similarly, Woman Creek was also monitored downstream at Indiana Street by POC GS01 through September 8, 2013. These locations are shown on Figure 7. Sampling and data evaluation protocols are summarized in Table 4.

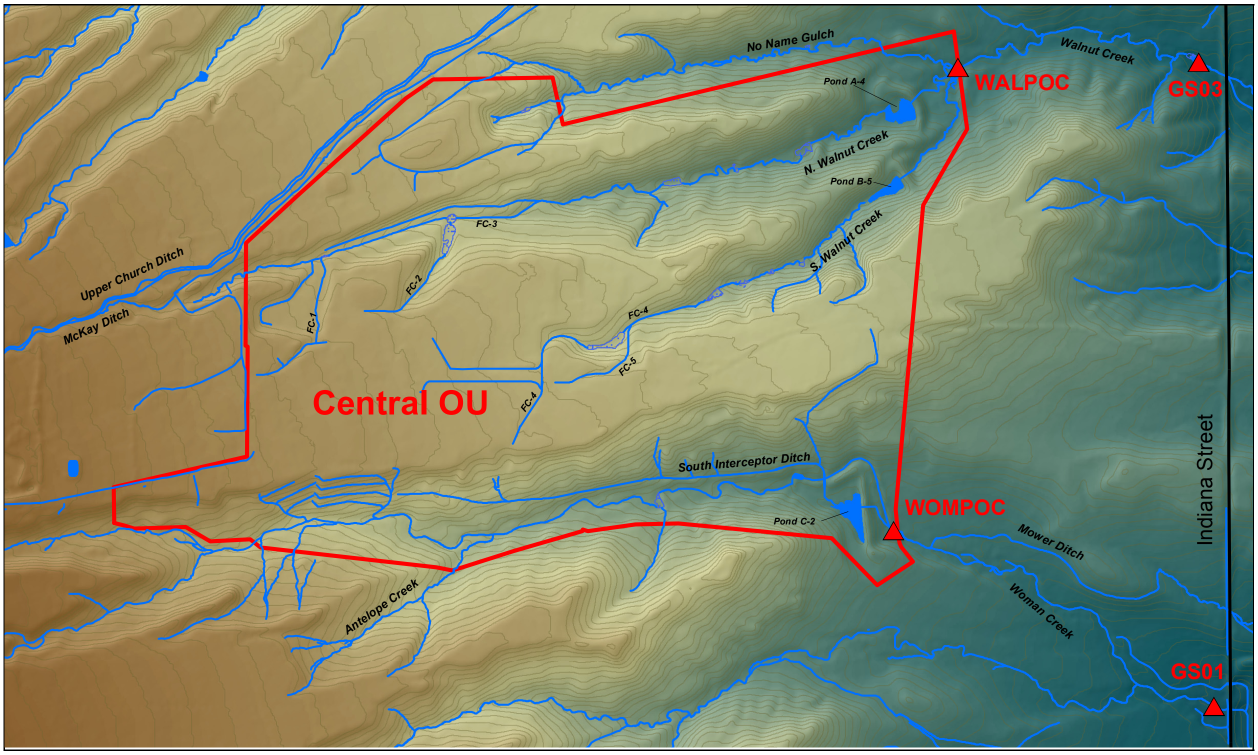

Figure 7. POC Monitoring Locations

Table 4. Sampling and Data Evaluation Protocols at POCs

Location Code	Location Description	Sample Types/Frequencies	Analytes	Data Evaluation
GS01[a]	Woman Creek at Indiana Street	Continuous flow-paced composites; frequency varies (target is 20–30 per year)	total Pu, Am, and U [TSS[b]]	See Figure 5 in Appendix D
GS03[a]	Walnut Creek at Indiana Street	Continuous flow-paced composites; frequency varies (target is 20–30 per year)	total Pu, Am, U, and nitrate[c] [TSS[b]]	See Figure 5 in Appendix D
WOMPOC	Woman Creek at Eastern COU Boundary	Continuous flow-paced composites; frequency varies (target is 20–30 per year)	total Pu, Am, and U [TSS[b]]	See Figure 5 in Appendix D
WALPOC	Walnut Creek at Eastern COU Boundary	Continuous flow-paced composites; frequency varies (target is 20–30 per year)	total Pu, Am, U, and nitrate[c] [TSS[b]]	See Figure 5 in Appendix D

Notes:
[a] GS01 and GS03 were POCs through September 8 and 27, 2013, respectively.
[b] Total suspended solids (TSS) is analyzed when the composite sampling period is within TSS holding-time limits.
[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 as soon as flow is available nitrate is analyzed as nitrate+nitrite as nitrogen; this result is conservatively compared to the nitrate standard only.

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.[3]

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 7). The Woman Creek headwaters, the southern portion of the COU, Pond C-2, and the southern portion of the Refuge contribute flow to GS01. As of September 9, 2013, GS01 is no longer a RFLMA POC.

Although GS01 was no longer a POC during the extremely high flows in September 2013, Table 5 shows automated composite sampling information collected during September 2013. Although telemetry indicated that the sampler was collecting samples up until 7:43 a.m. on September 12, sometime soon after that time the equipment shelter was overturned after being hit by a large tree. When the equipment was repaired a few days later, the composite bottle had only a small amount of water with significant quantities of mud. Obviously, analysis of this material cannot be considered representative of creek flows.

Table 5. September 2013 Composite Sampling Detail for POC GS03

Sampling Period	Number of Grabs	Sample Results			Flow Volume (MG)	Flow Rates (cfs)	Comments
		Am-241 (pCi/L)	Pu-239, 240 (pCi/L)	Uranium (µg/L)			
6/6/2013 9:59–9/12/2013 7:43	154 (est)	unusable data	unusable data	unusable data	33.2 (est)	0.0–349 (est)	Sampler overturned at ~9/12/2013 7:43
9/12/2013 7:43–9/17/2013 15:29	NSQ	NA	NA	NA	205.7 (est)	1.9–794 (est)	Sampler was non-functional
9/17/2013 15:29–10/2/2013 13:42	16	0.004	0.010	2.3	12.2	0.1–11.1	

Abbreviations:
est = estimated
µg/L = micrograms per liter
MG = million gallons
NA = not analyzed
NSQ = nonsufficient quantity for analysis
pCi/L = picocuries per liter

Table 6 shows that all of the annual average Pu and Am activities were well below the RFLMA standard of 0.15 picocurie per liter (pCi/L). Additionally, the long-term Pu and Am averages

[3] 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 the RFSOG for discussion).

(1997–2013) are well below 0.15 pCi/L. The annual 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 1997–2013

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
2012	0.003	0.002	5.89
2013[a]	0.003	0.005	2.83
Total (1997–2013)*	0.004	0.006	2.57

Notes: Collection of total U data began on February 3, 2003.
[a] Values use data through 9/8/2013

Abbreviations:
NA = not applicable.

Figure 8 and Figure 9 show no occurrences of reportable 30-day averages for the year through September 8, 2013.

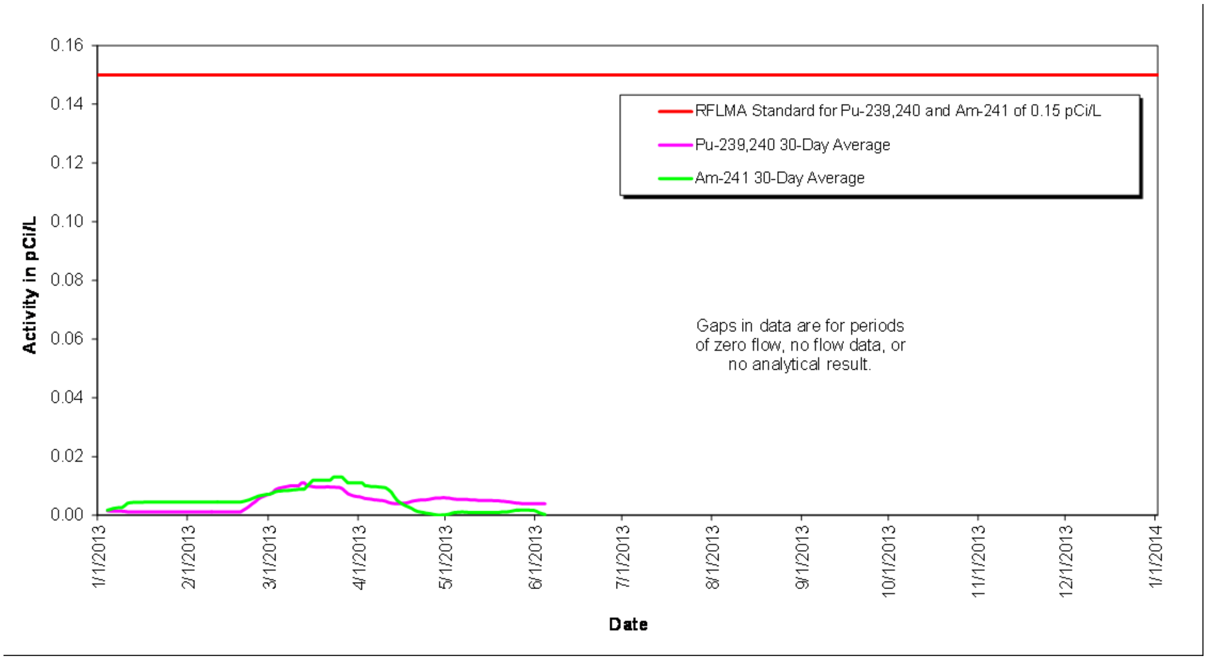

Figure 8. Volume-Weighted 30-Day Average Pu and Am Activities at GS01: CY 2013 Through September 8, 2013

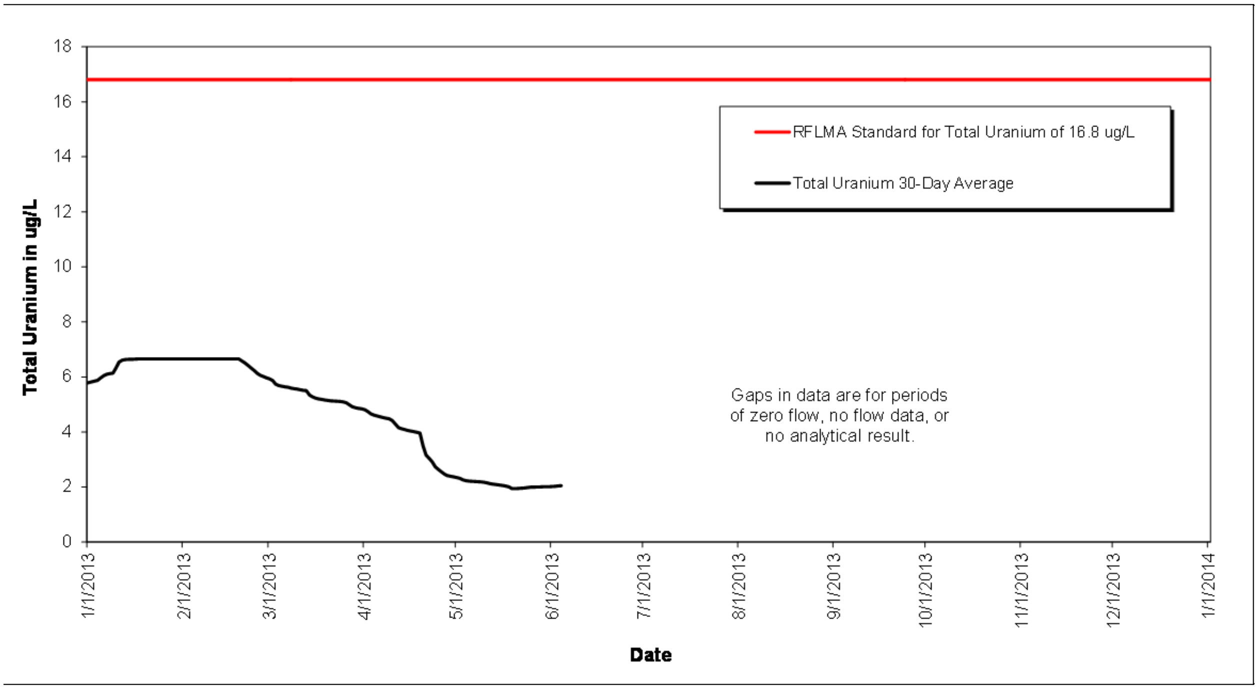

Figure 9. Volume-Weighted 30-Day Average Total U Concentrations at GS01: CY 2013 Through September 8, 2013

Figure 10 and Figure 11 show similar data for the entire post-closure period through September 8, 2013.

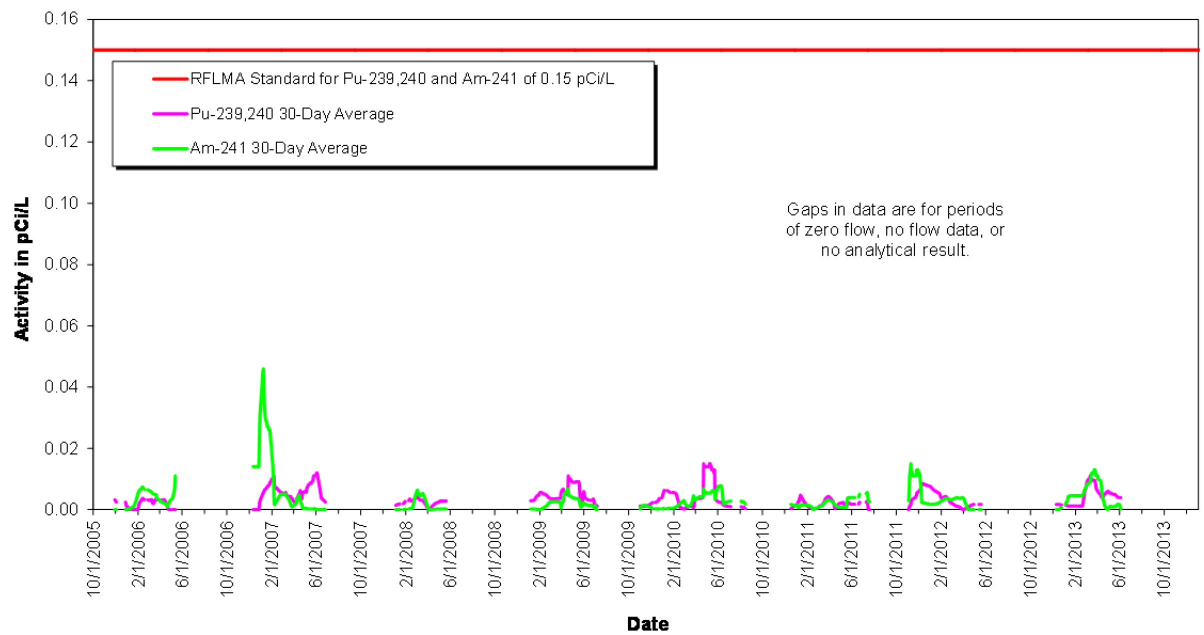

Figure 10. Volume-Weighted 30-Day Average Pu and Am Activities at GS01: Post-Closure Period Through September 8, 2013

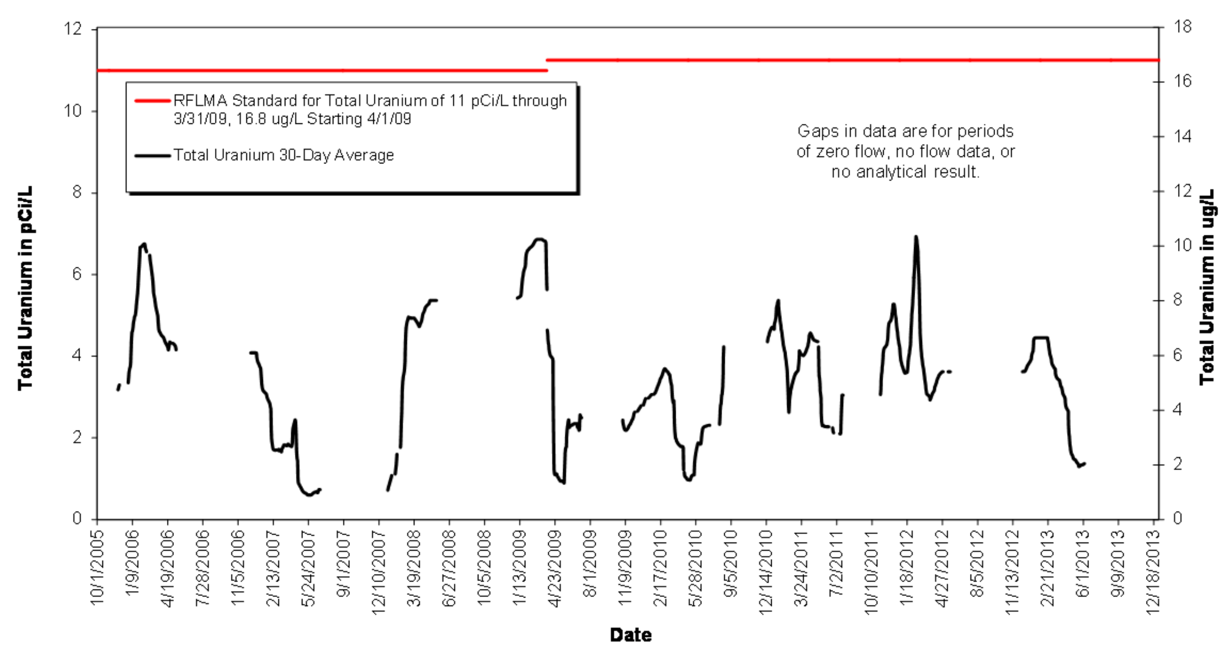

Figure 11. Volume-Weighted 30-Day Average Total U Concentrations at GS01: Post-Closure Period Through September 8, 2013

Location GS03

Monitoring location GS03 is on Walnut Creek at Indiana Street (Figure 7). The Walnut Creek headwaters, the majority of the COU, Pond A-4, Pond B-5, and the northeastern portion of the Refuge contribute flow to GS03. As of September 28, 2013, GS03 is no longer a RFLMA POC.

Table 7 shows automated composite sampling information collected during September 2013. Flow rates could not be accurately estimated for the period 9/12/2013 14:36 through 9/14/2013 09:50. Therefore, no discharge volumes are available and, in accordance with routine evaluation protocols, this period is not included in the calculation of 12-month rolling and 30-day averages.

Table 7. September 2013 Composite Sampling Detail for POC GS03

Sampling Period	Number of Grabs	Sample Results			Flow Volume (MG)	Flow Rates (cfs)	Comments
		Am-241 (pCi/L)	Pu-239, 240 (pCi/L)	Uranium (µg/L)			
6/25/2013 12:07–9/12/2013 14:36	249	0.016	0.036	8.90	NA	NA	Sampler was full on 9/12/2013 from 7:28 to 14:36
9/12/2013 14:36–9/14/2013 9:50	251	0.032	0.042	2.15	NA	NA	Sampler was full on 9/14/2013 from 6:43 to 9:50
9/14/2013 9:50–10/2/2013 14:37	52	0.011	0.017	2.91	50.2	0.2–68.4	

Abbreviations:
MG = million gallons
NA = not analyzed

Table 8 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 (1997–2013) are well below 0.15 pCi/L. The annual average total U and nitrate+nitrite as nitrogen (N) concentrations are also all below the RFLMA standard of 16.8 µg/L and 10 milligrams per liter (mg/L), respectively.

Table 8. Annual Volume-Weighted Average Radionuclide Activities and Nitrate+Nitrite as Nitrogen Concentrations at GS03 for 1997–2013[a]

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[b]	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
2012	0.001	0.004	12.5	3.62
2013[c]	0.013	0.018	4.18	2.55
Total[c] (1997–2013)[c]	0.009	0.012	4.09	1.59

Notes:
[a] For pond discharge periods only; nitrate+nitrite as nitrogen sampling began on October 13, 2005.
[b] Collection of total U data began on November 5, 2002.
[c] Values use data through September 27, 2013

Abbreviations:
NA = not applicable.

Figure 12, Figure 13, and Figure 14 show no occurrences of reportable 30-day averages for the year through September 27, 2013.

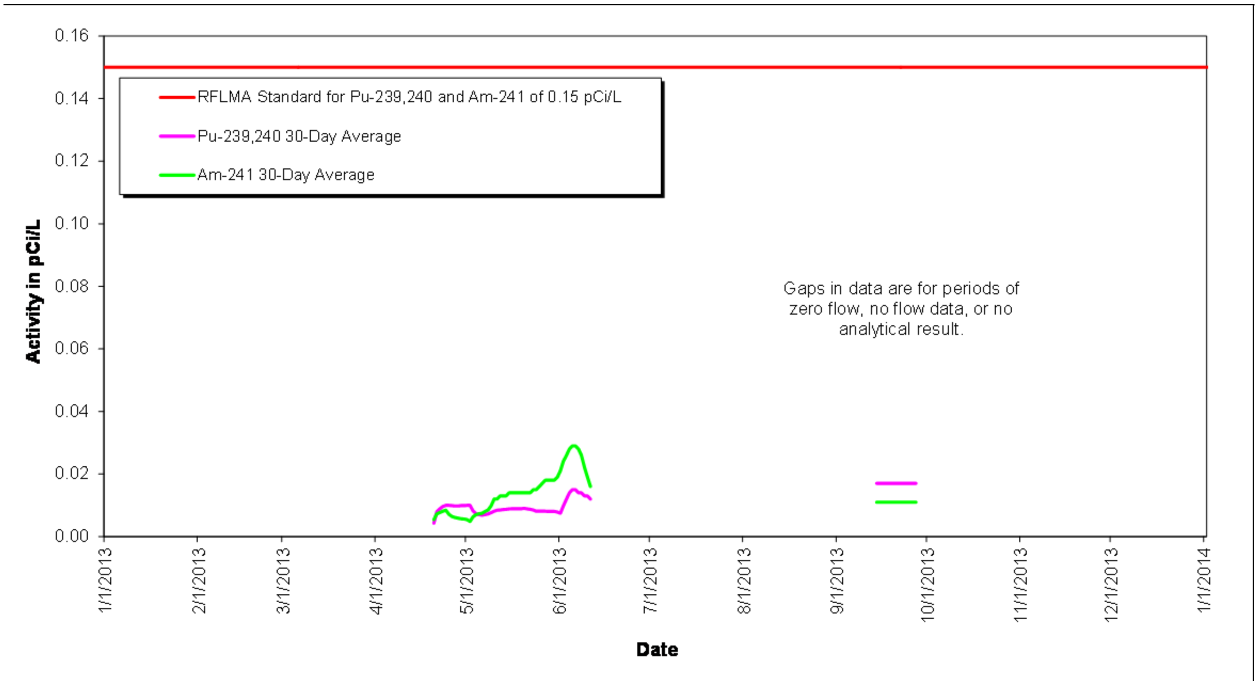

Figure 12. Volume-Weighted 30-Day Average Pu and Am Activities at GS03: CY 2013 Through September 27, 2013

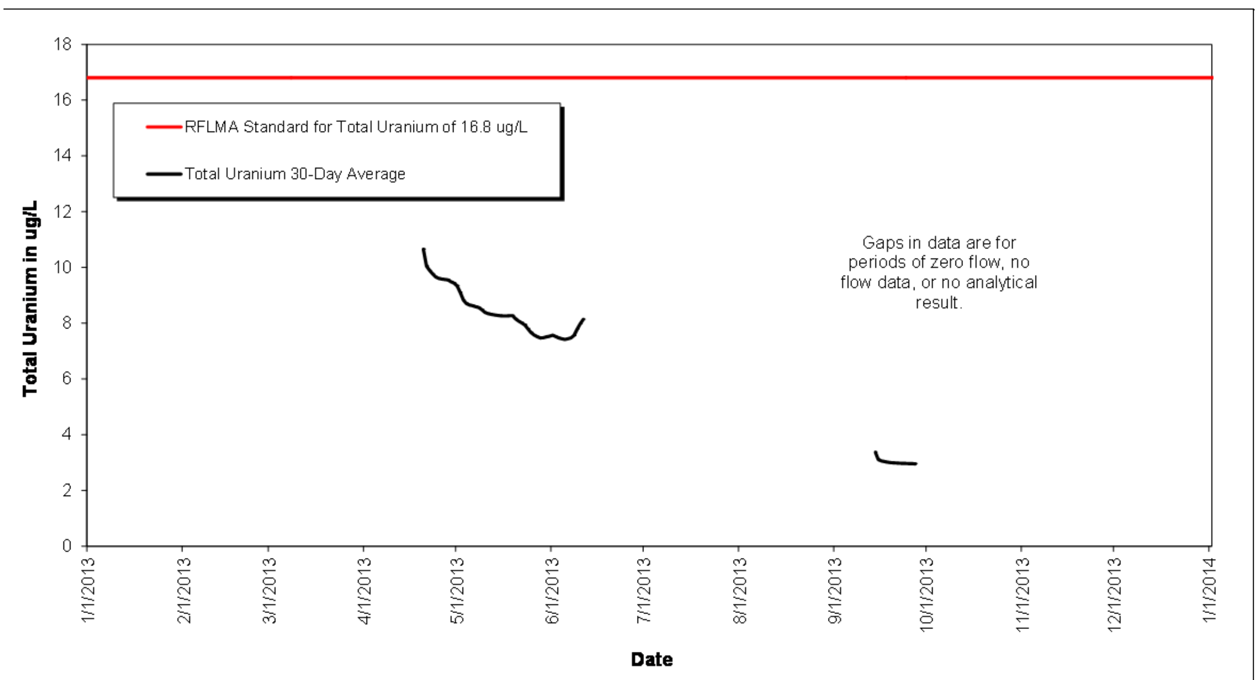

Figure 13. Volume-Weighted 30-Day Average Total U Concentrations at GS03: CY 2013 Through September 27, 2013

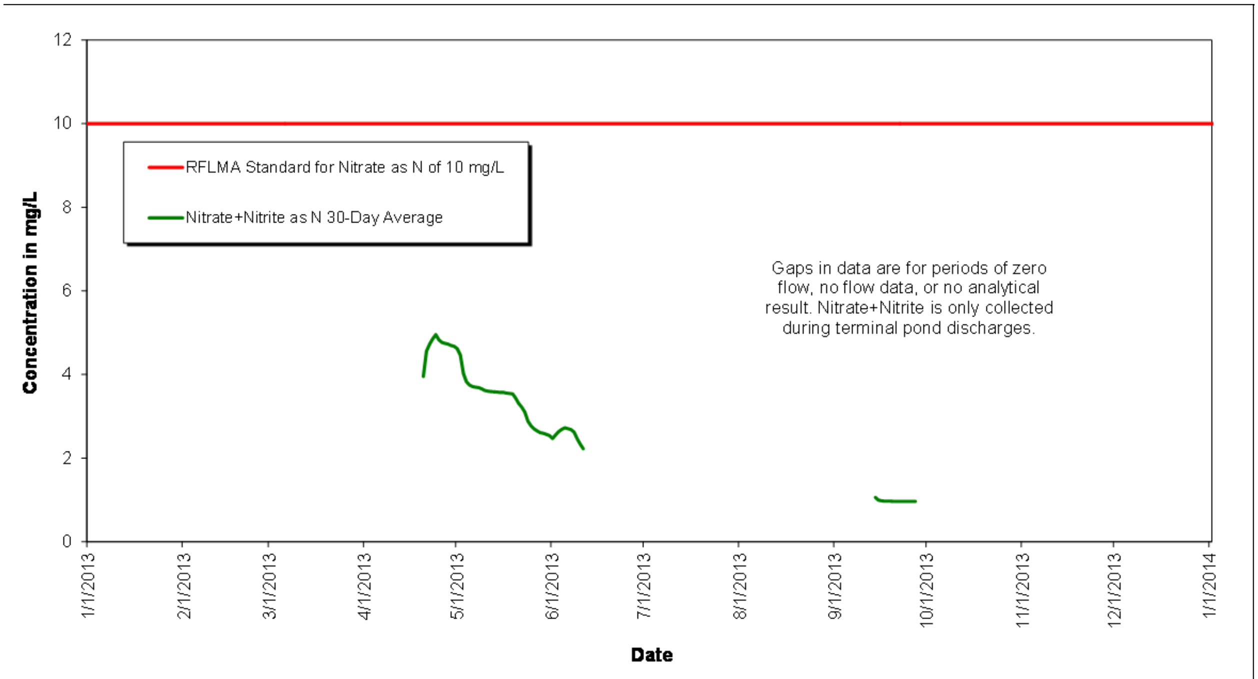

Figure 14. Volume-Weighted 30-Day Average Nitrate+Nitrite as N Concentrations at GS03: CY 2013 Through September 27, 2013

Figure 15, Figure 16, and Figure 17 show similar data for the entire post-closure period through September 27, 2013.

