2.0 Site Operations and Maintenance

2.1 Annual Site Inspection

Evidence of significant erosion and IC violations must be inspected for annually, in accordance with RFLMA Attachment 2, Sections 5.3.4 and 5.3.6. The 2009 inspection was conducted on March 25 and reported in the *Rocky Flats Site Quarterly Report of Site Surveillance and Maintenance Activities First Quarter Calendar Year 2009* (DOE 2008f).

The following categories were monitored during the inspection:

- Evidence of significant erosion in the COU and evaluation of the proximity of significant erosion to subsurface features in RFLMA Attachment 2, Figures 3 and 4. This monitoring included visual observation for precursor evidence of significant erosion (e.g., cracks, rills, slumping, subsidence, sediment deposition);
- The effectiveness of ICs, as determined by any evidence of their being violated; and
- Evidence of adverse biological conditions, such as unexpected morbidity or mortality, observed during the inspection and monitoring activities.

As part of the IC inspection, the Environmental Covenant's presence in the Administrative Record and in Jefferson County records was verified. This verification is required annually. In addition, physical controls (signs placed along the COU fence) were also inspected.

Marker flags were placed where conditions showed evidence of the three condition categories listed above, to track their location for follow up by Site subject matter experts. Areas that required evaluation were documented in the Site Observation Log for evaluation and follow up. Several areas with evidence of erosion, possible depressions, or holes were noted, but these imperfections appeared to be minor and of very limited areal extent. Rocky Flats field operations subject matter experts subsequently visited the areas, made minor repairs, collected debris, and determined that there was no significant indication of erosion or exposure of the subsurface.

No evidence of violations of ICs or physical controls was observed.

On March 31, 2009, a team member verified that the Environmental Covenant for the COU remains in the administrative record and on file with the Jefferson County land records, which are used by the Planning and Zoning Department.

No adverse biological conditions were noted during the inspection.

2.2 Colorado WQCC Proceedings Related to Rocky Flats

Two WQCC rulemaking proceedings occurred in 2009. These involved changes to site-specific surface-water standards for Big Dry Creek segments 4a, 4b, and 5, which encompass North and South Walnut Creek and portions of Woman Creek (including the ponds and tributaries associated with these creeks) in the COU. WQCC promulgated site-specific surface-water standards are the basis for the surface-water standards incorporated into RFLMA Attachment 2, Table1.

The Rocky Flats Stewardship Council was briefed on the status of the proceedings at each Rocky Flats RFLMA annual and quarterly report presentations during 2009. The following summary provides information regarding the proceedings in 2009.

2.2.1 Uranium, Gross Alpha, and Gross Beta Standards

The status of ongoing WQCC proceedings has been routinely updated in quarterly and annual reports. There were two WQCC proceedings during this calendar quarter. The first was related to the uranium, gross alpha, and gross beta surface-water standards, and the second was related to the triennial review of site-specific standards for the South Platte River Basin. Big Dry Creek segments 4a, 4b, and 5 on Rocky Flats property are part of this basin.

A WQCC rulemaking hearing was held January 12, 2009, to consider revising "Classifications and Numeric Standards for South Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin" (Title 5 *Code of Colorado Regulations* 1002-38) (Regulation 38) to eliminate the site-specific standards in Big Dry Creek segments 4a, 4b, and 5 for uranium, gross alpha, and gross beta in Regulation 38, Table 2, due to changed hydrological conditions after cleanup and closure of Rocky Flats. The site-specific ambient-based radionuclide standards for these analytes were first adopted in 1989 based on ambient conditions during operations. DOE petitioned the WQCC to remove the site-specific uranium standard, which would result in the statewide basic standard for uranium becoming the RFLMA standard. The statewide basic standard is EPA's maximum contaminant level (MCL) for uranium of 30 micrograms per liter (μg/L). The MCL is approximately twice the RFLMA standard. There is no promulgated statewide basic standard for gross alpha and gross beta. The basis for DOE's petition is the changed conditions resulting from cleanup and closure.

Uranium in groundwater at Rocky Flats is predominantly natural, as determined prior to closure, through hundreds of samples analyzed at Los Alamos National Laboratory (LANL) using high-resolution analytical methods. Post-closure high-resolution analysis of targeted groundwater and surface water locations also show that the uranium is predominantly natural. Uranium that has been confirmed to be 100 percent natural has been measured in Rocky Flats groundwater at concentrations of more than 30 times the current site-specific standard. With the quantity of runoff reduced through the removal of impervious surfaces and the elimination of imported water, the relative contribution of groundwater to surface water flows at Rocky Flats has increased greatly, and consequently, uranium concentrations are also increasing. The groundwater uranium contribution to surface water base flow indicates that the post-closure ambient uranium concentration may approach or exceed the 1989 ambient-based standards developed when the plant was operating.

Gross alpha and gross beta standards are used for screening purposes to limit radionuclide concentrations when specific radionuclides contributing to alpha and/or beta radioactivity are uncertain. The characterization of soil and water during cleanup and closure identified the radionuclide contaminants of concern as uranium-233/234, uranium-235, uranium-238, americium-241, and plutonium-239/240. Specific standards for these isotopes are established in RFLMA Attachment 2, Table 1, making gross alpha and gross beta standards redundant and unnecessary.

