3.0 Environmental Monitoring

3.1 Water Monitoring

3.1.1 Introduction

This section presents data collected to satisfy water monitoring objectives implemented at the Site in accordance with RFLMA. The RFSOG provides a guidance framework in support of conducting LM activities, including monitoring, at the Site. Figure 3–1 shows a map with the water monitoring locations that were operational during the fourth quarter of CY 2009. Sampling maps for the first through third quarters of CY 2009 are available in the quarterly reports.

This annual report focuses on data collected during CY 2009 (January through December 2009). This section includes:

- An evaluation of analytical results from routine monitoring as required by RFLMA and detailed in the RFSOG, organized by monitoring objective;
- A summary of hydrologic data for the calendar year; and
- Supplemental data interpretation and evaluation for CY 2009.

Analytical water quality data are available in Appendix B.

3.1.1.1 Water Monitoring Highlights: CY 2009

During CY 2009, the water monitoring network successfully fulfilled the targeted monitoring objectives as required by RFLMA and using the RFSOG implementation guidance. During CY 2009, the RFLMA network consisted of 99 wells, 11 gaging stations, 10 surface-water grab sampling locations (three of which are pre-discharge pond locations), 8 treatment system grab sampling locations, and 8 precipitation gages. During CY 2009, 164 samples composed of 6,992 individual aliquots ("grabs") were collected at the surface-water locations,[4] 37 samples were collected from treatment system locations, and 121 samples were collected from monitoring wells. Additional samples were collected beyond the RFLMA requirements, as discussed in this report.

Precipitation in CY 2009 was above average, with 13.14 inches of precipitation, which is approximately 107.1 percent of the average (the CY 1993−2008 average is 12.27 inches). The winter was significantly drier than average (39.9 percent of the CY 1993−2008 average of 0.66 inch). The summer was measurably wetter than average (128.9 percent of the CY 1993−2008 average of 4.20 inches). June and July were significantly wetter than average (220 percent and 176 percent of the average, respectively), while March and August were significantly drier than average (31 percent and 27 percent of the average, respectively). The largest events occurred on April 18 (0.97 inch) and June 24 (0.75 inch).[5] The largest 2-day total (1.14 inches) occurred on April 17−18. The highest peak flow rates for the year from the COU

[4] Composite samples consist of multiple grabs of identical volume. Each grab is delivered by the automatic sampler to the composite container at each predetermined flow volume or time interval.
[5] The precipitation gages used in the automated surface-water monitoring network are not heated due to the lack of AC power at the locations. Thus, the gages do not accurately measure snowfall (as water equivalent).

were 17.2 cubic feet per second (cfs) in North Walnut Creek (April 19), 23.7 cfs in South Walnut Creek (April 19), and 5.09 cfs in the South Interceptor Ditch (SID); all of these peak flows were a result of snowmelt.

All water quality data at the RFLMA Points of Compliance (POCs) remained below the applicable standards throughout CY 2009.

Reportable 12-month rolling average total U concentrations continued to be observed through March 31, 2009, in surface water at RFLMA Point of Evaluation (POE) monitoring station GS10, which is located in South Walnut Creek upstream of Pond B-1 in the Walnut Creek Basin. As of April 30, 2009, total U was no longer reportable at GS10. The Site continues to evaluate, in coordination with CDPHE and under RFLMA, the measured U concentrations at GS10. Recent GS10 data are evaluated in Section 3.1.2.2 of this report.

All other POE analyte concentrations remained below reporting levels throughout CY 2009. Erosion and runoff controls, as well as extensive revegetation efforts, have been effective in measurably reducing both sediment transport and constituent concentrations. During CY 2009, all of the POEs showed Pu and Am concentrations well below the RFLMA standards. With the removal of impervious areas resulting in decreased runoff, the stabilization of soils within the drainages, and the progression of revegetation, acceptable water quality is expected to continue.

Groundwater monitoring results at the PLF and OLF are evaluated in Section 3.1.2.8 and Section 3.1.2.9, respectively, of this report. Groundwater was monitored in accordance with RFLMA (DOE 2007a).

3.1.1.2 Use of Analytical Data

Analytical data are evaluated statistically to meet many objectives in accordance with RFLMA. Rejected data are not included in statistical evaluations. Statistical and other evaluations of analytical data focus solely on those results reported for RFLMA analytes (as listed in RFLMA Attachment 2, Table 1 [DOE 2007a]).

Surface-water data from POCs and POEs are evaluated semimonthly, and results of these evaluations are included in the quarterly reports. Details regarding data handling for all surface water can be found in Appendix B.