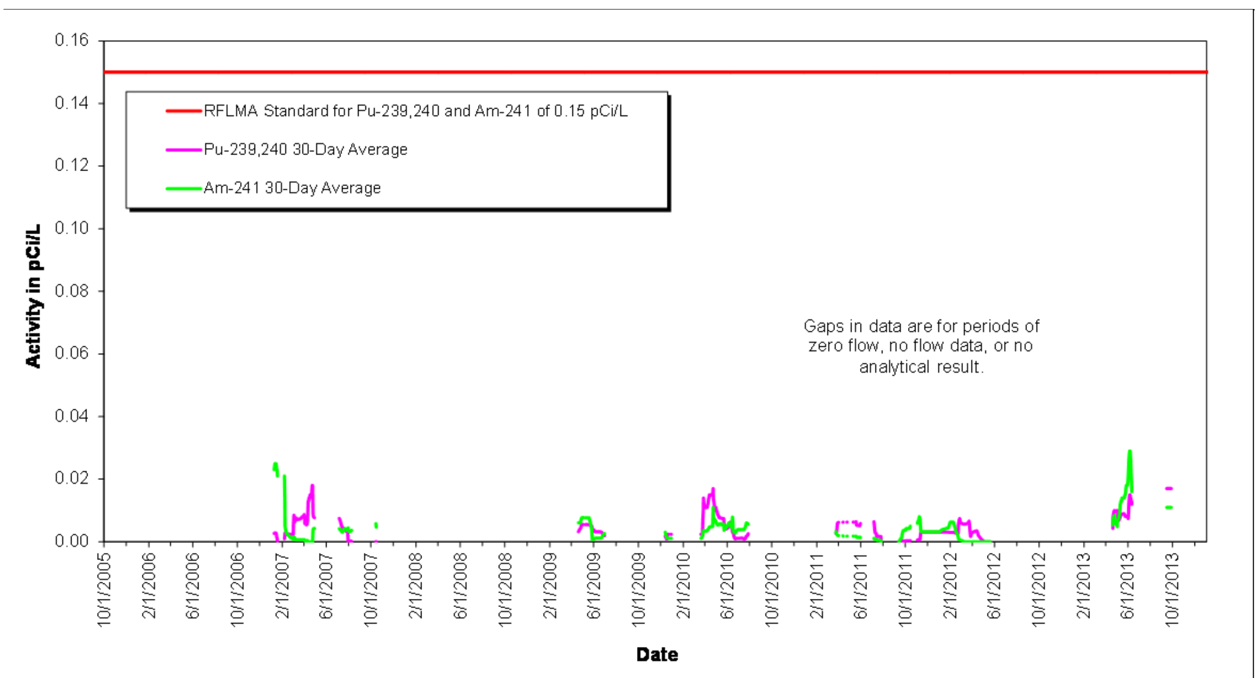

Figure 15. Volume-Weighted 30-Day Average Pu and Am Activities at GS03: Post-Closure Period Through September 27, 2013

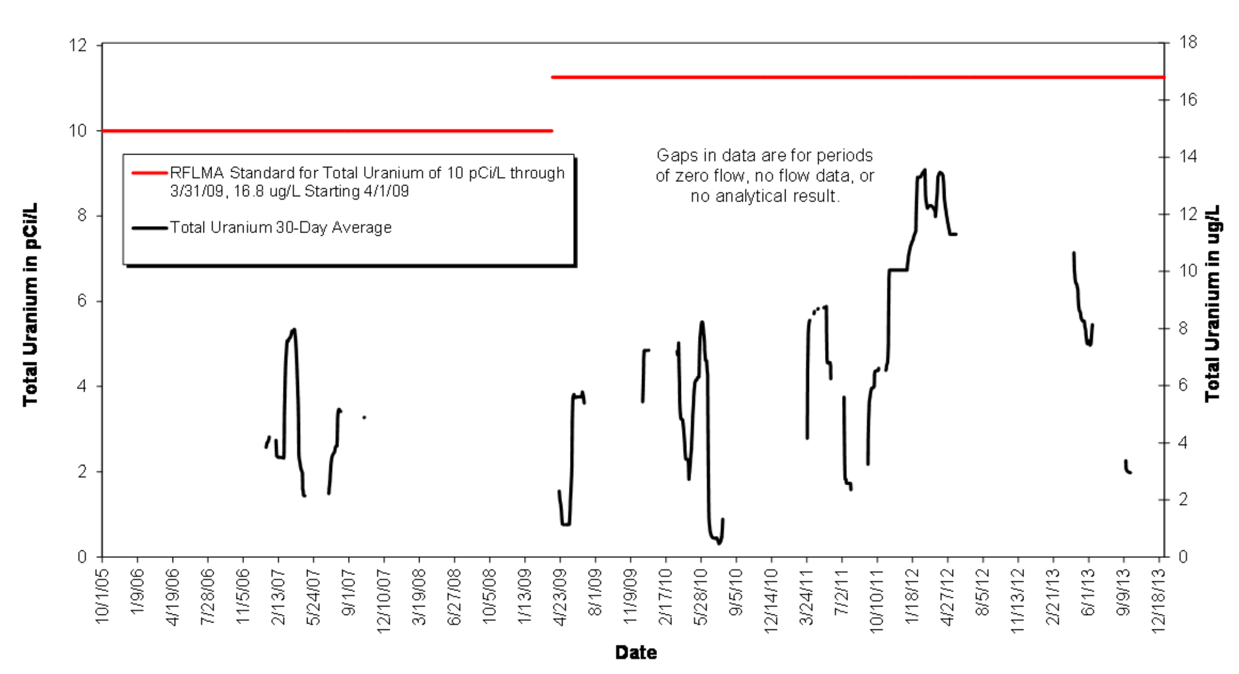

Figure 16. Volume-Weighted 30-Day Average Total U Concentrations at GS03: Post Closure-Period Through September 27, 2013

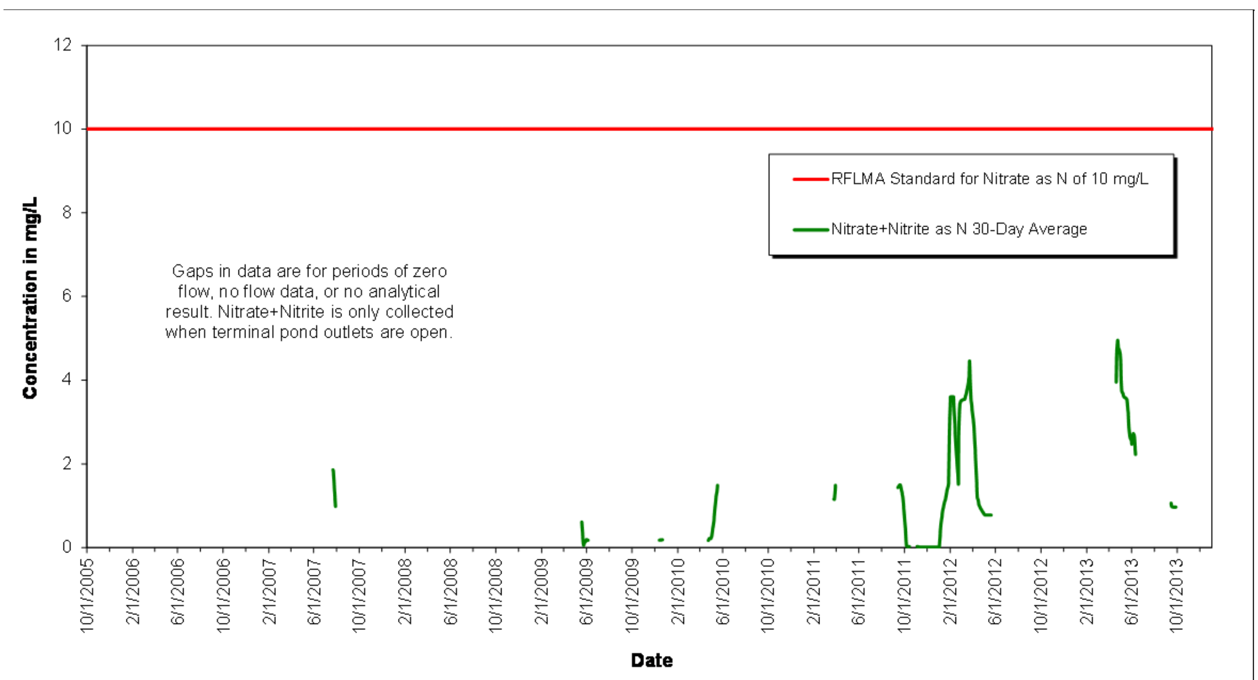

Figure 17. Volume-Weighted 30-Day Average Nitrate+Nitrite as N Concentrations at GS03: Post-Closure Period Through September 27, 2013

Location WOMPOC

Monitoring location WOMPOC is located on Woman Creek at the eastern COU boundary (Figure 7). The Woman Creek headwaters, the southern portion of the COU, and Pond C-2 contribute flow to WOMPOC. WOMPOC began operating as a POC on September 28, 2011.

Table 9 shows automated composite sampling information collected during September 2013. It should be noted that the sampler was full and did not collect any water for the period 9/12/2013 14:13 to 9/13/2013 12:23. For the period 9/23/2013 13:37 to 9/28/2013 9:24, the sampler pacing was too large for the actual flows and only two grab samples were collected. These two grabs were discarded and a more appropriate pace was selected on September 28, 2013. Therefore, no analytical results are available for these two periods and, in accordance with routine evaluation protocols, these periods are not included in the calculation of 12-month rolling and 30-day averages.

Table 9. September 2013 Composite Sampling Detail for POC WOMPOC

Sampling Period	Number of Grabs	Sample Results			Flow Volume (MG)	Flow Rates (cfs)	Comments
		Am-241 (pCi/L)	Pu-239, 240 (pCi/L)	Uranium (µg/L)			
6/6/2013 10:20–9/12/2013 14:13	250	0.007	0.038	7.11	48.5 (est)	0.0–682 (est)	Sampler filled 9/12/2013 14:13
9/12/2013 14:13–9/13/2013 12:23	0 NSQ	NA	NA	NA	74.8 (est)	24.4–414 (est)	
9/13/2013 12:23–9/14/2013 10:50	127	0.005	0.009	1.14	6.44 (est)	3.3–29.8 (est)	Sampler was full on 9/14/2013 from 8:05 to 10:50
9/14/2013 10:50–9/19/2013 11:39	58	0.004	0.023	1.44	16.1 (est)	0.7–33.7 (est)	
9/19/2013 11:39–9/23/2013 13:37	85	0.0	0.002	2.35	1.65 (est)	0.3–4.2 (est)	
9/23/2013 13:37–9/28/2013 9:24	2 NSQ	NA	NA	NA	1.48 (est)	0.2–1.7 (est)	Only two grabs collected and discarded.
9/28/2013 9:24–10/7/2013 14:43	76	0.001	0.002	2.89	3.05	0.2–2.4	

Abbreviations:
est = estimated
MG = million gallons
NA = not analyzed
NSQ = nonsufficient quantity for analysis

Table 10 shows annual average Pu and Am activities all well below the RFLMA standard of 0.15 pCi/L. The annual average total U concentrations are also well below the RFLMA standard of 16.8 µg/L.

Table 10. Annual Volume-Weighted Average Radionuclide Activities at WOMPOC for 2011–2013

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
2012	0.001	0.003	3.07
2013	0.004	0.009	2.34
Total (2011–2013)	0.003	0.007	2.78

Notes: WOMPOC began operating on September 28, 2011.

Figure 18 through Figure 21 show no occurrences of reportable 30-day or 12-month rolling averages for the year.

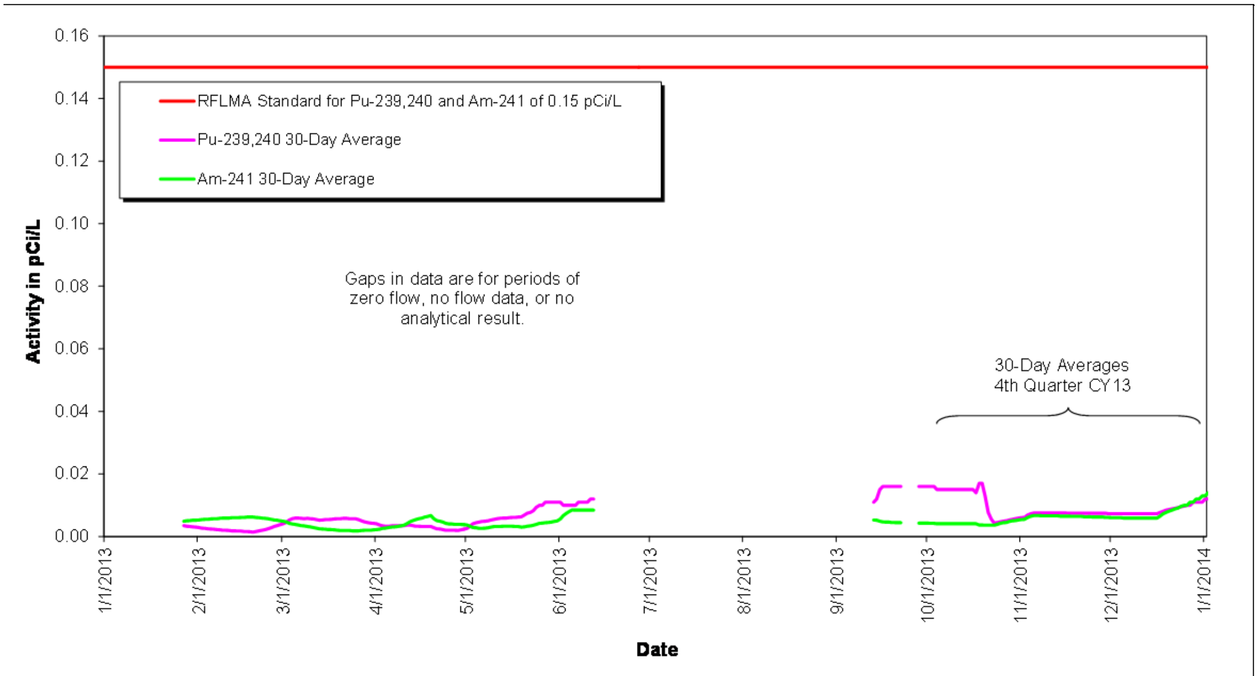

Figure 18. Volume-Weighted 30-Day Average Pu and Am Activities at WOMPOC: Year Ending Fourth Quarter CY 2013

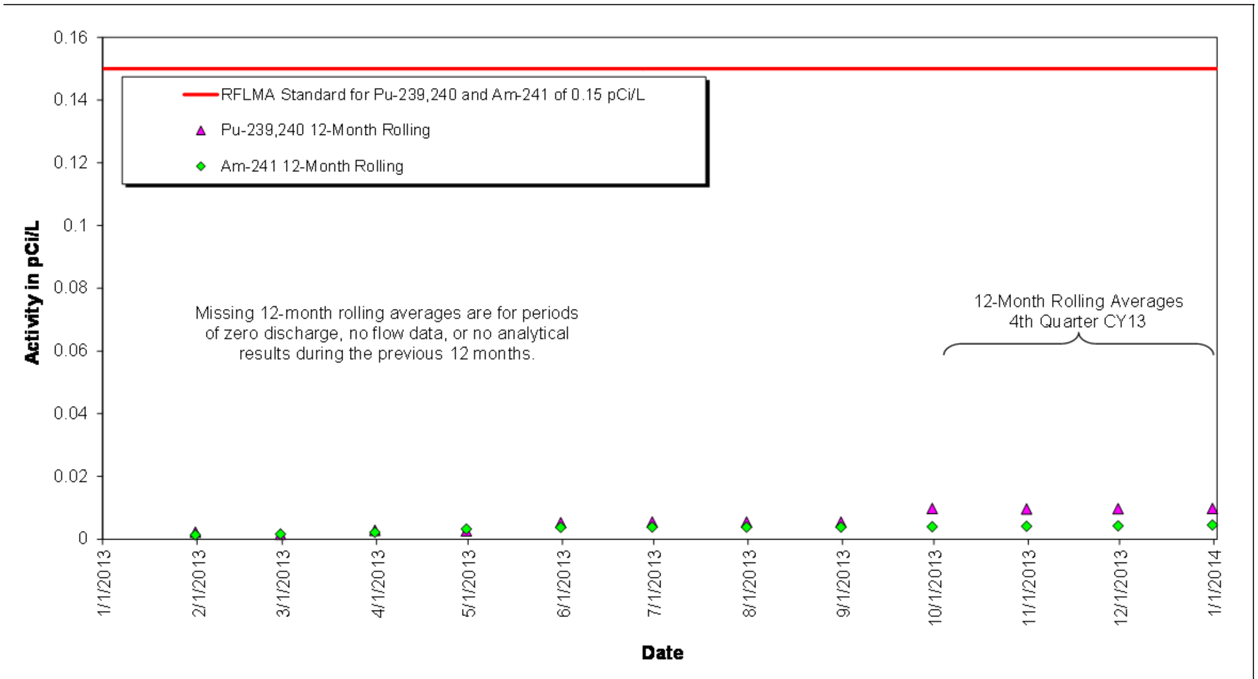

Figure 19. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at WOMPOC: Year Ending Fourth Quarter CY 2013

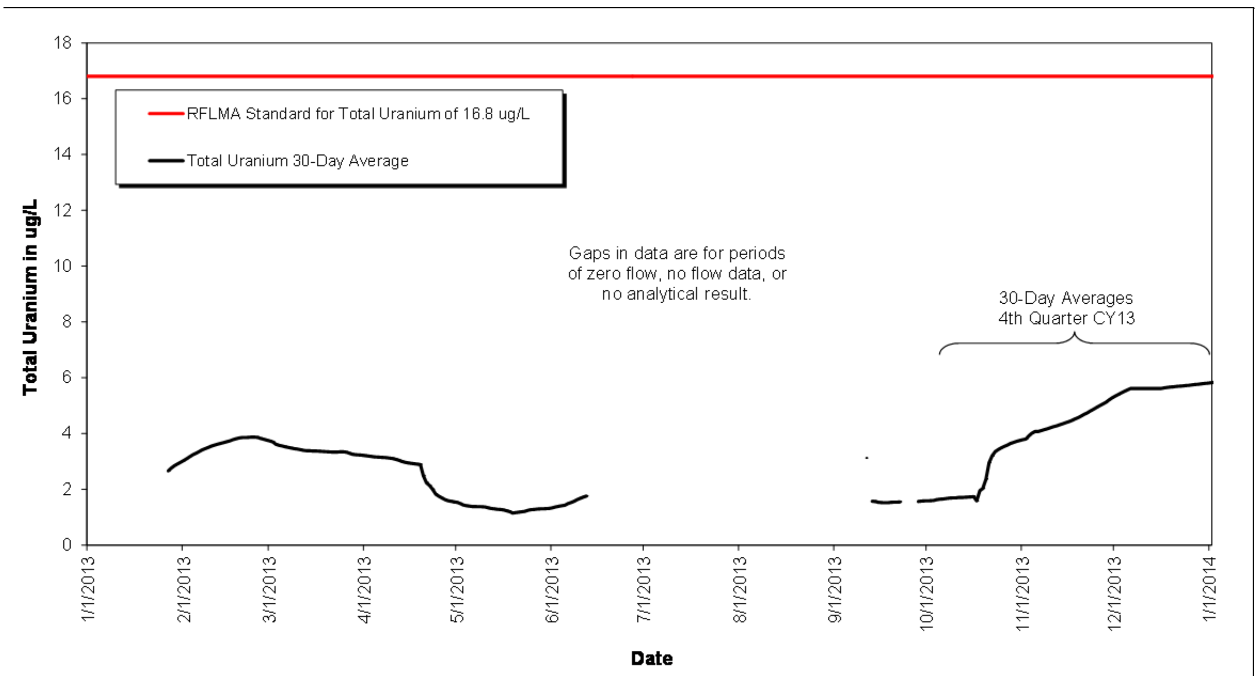

Figure 20. Volume-Weighted 30-Day Average Total U Concentrations at WOMPOC: Year Ending Fourth Quarter CY 2013

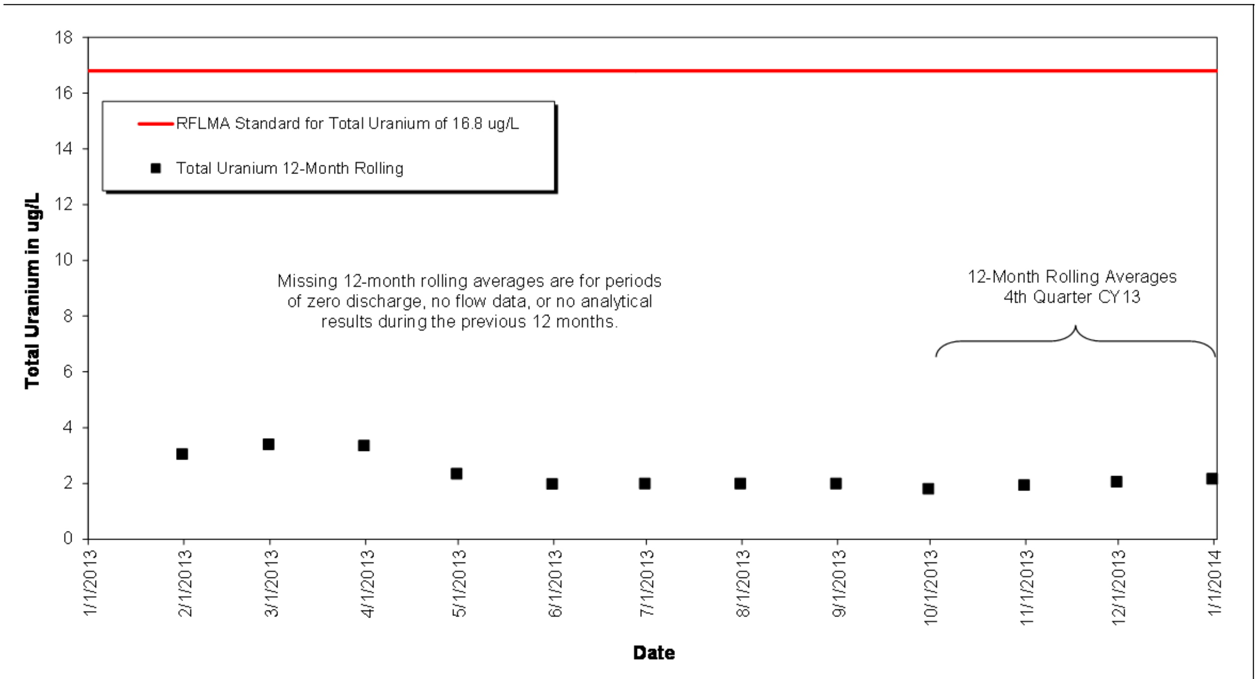

Figure 21. Volume-Weighted 12-Month Rolling Average Total U Concentrations at WOMPOC: Year Ending Fourth Quarter CY 2013

Location WALPOC

Monitoring location WALPOC is located on Walnut Creek at the eastern COU boundary (Figure 7). 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 11 shows automated composite sampling information collected during September 2013. It should be noted that the sampler was full and did not collect any water for the period 9/12/2013 7:08 to 9/13/2013 14:54. Therefore, no analytical results are available and, in accordance with routine evaluation protocols, this period is not included in the calculation of 12-month rolling and 30-day averages.

Table 11. September 2013 Composite Sampling Detail for POC WALPOC

Sampling Period	Number of Grabs	Sample Results			Flow Volume (MG)	Flow Rates (cfs)	Comments
		Am-241 (pCi/L)	Pu-239, 240 (pCi/L)	Uranium (µg/L)			
6/4/2013 13:19–9/12/2013 7:08	231	0.007	0.026	3.21	5.14	0.0–30.8 (est)	Sampler filled at 9/12/2013 7:08
9/12/2013 7:08–9/13/2013 14:54	0 NSQ	NA	NA	NA	43.2 (est)	22.3–83.5 (est)	Sampler was full for this period and no water was collected
9/13/2013 14:54–9/14/2013 11:54	62	0.028	0.039	1.99	17.5 (est)	22.5–41.8 (est)	
9/14/2013 11:54–9/16/2013 11:20	89	0.013	0.025	2.55	25.1 (est)	6.2–41.6 (est)	
9/16/2013 11:20–10/25/2013 14:12	32	0.010	0.010	11.5	10.2	0.12–6.1	

Abbreviations:
est = estimated
MG = million gallons
NA = not analyzed
NSQ = nonsufficient quantity for analysis

Table 12 shows that annual average Pu and Am activities are all well below the RFLMA standard of 0.15 pCi/L. The annual average 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 12. Annual Volume-Weighted Average Radionuclide Activities and Nitrate+Nitrite as Nitrogen Concentrations at WALPOC for 2011–2013

Calendar Year	Volume-Weighted Average			
	Am-241 (pCi/L)	Pu-239, 240 (pCi/L)	Total U (µg/L)	Nitrate+Nitrite as N (mg/L)
2011 (partial year)	0.004	0.003	7.99	0.055
2012	0.002	0.006	12.8	4.52
2013	0.013	0.018	7.79	1.58
Total (2011–2013)	0.009	0.014	8.54	1.70

Notes: WALPOC began operating on September 9, 2011.

Figure 22 through Figure 25 show no occurrences of reportable 30-day or 12-month rolling averages for plutonium, americium, or nitrate+nitrite as N.

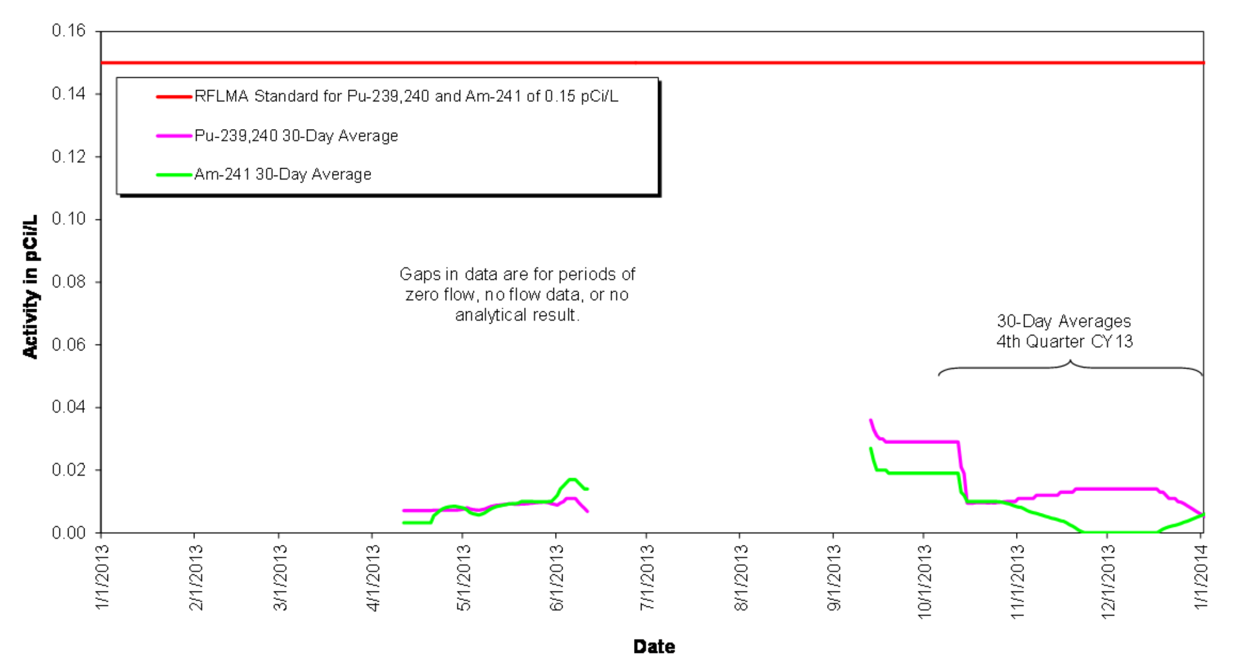

Figure 22. Volume-Weighted 30-Day Average Pu and Am Activities at WALPOC: Year Ending Fourth Quarter CY 2013

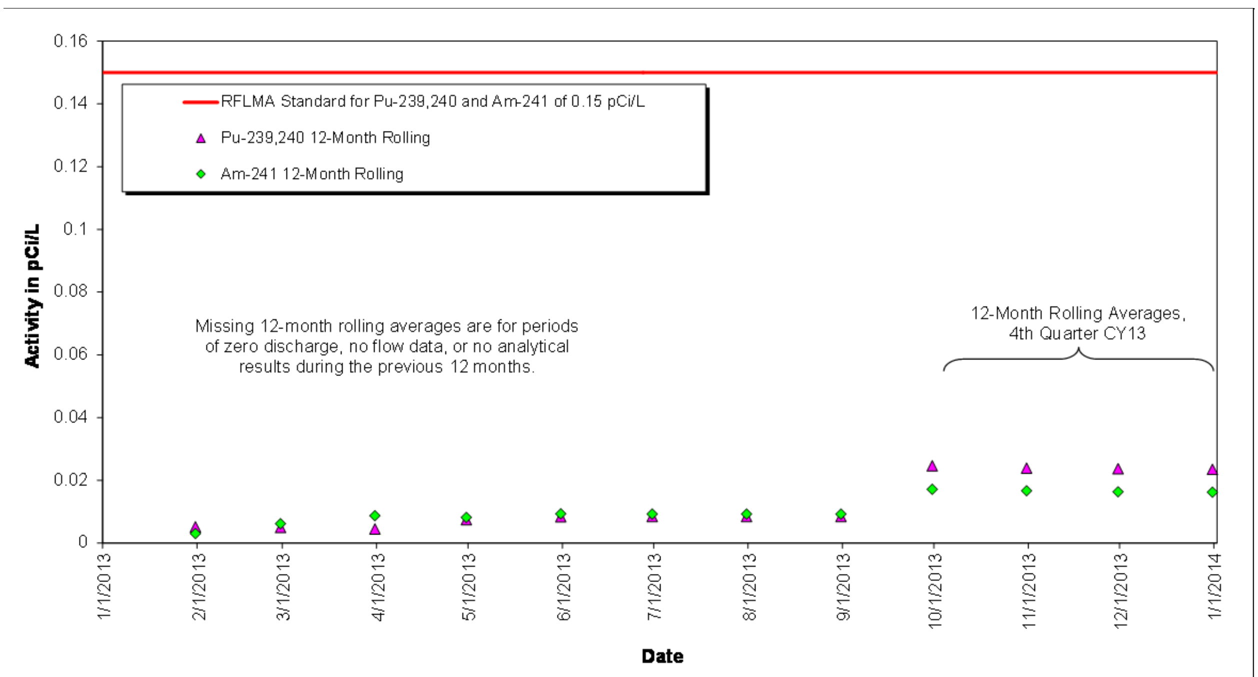

Figure 23. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at WALPOC: Year Ending Fourth Quarter CY 2013

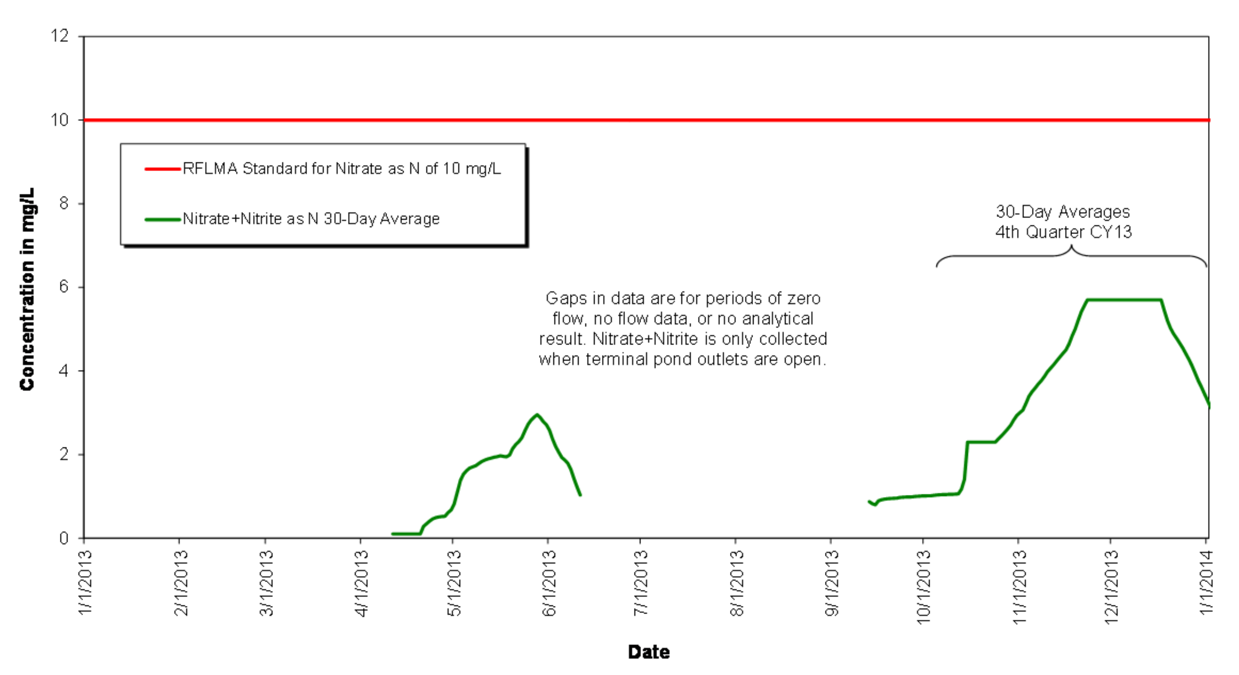

Figure 24. Volume-Weighted 30-Day Average Nitrate+Nitrite as N Concentrations at WALPOC: Year Ending Fourth Quarter CY 2013

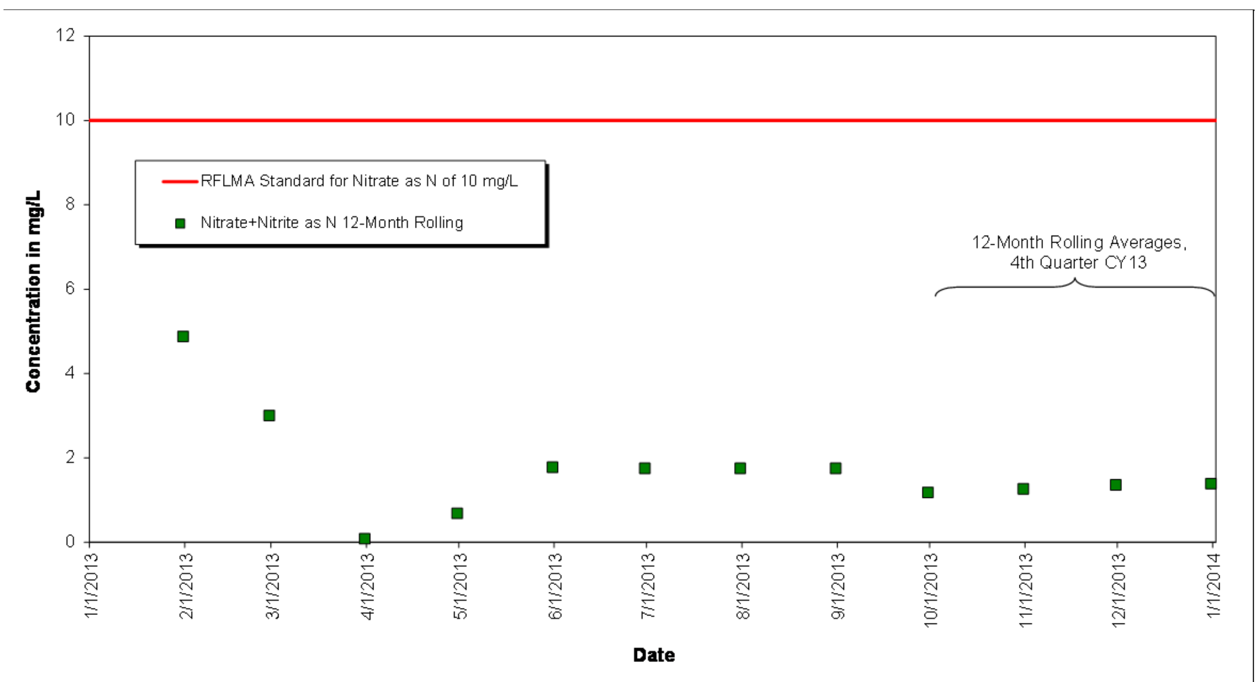

Figure 25. Volume-Weighted 12-Month Rolling Average Nitrate+Nitrite as N Concentrations at WALPOC: Year Ending Fourth Quarter CY 2013

Figure 26 shows that the 30-day average for uranium exceeded the RFLMA standard of 16.8 µg/L at the end of CY 2013. The 12-month rolling average remains well below RFLMA standard (Figure 27).

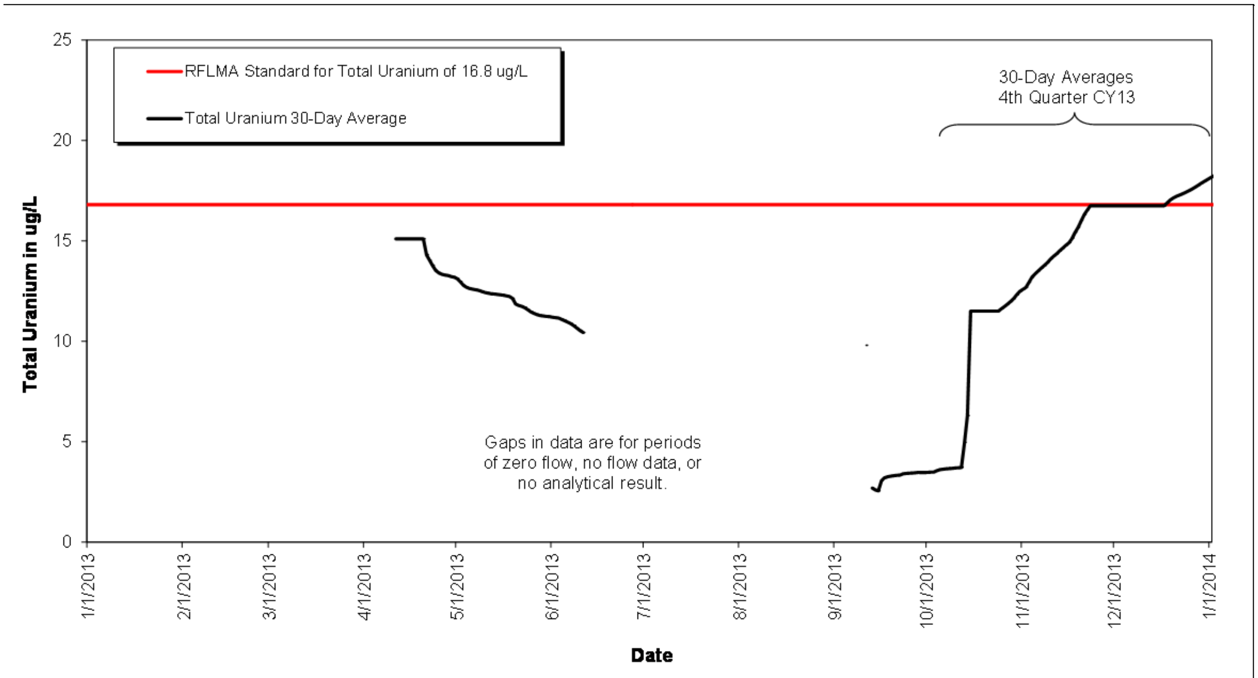

Figure 26. Volume-Weighted 30-Day Average Total U Concentrations at WALPOC: Year Ending Fourth Quarter CY 2013

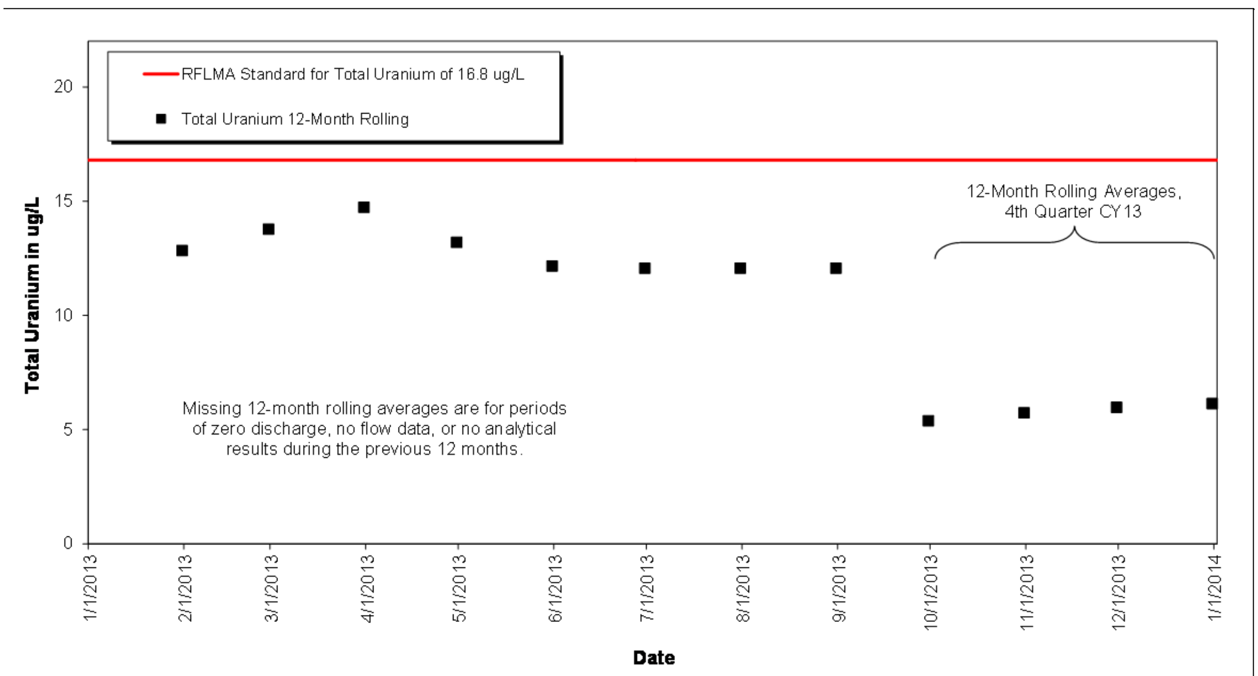

Figure 27. Volume-Weighted 12-Month Rolling Average Total U Concentrations at WALPOC: Year Ending Fourth Quarter CY 2013

The evaluation of WALPOC uranium data was performed in accordance with RFLMA Attachment 2, Figure 6, "Points of Evaluation," and resulted in a calculated 30-day average concentration for uranium of 16.9 µg/L on December 18, 2013. This value exceeds the RFLMA Table 1 standard of 16.8 µg/L. Validated results were received on February 3, 2014, and notification to the regulatory agencies and the public—in accordance with RFLMA Attachment 2, Figure 6—was made by e-mail on February 13, 2014. Representatives of the regulatory agencies and DOE met on February 18, 2014, to discuss the observations and develop a path forward.

RFLMA Contact Record 2014-05 (approved April 8, 2014), "Reportable condition for evaluation purposes for uranium at point of compliance WALPOC," provides a discussion of the monitoring results and recaps the outcome of the RFLMA Parties consultation regarding the evaluation steps to be taken. This contact record is available on the Rocky Flats website, http://www.lm.doe.gov/Rocky_Flats/ContactRecords.aspx.

The RFLMA Parties agreed on the evaluation steps described below and agreed that no mitigating actions are necessary at this time, for the following reasons taken directly from Contact Record 2014-05:

- The remedy remains protective. The remedy standard for total uranium at the WALPOC sampling location is the calculated 12-month rolling average. Using the most recent validated data, the calculated 12-month rolling average at WALPOC for total uranium on December 31, 2013, is 6.1 µg/L, well below the remedy performance standard of 16.8 µg/L.
- WALPOC has been an RFLMA monitoring location for roughly 2.5 years. During that period, the Site experienced one of its driest years (2012) and its wettest month (September 2013) according to precipitation data collected since 1990. Because uranium concentrations are influenced by changing environmental conditions, varying uranium concentrations at WALPOC are anticipated. While significant uranium concentration variability can be seen in both individual sample results and in the 30-day averages, the observed variability is not outside of anticipated ranges nor do these levels suggest the existence of a new source term.
- Although the recent result was above the Site standard of 16.8 µg/L, it remains well below the drinking water standard (i.e., the maximum contaminant level [MCL]) of 30 µg/L. While the MCL is not applied at the Site, the fact that the uranium concentration triggering this reportable condition was well below that level indicates that the remedy remains protective of human health and the environment.

However, the RFLMA Parties also agreed that further evaluation should be completed to help confirm the foregoing conclusions and to aid in developing future mitigating actions if they become necessary. The following steps taken directly from Contact Record 2014-05 serve as the plan and schedule for the WALPOC evaluation:

- Measured concentrations of total uranium at WALPOC include both naturally occurring and anthropogenic uranium. Previous high-resolution isotopic uranium analyses for WALPOC show signatures that are between 76 and 80 percent naturally occurring uranium. Additional high-resolution isotopic uranium analysis on the most recent WALPOC samples is being conducted to determine the percentages of natural and anthropogenic uranium for comparison to the historical data. These samples include a split from the

December 18, 2013, composite sample that triggered the reportable condition. Additional grab samples were collected on February 13, 2014, from WALPOC, Pond A-4, GS11 (Pond A-4 outlet), Pond B-5, and GS08 (Pond B-5 outlet). These samples will also be evaluated using high-resolution uranium analysis techniques.

- Split samples will continue to be collected from each flow-paced composite collected at WALPOC and held for possible high-resolution isotopic uranium analysis.
- Flow-paced composite samples routinely being collected at WALPOC will continue to be analyzed on a 2-week turnaround.
- A qualified geochemistry subcontractor with direct and applicable experience at the Rocky Flats site is currently conducting an extensive evaluation of the fate and transport of uranium at the Site. The data collected throughout the Walnut Creek drainage for the fate and transport study will also be utilized in this WALPOC reportable condition evaluation.

  The purpose of the study, as it relates to this reportable condition, is to evaluate variability in uranium concentrations—due to seasonal, hydrologic, geochemical, and geographic effects—through the collection of targeted analytical and field data. The study also incorporates the ongoing calculation of the percentages of natural uranium versus anthropogenic uranium in Walnut Creek.

  The methods used for the study include assessing historical and current data, identifying patterns or correlations, and evaluating potential geochemical mechanisms that may contribute to the noted results. The study has also identified additional data needs; collection of these data is ongoing.

  The study is scheduled to be completed in CY 2014.
- On February 26, 2014, DOE provided a split sample from the sample collected on January 16, 2014, to CDPHE for analysis of uranium at the State's Radiochemistry Laboratory.

  DOE will report the results of this monitoring and of the subsequent evaluation in RFLMA quarterly and annual reports of surveillance and monitoring activities. This plan and schedule may be modified based on the outcome of RFLMA Party consultation related to the evaluation.

  To keep the public informed, the outcome of continuing RFLMA Party consultation regarding the evaluation will be reported in RFLMA quarterly and annual reports of surveillance and monitoring activities or in subsequent contact records.

The composite sampling results for uranium from composite samples collected at WALPOC during CYs 2013–2014 are given below in Table 13.

Table 13. CYs 2013–2014 Composite Sampling Results at WALPOC

Date–Time Start	Date–Time End	Uranium Result (µg/L)
4/13/2012 10:08	4/21/2013 12:06	15.1
4/21/2013 12:06	4/29/2013 12:46	12.6
4/29/2013 12:46	5/3/2013 11:50	11.5
5/3/2013 11:50	5/7/2013 12:13	11.3
5/7/2013 12:13	5/17/2013 9:41	11.4
5/17/2013 9:41	6/4/2013 13:19	10.6
6/4/2013 13:19	9/12/2013 7:08	3.21
9/12/2013 7:08	9/13/2013 14:54	NSQ
9/13/2013 14:54	9/14/2013 11:54	1.99
9/14/2013 11:54	9/16/2013 11:20	2.55
9/16/2013 11:20	10/25/2013 14:12	11.5
10/25/2013 14:12	12/18/2013 11:39	16.8
12/18/2013 11:39	1/16/2014 13:27	18.8
1/16/2014 13:27	2/18/2014 12:39	22.5
2/18/2014 12:39	3/6/2014 10:43	Results pending
3/6/2014 10:43	3/10/2014 10:25	Results pending
3/10/2014 10:25	In progress	Sample in progress

Notes: Recent results from 2014 are not yet validated and are subject to revision.
NSQ = nonsufficient quantity for analysis due to a full bottle because of high runoff (September 2013; see Table 11).

3.1.2.2 POE Monitoring

This objective deals with monitoring runoff and baseflow from the interior of the COU for comparison with surface-water-quality standards (see Table 1 of RFLMA Attachment 2). Water quality data are reportable under RFLMA when the applicable evaluation 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 28. Sampling and data evaluation protocols are summarized in Table 14.

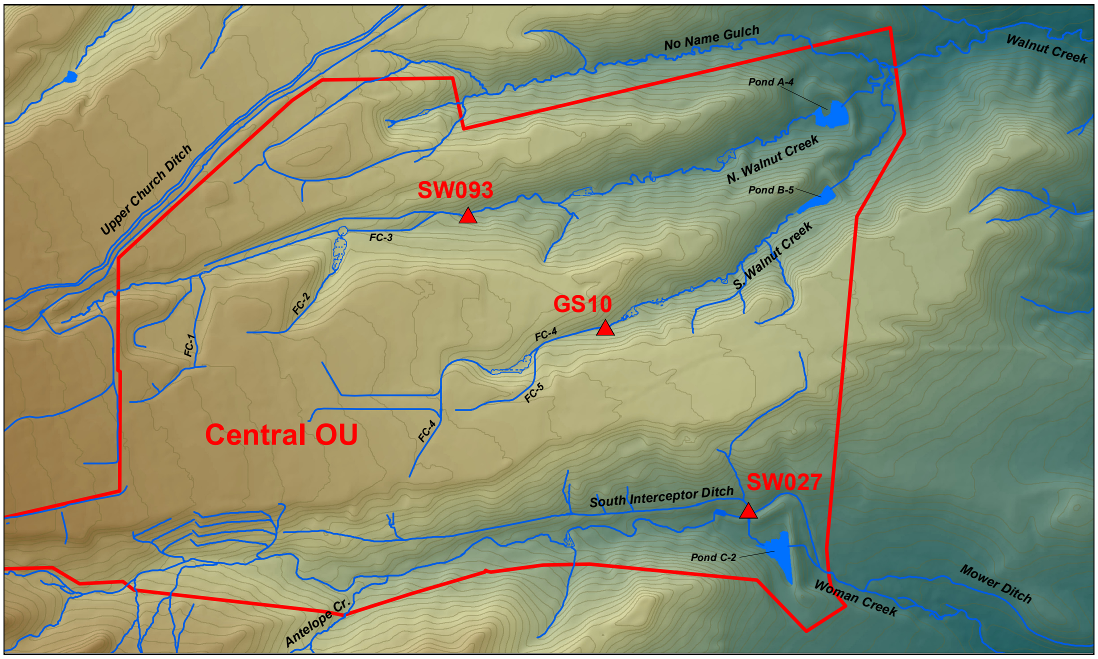

Figure 28. POE Monitoring Locations

Table 14. 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 30–40 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 10–15 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 10–15 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.

Abbreviations:
Ag = silver
Be = beryllium
Cd = cadmium
TSS = total suspended solids

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.[4]

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 former B-Series Ponds (Figure 28). The central portion of the COU contributes flow to GS10 through FC-4 and FC-5.

Table 15 shows automated composite sampling information collected during September 2013. It should be noted that the sampler was full and did not collect any water for the period 9/11/2013 21:49 to 9/13/2013 15:30. Therefore, no analytical results are available for this period and, in accordance with routine evaluation protocols, this period is not included in the calculation of 12-month rolling and 30-day averages.

Table 15. September 2013 Composite Sampling Detail for POE GS10

Sampling Period	Number of Grabs	Sample Results			Flow Volume (MG)	Flow Rates (cfs)	Comments
		Am-241 (pCi/L)	Pu-239, 240 (pCi/L)	Uranium (µg/L)			
8/9/2013 13:06–9/11/2013 21:49	109	0.041	0.033	5.61	0.85	0.0–15.7	Sampler filled 9/11/2013 21:49
9/11/2013 21:49–9/13/2013 15:30	0 NSQ	NA	NA	NA	16.0 (est)	1.4–65.1 (est)	Sampler was full 9/11/2013 21:49–9/13/2013 15:30
9/13/2013 15:30–9/16/2013 12:09	110	0.0	0.012	5.55	3.0	0.2–13.2	Sampler was full 9/15/2013 17:06–9/16/2013 12:09
9/16/2013 12:09–9/24/2013 16:26	41	0.013	0.010	12.7	1.2	0.1–1.3	
9/24/2013 16:26–10/16/2013 14:45	47	0.009	0.002	16.3	1.4	0.04–0.4	

Abbreviations:
est = estimated
MG = million gallons
NA = not analyzed
NSQ = nonsufficient quantity for analysis

Table 16 shows annual average Pu and Am activities at GS10 that 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 2011–2013 data show increased Pu and Am activities. Figure 29 shows that recent 12-month rolling averages for americium and

[4] 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 RER or RPD, depending on the analyte, is required to assess the representativeness of the sample and its usability for compliance decisions (see the RFSOG for discussion).

plutonium exceed the RFLMA standard of 0.15 pCi/L. Figure 30 shows the 12-month rolling averages for Am and Pu in the context of the entire post-closure period.

Table 16. Annual Volume-Weighted Average Radionuclide Activities at GS10 for 1997–2013

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	12.0
2006	0.010	0.014	19.3
2007	0.010	0.020	16.5
2008	0.025	0.020	22.9
2009	0.009	0.019	13.4
2010	0.007	0.012	14.4
2011	0.319	0.207	20.7
2012	0.260	0.175	24.1
2013	0.579	0.356	18.2
Total (1997–2013)	0.184	0.160	7.35

Figure 31 shows that the 12-month rolling average for uranium exceeded the RFLMA standard of 16.8 µg/L during portions of CY 2013.

An updated discussion of these reportable conditions is presented below.

The composite sampling results for americium, plutonium, and uranium from composite samples collected at GS10 during CY 2012–2014 are given below in Table 17. All individual americium and plutonium results have been below 0.15 pCi/L since August 2013.

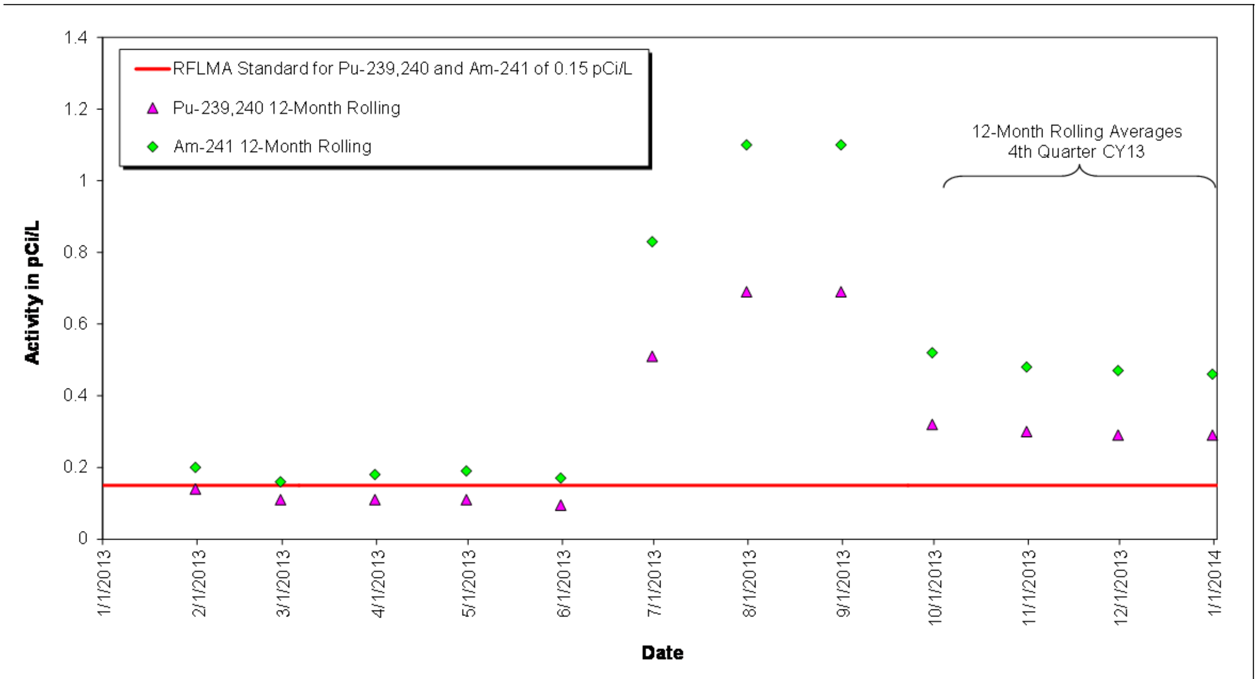

Figure 29. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at GS10: Year Ending Fourth Quarter CY 2013

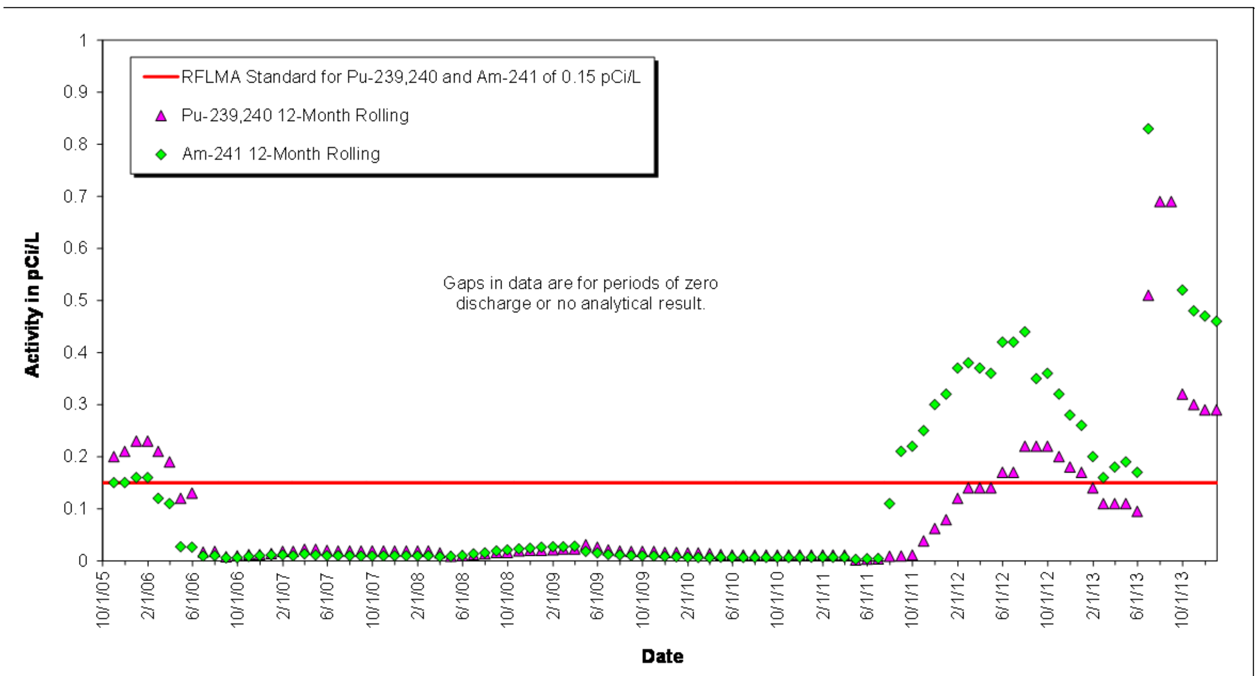

Figure 30. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at GS10: Post-Closure Period

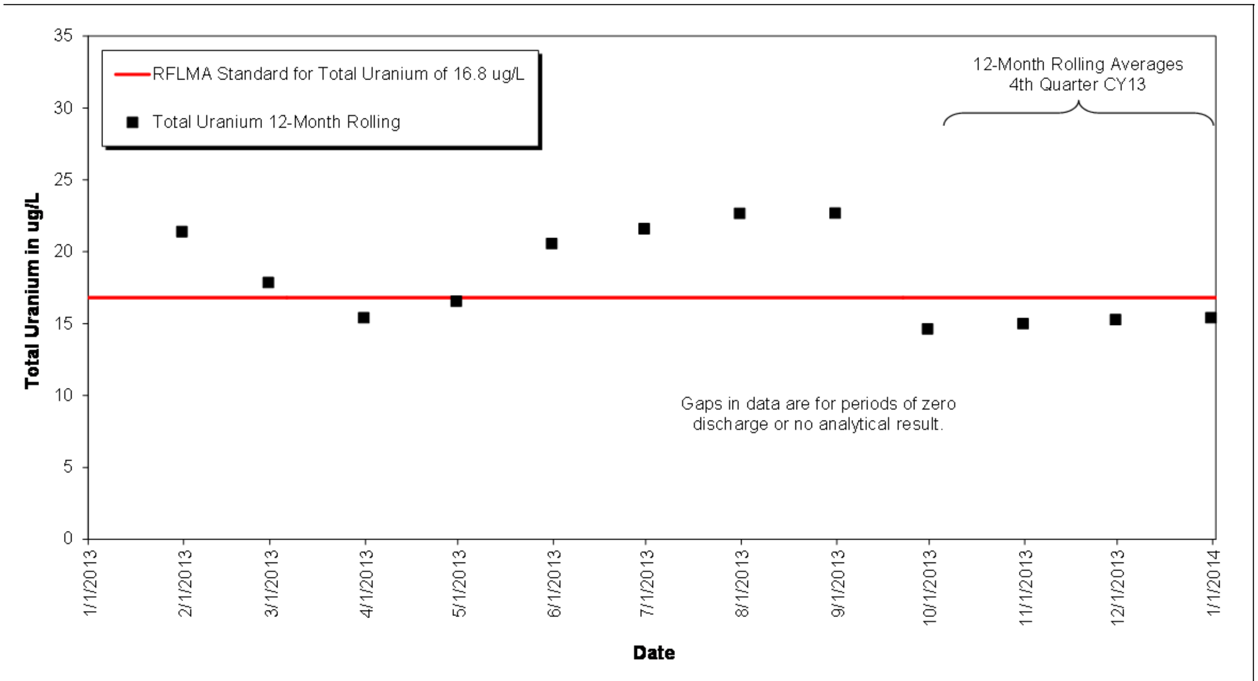

Figure 31. Volume-Weighted 12-Month Rolling Average Total U Concentrations at GS10: Year Ending Fourth Quarter CY 2013