Groundwater data evaluations are reported annually because the groundwater regime is less dynamic than the surface-water regime and because groundwater conditions change much more gradually than surface-water conditions. However, groundwater data from Area of Concern (AOC) wells are evaluated for reportable conditions as they are received; when such conditions exist, they are described in the corresponding quarterly report as well as the annual report.

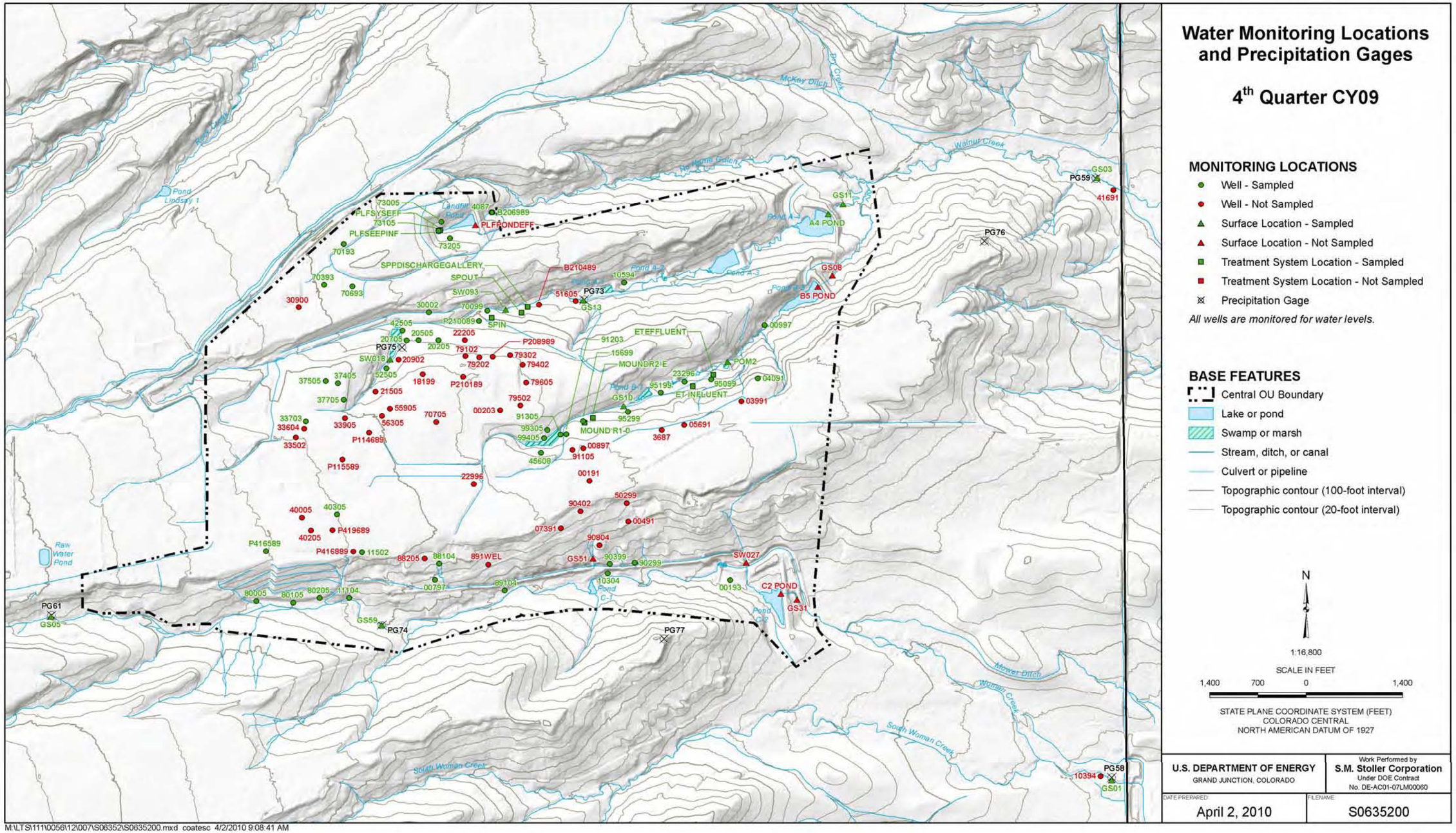

Figure 3–1. Rocky Flats Site Water Monitoring Locations and Precipitation Gages: Fourth Quarter CY 2009