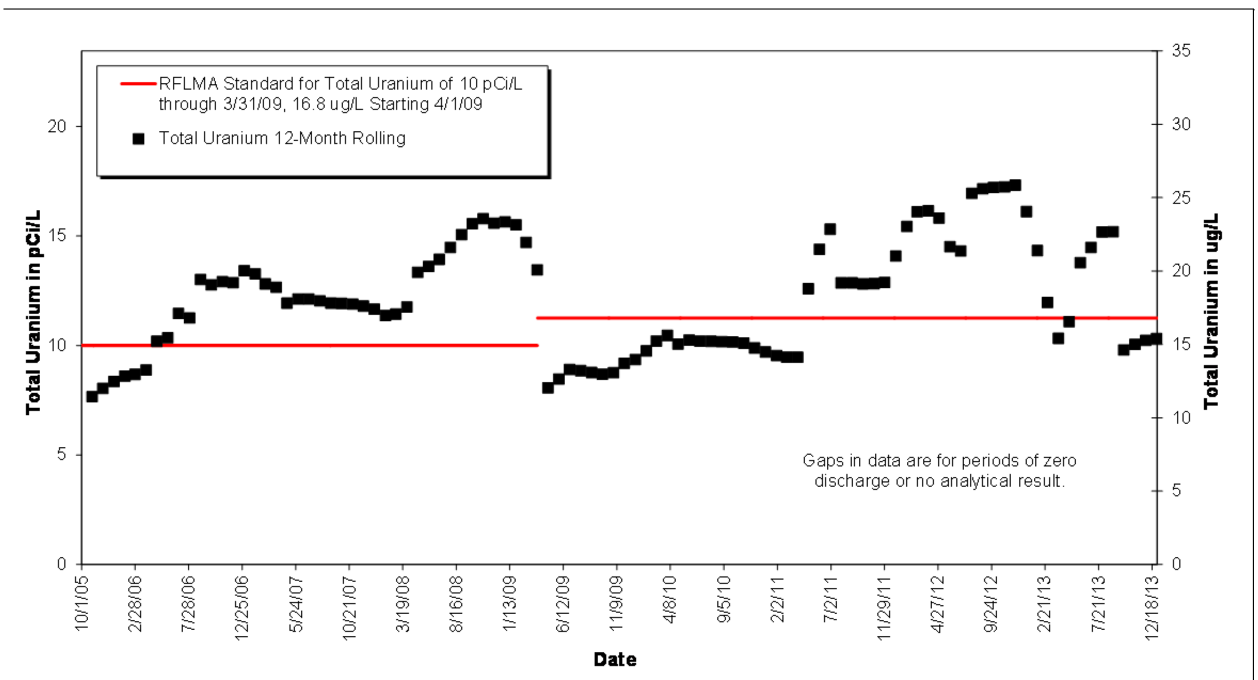

Figure 32. Volume-Weighted 12-Month Rolling Average Total U Concentrations at GS10: Post-Closure Period

Table 17. CY 2012–2014 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)
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	0.050	33.9
3/6/2012–12:04	3/21/2012–9:37	0.150	0.114	38.7
3/21/202–9:37	4/4/2012–10:20	0.318	0.246	35.5
4/4/2012–10:20	4/25/2012–9:31	0.052	0.034	27.6
4/25/2012–9:31	5/9/2012–13:36	0.478	0.264	16.1
5/9/2012–13:36	5/23/2012–9:37	0.159	0.107	12.9
5/23/2012–9:37	6/14/2012–10:08	0.034	0.033	8.98
6/14/2012–10:08	7/9/2012–11:53	0.085	0.049	4.68
7/9/2012–11:53	7/26/2012–8:58	0.224	0.173	7.07
7/26/2012–8:58	9/12/2012–13:06	0.464	0.314	4.20
9/12/2012–13:06	10/24/2012–10:19	0.012	0.009	3.75
10/24/2012–10:19	12/4/2012–10:44	0.080	0.043	7.16
12/4/2012–10:44	1/10/2013–10:39	0.054	0.032	12.3
1/10/2013–10:39	3/4/2013–11:22	NSQ	NSQ	NSQ
3/4/2013–11:22	4/1/2013–10:35	0.724	0.325	39.5
4/1/2013–10:35	4/20/2013–18:54	0.183	0.110	28.8
4/20/2013–18:54	4/24/2013–9:51	0.221	0.131	27.2
4/24/2013–9:51	4/29/2013–12:21	0.133	0.085	26.3
4/29/2013–12:21	5/3/2013–12:24	0.191	0.080	36.5
5/3/2013–12:24	5/8/2013–9:01	0.353	0.201	34.2
5/8/2013–9:01	5/16/2013–11:04	0.038	0.029	18.9
5/16/2013–11:04	5/28/2013–10:54	0.023	0.014	26.8
5/28/2013–10:54	6/14/2013–9:15	0.145	0.058	19.4
6/14/2013–9:15	7/3/2013–7:36	8.410	5.275	21.9
7/3/2013–7:36	8/9/2013–13:06	4.540	2.820	28.8
8/9/2013–13:06	9/11/2013–21:49	0.041	0.033	5.61
9/11/2013–21:49	9/13/2013–15:30	NSQ	NSQ	NSQ
9/13/2013–15:30	9/16/2013–12:09	0.000	0.012	5.55
9/16/2013–12:09	9/24/2013–16:26	0.013	0.010	12.7
9/24/2013–16:26	10/16/2013–14:45	0.009	0.002	16.3
10/16/2013–14:45	11/13/2013–13:38	0.042	0.004	18.0
11/13/2013–13:38	1/2/2014–13:09	0.000	0.011	17.3
1/2/2014–13:09	1/29/2014–12:55	0.020	0.000	20.7
1/29/2014–12:55	In progress	In progress	In progress	In progress

Notes: NSQ = nonsufficient quantity for analysis due to ice (January–March 2013) or a full bottle due to high runoff (September 2013).
Recent results from 2014 are not yet validated and are subject to revision.

Table 18 shows that all of the annual average metals concentrations were less than the standards/PQLs. Additionally, the long-term metals averages (1997–2013) were all less than the RFLMA standards/PQLs. Figure 33 shows that none of the 85th percentile 30-day average metals concentrations were reportable for the year.

Table 18. Annual Volume-Weighted Average Hardness and Metals Concentrations at GS10 for 1997–2013

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
2012	562	0.50	0.06	0.90	0.10
2013	431	0.50	0.06	1.50	0.11
Total (1997–2013)	247	0.38	0.09	5.22	0.13

Abbreviations:
Ag = silver
Be = beryllium
Cd = cadmium

Reportable Americium and Plutonium Activities at GS10

Formal notification of a reportable condition for 12-month rolling average americium values at GS10 was made on December 12, 2011. Formal notification of a reportable condition for 12-month rolling average plutonium values at GS10 was made on July 24, 2012.

The above notifications were triggered by routine data evaluation performed in accordance with RFLMA Attachment 2, Figure 6, "Points of Evaluation," which resulted in a 12-month rolling average value for americium of 0.21 pCi/L on August 31, 2011. Similarly, data evaluation resulted in a 12-month rolling average value for plutonium of 0.17 pCi/L on May 31, 2012. As of December 31, 2013, using validated data, the 12-month rolling average for both americium and plutonium remained above the standard at 0.46 pCi/L and 0.29 pCi/L, respectively. The applicable RFLMA Table 1 standard for americium and plutonium is 0.15 pCi/L.

Downstream monitoring at GS08, WALPOC, and GS03 continue to show plutonium and americium activities below the RFLMA standard of 0.15 pCi/L. Recent analytical results from these downstream locations are given in Table 19. The latest available 12-month rolling and 30-day average plutonium and americium activities calculated from flow-paced composite samples are shown on Figure 34 and Figure 35.

Table 19. Recent Plutonium and Americium 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)**
1/5–2/1/2012	0.001/0.0	1/3–2/23/2012	0.0/0.009	1/3–2/10/2012	0.006/0.003
2/1–4/4/2012	0.0/0.0			2/10–2/23/2012	0.0/0.003
		2/23–3/6/2012	0.003/0.001	2/23–2/27/2012	0.0/0.012
				2/27–3/1/2012	0.0/0.0
		3/6–3/21/2012	0.004/0.009	3/1–3/15/2012	0.0/0.002
		3/21–4/13/2012	0.018/0.0	3/15–4/4/2012	0.0/0.005
4/4/2012–4/25/2013	0.016/0.055	4/13/2012–4/21/2013	0.003/0.007	4/4/2012–1/15/2013	0.0/0.0
				1/15–4/21/2013	0.008/0.006
		4/21–4/29/2013	0.010/0.007	4/21–4/25/2013	0.009/0.012
4/25–5/7/2013	0.010/0.004			4/25–4/29/2013	0.0/0.009
		4/29–5/3/2013	0.001/0.012	4/29–5/3/2013	0.0/0.012
		5/3–5/7/2013	0.0/0.005	5/3–5/7/2013	0.012/0.0
5/7–6/4/2013	0.065/0.037	5/7–5/17/2013	0.022/0.016	5/7–5/17/2013	0.036/0.016
		5/17–6/4/2013	0.010/0.0	5/17–6/25/2013	0.0/0.009
6/4–9/12/2013	0.031/0.039	6/4–9/12/2013	0.007/0.026	6/25–9/12/2013	0.016/0.036
9/12–9/14/2013	NSQ	9/12–9/13/2013	NSQ	9/12–9/14/2013	0.032/0.042
9/14–9/15/2013	0.017/0.006	9/13–9/14/2013	0.028/0.039	9/14–10/2/2013	0.011/0.017
9/15–9/17/2013	NSQ	9/14–9/16/2013	0.013/0.025		
9/17–9/24/2013	0.008/0.004	9/16–10/25/2013	0.010/0.010		
9/24–10/9/2013	0.0/0.001			10/2–10/7/2013	0.0/0.004
10/9–11/14/2013	0.033/0.005	10/25–12/18/2013	0.0/0.014	10/7–10/25/2013	0.0/0.002
11/14/2013–1/16/2014	0.007/0.013	12/18/2013–1/16/2014	0.008/0.002	10/25/2013–1/2/2014	0.002/0.0
1/16–2/13/2014	[a]	1/16–2/18/2014	0.0/0.003	1/2–3/10/2014	[a]
2/13–3/10/2014	[a]	2/18–3/6/2014	[a]		
		3/6–3/10/2014	[a]		
3/10/2014–	[b]	3/10/2014–	[b]	3/10/2014–	[b]

Notes: Some results are preliminary and subject to revision; negative results are set to zero.
NSQ = nonsufficient quantity for analysis (no analytical results).
[a] Results pending
[b] Sample in progress

An aliquot from each flow-paced composite sample routinely being collected at B5INFLOW (supporting the GS10 uranium evaluation; Figure 36) is also being held for plutonium and americium analysis if upstream sample results at GS10 suggest analysis would inform the evaluation. To date, 10 plutonium and americium results have been obtained and all results are well below the RFLMA standard of 0.15 pCi/L. The highest single result is 0.012 pCi/L of americium for the March 14–April 1, 2013, composite sample.

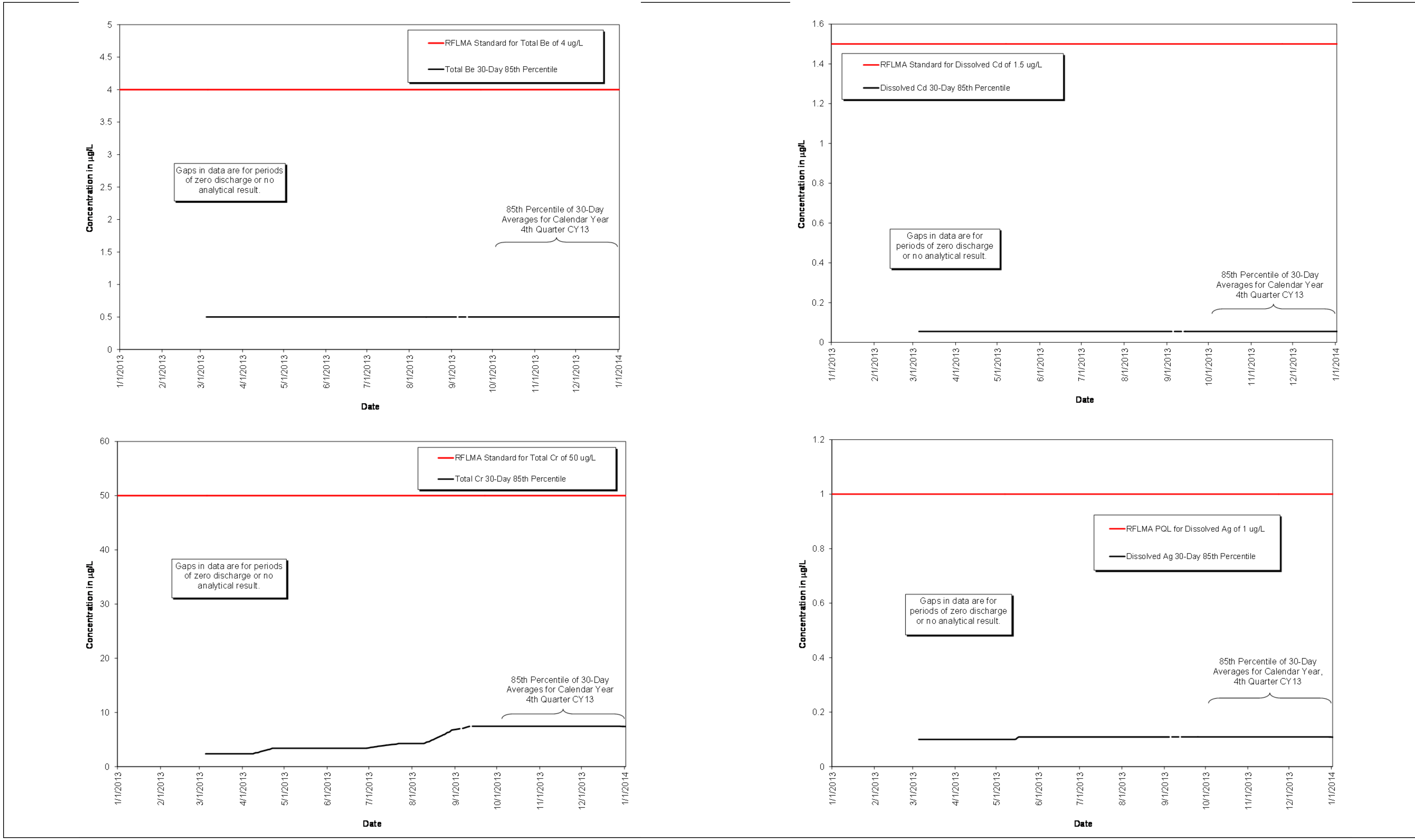

Figure 33. Volume-Weighted Average Metals Compliance Values at GS10: Year Ending Fourth Quarter CY 2013

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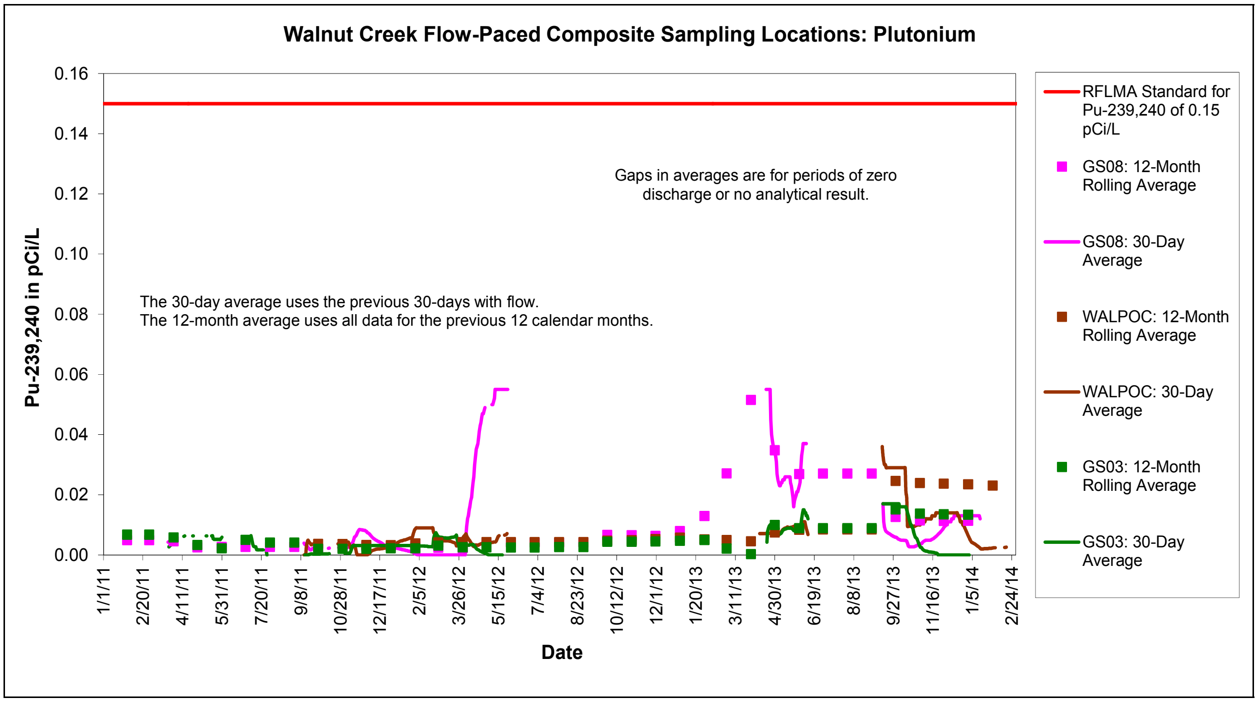
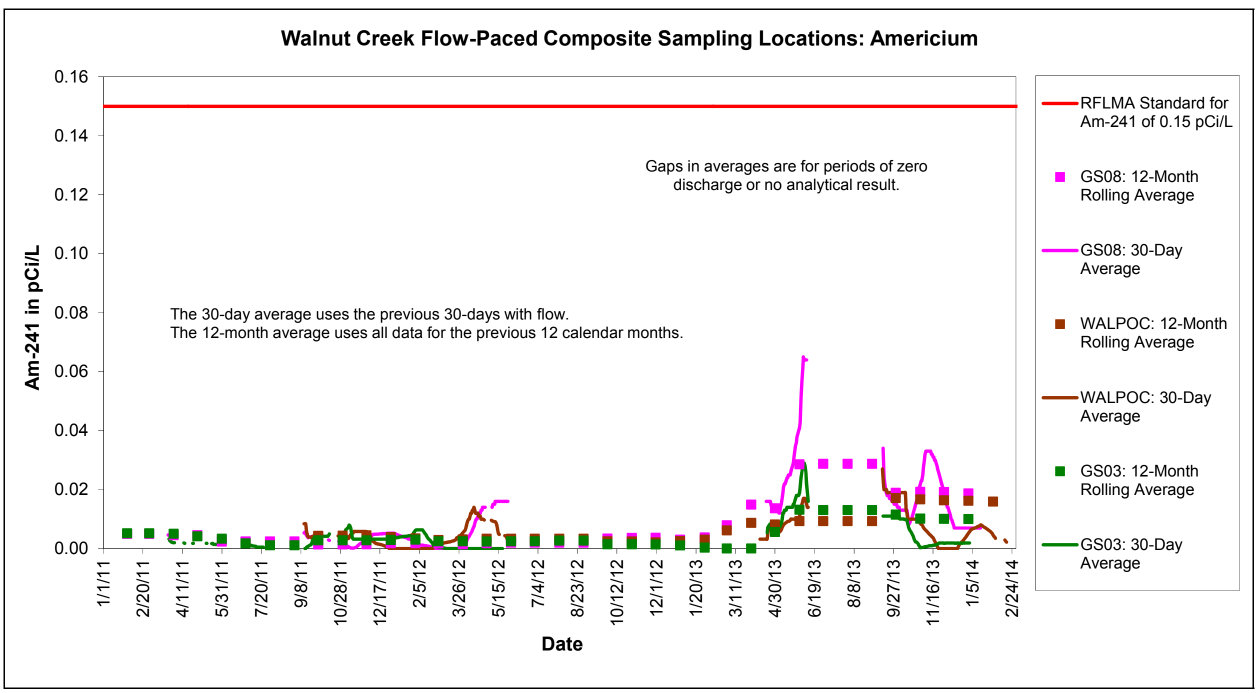


Notes: Values for 12-month and 30-day averages shown here are presented for comparison purposes only.

Figure 34. Average Plutonium Activities at Locations Downstream of GS10



Notes: Values for 12-month and 30-day averages shown here are presented for comparison purposes only.

Figure 35. Average Americium Activities at Locations Downstream of GS10

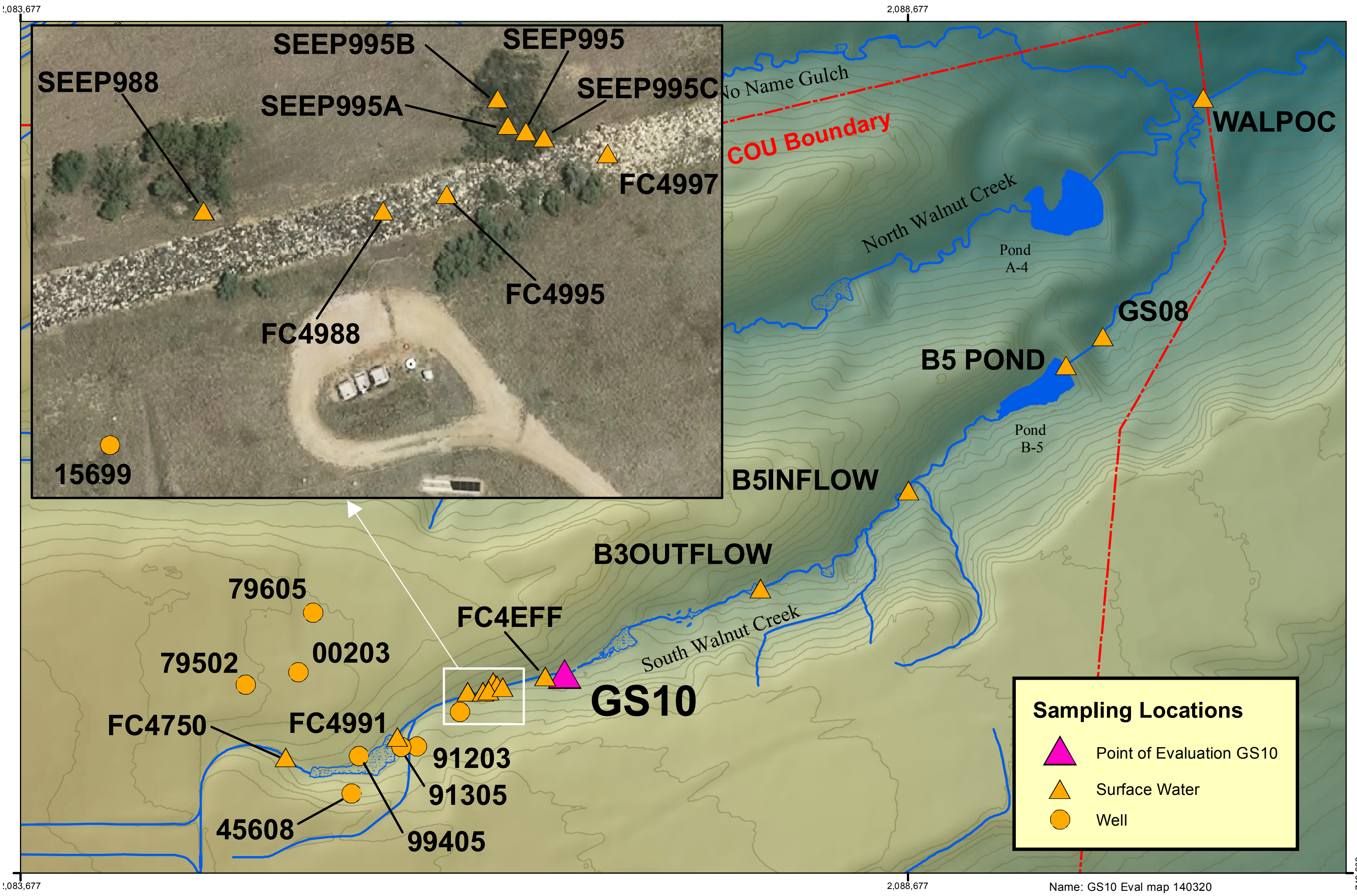


Figure 36. Evaluation Sampling Location Map for GS10 Drainage Area

Many additional water samples have been collected both upstream and downstream of GS10. Although further evaluation and consultation is ongoing, the following list summarizes action to date:

- Rocky Flats site 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 may have been useful, but given that the current water quality does not appear to be a result of soil transport, additional erosion controls were not implemented. A closer examination of the drainage to focus on seeps and former utility corridors was conducted; representatives from DOE and EPA were in attendance. Additional seed was spread and raked into the ground along the riprap areas upstream of GS10 in FC-4 and at the confluence of FC-4/FC-5 on November 29, 2011.
- Historical plutonium and americium 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 have been reviewed for information that may aid this current evaluation.
- Several of the sampling locations already designated for evaluation of the reportable condition for uranium at GS10 (FC4991, GS10, and B3OUTFLOW; Figure 36) were grab-sampled on November 25, 2011. Several seep sampling locations (SEEP995, SEEP995A, SEEP995B, and SEEP995C; Figure 36) were also grab-sampled on November 25, 2011. The Seep 995 area was chosen for sampling for the following reasons:
  - GS10 samples with elevated plutonium/americium were collected during low-flow conditions, not during high-flow conditions when soil and 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 outfall and a former utility corridor that included Original Process Waste Lines.

  The results in Table 20 suggest that the SEEP995 locations could be contributing plutonium and americium to GS10. However, activities at GS10 for this grab sample are low.

Table 20. 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

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

Additional samples were collected at the SEEP995 locations when water was available (i.e., unfrozen seep flow not affected by surface flow, such as snowmelt). Table 21 through Table 24 summarize sample results. While the activities are not as high as seen at GS10, the results do suggest that the SEEP995 area could be contributing some plutonium and americium to GS10.

For the January 24, 2012, sample from SEEP995A, analysis was performed for total plutonium and americium (unfiltered) and also for filtered plutonium and americium (sample filtered with 0.45-micron filter) to evaluate for the possibility of colloidal transport. However, the low activities for the January 24 samples do not provide additional insight into colloidal transport.

- The GS10 evaluation was discussed during a RFLMA Parties meeting on February 18, 2014. Based on seep water sampling results to date, along with the recently lower observed activities at GS10, the RLFMA Parties concluded that continued sampling or any additional investigation actions for this area would be unlikely to further inform the ongoing GS10 evaluation. Therefore, in accordance with Contact Record 2011-08, the RFLMA Parties agreed to discontinue sampling the former Building 995 hillside seeps as part of the evaluation for the GS10 americium reportable condition. Monitoring of the remaining evaluation locations discussed in Contact Record 2011-08 will continue.

Table 21. Americium Grab Sampling Results for SEEP995 Locations (pCi/L)

Sample Date(s)	SEEP995	SEEP995A	SEEP995B	SEEP995C
11/25/2011	0.066	0.127	0.035	0.052
1/6/2012	---	0.052	---	---
1/24/2012	---	0.000	---	---
3/6/2012	---	0.003	---	---
4/13/2012	---	0.040	---	---
2/14/2013	---	---	---	0.020
2/20/2013	0.002	---	---	---
3/26/2013	0.028	---	---	---
5/15/2013	0.008	0.045	0.008	---
5/28/2013	0.120	0.074	0.007	---
6/10-6/20	0.135	0.138	0.079	---
9/19/2013	0.023	0.033	0.013	0.005
9/24/2013	0.012	0.010	0.017	0.000
9/30/2013	0.069	0.083	0.045	0.077
10/10/2013	0.016	0.041	0.156	0.045
10/17/2013	0.055	0.056	0.010	0.071
10/24/2013	0.054	0.021	0.031	0.022
10/31/2013	0.071	0.016	0.004	0.079
11/14/2013	0.012	0.089	0.013	0.007
11/25/2013	0.009	0.203	0.002	0.003
12/30/2013	0.002	0.012	0.009	---

Notes: --- = not sampled

Table 22. Plutonium Grab Sampling Results for SEEP995 Locations (pCi/L)

Sample Date(s)	SEEP995	SEEP995A	SEEP995B	SEEP995C
11/25/2011	0.096	0.156	0.157	0.105
1/6/2012	---	0.079	---	---
1/24/2012	---	0.007	---	---
3/6/2012	---	0.004	---	---
4/13/2012	---	0.052	---	---
2/14/2013	---	---	---	0.043
2/20/2013	0.051	---	---	---
3/26/2013	0.058	---	---	---
5/15/2013	0.007	0.028	0.007	---
5/28/2013	0.135	0.157	0.030	---
6/10-6/20	0.179	0.350	0.122	---
9/19/2013	0.040	0.069	0.045	0.022
9/24/2013	0.015	0.015	0.022	0.000
9/30/2013	0.190	0.245	0.101	0.108
10/10/2013	0.024	0.068	0.512	0.059
10/17/2013	0.150	0.123	0.023	0.145
10/24/2013	0.083	0.055	0.088	0.058
10/31/2013	0.129	0.054	0.015	0.143
11/14/2013	0.004	0.190	0.033	0.000
11/25/2013	0.000	0.452	0.013	0.019
12/30/2013	0.002	0.016	0.127	---

Notes: --- = not sampled

Table 23. Uranium Grab Sampling Results for SEEP995 Locations (µg/L)

Sample Date(s)	SEEP995	SEEP995A	SEEP995B	SEEP995C
11/25/2011	---	---	---	---
1/6/2012	---	12.3	---	---
1/24/2012	---	13.7	---	---
3/6/2012	---	11.2	---	---
4/13/2012	---	7.8	---	---
2/14/2013	---	---	---	22.4
2/20/2013	23.9	---	---	---
3/26/2013	23.4	---	---	---
5/15/2013	14.1	10.9	11.6	---
5/28/2013	14.7	9.4	11.0	---
6/10-6/20	12.6	7.8	11.1	---
9/19/2013	11.7	10.2	12.0	22.3
9/24/2013	14.8	14.4	14.9	26.5
9/30/2013	16.6	19.1	16.0	19.2
10/10/2013	18.2	19.1	21.9	16.8
10/17/2013	24.2	23.1	22.4	19.7
10/24/2013	22.0	21.4	23.9	19.6
10/31/2013	24.0	23.5	23.7	19.3
11/14/2013	18.5	21.3	19.2	16.0
11/25/2013	23.1	27.8	23.1	20.5
12/30/2013	19.5	21.1	18.0	

Notes: --- = not sampled

Table 24. Filtered Results for SEEP995A

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

Abbreviations:
NA = not analyzed

- 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 rocks (Figure 36). These locations were originally grab-sampled on March 6, 2012, for both total and filtered analytes.

  The results in Table 25 show low plutonium and americium activities and no significant spatial trends for any of the analytes. These results are presented in Table 26.

Table 25. 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

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

Abbreviations:
Alk = alkalinity
CaCO3 = calcium carbonate
TSS = total suspended solids

Table 26. Americium, Plutonium, and Uranium Grab Sampling Results for FC-4 Locations (pCi/L)

Americium

Sample Date(s)	FC4988	FC4995	FC4997	FC4EFF
3/26/2013	---	0.003	0.049	---
9/19/2013	0.005	0.021	0.000	0.005
9/30/2013	0.003	0.025	0.000	0.008
10/17/2013	0.000	0.000	0.008	0.002
10/31/2013	0.004	0.005	0.033	0.000
11/14/2013	0.005	0.004	0.005	0.010
11/25/2013	0.029	0.002	0.005	0.006

Plutonium

Sample Date(s)	FC4988	FC4995	FC4997	FC4EFF
3/26/2013	---	0.004	0.046	---
9/19/2013	0.005	0.022	0.006	0.004
9/30/2013	0.000	0.004	0.000	0.000
10/17/2013	0.000	0.006	0.001	0.006
10/31/2013	0.003	0.001	0.003	0.003
11/14/2013	0.005	0.000	0.004	0.008
11/25/2013	0.020	0.000	0.007	0.004

Uranium

Sample Date(s)	FC4988	FC4995	FC4997	FC4EFF
3/26/2013	---	31.3	29.5	---
9/19/2013	13.5	13.9	14.0	14.7
9/30/2013	15.5	16.1	15.3	15.5
10/17/2013	19.0	19.6	19.2	17.8
10/31/2013	22.2	23.4	22.0	20.3
11/14/2013	19.5	20.0	19.2	19.2
11/25/2013	26.5	26.1	24.3	24.9

Notes: --- = not sampled

- To evaluate for any plutonium and americium transport characteristics specifically related to the dissolved, colloidal, and particulate mechanisms, water from the routine GS10 composite samples is periodically analyzed after filtration with a 0.45-micron filter.

  A filtered sample split is prepared from each composite sample collected at GS10. The routine RFLMA sample is analyzed for total (unfiltered) plutonium, americium, uranium, beryllium, chromium, and hardness. If the unfiltered analytical results show plutonium and americium concentrations above the 0.15 pCi/L standard, then the corresponding filtered sample may be submitted for analysis. Seven GS10 composite samples that have been analyzed as filtered and unfiltered to date (Table 27) indicate the Pu and Am can be removed with a 0.45-micron filter.

Table 27. Results for Filtered and Unfiltered Composite Sample Pairs at GS10

Composite Dates	Am-241 (pCi/L)		Pu-239, 240 (pCi/L)		Uranium (µg/L)	
	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
3/21–4/4/2012	0.318	0.000	0.246	0.000	35.5	34.2
4/25–5/9/2012	0.478	0.000	0.264	0.026	16.1	NA
7/26–9/12/2012	0.464	0.000	0.314	0.002	3.75	3.63
3/4–4/1/2013	0.724	0.003	0.325	0.000	39.5	NA
4/1–4/20/2013	0.183	0.000	0.110	0.000	28.8	NA
4/20–4/24/2013	0.221	0.000	0.131	0.004	27.2	NA
6/14–7/3/2013	8.41	0.007	5.28	0.010	21.9	27.2

Table 27 shows that nearly all of the plutonium and americium was removed by the 0.45-micron filter. Additionally, nearly all of the uranium passed through the filter. These results support the conclusions of previous research showing that plutonium and americium move in association with particulates, while uranium is predominantly dissolved. However, these results only indicate that the plutonium and americium are associated with particles larger than 0.45 micron once they reach GS10 and are processed for submittal to the laboratory. It is still possible that plutonium and americium could reach surface water in association with sub-0.45 micron colloids, but then adsorb to other geologic materials or simply aggregate.

Additional unfiltered-filtered sample pairs may periodically be collected from seeps and surface water upstream of GS10.

- Grab samples have been collected upstream of GS10 from both seeps and surface water in an attempt to define the spatial variability of plutonium and americium activities. However, grab samples have failed to show activities similar to those measured in flow-paced composites collected at GS10. This suggests that either the source of the GS10 plutonium and americium is not affecting the grab sample locations, the source could be very close to GS10, the plutonium and americium follow a pathway that is difficult to sample (e.g., below the riprap and fill in FC-4), or the source is intermittent, such that grabs have missed the plutonium and americium, while the flow-paced composites at GS10 (with up to 100 individual grabs) have been more successful.

  Therefore, time-paced automated samplers were deployed at FC4991, FC4997, and GS10 (Figure 36; the latter is a secondary sampler located at GS10) to collect composite samples over the course of a few days. Table 28 presents the results for the May 2012 sampling event, which show very low plutonium and americium activities and give practically no indication of spatial variability (FC4991 did not provide a sample this period). Table 29 presents results for the April 2013 sampling event. Some activity is noted at FC4997, which is located in FC-4 immediately downstream from SEEP995, suggesting that SEEP995 could be contributing some plutonium and americium to GS10.

Table 28. Results for Time-Paced Composites at GS10 and FC4997: May 22–28, 2012

Analyte	FC4997 (upstream)	GS10 (downstream)
Am-241 (pCi/L)	0.005	0.005
Pu-239, 240 (pCi/L)	0.00	0.00
Uranium (µg/L)	10.4	10.6
Alkalinity as $CaCO_3$ (mg/L)	205	246
Hardness as $CaCO_3$ (mg/L)	492	517

Abbreviations:
$CaCO_3$ = calcium carbonate

Table 29. Results for Time-Paced Composites at GS10, FC4997, and FC4991: April 22–25, 2013

Analyte	FC4991 (upstream)	FC4997	GS10 (downstream)
Am-241 (pCi/L)	0.003	0.035	0.006
Pu-239, 240 (pCi/L)	0.003	0.054	0.000
Uranium (µg/L)	13.6	21.1	23.4

- A 2-week turnaround will continue to be requested for analysis of flow-paced composite samples routinely being collected at WALPOC. A 2-week turnaround is also currently being requested for analysis of flow-paced composite samples routinely being collected at GS10 and GS08.

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 of 18.8 µg/L on April 30, 2011, exceeding the applicable RFLMA Table 1 standard of 16.8 µg/L. As of December 31, 2013, the 12-month rolling average concentration for uranium was no longer reportable at 15.4 µg/L. However, given the variable nature of the uranium concentrations at GS10, the RFLMA source evaluation is continuing.

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 at http://www.lm.doe.gov/Rocky_Flats/ContactRecords.aspx.

Figure 37 shows the locations sampled in support of the evaluation for GS10.

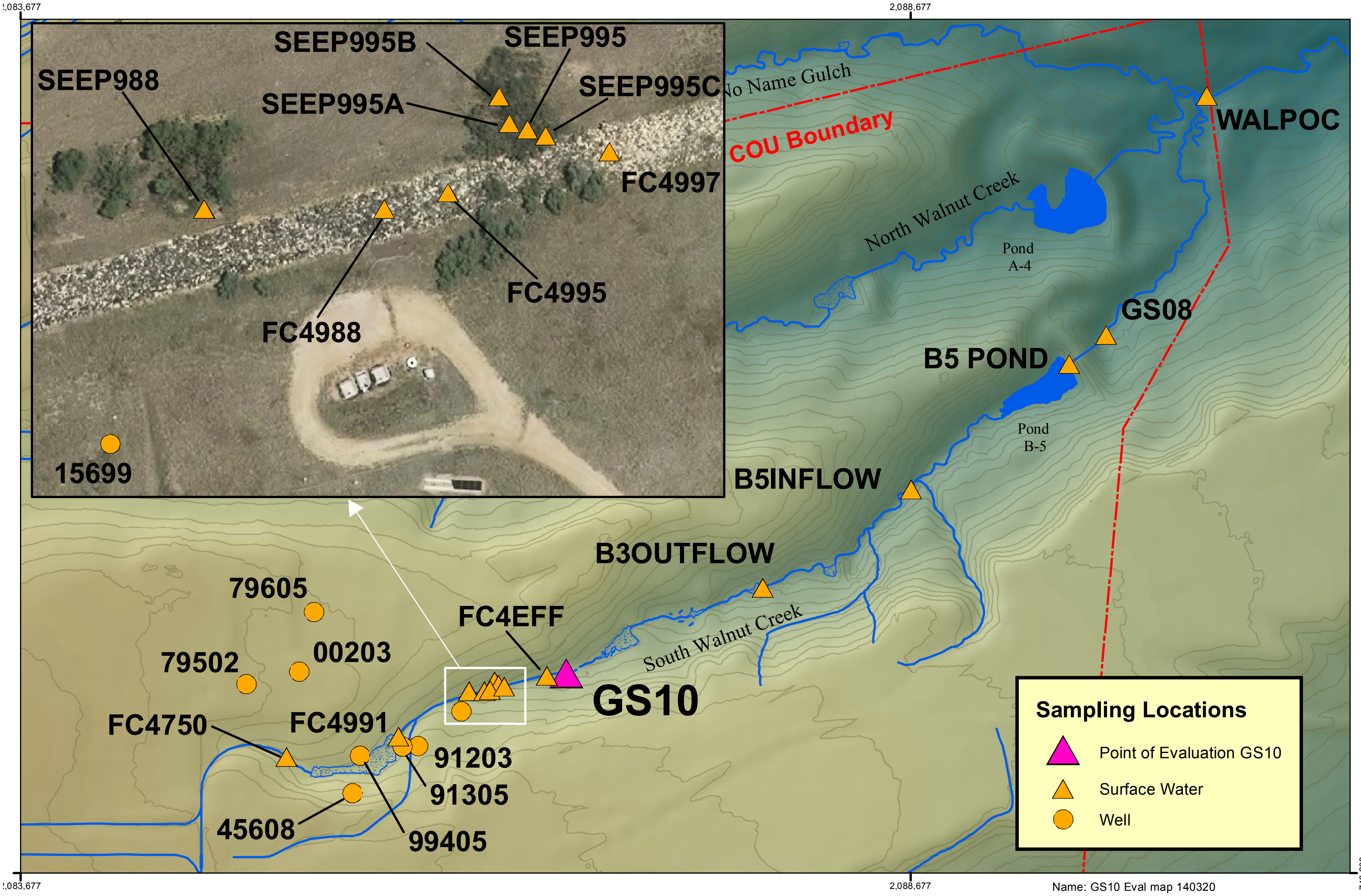


Figure 37. Location Map for Evaluation Sampling GS10 Drainage Area

The following is an update to the ongoing GS10 uranium evaluation:

- Downstream monitoring at B5INFLOW, GS08, and GS03 continue to show uranium concentrations that are generally lower than GS10 (Figure 37; GS03, which was the POC on Walnut Creek at Indiana Street through September 27, 2013, is not shown). Recent analytical results at these locations are given in Table 30. The latest available 12-month rolling and 30-day average uranium concentrations calculated from flow-paced composite samples are shown in Figure 38.

  Recently collected composite samples from WALPOC show uranium concentrations above 16.8 µg/L (see Section 3.1.2.1). However, based on uranium results from GS08 (Figure 37), these higher concentrations do not appear to be attributable to South Walnut Creek. The 12-month rolling average at the downstream POC (WALPOC) is well below 16.8 µg/L.

- Additional sampling and analysis for uranium within the GS10 drainage continues. Following the initial RFLMA Parties consultation, two temporary surface water sample locations upstream of GS10 were established for biweekly uranium grab sampling (FC4991 and FC4750; Figure 37). Biweekly grab sampling at these locations was initiated on June 30, 2011.

  These new locations supplement GS10, B3OUTFLOW, B5INFLOW, and B5 POND (Figure 37), which have been grab sampled biweekly for uranium since January 27, 2010. Data from these six locations are summarized in Table 31.

Table 30. Recent Uranium Flow-Paced Composite Sample Results

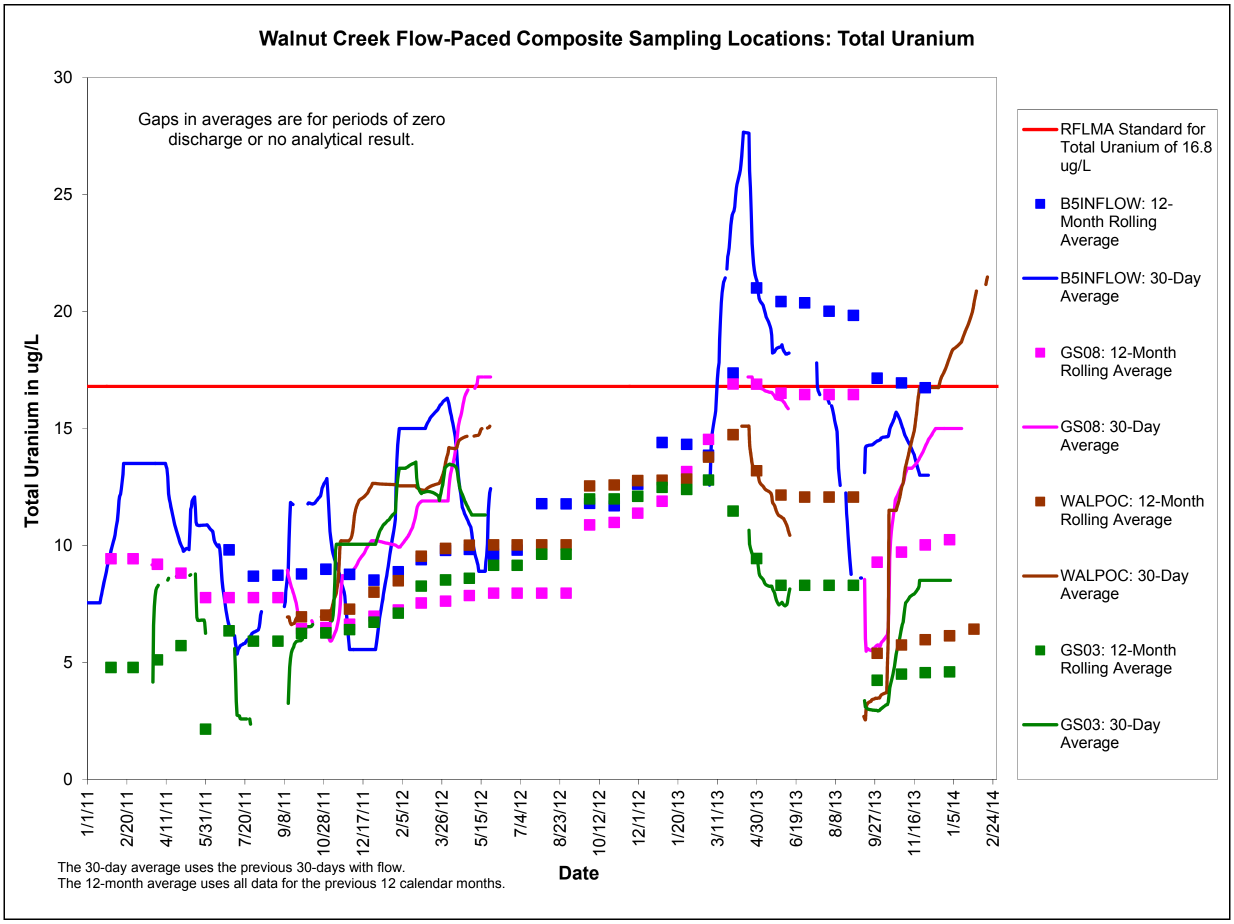
B5INFLOW		GS08		WALPOC		GS03	
Sample Period	Result (µg/L)	Sample Period	Result (µg/L)	Sample Period	Result (µg/L)	Sample Period	Result (µg/L)
11/1/2011–1/3/2012	5.6	9/27–11/9/2011	8.8	9/27–11/30/2011	10.2	9/27/2011–1/3/2012	10.1
		11/9–11/29/2011	8.5				
		11/29/2011–1/5/2012	10.2	11/30/2011–1/3/2012	12.7		
1/3–3/6/2012	15.0	1/5–2/1/2012	9.9	1/3–2/23/2012	12.6	1/3–2/10/2012	13.3
		2/1–4/4/2012	11.9			2/10–2/23/2012	13.7
				2/23–3/6/2012	12.2	2/23–2/27/2012	11.2
						2/27–3/1/2012	11.4
3/6–3/23/2012	17.4			3/6–3/21/2012	14.2	3/1–3/15/2012	13.1
3/23–4/13/2012	13.2			3/21–4/13/2012	14.1	3/15–4/4/2012	14.2
4/13–5/21/2012	8.90						
5/21/2012–3/14/2013	20.5	4/4/2012–4/25/2013	17.2	4/13/2012–4/21/2013	15.1	4/4/2012–1/15/2013	11.3
3/14–4/1/2013	27.7					1/15–4/21/2013	10.4
4/1–4/21/2013	27.6						
4/21–4/29/2013	17.8			4/21–4/29/2013	12.6	4/21–4/25/2013	9.36
		4/25–5/7/2013	16.4			4/25–4/29/2013	9.37
4/29–5/3/2013	17.9			4/29–5/3/2013	11.5	4/29–5/3/2013	7.18
5/3–5/8/2013	19.4			5/3–5/7/2013	11.3	5/3–5/7/2013	7.74
5/8–5/23/2013	18.1	5/7–6/4/2013	16.1	5/7–5/17/2013	11.4	5/7–5/17/2013	7.02
5/23–6/26/2013	18.4			5/17–6/4/2013	10.6	5/17–6/25/2013	9.03
6/26–9/11/2013	8.6	6/4–9/12/2013	7.1	6/4–9/12/2013	3.2	6/25–9/12/2013	8.9
9/11–9/16/2013	NSQ	9/12–9/14/2013	NSQ	9/12–9/13/2013	NSQ	9/12–9/14/2013	2.2
		9/14–9/15/2013	4.3	9/13–9/14/2013	2.0	9/14–10/2/2013	2.9
		9/15–9/17/2013	NSQ	9/14–9/16/2013	2.6		

Table 30 (continued). 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)
9/16–9/25/2013	14.4	9/17–9/24/2013	7.4	9/16–10/25/2013	11.5		
9/25–10/25/2013	15.7	9/24–10/9/2013	11.1			10/2–10/7/2013	4.9
		10/9–11/14/2013	13.3	10/25–12/18/2013	16.8	10/7–10/25/2013	7.1
10/25/2013–2/24/2014	13.0	11/14/2013–1/16/2014	15.0	12/18/2013–1/16/2014	18.8	10/25/2013–1/2/2014	8.51
		1/16–2/13/2014	a	1/16–2/18/2014	22.5	1/2–3/10/2014	a
2/24/2014–	b	2/13–3/10/2014	a	2/18–3/6/2014	a		
				3/6–3/10/2014	a		
		3/10/2014–	b	3/10/2014–	b	3/10/2014–	b

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

Abbreviations:
NSQ = nonsufficient quantity for analysis



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

Figure 38. Average Uranium Concentrations at Locations Downstream of GS10

Table 31. Summary of Biweekly Uranium Grab Sampling in South Walnut Creek

South Walnut Creek		**Uranium (ug/L)**			
	Location Code	**Average**	**Sample Count**	**85th Percentile**	**50th Percentile**
Upstream	FC4750	18.9	38	21.0	17.0
⬇	FC4991	15.0	43	23.7	14.0
⬇	GS10	15.1	104	22.0	15.0
⬇	B3OUTFLOW	16.4	77	23.0	17.0
⬇	B5INFLOW	14.0	72	18.5	14.0
Downstream	B5 POND	8.57	105	12.0	7.50

- As noted in previous RFLMA quarterly and annual reports, samples have been periodically sent to either Los Alamos National Laboratory (LANL) or Lawrence Berkeley National Laboratory for high-resolution isotopic analysis (Section 3.1.6). This analysis technique determines the percentages of natural and anthropogenic uranium in a sample. These percentages can be compared with percentages in pre-closure and post-closure samples previously analyzed. Table 32 summarizes uranium signature results for locations related to GS10. The locations described below are shown on Figure 37.

Table 32. Summary of High-Resolution Isotopic Uranium Results for Locations Related to GS10

Location	**Sample Date or Period**	**Uranium Concentration (µg/L)**	**Percentage Natural Uranium**
GS10	Pre–Closure Average (2 samples)	11.4	70.8%
	7/23–8/6/2007	10.1	70.5%
	10/1–10/16/2007	9.99	70.9%
	8/25–9/12/2008	15.2	66.8%
	3/17–3/24/2010	24.1	71.7%
	6/3–6/13/2011	21.6	50.6%
	8/24–9/29/2011	8.90	70.2%
	1/5–1/23/2012	49.7	52.6%
	3/6–3/21/2012	38.7	43.3%
	7/26–9/12/2012	4.20	64.3%
	4/29–5/3/2013	36.5	59.1%
	9/13–9/16/2013	5.55	70.1%
	9/24–10/16/2013	16.3	73.3%
	10/1/2013	15.4	71.2%
	10/1/2013	15.4	74.0%
	11/25/2013	23.7	71.5%
99405	Pre-Closure (1 sample)	396	99.9%
	9/12/2007	439	99.9%
	4/20/2011	411	100%
FC4750	9/28/2011	17.6	70.9%
FC4991	9/28/2011	5.0	78.3%
B5INFLOW	8/24–9/29/2011	11.7	78.5%
SEEP995A	9/30/2013	19.1	68.1%
	11/25/2013	27.8	59.7%
FC4EFF	9/30/2013	15.5	73.9%
	11/25/2013	24.9	71.2%
B3OUTFLOW	3/17/2010	19.9	74.3%
	9/27/2011	10.7	76.6%

Table 32 (continued). Summary of High-Resolution Isotopic Uranium Results for Locations Related to GS10

Location	Sample Date or Period	Uranium Concentration (µg/L)	Percentage Natural Uranium
91305	Pre-Closure (1 sample)	54.1	94.4%
	10/10/2011	39.9	90.8%
WALPOC	9/22–9/27/2011	7.60	77.4%
	9/27–11/30/2011	10.2	77.6%
	1/3–2/23/2012	12.6	79.6%
	2/23–3/6/2012	12.2	79.5%
	3/6–3/21/2012	14.2	78.4%
	4/13/12–4/21/2013	15.1	77.5%
	4/21–4/29/2013	12.6	77.8%
	5/3–5/7/2013	11.3	76.0%
	6/4–9/12/2013	3.21	76.6%
	9/13–9/14/2013	1.99	79.5%
	9/14–9/16/2013	2.55	77.5%
	9/16–10/25/2013	11.5	74.9%

- Samples from GS10 show variable percentages of natural uranium ranging from 43 percent to 74 percent. The cause of this variation is unknown at this time.
- Grab samples from upgradient well 99405 show very high uranium concentrations relative to GS10. This well consistently shows a signature of 99.9 to 100 percent natural uranium.
- Samples from FC4750, FC4991, B5INFLOW, FC4EFF, and B3OUTFLOW also show a predominantly natural uranium signature ranging from 71 percent to 79 percent.
- Samples from SEEP995A show higher concentrations of anthropogenic uranium. Since SEEP995 is locate at the downgradient end of a former utility corridor that extends to the former Solar Ponds / 700 Area, this anthropogenic uranium could originate from residual low-level contamination associated with the utility trench bedding materials.
- Grab samples from upgradient well 91305 also show high uranium concentrations relative to GS10. This well also consistently shows a signature of more than 90 percent natural uranium.
- WALPOC shows more consistent percentages of natural uranium, ranging from 75 percent to 80 percent.

• 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. These additional samples included the following:

- Wells 15699, 45608, 91305, and 91203 were grab-sampled for uranium on October 10–11, 2011.
- Wells 00203, 79502, and 79605 were grab-sampled for uranium and nitrate+nitrite as nitrogen on October 6, 2011. Nitrate+nitrite was included as an indicator of potential contributions from the Solar Ponds Plume area.

- GS10 and hillside seep locations SEEP988 and SEEP995 were also grab-sampled for uranium and nitrate + nitrite as nitrogen on September 28–29, 2011.
- Many of the samples collected in support of the GS10 Pu and Am evaluation are also being analyzed for both uranium and nitrate+nitrite as N.

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 28). The southern portion of the COU contributes flow to SW027 through the SID.

Table 33 shows automated composite sampling information collected during September 2013. It should be noted that the sampler was full and did not collect any water for the period 9/12/2013 12:21 to 9/13/2013 13:17. Therefore, no analytical results are available for this period and, in accordance with routine evaluation protocols, this period is not included in the calculation of 12-month rolling averages.

Table 33. September 2013 Composite Sampling Detail for POE SW027

Sampling Period	Number of Grabs	Sample Results			Flow Volume (MG)	Flow Rates (cfs)	Comments
		Am-241 (pCi/L)	Pu-239, 240 (pCi/L)	Uranium (µg/L)			
2/4/2013 11:38–9/12/2013 12:21	109	0.026	0.108	1.91	0.24	0–3.5	Sampler filled 9/12/2013 12:21.
9/12/2013 12:21–9/13/2013 13:17	0 NSQ	NA	NA	NA	5.1 (est)	0.8–28.4 (est)	Sampler full from 9/12/2013 12:21–9/13/2013 13:17
9/13/2013 13:17–10/3/2013 17:49	47	0.014	0.126	1.98	1.0	0–4.6	

Abbreviations:
est = estimated
MG = million gallons
NA = not analyzed
NSQ = nonsufficient quantity for analysis

Table 34 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 Site closure and reduced runoff, transport of Pu and Am has been significantly reduced. The annual average total U concentrations are well below the RFLMA standard of 16.8 µg/L.

Table 34. Annual Volume-Weighted Average Radionuclide Activities at SW027 for 1997–2013

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[a]	NA (no analytical data)	NA (no analytical data)	NA (no analytical data)
2012	NA (no flow)	NA (no flow)	NA (no flow)
2013	0.014	0.126	1.98
Total (1997–2013)	0.055	0.302	3.10

Notes:

[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.

Abbreviations:

NA = not applicable.

Figure 39 and Figure 40 show no reportable Pu, Am, or total U values during the year.

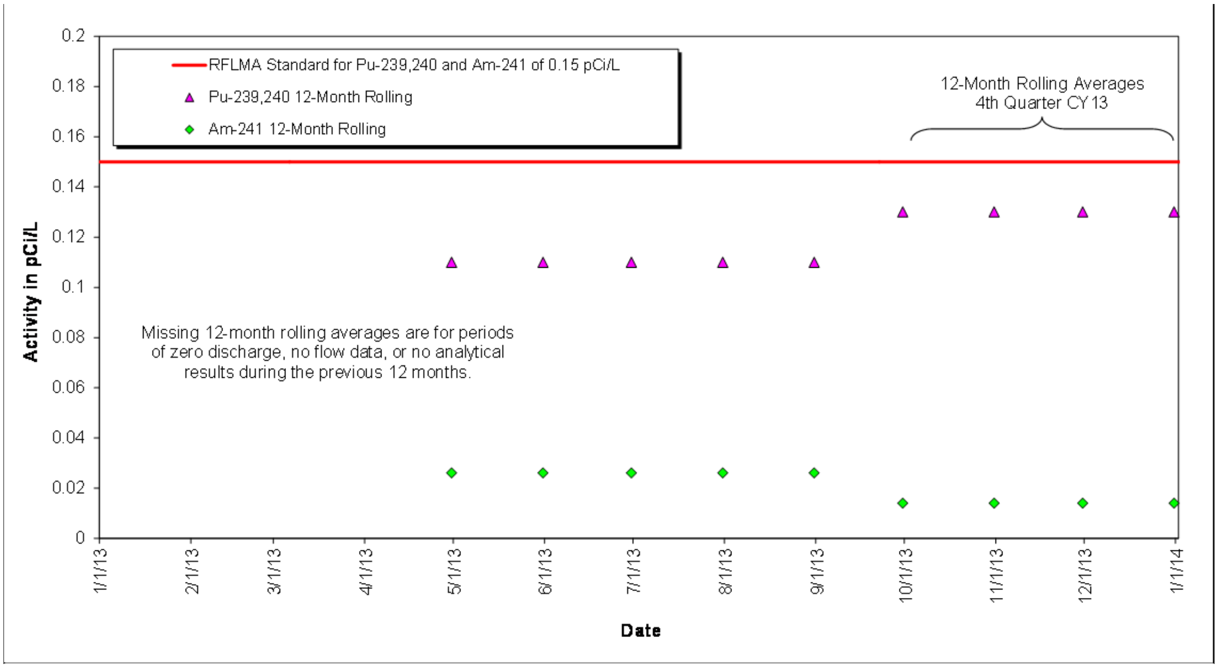


Figure 39. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at SW027: Year Ending Fourth Quarter CY 2013

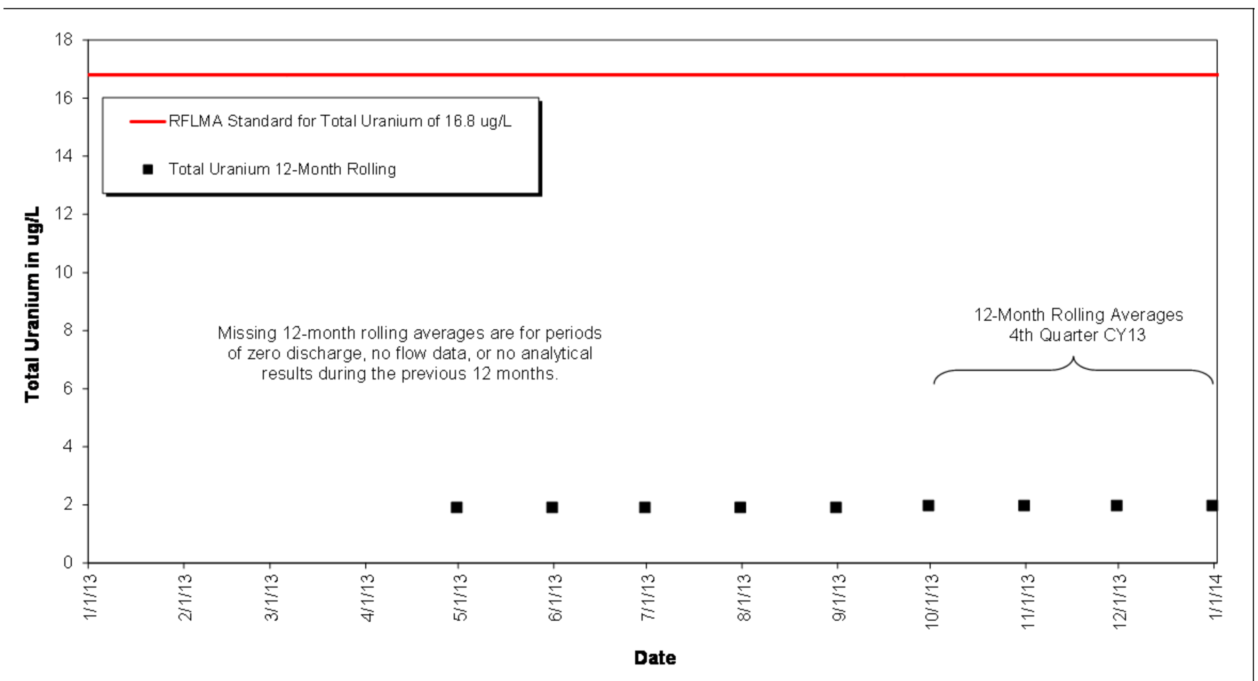


Figure 40. Volume-Weighted 12-Month Rolling Average Total U Concentrations at SW027: Year Ending Fourth Quarter CY 2013

Figure 41 and Figure 42 show 12-month rolling averages for the entire post-closure period. Figure 43 presents the volume-weighted average metals compliance values at SW027.