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Groundwater statistics require a minimum of eight results representing routinely collected samples. A commercially available geostatistical software program (e.g., Sanitas, Visual Sample Plan) is used for these calculations. (**Note:** This report does not recommend any particular software; this information is merely included for the sake of completeness.) Furthermore, if trend calculations employ the Seasonal-Kendall (S-K) statistical method, the data representing these routinely collected samples must comprise four sets of results per season. For example, wells required to be monitored semiannually are sampled in the second and fourth quarters of a calendar year. Trending will require a minimum of eight sets of results from routinely collected samples, distributed as four per season—four in the second quarter and four in the fourth quarter. In this example, therefore, a well would need to be sampled for 4 years (4 samples × 2 samples/year = 8 samples total; 4 each of second quarter samples and fourth quarter samples requires 4 full years of semiannual samples) to provide the necessary and appropriate data for statistical analysis. For wells sampled quarterly, although the minimum eight sets of results could be collected in 2 years of routine sampling, the minimum four sets of results per season (four seasons) would not be collected until 4 years of successful, routine sampling had been completed.

Groundwater field duplicates are omitted from statistical evaluations. Groundwater samples assigned the laboratory qualifier "J" (estimated) are taken at face value, rather than being assigned a value of less than the method detection limit plus the practical quantitation limit (PQL). Samples assigned a "B" qualifier (which, for organics, indicates that the constituent was also detected in the blank) were also used at face value. This qualifier is commonly associated with results for methylene chloride. Because methylene chloride is a commonly used laboratory solvent, "B"-qualified results should be carefully reviewed alongside corresponding detection limits, concentrations in the blanks, and other relevant data before any decisions are based on them. (**Note:** In some cases, these considerations have led to the results being assigned a validation "U" qualifier, signifying that the result is so suspect as to be considered a nondetect.)

For consistency, the RFSOG (DOE 2010a) instructs that nondetects reported for groundwater data be replaced by zeroes when performing statistical assessments. However, to calculate trends, the data cannot contain zeroes. Therefore, instead of zeroes, nondetects are replaced with a value of 0.001. (Note: This includes data with lab qualifiers as well as validation qualifiers that include "U.") Likewise, the statistical program cannot perform the necessary calculations if negative numbers are included in the results, as is occasionally the case for U isotopes and other radionuclides. Therefore, any negative results are replaced with 0.001. Calculated trends may be affected by this data replacement; therefore, the data from calculated trends of interest should be carefully inspected before any conclusions are reached or decisions made.

Evaluations of U in groundwater are based on total U concentrations. In some cases, surface-water data are also evaluated (e.g., at GS13, the performance monitoring location supporting the SPPTS). The latter data through mid-2009, as well as some earlier groundwater data, are typically reported as isotopic activities. Any negative values for individual isotopic analyses are first replaced with 0.001 as described above, and then the individual results for a given location and date are converted to mass units and summed to provide a conservative approximation of total U by mass. Any total U results that were equal to or less than zero were also replaced with 0.001 to allow for the requirements of the statistical calculations. Conversion factors used to support these groundwater evaluations are listed in Table 3–1.

Table 3–1. U Isotope Conversion Factors Used in Groundwater Evaluations

Isotope	Conversion Factor	Typical Activity Units	Typical Mass Units
U-233[a]	9,636.6 pCi/µg	pCi/L	µg/L
U-234	6,235.1 pCi/µg	pCi/L	µg/L
U-235	2.1612 pCi/µg	pCi/L	µg/L
U-236[a]	64.672 pCi/µg	pCi/L	µg/L
U-238	0.33614 pCi/µg	pCi/L	µg/L

Notes: [a]U-233 and U-236 are absent in natural U and, therefore, can be used as definitive markers for anthropogenic U. LANL analyzes U-236 and also evaluates isotopic ratios for this purpose.
Source of conversion factors: Friedlander et al. 1981.
pCi/µg = picocuries per microgram

There are many instances in the database of multiple results for U on the same date at the same well. These results may represent any of the following: isotopic analysis providing results in activity units, isotopic analysis providing results in mass units, total U analysis via a metals analytical method, total U via a total U analytical method, filtered sample, unfiltered sample, unvalidated result, partially validated result, validated result, and result[s] 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:

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

Because most samples for U analysis were 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 result closer to others from the 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, given that the data populations from original and replacement wells may be discontinuous, which suggests that data from the original wells should be removed from statistical assessments of the 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 calculated for replacement wells may be misleading in that they may be strongly affected by well replacement and do not reflect only groundwater geochemistry and hydrology.