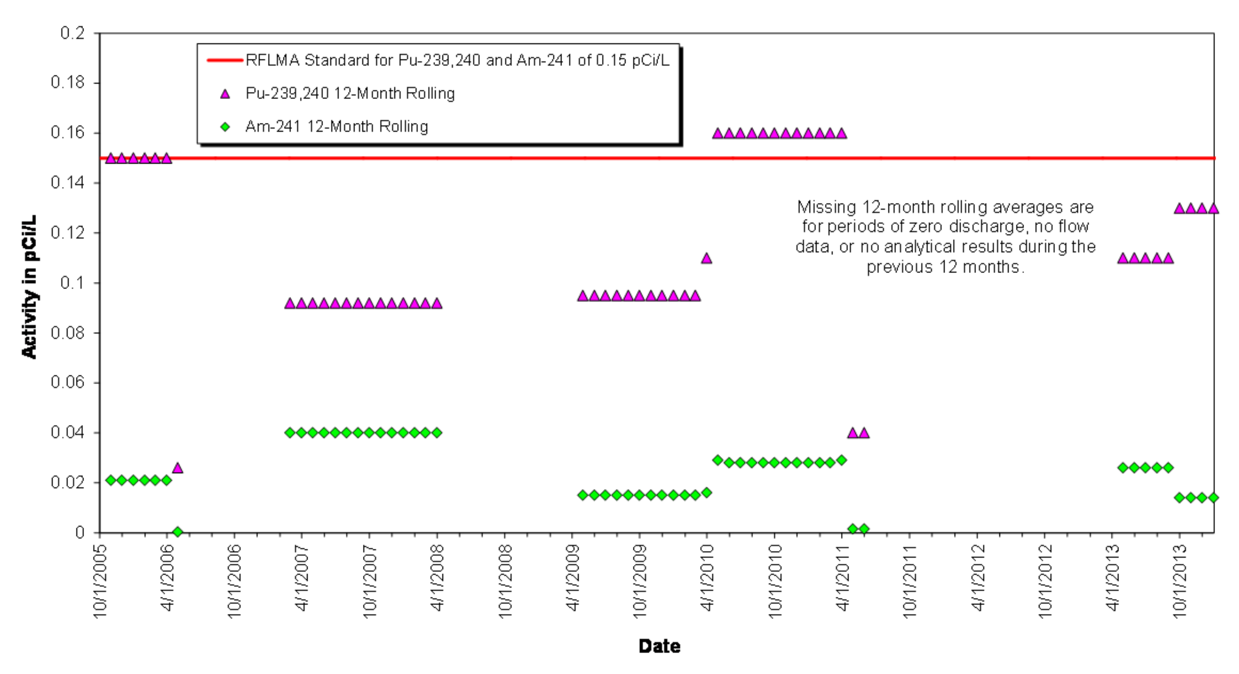


Figure 41. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at SW027: Post-Closure Period

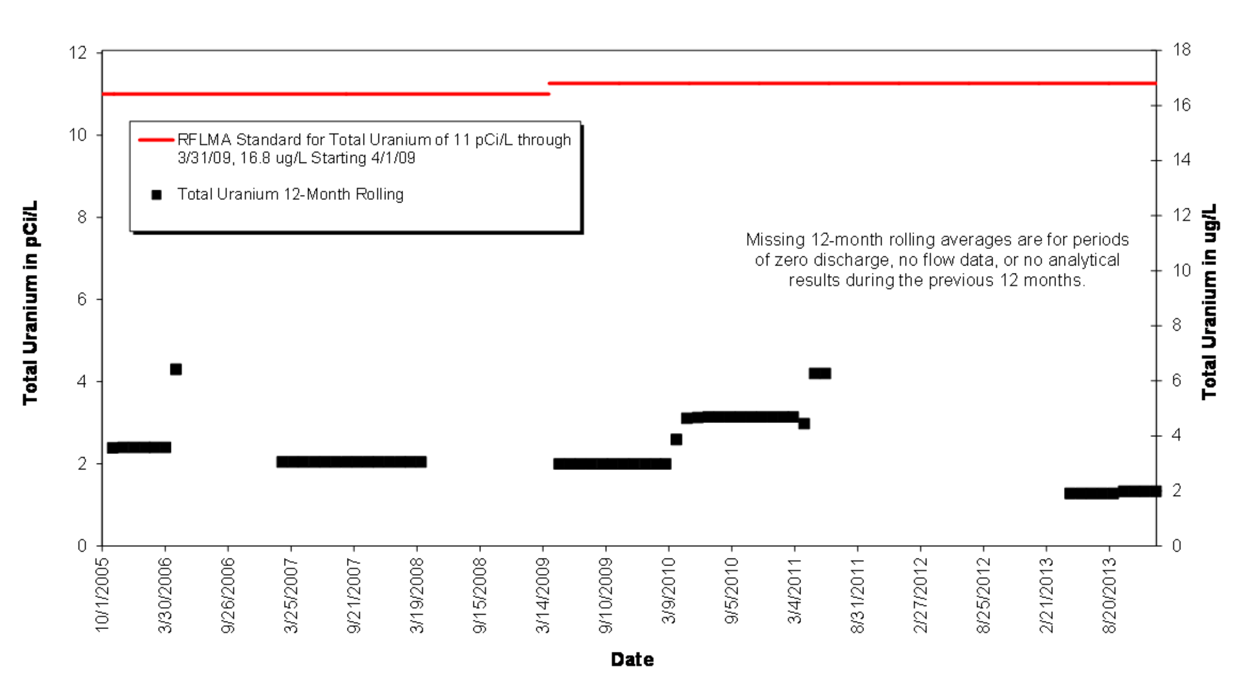


Figure 42. Volume-Weighted 12-Month Rolling Average Total U Concentrations at SW027: Post-Closure Period

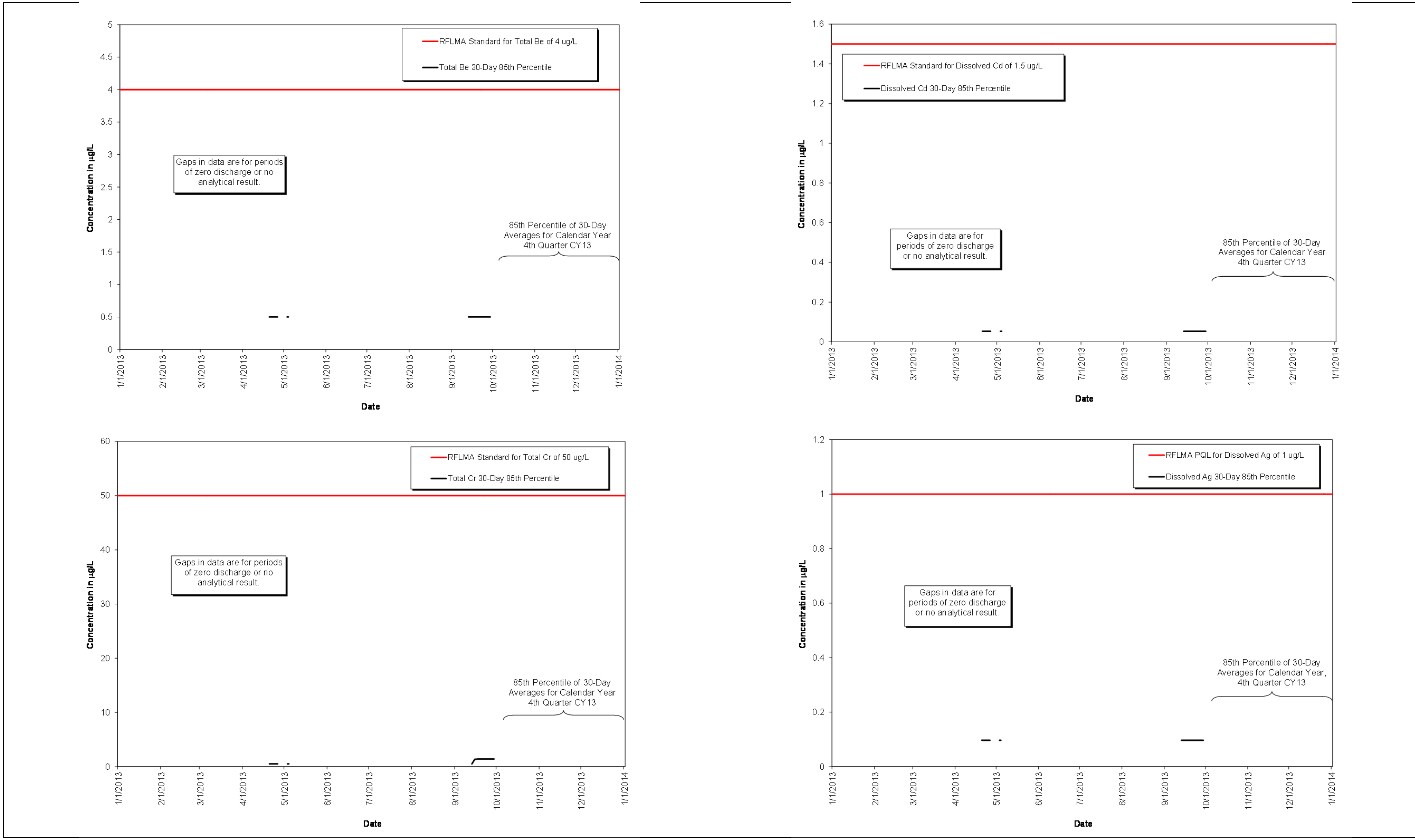


Figure 43. Volume-Weighted Average Metals Compliance Values at SW027: Year Ending Fourth Quarter CY 2013

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Table 35 shows that all of the annual average metals concentrations are less than the standards/PQLs. Additionally, the long-term metals averages (1997–2013) are less than the standards/PQLs.

Table 35. Annual Volume-Weighted Average Hardness and Metals Concentrations at SW027 for 1997–2013

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]
2012	NA (no flow)	NA (no flow)	NA (no flow)	NA (no flow)	NA (no flow)
2013	126	0.50	0.06	1.44	0.10
Total (1997–2013)	138	0.23	0.08	2.18	0.16

Notes:
[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.

Abbreviations:
Ag = silver
Be = beryllium
Cd = cadmium
NA = not applicable.

Location SW093

Monitoring location SW093 is located on North Walnut Creek 1,300 feet upstream of the A-Series Ponds (Figure 28). The northern portion of the COU contributes flow to SW093 through FC-2 and FC-3.

Table 36 shows automated composite sampling information collected during September 2013. It should be noted that the sampler was full and did not collect any water for the period 9/11/2013 20:17 to 9/15/2013 11:01. Therefore, no analytical results are available for this period and, in accordance with routine evaluation protocols, this period is not included in the calculation of 12-month rolling averages.

Table 36. September 2013 Composite Sampling Detail for POE SW093

Sampling Period	Number of Grabs	Sample Results			Flow Volume (MG)	Flow Rates (cfs)	Comments
		Am-241 (pCi/L)	Pu-239, 240 (pCi/L)	Uranium (µg/L)			
7/23/2013 12:28–9/11/2013 20:17	110	0.031	0.011	2.88	1.7	0–10.2	Sampler filled 9/11/2013 20:17
9/11/2013 20:17–9/15/2013 11:01	0 NSQ	NA	NA	NA	43.3 (est)	0.7–136 (est)	Sampler full from 9/11/2013 20:17 to 9/15/2013 11:01
9/15/2013 11:01–9/19/2013 12:34	58	0.018	0.0	5.33	4.3	0.3–17.5	
9/19/2013 12:34–10/15/2013 14:15	63	0.003	0.002	12.1	3.6	0.1–2.3	

Abbreviations:
est = estimated
MG = million gallons
NA = not analyzed
NSQ = nonsufficient quantity for analysis

Table 37 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 (1997–2013) are below 0.15 pCi/L. The average annual total U concentrations are also below the RFLMA standard of 16.8 µg/L.

Table 37 shows 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 transport of Pu and Am having been virtually eliminated. Figure 44 and Figure 45 show no reportable Pu, Am, or total U values during the year.

Table 37. Annual Volume-Weighted Average Radionuclide Activities at SW093 for 1997–2013

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
2012	0.003	0.002	6.91
2013	0.006	0.003	6.71
Total (1997–2013)	0.062	0.067	4.33

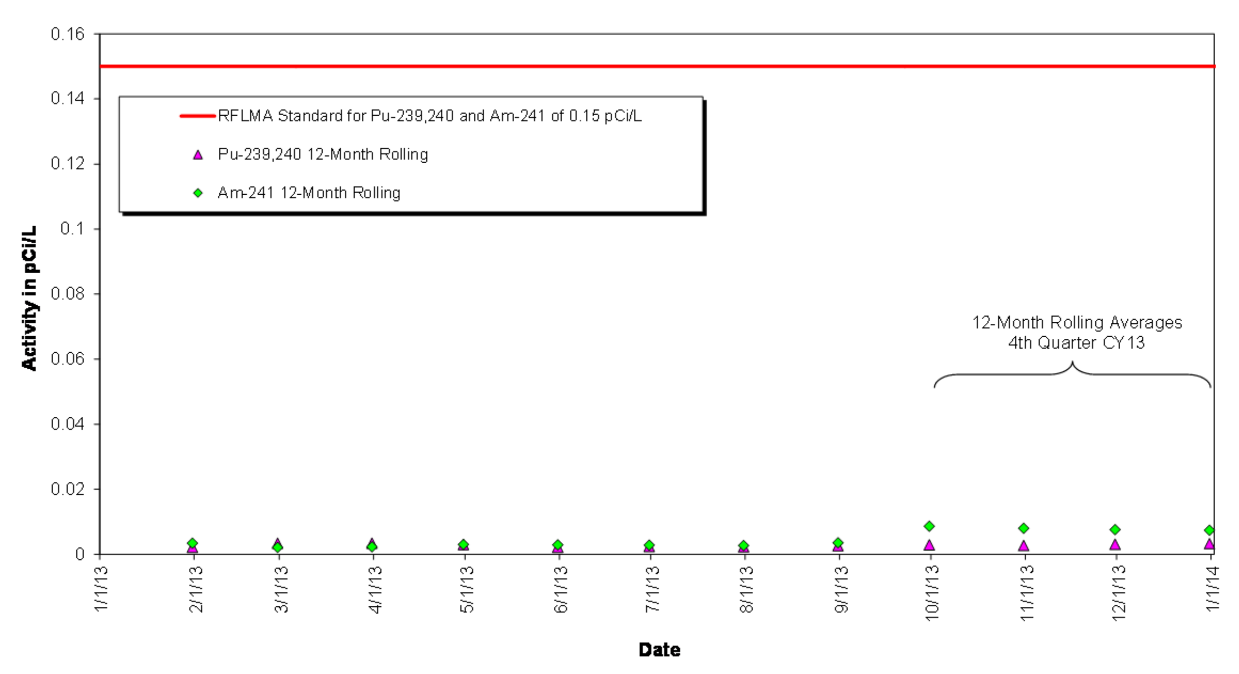

Figure 44. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at SW093: Year Ending Fourth Quarter CY 2013

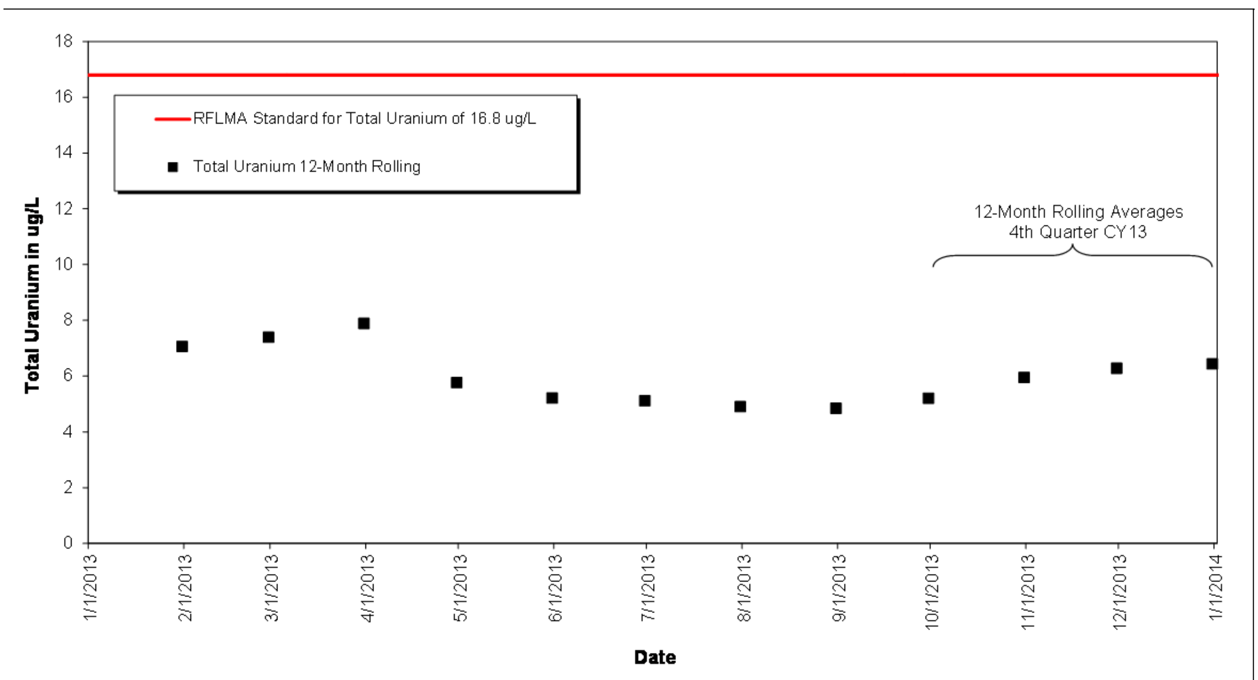

Figure 45. Volume-Weighted 12-Month Rolling Average Total U Concentrations at SW093: Year Ending Fourth Quarter CY 2013

Figure 46 and Figure 47 show 12-month rolling averages for the entire post-closure period.

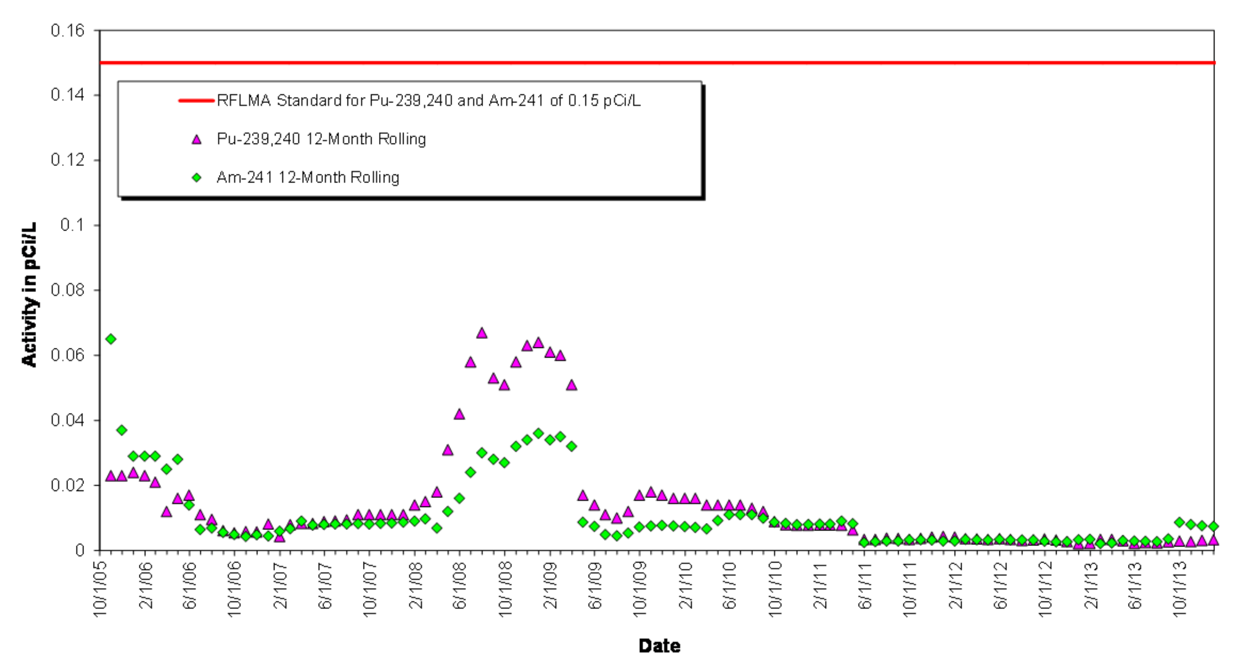

Figure 46. Volume-Weighted 12-Month Rolling Average Pu and Am Activities at SW093: Post-Closure Period

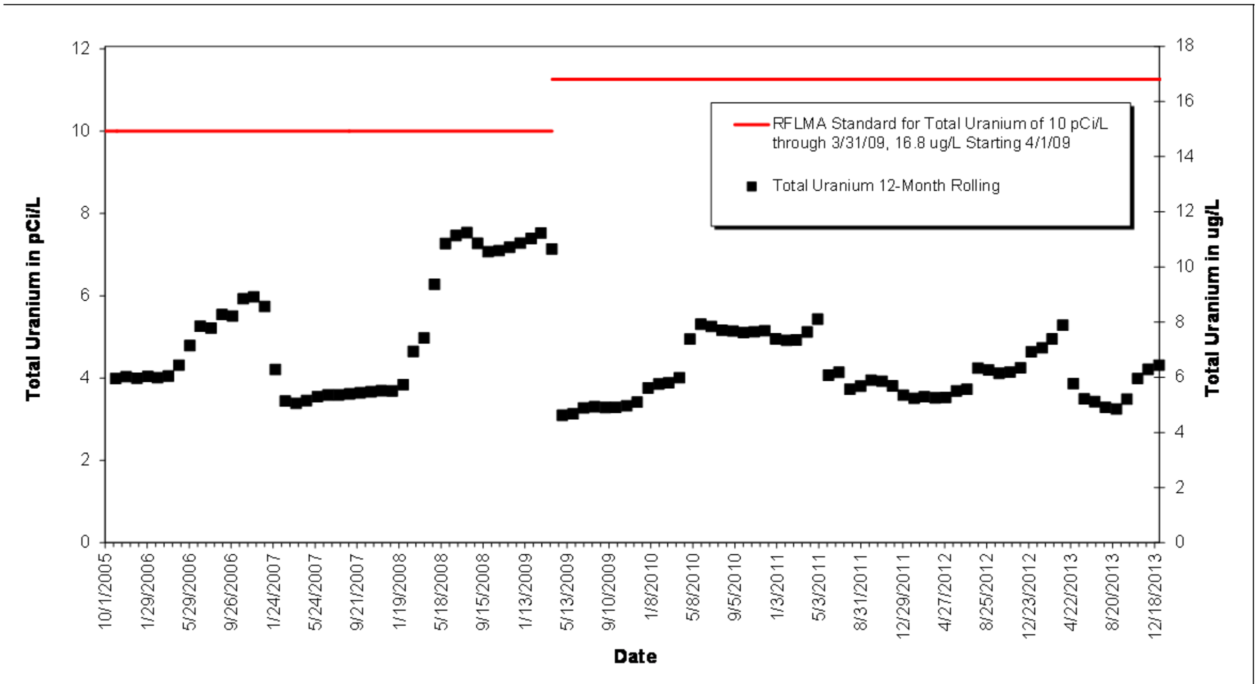

Figure 47. Volume-Weighted 12-Month Rolling Average Total U Concentrations at SW093: Post-Closure Period

Table 38 shows that all of the annual average metals concentrations are less than the standards/PQLs. Additionally, the long-term metals averages (1997–2013) are less than the standards/PQLs. Figure 48 shows that none of the 85th percentile 30-day average metals concentrations were reportable for the year.

Table 38. Annual Volume-Weighted Average Hardness and Metals Concentrations at SW093 for 1997–2013

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
2012	373	0.50	0.07	0.64	0.10
2013	302	0.50	0.10	0.58	0.10
Total (1997–2013)	254	0.35	0.10	3.99	0.13

Abbreviations:
Ag = silver
Be = beryllium
Cd = cadmium

3.1.2.3 AOC Wells and SW018

AOC wells (Table 39 and Figure 49) 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 39. 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 former 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 former Landfill Pond area	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 former Landfill Pond area	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 inline 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).

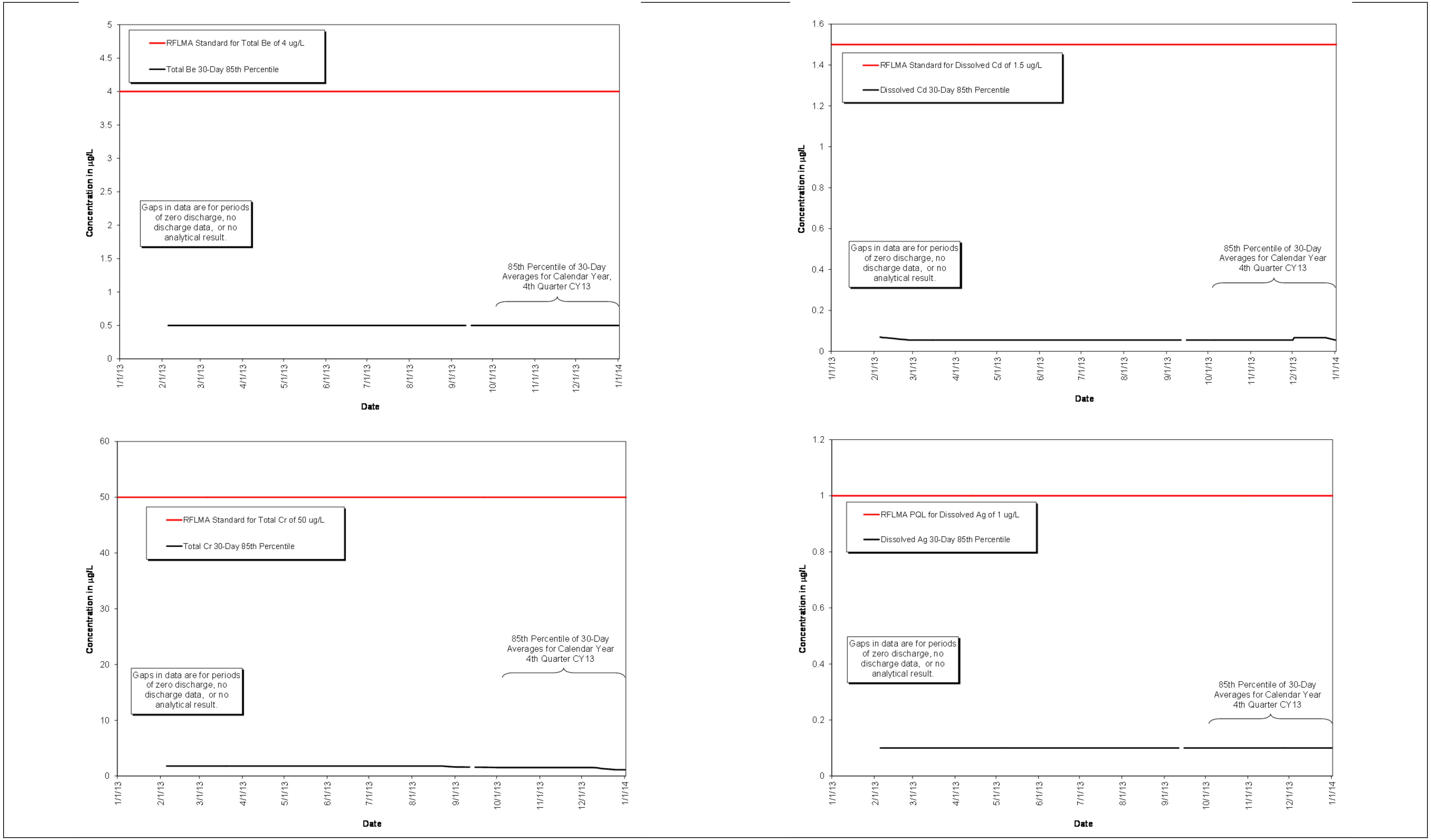

Figure 48. Volume-Weighted Average Metals Compliance Values at SW093: Year Ending Fourth Quarter CY 2013

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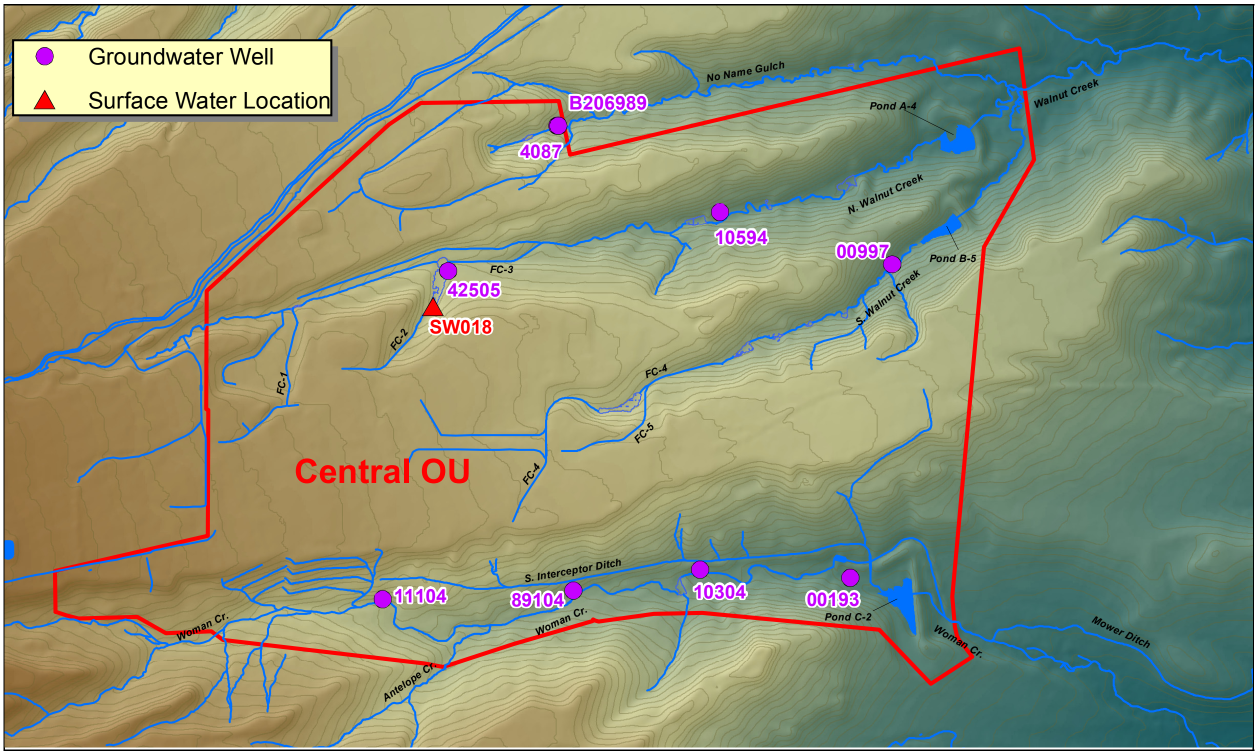


Figure 49. AOC Wells and SW018 Locations

Data Evaluation

All AOC wells and SW018 were scheduled for routine monitoring in the fourth quarter of CY 2013. No decision criteria were triggered by the associated analytical results (Appendix B), which were generally consistent with previous data. Monitoring will continue as prescribed in RFLMA (CDPHE et al. 2012).

A reportable condition was encountered for AOC well B206989 in August 2007 (see RFLMA Contact Record 2007-06) due to elevated concentrations of nitrate in groundwater samples from this well. The fourth-quarter 2013 result was 3.5 mg/L, the same as was reported in the second-quarter 2013 sample. This is the lowest concentration of nitrate reported at this location over the period of record (i.e., since 2000). Each of the last seven nitrate results, representing samples collected from the fourth quarter of 2010 through the end of 2013, 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. Consistent with the results obtained in the years since 2009, the 2013 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 for additional discussion.

3.1.2.4 Sentinel Wells

Sentinel wells (Table 40 and Figure 50) 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 with those from Evaluation wells and are used to determine when monitoring can be ended and when additional remedial work should be considered.

Table 40. 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 Building 444 (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 Building 771 (B771)/Building 774 (B774) 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/B774 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 Building 371 (B371)/ Building 374 (B374) 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/B374 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

Table 40 (continued). Sampling and Data Evaluation Protocols at Sentinel Wells

Location Code	Location Description	Sample Types/Frequencies	Analytes[a]	Data Evaluation
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
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 Individual Hazardous Substance Site 118.1 area	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	VOCs	See Figure 8 in Appendix D
70099	Northwest (sidegradient) 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 #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 Building 991 (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 the Solar Ponds Plume	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 inline filter.
Nitrate is analyzed as nitrate+nitrite as nitrogen; this result is conservative compared to the nitrate standard only.

Abbreviations:
B371 = former Building 371
B374 = former Building 374
B444 = former Building 444
B771 = former Building 771
B774 = former Building 774
B881 = former Building 881
B991 = former Building 991

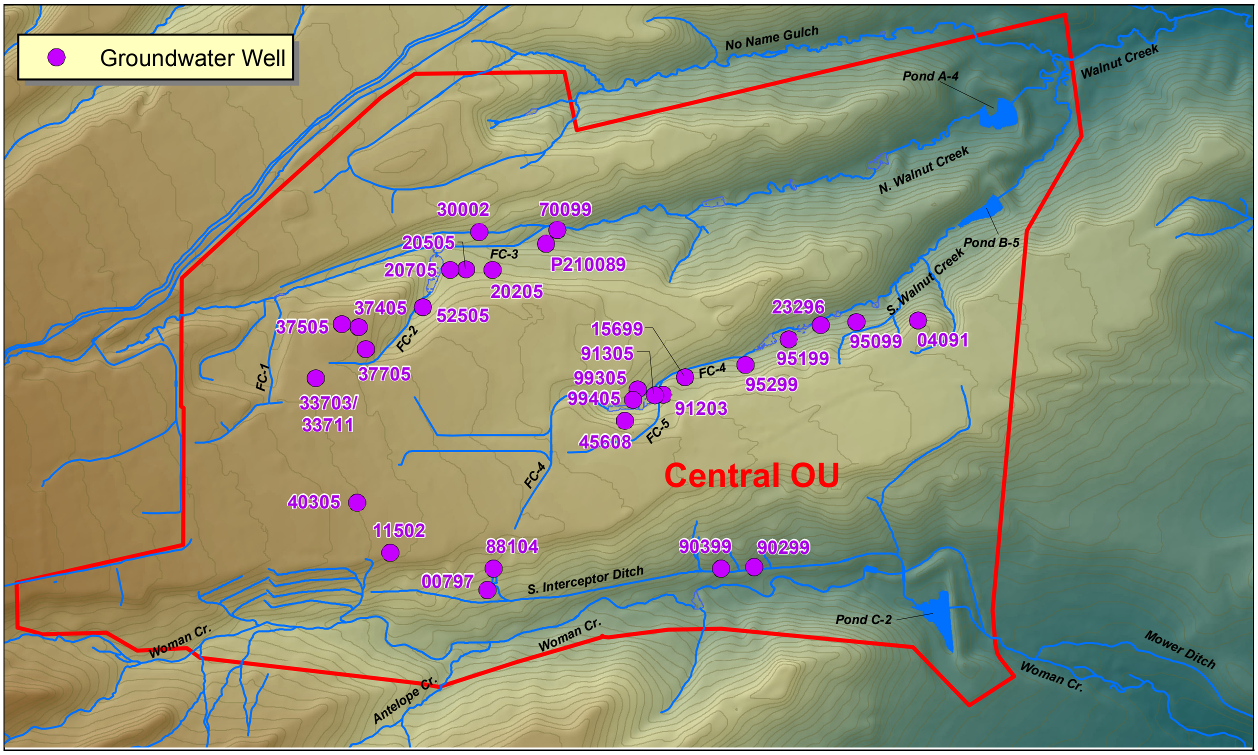


Figure 50. Sentinel Well Locations

Data Evaluation

All Sentinel wells were monitored in the fourth quarter of CY 2013 (refer to Appendix B for analytical results). Analytical data are generally consistent with previous results. Refer to Section 3.1.5 for discussion of Sentinel well data, including statistical results, and Appendix B for trend plots.

3.1.2.5 Evaluation Wells

Evaluation wells (Table 41 and Figure 51) 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 be stopped, 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 41. 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 Individual Hazardous Substance Site (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 Building 776/ Building 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
22996	East/northeast part of former Building 886 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	Oil Burn Pit (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 Building 444 (B444) area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs	See Figure 9 in Appendix D
40205	South part of former B444 area	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 Building 559 (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 Building 707 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

Table 41 (continued). Sampling and Data Evaluation Protocols at Evaluation Wells

Location Code	Location Description	Sample Types/Frequencies	Analytes[a]	Data Evaluation
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 Building 881 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 Building 551 Warehouse area	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U	See Figure 9 in Appendix D
P208989	SPP source area—north	Biennial grabs; second calendar quarter (high-water conditions)	VOCs, U, nitrate	See Figure 9 in Appendix D
P210189	Solar Evaporation Pond 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 inline filter.
Nitrate is analyzed as nitrate+nitrite as nitrogen; this result is conservatively compared to the nitrate standard only.

Abbreviations:
B444 = former Building 444
B559 = former Building 559
IHSS = Individual Hazardous Substance Site
OBP = Oil Burn Pit
PU&D = Property Utilization and Disposal

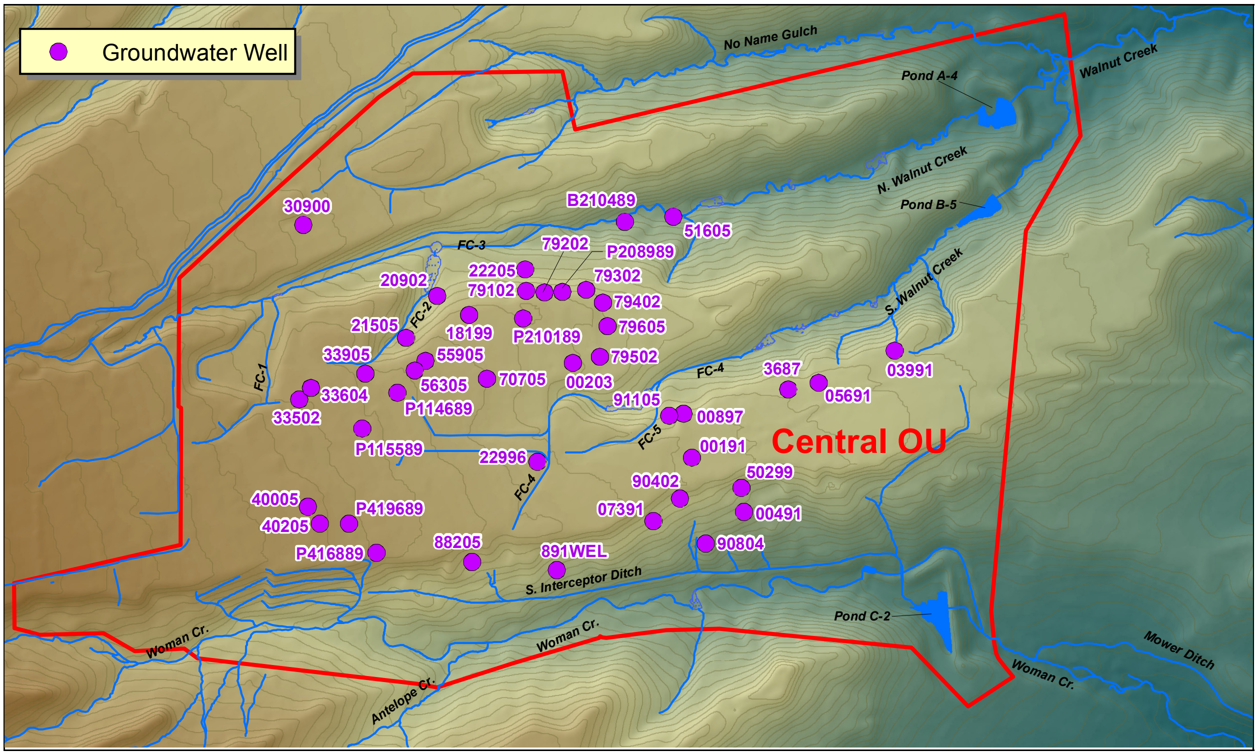


Figure 51. Evaluation Well Locations

Data Evaluation

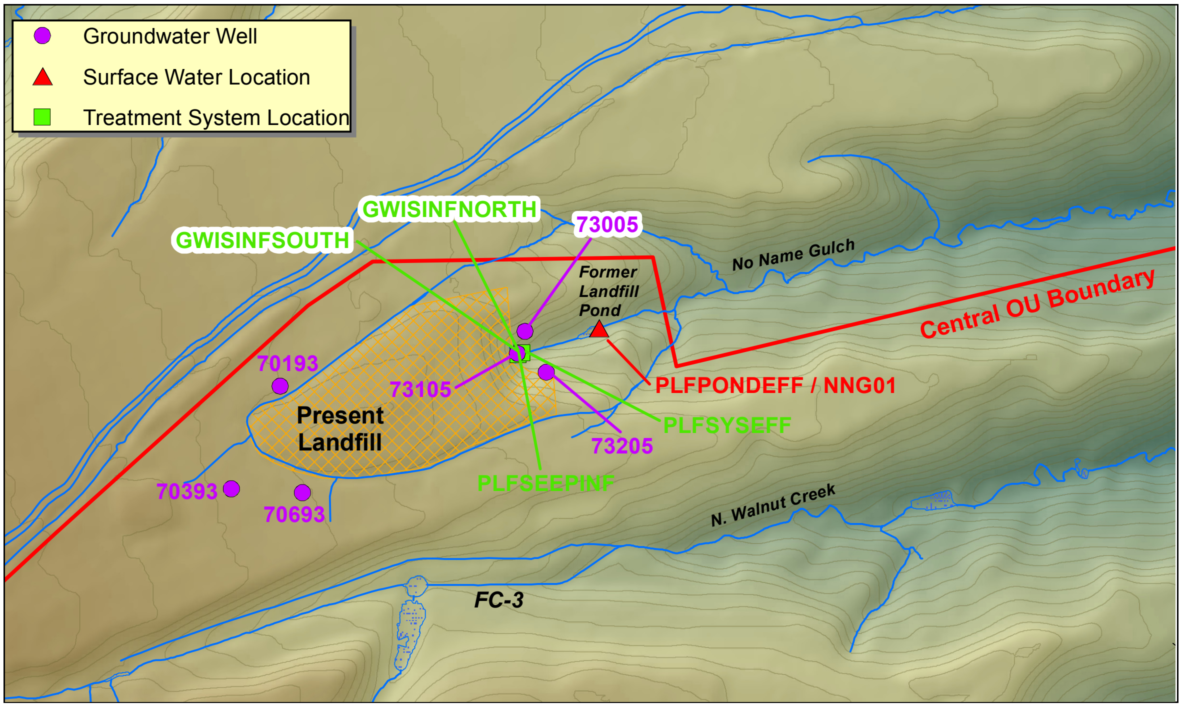
Evaluation wells were not scheduled for RFLMA monitoring in the fourth quarter of 2013. However, selected Evaluation wells were sampled in that quarter to investigate effects from the heavy precipitation in September 2013. Analytical data are generally consistent with previous results. Refer to Section 3.1.5 for discussion of Evaluation well data, including statistical results, and to Appendix B for analytical data and trend plots.

3.1.2.6 PLF Monitoring

The PLF is located in the COU just north of the former Industrial Area (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 52. The surface-water and treatment system monitoring requirements deal specifically with the PLFTS and are discussed in detail in Section 3.1.2.8. Details regarding the 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 former Landfill Pond area. 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.



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

Figure 52. PLF Monitoring Locations

Sampling and data evaluation protocols for the RCRA wells at the PLF are provided in Table 42.

Table 42. 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 inline 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 2013. Results are included in Appendix B.

This section presents the evaluation of the PLF groundwater quality data for all of CY 2013. Monitoring performed in 2013 at the PLF RCRA wells is summarized in Table 43.

Table 43. RCRA Groundwater Sampling Performed in 2013 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 (CDPHE et al. 2012) 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. (The PU&D Yard Plume is discussed separately later in this report.)

Statistical evaluation of the analytical data from the PLF was performed using all valid, nonrejected 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 2013). The data were also assessed for trends, again using Sanitas and the S-K trending method in keeping with the findings of previous studies that indicated this is the most appropriate method 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. As in previous years, all of these constituents are metals. Also consistent with previous years, these ANOVA results must be considered carefully, as quite a few of the statistical conclusions may not be valid due to the presence of numerous nondetects and/or estimated concentrations in the dataset. Table 44 summarizes the ANOVA conclusions for 2013. These results are identical to those reported for 2012 (DOE 2013b) and almost identical to those reported for prior years (DOE 2010b, DOE 2011c, DOE 2012).

Table 44. Results of Groundwater ANOVA Evaluation for 2013 at the PLF

Analyte	73005	73105	73205
Boron	x (est)	x	X
Cadmium			x (U, est)
Chromium	x (U, est)		
Copper			x (U, est)
Nickel		x (U, est)	x (U, est)
Selenium	x (est)		x
Uranium	x (est)	x (est)	x
Zinc		x (est)	

Notes: 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.

As mentioned above and flagged in Table 44, the analytical data sets include many nondetects and estimated concentrations. (Results with a J qualifier are defined as estimated; the B qualifier may indicate the constituent was also identified in the blank, or that the result is greater than the method detection limit but less than the practical quantitation limit. As such, B-qualified data may also be interpreted as estimated quantities.) The accumulating, qualified data (i.e., flagged as nondetect or with a J or B) is what has led to the addition to this table of several metals over the years since 2007, including cadmium (Cd), Cr, copper (Cu), nickel (Ni), and zinc (Zn). In fact, the statistical results for Cd at well 73205, Cr at well 73005, Cu at well 73205, Ni at wells 73105 and 73205, and Zn in samples from 73105 are based on data sets containing *only* qualified data; not a single result is unqualified. In addition, the statistical outcome for selenium (Se) at well 73005 is based on a data set in which more than three quarters of the results are qualified. Of those analyte-well pairs listed in Table 44, only the data for boron (B), U, and Se at well 73205 are based on data sets in which at least half the results are unqualified.

Changes to detection limits represent another complication with respect to performing and interpreting the results of statistical evaluations and the associated summary presented in Table 44 above. The detection limits for Cr and Ni have decreased since mid-2008. Prior to that date, the corresponding results were consistently nondetect; since that date, results have fallen between the older and newer detection limits, and are consistently qualified as estimated. The data replacement approach used for nondetects in such cases leads to an appearance of consistently low values (0.001, to be specific) when the constituent was not detected under the older detection limit, followed by detections at estimated concentrations that are higher than the replacement value of 0.001. This can affect the outcome of the ANOVA assessment as well as the calculated trends (as indicated previously; see Figure 6 and related discussion for an example). 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 and trending determinations.

Sections 3.1.1.2 and 3.1.5 provide more detailed discussions of statistical trend testing using the S-K method. The results of these statistical calculations for the downgradient PLF wells are summarized below in Table 45. The statistical calculations in Table 45 are almost identical to statistical trending results of previous years. The difference in 2013 compared to 2012 is that a 95-percent level of confidence is now calculated for B for all three downgradient wells;

previously, this was not the case at well 73005. Increasing trends of the same statistical significance are calculated for Cr and Se in groundwater at well 73005, and for Ni in groundwater at well 73105, although the trends for Cr and Ni may not be valid, as noted above in the discussion on the ANOVA results. (Additional information and summary results of trend testing are provided in subsequent sections of this report; see also Appendix B for statistical output, including trend plots.)

Table 45. Results of Groundwater S-K Trend Testing for 2013 at the PLF Downgradient Wells

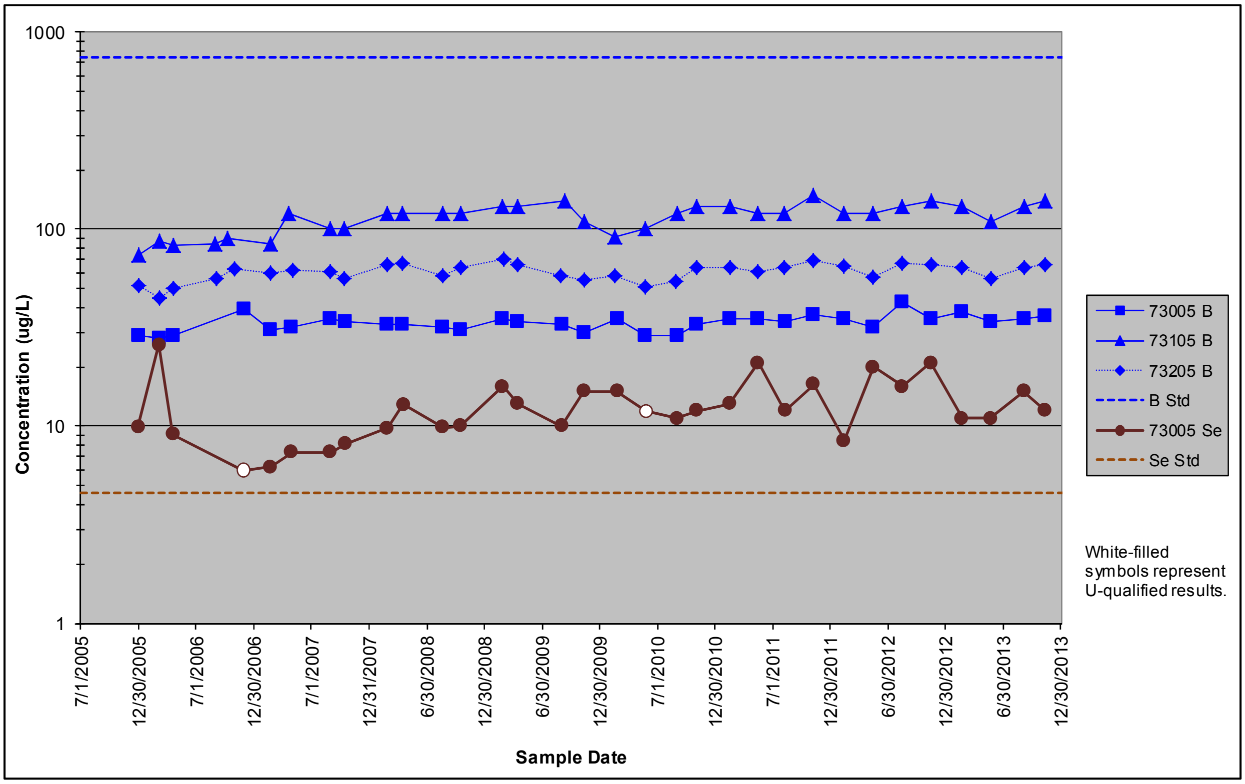
Analyte	73005	73105	73205
B	x (est)	x	x
Cr	x (U, est)		
Ni		x (U, est)	
Se	x (est)		

Notes: 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.

Note that statistically significant trends are also calculated for some constituents in groundwater from upgradient wells. For example, B is suggested as increasing in wells 70193 and 70693 at lower levels of statistical confidence. In each of these cases, the calculated trends are almost certainly affected by the numerous qualified data, including nondetects and estimated results. Identification of statistical trends in upgradient RCRA well data is not required by the RFLMA, but was performed for informational purposes. These trend results are summarized later in this report. In addition, U in well 73105 is suggested to be on a decreasing trend with a statistical significance of 95 percent. Again, uranium data for this well include numerous estimated values.

As discussed above and indicated in Table 44 and Table 45, the data for several of these constituents largely represent nondetects and/or estimated values. As explained in Section 3.1.1.2 and illustrated in Figure 6 (which uses Cr in well 73005 as the example), data replacement can strongly affect the calculated trend of a constituent represented by a data set that includes numerous nondetects. Because this is the case with the Cr at well 73005 and Ni at well 73105, the calculated trends for those constituents may not be viable. Also, as discussed above, the change in detection limits may be another factor in these suggested trends.

Figure 53 presents a time-series plot of B in all three downgradient wells, and Se in 73005. Note that nondetects are called out, but estimated values are not plotted differently. (Plots of Cr in 73005 and Ni in 73105 are not included because of the numerous nondetects. However, all calculated trend plots are provided in Appendix B.) Concentrations of B are well below their associated RFLMA Table 1 standard, but Se in well 73005 is above the corresponding RFLMA standard. Although the data set for Se at 73005 contains a large number of estimated results, the unqualified detections are consistently similar in concentration to the results reported as estimated, suggesting the estimated data are representative.



Notes: Constituents and corresponding RFLMA standards (CDPHE et al. 2012): B = boron, 750 µg/L; Se = selenium, 4.6 µg/L. This figure shows only those analyte-well combinations that were (1) identified in the ANOVA evaluation of PLF groundwater data as having statistically significant higher concentrations in the downgradient RCRA well (as listed in Table 44), (2) on an increasing concentration trend at the 95% level of significance (Table 45), and (3) predominantly represented by detections. The nondetects are highlighted, but numerous other results were qualified but are not shown differently for the sake of simplicity. Note the logarithmic concentration scale.

Figure 53. Consistently Detected Constituents Meeting Both ANOVA and Trending Decision Criteria at the PLF Through 2013

The highest reported concentration of Se in samples from well 73005 collected in 2013 was 15 µg/L; the associated RFLMA Table 1 value is 4.6 µg/L. The highest concentration of B in any of these three downgradient wells was 140 µg/L (the RFLMA Table 1 value is 750 µg/L). The highest reported concentration of Cr at well 73005 in 2013 was estimated at 2.3 µg/L (the RFLMA Table 1 value is 50 µg/L). Ni in well 73105 was estimated at up to 3.4 µg/L (RFLMA Table 1: 123 µg/L). Therefore, of these constituents only the Se in well 73005 exceeded RFLMA values.

As in most other years, no VOCs were detected in samples from downgradient PLF RCRA wells in 2013.

The constituents identified via the ANOVA statistical evaluation are all found in natural settings, and the statistical results summarized above—irrespective of issues with nondetects and estimated values—may not reflect the presence of contaminants related to the PLF. For example, B is present in evaporite minerals, metamorphic minerals, and in coals and similar deposits of carbonaceous fossilized organic matter. Lithologic logs from some of these wells (including one upgradient and all three downgradient) 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 groundwater 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.

RFLMA Attachment 2 states that if a constituent is found to be present at a statistically significant higher concentration in a downgradient well than in the upgradient wells (i.e., results of ANOVA analysis), *and* is on an increasing trend (S-K trending results), then consultation is triggered. Both of these conditions are met for the wells and constituents listed in Table 45: B in all three wells, Cr and Se in well 73005, and Ni in well 73105.

Many of these same statistical conclusions have been reached in previous years; for example, see the 2009, 2010, 2011, and 2012 Annual Reports (DOE 2010b, 2011c, 2012, 2013b). The consultative process has been initiated in response (for example, see Contact Record 2010-05). In accordance with Contact Record 2011-03, the 2012 consultation on April 5, 2012, did not generate a new contact record. Similarly, consultation was held on March 13, 2013, regarding the results of statistical evaluations of the 2012 groundwater data, and concluded that no response action was required, and no modification of RFLMA monitoring is needed. After reviewing the results of statistical evaluation of the 2013 groundwater data presented in this annual report the RFLMA Parties may decide that subsequent consultation regarding the appropriate response is required. Such consultation, if it occurs, will be documented in a new contact record (Contact Record 2011-03).

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 8 years of data as of the end of 2013. Therefore, although CERCLA reviews were conducted in 2007 and 2012, such a comparison cannot properly 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.) As noted above, data from the downgradient RCRA wells in 2013 showed no detections of VOCs.

Groundwater flow at the PLF is strongly affected by the Groundwater Intercept System (GWIS), which is designed to divert 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 sidegradient perimeter of the PLF and acts to isolate groundwater within the PLF from groundwater outside of 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.

3.1.2.7 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 2005), 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 54. Sampling and data evaluation protocols are summarized in Table 46 and Table 47.

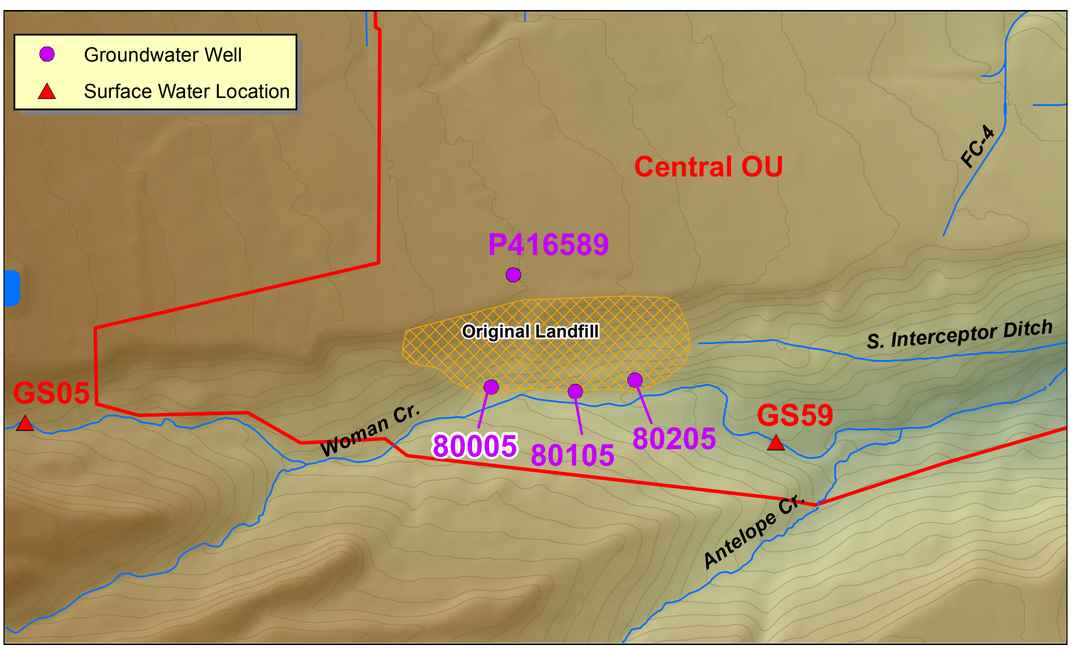


Figure 54. OLF Monitoring Locations

Table 46. 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; decisions specifically for the OLF monitoring objective require only quarterly grabs.
[b] Laboratory analytes are limited to those based on the analytical methods listed in the OLF M&M Plan.

Table 47. 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 inline filter. Metals include U. Laboratory analytes are limited to those based on the analytical methods listed in the OLF M&M Plan.

Abbreviations:
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 the fourth quarter of CY 2013, routine sampling at monitoring location GS59 showed results for selenium of 5.5 µg/L, above the surface-water standard of 4.6 µg/L. This composite sample was collected during the period from October 29, 2013, to January 9, 2014. According to RFLMA evaluation protocols, this result triggered sampling for selenium at an increased frequency. Due to winter ice conditions and very little flow, the subsequent composite sample was completed on March 6, 2014. At the time of this report’s publication, analysis had not been completed. There were no other instances at GS59 where analytes were detected above the applicable standards during CY 2013.

All RCRA wells at the OLF were sampled in the fourth quarter of CY 2013. Results are included in Appendix B.

This section presents the evaluation of the CY 2013 groundwater quality data for the OLF, previously known as OU 5. All RCRA wells are monitored quarterly. Monitoring performed in 2013 is summarized in Table 48.

Table 48. RCRA Groundwater Sampling Performed in 2013 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. Metals include U. SVOCs = semivolatile organic compounds. 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, with resulting analytical data evaluated by upgradient-downgradient comparisons), the three downgradient wells are also 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 2013). 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 the following two conditions is true of OLF groundwater: (1) concentrations of certain constituents are statistically higher in downgradient than upgradient groundwater, or (2) concentrations of constituents in a downgradient well are on an increasing trend meeting the 95-percent level of significance. Results of these statistical evaluations are summarized in the following paragraphs.

An 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 or semivolatile organic compounds (SVOCs) were found in downgradient wells at statistically higher concentrations than in upgradient wells, but the concentrations of three metals were calculated to be statistically higher in one or more downgradient wells. These results are summarized in Table 49, and are almost identical to those reported in the annual report for 2012 (DOE 2013b) and very similar to those presented in earlier annual reports (e.g., DOE 2010b, 2011c, and 2012). The calculation for U at well 80105 is new as of 2013; the highest concentration reported over the year was 14 µg/L (RFLMA threshold is 120 µg/L).

Table 49. Results of Groundwater ANOVA Evaluation for 2013 at the OLF

Analyte	80005	80105	80205
B	x	x	x
Ni			x (U, est)
U		x	x

Notes: 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.

It is important to stress that, similar to the discussion above regarding the PLF RCRA wells, the Ni data set for well 80205 contains only qualified results—either nondetects, estimated concentrations, or results rendered questionable because the constituent was also detected in the laboratory blank. In addition, as noted above for the PLF, the detection limit for this constituent was lowered in 2008, after which what had previously been reported as nondetects (and, for these statistical calculations, the associated values were replaced with 0.001) were now reported as estimated values. This can impact the ANOVA calculations as well as lead to the suggestion of an increasing trend. For these reasons, the finding that Ni at well 80205 is elevated with respect to upgradient groundwater is suspect. The highest concentration of Ni reported from this well in 2013 was 9 µg/L (RFLMA Table 1 standard: 123 µg/L).

S-K statistical trending calculations were also completed for analytical data from downgradient wells at the OLF. Results from 2013 are identical to those reported in 2012 (DOE 2013b), when B in 80205 was the first increasing trend meeting the criterion of adequate statistical significance (Table 50). Although not listed in the table, B is calculated to be on a decreasing trend at the 95-percent level of significance in groundwater at well 80005, and is increasing at a lower level of statistical significance in the upgradient well (P416589). All calculated trends are summarized in a later section of this report, and the associated summary tables and plots are presented in Appendix B.

Table 50. Results of Groundwater S-K Trend Testing for 2013 at OLF Downgradient Wells

Analyte	80005	80105	80205
B			x

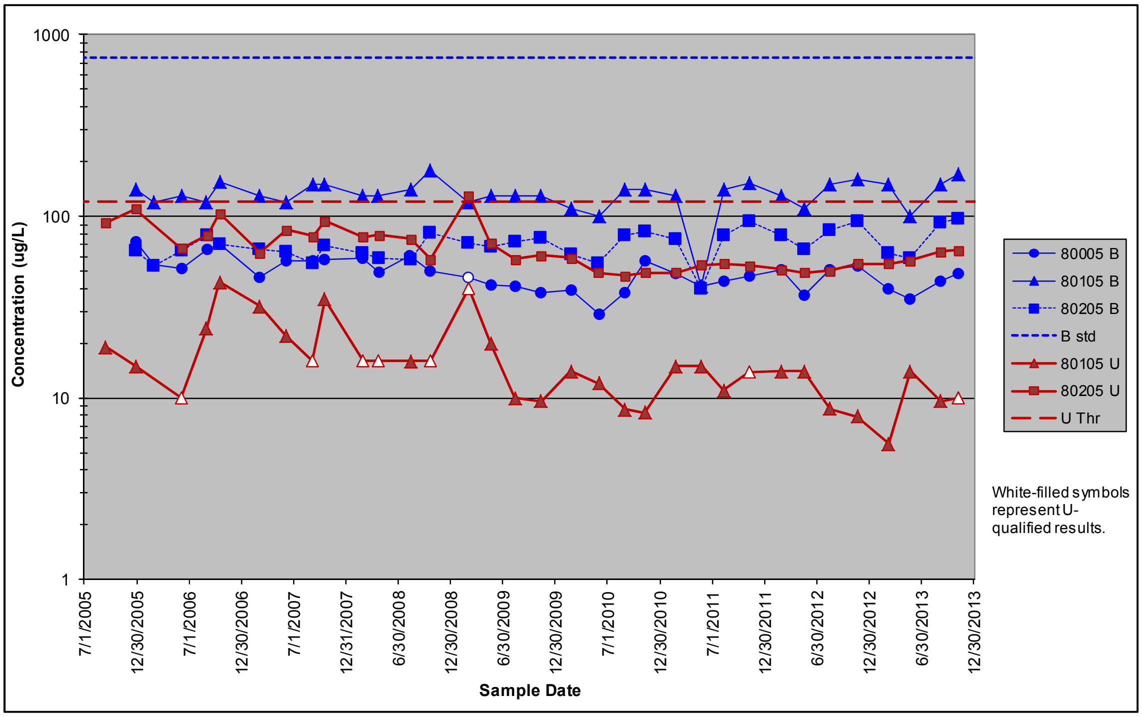
Notes: x = analyte is on an increasing trend, with a statistical significance of 95%, in the indicated downgradient well. This notation is assigned the qualifier (U) if the dataset contains at least 25% nondetects.

RFLMA instructs that if concentrations in downgradient wells are found to be significantly higher than in an associated upgradient well, 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 Ni (if the quality of the data are not questioned) in well 80205, and U in wells 80105 and 80205. Except for the results for Ni in 80205 and for U in well 80105, this is identical to ANOVA results reported since 2007 (DOE 2008b, 2009d, 2010b, 2011c, 2012, 2013b). RFLMA also instructs that the presence of a statistically significant increasing trend in a constituent at a downgradient OLF well triggers consultation, as is the case with B in well 80205.

Previous consultation on the statistical results related to OLF groundwater has taken place (for example, see Contact Record 2010-05). More recently, consultation was held on March 13, 2013, regarding the results of statistical evaluations of the 2012 groundwater data. This regulatory consultation concluded that no response action is required, and no modification of RFLMA monitoring is needed. After reviewing the results of statistical evaluation of the 2013 groundwater data presented in this annual report the RFLMA Parties may decide that subsequent consultation regarding the appropriate response is required. Such consultation, if it occurs, will be documented in a new contact record (Contact Record 2011-03).

The concentrations of the constituents in downgradient OLF groundwater as identified through ANOVA and S-K trending are all well below the associated RFLMA values. The RFLMA Table 1 standard for B is 750 µg/L, and the highest concentration reported in 2013 from any of the three downgradient OLF wells was 170 µg/L (from well 80105). At well 80205, which has produced samples leading to the statistical calculation of an increasing trend in B, the highest concentration in 2013 was 96.2 µg/L. As for Ni, which is suggested as having a higher concentration at downgradient well 80205 than in the upgradient well, the highest validated detection in 2013 was an estimated (J-qualified) concentration of 4.5 µg/L; the Table 1 value is 123 µg/L. The highest concentration of U reported from well 80105 in 2013 was 14 µg/L and from well 80205 was 64.8 µg/L; the associated threshold is 120 µg/L. As reported previously (DOE 2012, 2013b) and again confirmed using 2013 data, results of statistical trending calculations indicate U at 80205 is decreasing with a statistical significance of 95 percent. Groundwater from this well was analyzed for anthropogenic U content in late 2007 and found to be 100 percent natural (DOE 2008b).

Figure 55 provides time-series plots of reported B and U concentrations in groundwater from the wells listed in Table 49. (Due to the questions of data quality, Ni at well 80205 is not illustrated.) Figure 56 presents the calculated trend plot for B at well 80205, and does not use a logarithmic concentration scale.



Notes: Refer to text for explanation of how constituents were selected for this figure. Illustrated RFLMA action levels (CDPHE et al. 2012): B standard = 750 µg/L; U Thr (threshold) = 120 µg/L. Several detections were qualified but for simplicity are not shown differently. Note logarithmic concentration scale.

Figure 55. B and U in Downgradient Groundwater from OLF RCRA Wells Identified in 2013 ANOVA Data Evaluations

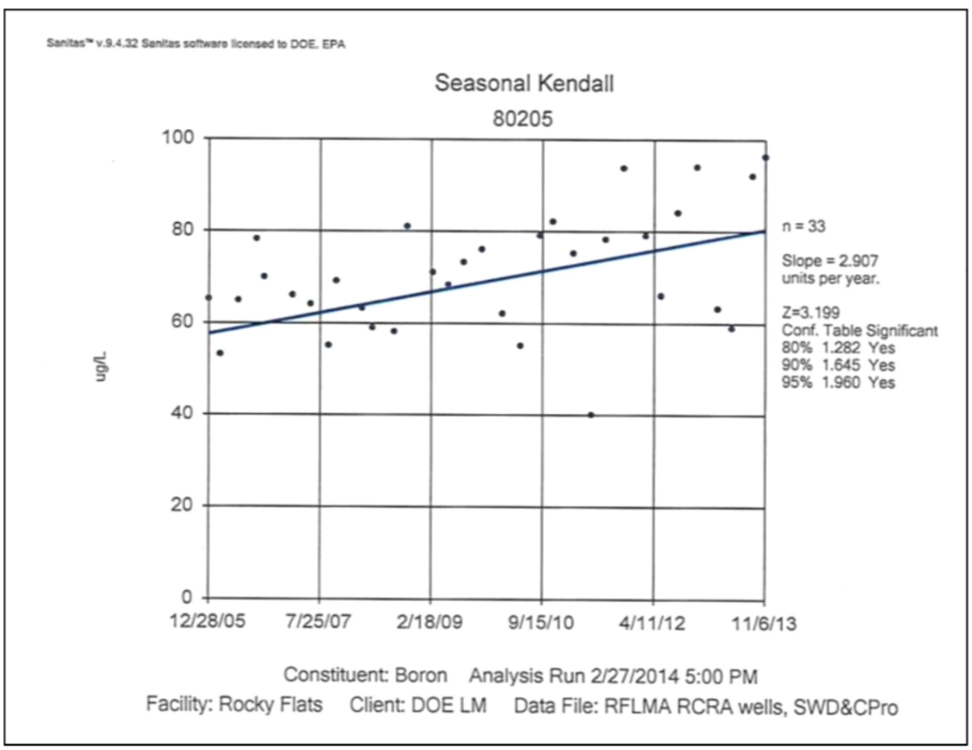


Figure 56. Calculated S-K Trend Plot for Boron at Downgradient OLF Well 80205

As discussed above with respect to the PLF groundwater results, the suggestion of higher concentrations of these constituents in downgradient groundwater than in upgradient groundwater at the OLF may be a result of natural geological and geochemical conditions, and not necessarily related to the presence of the OLF.

Data reported in 2013 from downgradient RCRA wells at the OLF include one validated detection of a VOC and three validated detections of a single SVOC (Table 51). In every case, the result is estimated (J-qualified), and is well below the associated RFLMA Table 1 standard. Neither of these constituents has been consistently detected in downgradient groundwater from the OLF. Note that diethyl phthalate was also detected in the upgradient well, P416589, in a sample collected on September 4; the concentration was estimated at 1 µg/L (i.e., higher than is estimated in two of the downgradient wells). In previous years, several VOCs and SVOCs have been detected at very low concentrations in downgradient OLF groundwater, but these detections have never been consistent from year to year.

Table 51. VOCs and SVOCs Detected in 2013 at Downgradient Wells at the OLF

Well	Sample Date	Analyte	Result	Units	Lab Qualifier
80005	9/5/2013	Diethyl phthalate	0.5	µg/L	J
80005	11/6/2013	Methylene chloride	0.98	µg/L	J
80105	9/5/2013	Diethyl phthalate	0.66	µg/L	J
80205	9/5/2013	Diethyl phthalate	1.1	µg/L	J

Notes: J = analyte detected, result is estimated. Applicable RFLMA standards are 4.6 µg/L (methylene chloride) and 5,600 µg/L (diethyl phthalate).

According to RFLMA, downgradient OLF wells are also assessed in a manner consistent with that used for Sentinel wells (CDPHE et al. 2012); concentrations are evaluated for statistically significant (95 percent) trends, and 85th percentile concentrations are assessed in comparison with the applicable RFLMA standards or thresholds. As stated above, the only analyte with an increasing trend meeting the 95 percent level of significance for the downgradient wells was B in well 80205. 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 8 years of data as of the end of 2013. Therefore, such a comparison cannot be properly 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 moves in 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 2013 are approximately 2.75 to 3 years (Table 60), approximately the same as in 2011 and 2012 (DOE 2012, 2013b). Note that this calculated velocity is simplistic and applies only to pure water; the migration of dissolved constituents, including groundwater 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 3.1.3.6; a discussion of analytical data from grab samples collected in 2011 from selected seeps on the OLF is provided in the 2011 Annual Report (DOE 2012).

3.1.2.8 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.

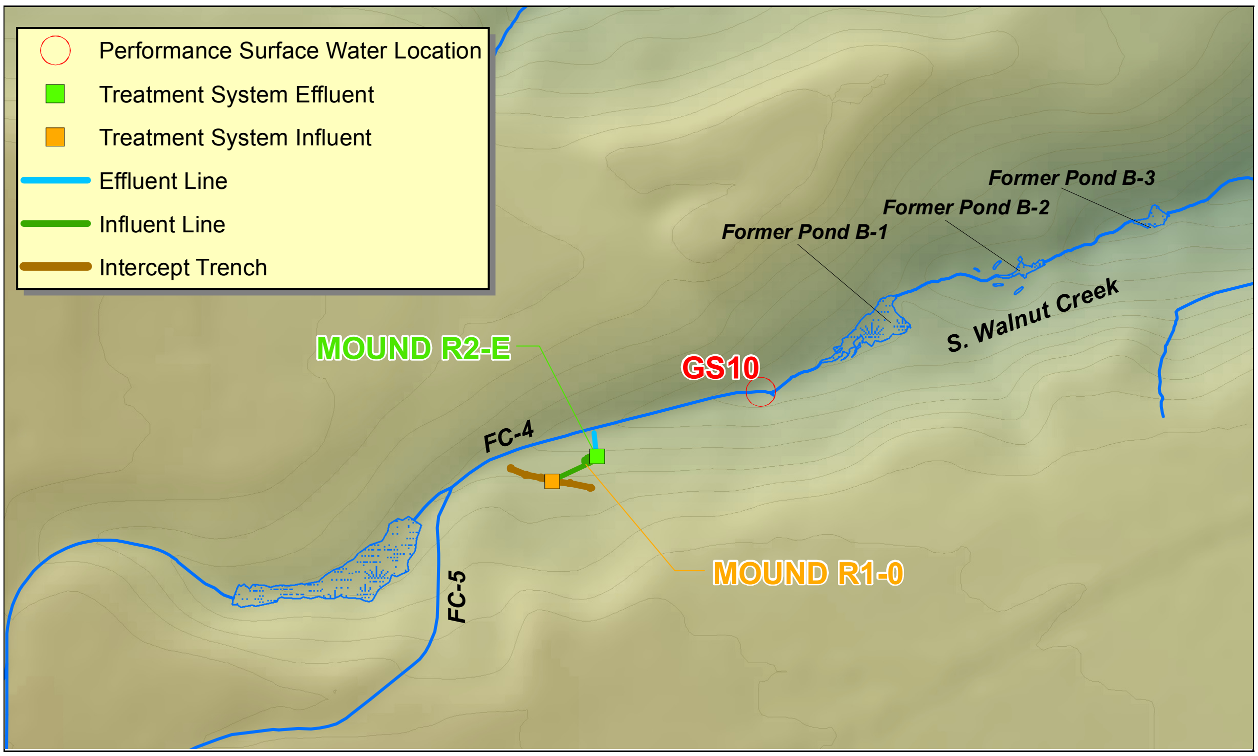
Note that groundwater monitoring wells also support the MSPTS, ETPTS, and SPPTS. (Wells are also present in the vicinity of the PLFTS, but their objectives differ as they directly support the PLF as RCRA wells.) These locations are discussed in the sections that correspond to their respective objectives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

Mound Site Plume Treatment System

RFLMA monitoring locations specific to the MSPTS are shown on Figure 57. Sampling and data evaluation protocols are summarized in Table 52. 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 52. 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



Notes: 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 2007b) for additional discussion, and subsequent sections of this annual report for water quality updates.

Figure 57. RFLMA MSPTS Monitoring Locations

Data Evaluation

All MSPTS locations listed in Table 52 were scheduled for routine monitoring in the fourth quarter of CY 2013. Results are provided in Appendix B and are discussed in Section 3.1.5.

In addition to the RFLMA locations at the MSPTS, locations associated with the air stripper that polishes effluent from the treatment cells and is housed within the effluent manhole were sampled in the fourth quarter to continue evaluation of this component. This is discussed in Section 3.1.5.

East Trenches Plume Treatment System

RFLMA monitoring locations specific to the ETPTS are shown on Figure 58. Sampling and data evaluation protocols are summarized in Table 53. In addition to the monitoring locations shown, several monitoring wells are present in this area, 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 53. 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

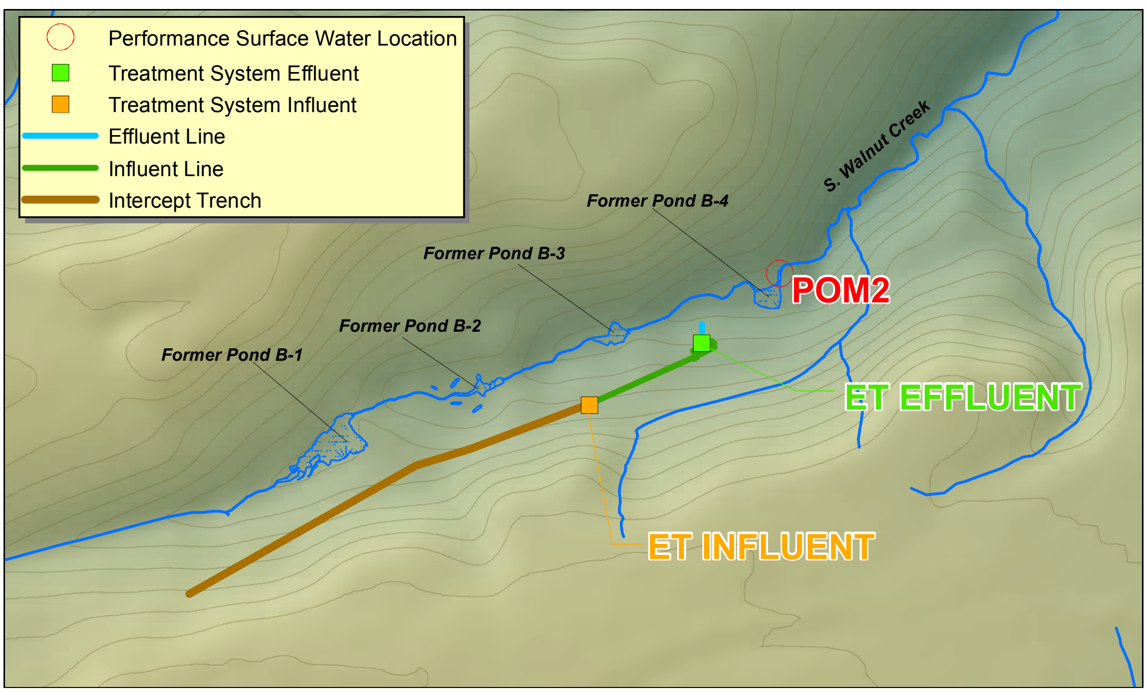


Figure 58. RFLMA ETPTS Monitoring Locations

Data Evaluation

All ETPTS locations listed in Table 53 were scheduled for routine monitoring in the fourth quarter of CY 2013. Results are provided in Appendix B and are discussed in Section 3.1.5.

In addition to the RFLMA locations at the ETPTS, a location associated with the air stripper that is housed within the influent manhole was sampled in the fourth quarter to continue evaluation of this component. This is discussed in Section 3.1.5.

Solar Ponds Plume Treatment System

RFLMA monitoring locations specific to the SPPTS are presented on Figure 59. Sampling and data evaluation protocols are summarized in Table 54. 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 54. 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	Effluent sampling location	Semiannual grabs; second and fourth calendar quarters (high- and low-water conditions)	U, nitrate	See Figure 11 in Appendix D
GS13[a]	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] 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.

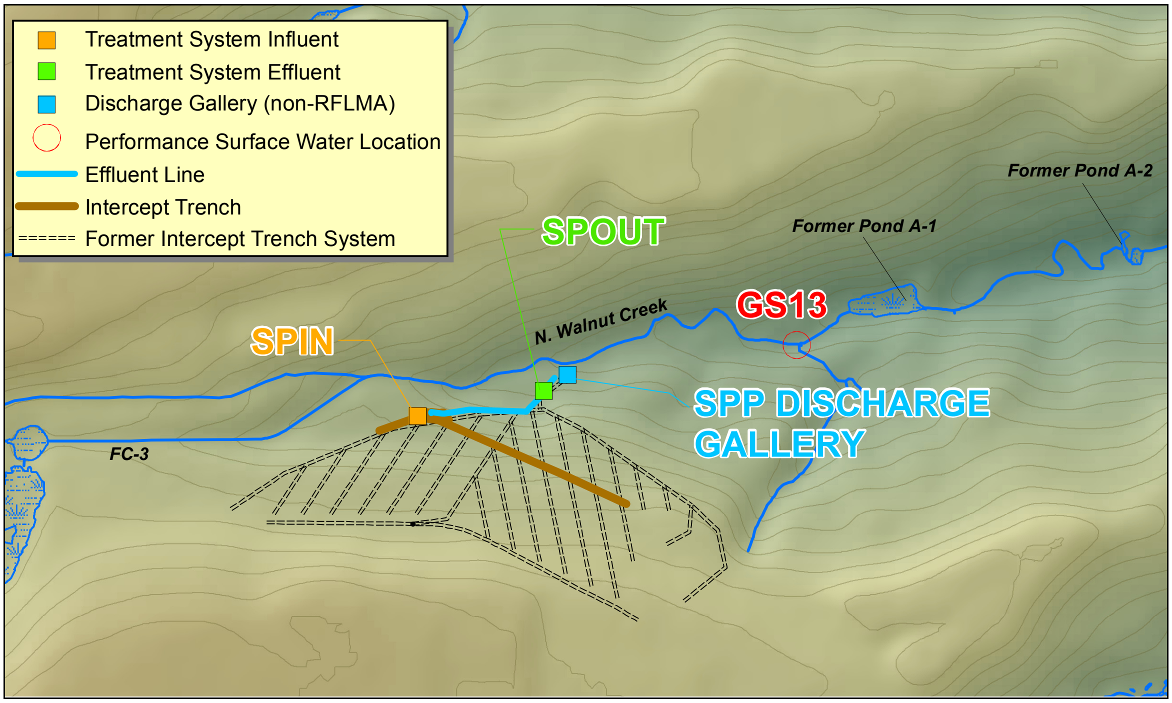


Figure 59. RFLMA SPPTS Monitoring Locations

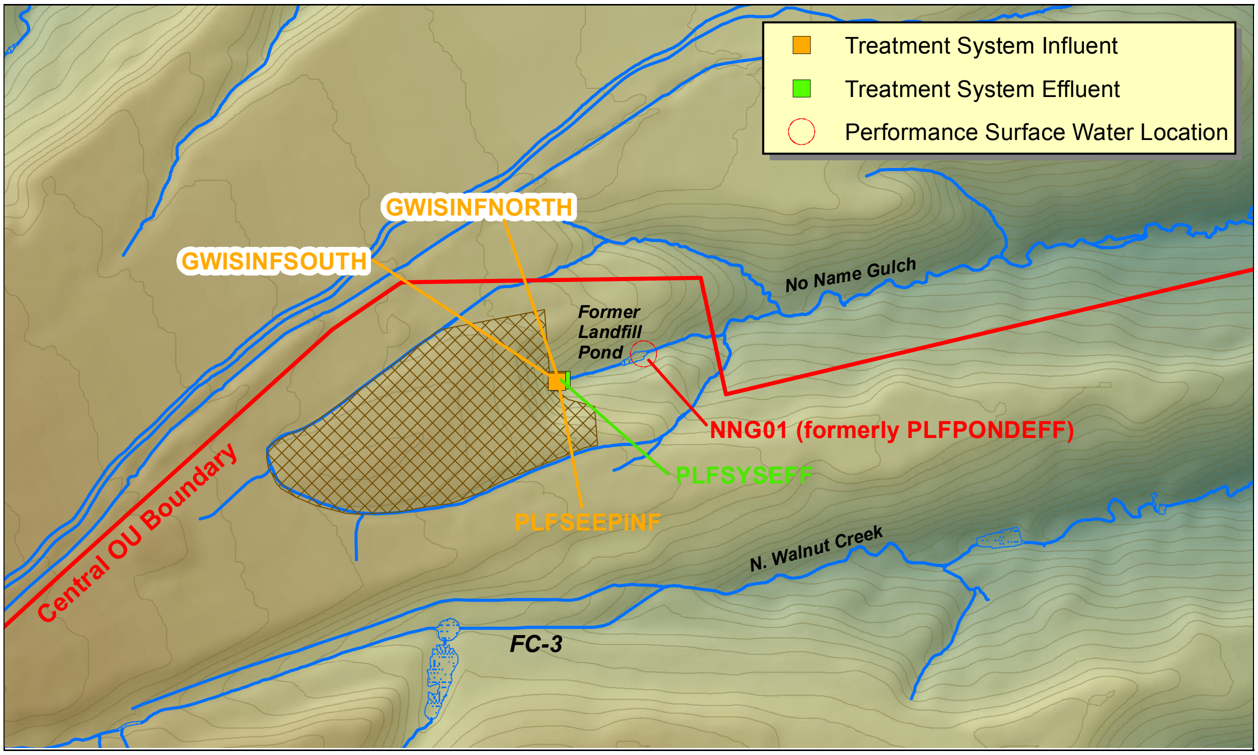
Data Evaluation

All SPPTS locations listed in Table 54 were scheduled for routine monitoring in the fourth quarter of CY 2013. Results are included in Appendix B; see Section 3.1.5 for discussion.

In addition to the RFLMA locations, in the fourth quarter the SPPTS Discharge Gallery, often referred to colloquially as the DG, was sampled. Extra (non-RFLMA) samples were collected from several system locations to support system operation, optimization, and performance (see Section 3.1.5); one of these, SPOUT, was also sampled to support the ongoing Adaptive Management Plan requirements.

PLF Treatment System

Water monitoring locations for the PLF are shown on Figure 60. The general groundwater monitoring requirements deal specifically with the RCRA wells and are discussed in detail in Section 3.1.2.6. Details regarding surface-water and treatment system monitoring are provided below.



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

Figure 60. 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 former Landfill Pond area. This section presents the monitoring data for the treatment system effluent as well as the former Landfill Pond area 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 60. Sampling and data evaluation protocols are summarized in Table 55. As of December 21, 2007, collection of samples at the GWIS locations (GWISINFNORTH and GWISINFSOUTH) was discontinued. This action was taken subsequent to the consultative process and, in accordance with the Groundwater Treatment Systems flowchart (Appendix D), it was documented in Contact Record 2007-08.

Table 55. 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
NNG01 (formerly PLFPONDEFF)	Former Landfill Pond area at the downstream (east) end	As needed; triggered by data evaluation	As needed; determined by decision rule	See Figure 11 in Appendix D

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

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 2013 there were only three analytes detected above the applicable standard:

- During the second quarter of CY 2013, routine sampling of the treated effluent exiting the system (monitoring location PLFSYSEFF) showed results for selenium of 8.6 µg/L, above the surface-water standard of 4.6 µg/L. According to RFLMA evaluation protocols, this result triggered monthly sampling for selenium. The first monthly sample was collected on May 15, 2013. Selenium was not detected in this sample and monthly sampling was discontinued.
- During the third quarter of CY 2013, routine sampling of the treated effluent exiting the system (monitoring location PLFSYSEFF) showed results for arsenic of 11 µg/L, above the surface water standard of 10 µg/L. According to RFLMA evaluation protocols, this result triggered monthly sampling for arsenic. The first two monthly samples, collected on October 29, 2013, and November 27, 2013, also showed arsenic above the standard at 34 µg/L and 12 µg/L, respectively. A third monthly sample for arsenic was then collected on January 21, 2014. Analytical results for this sample showed arsenic below the standard at 8.5 µg/L and monthly sampling was discontinued.
- During the fourth quarter of CY 2013, routine sampling of the treated effluent exiting the system (monitoring location PLFSYSEFF) showed results for VC of 0.21 µg/L, above the surface water standard of 0.2 µg/L. According to RFLMA evaluation protocols, this result triggered increased sampling for VC. The first two monthly samples collected on November 27, 2013, and January 21, 2014, also showed VC above the standard at 0.29 µg/L and 0.28 µg/L, respectively. A subsequent sample for VC was collected on February 26, 2014, and the results were pending when this document was published.

3.1.2.9 Predischarge Monitoring

This monitoring objective is intended to evaluate whether pond water from Ponds A-4, B-5, or C-2 is expected to meet water-quality standards (see Table 1 of RFLMA Attachment 2) at downstream POCs prior to opening a valve to initiate discharge. 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 61. Sampling and data evaluation protocols are summarized in Table 56.

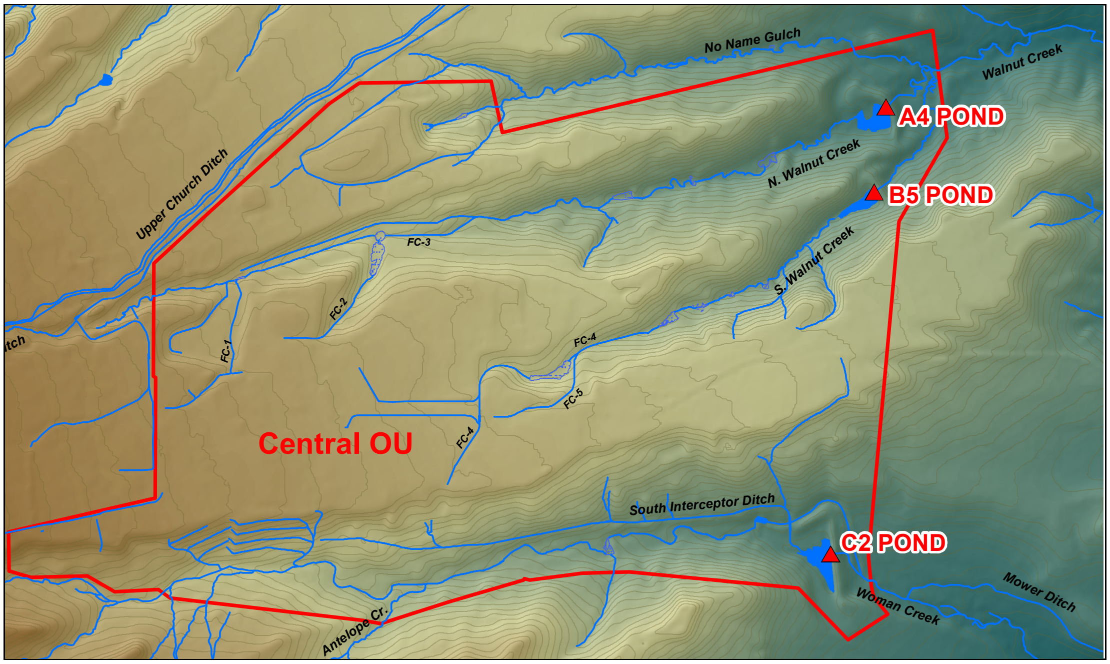


Figure 61. Predischarge Sampling Locations

Table 56. 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 2013, no predischarge samples were collected from Ponds A-4, B-5, or C-2. All three terminal ponds were operated in a flow-through mode for all of CY 2013.