The WQCC revised the uranium standard to16.8 µg/L rather than the requested revision to 30 µg/L and eliminated the gross alpha and gross beta site-specific standards. The WQCC statement of basis, Regulation 38, sec. 38.71 is as follows:

> **BASIS AND PURPOSE:** The Commission considered revisions to Table 2 standards for uranium, gross alpha and gross beta for segments 4a, 4b, and 5 of Big Dry Creek. The previous uranium standards (10 pCi/L for Walnut Creek and 11 pCi/L for Woman Creek) were set in 1996 based on the then current ambient conditions. Recently, post-closure surface water runoff has decreased and the relative contribution of uranium from groundwater has increased. However, the effects of this hydrologic change have not been quantified. In addition, increased treatment of the Solar Pond Plume area will result in a decrease in uranium from that source. Since there is continued uncertainty about the eventual equilibrium surface water uranium concentrations, the Commission decided that human health-based criteria were more appropriate than table value standards, new ambient-based standards or maintaining the current standards. The question of determining the "lowest practical level" will be left to the future when DOE completes a feasibility study of enhanced treatment of the Solar Pond Plume. The Commission adopted a total uranium standard of 16.8 µg/L to protect human health since the goal for the Rocky Flats site has been to protect all uses. This concentration-based criterion was derived using a reference dose of 0.0006 mg/kg/day and a relative source contribution of 0.8 (see Policy 96-2, Equation 1-1). Based upon a conversion factor of 0.67 pCi/µg uranium, 16.8 µg/L equates to 11.3 pCi/L.

2.2.2 Regulation 38 Triennial Review

The Water Quality Control Act directs WQCC to review all water quality classifications and standards at least once every 3 years. There are three steps in the triennial review process:

1. An issues scoping hearing, to identify early any issues that will likely need to be addressed in the next major rulemaking hearing;
2. An issues formulation hearing, to formulate the specific issues that will be addressed in the next major rulemaking hearing; and
3. A rulemaking hearing.

The issues scoping and formulation proceedings were discussed in the 2008 Annual Report. The rulemaking hearing occurred on June 8, 2009.

The WQCC's triennial review of "Classifications and Numeric Standards for South Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin," Regulation 38 (Title 5 *Code of Colorado Regulations* 1002-38) (Regulation 38) was completed in 2009. Big Dry Creek segments 4a, 4b, and 5 on Rocky Flats property are part of the South Platte River Basin. The WQCC rulemaking hearing was held on June 8, 2009. Changes to Regulation 38 adopted by the WQCC for this triennial review are effective January 1, 2010.

There were two potential issues for the Rocky Flats stream segments. The first was related to the proposed lowering of the site-specific arsenic standard from 50 µg/L to the basic statewide water supply standard of 0.02−10 µg/L. The second was related to the proposed change of segment 4b and segment 5 recreational use classification from recreation class N (not primary contact

recreation use) to recreation class E (existing primary contact use).[1] The segment 4a recreational use classification is recreation class E, and the Water Quality Control Division (WQCD) did not propose any change.

Figure 2–1 shows the Rocky Flats stream segments.

A summary of the post-closure arsenic data for the locations where arsenic is monitored as one of the metals analytes (GS05, GS59, and PLFSYSEFF) was submitted to WQCD staff for consultation. The data indicated the 50th percentile of the data did not exceed the higher value in the standard range (10 μg/L), and ambient standards for total recoverable metals (such as arsenic) are typically based on the 50th percentile of the data. Water bodies are considered in attainment of the standard so long as the existing ambient water quality does not exceed the highest number of the range for the standard. Thus, arsenic was considered in attainment with the proposed revised standard.

The proposed change to the recreation class for segments 4b and 5 was the only issue for Rocky Flats in the triennial review. The proposed recreational class change lowers the *E. coli* standard from 630/100 milliliters (mL) for class N waters to 205/100 mL for class P waters.

The cleanup and closure of Rocky Flats included the removal of the sanitary sewer system and the Sewage Treatment Plant (STP) facility in 2005 and termination of the STP discharge permit. Thus, the proposed change does not present an attainment issue for *E. coli*, but the proposed use revisions did not reflect the post-closure restricted-access conditions at Rocky Flats.

The DOE Responsive Pre-Hearing Statement (RPS) was filed in accordance with the April 28, 2009, due date. The RPS included the evidentiary materials supporting DOE's objection to the WQCD proposed reclassification of either segment, because Rocky Flats is not open to public access that would allow recreational use of the water. The COU is subject to institutional controls and is posted with signs prohibiting public access. The property outside the COU is also currently not open to public access, and the National Wildlife Refuge will restrict visitors to designated trails when it is open.

[1]In the 2005 triennial review of "The Basic Standards and Methodologies for Surface Water" (Title 5 *Code of Colorado Regulations* 1002-31 (Regulation 31), the WQCC revised the recreational classification designation codes from recreation class 1a to recreation class E for "existing primary contact use", from recreation class 1 b to recreation class P for "potential primary contact use" and from recreation class 2 to recreation class N for "not primary contact recreation use". The Regulation 38 triennial review included revising the designation codes as specified by Regulation 31.

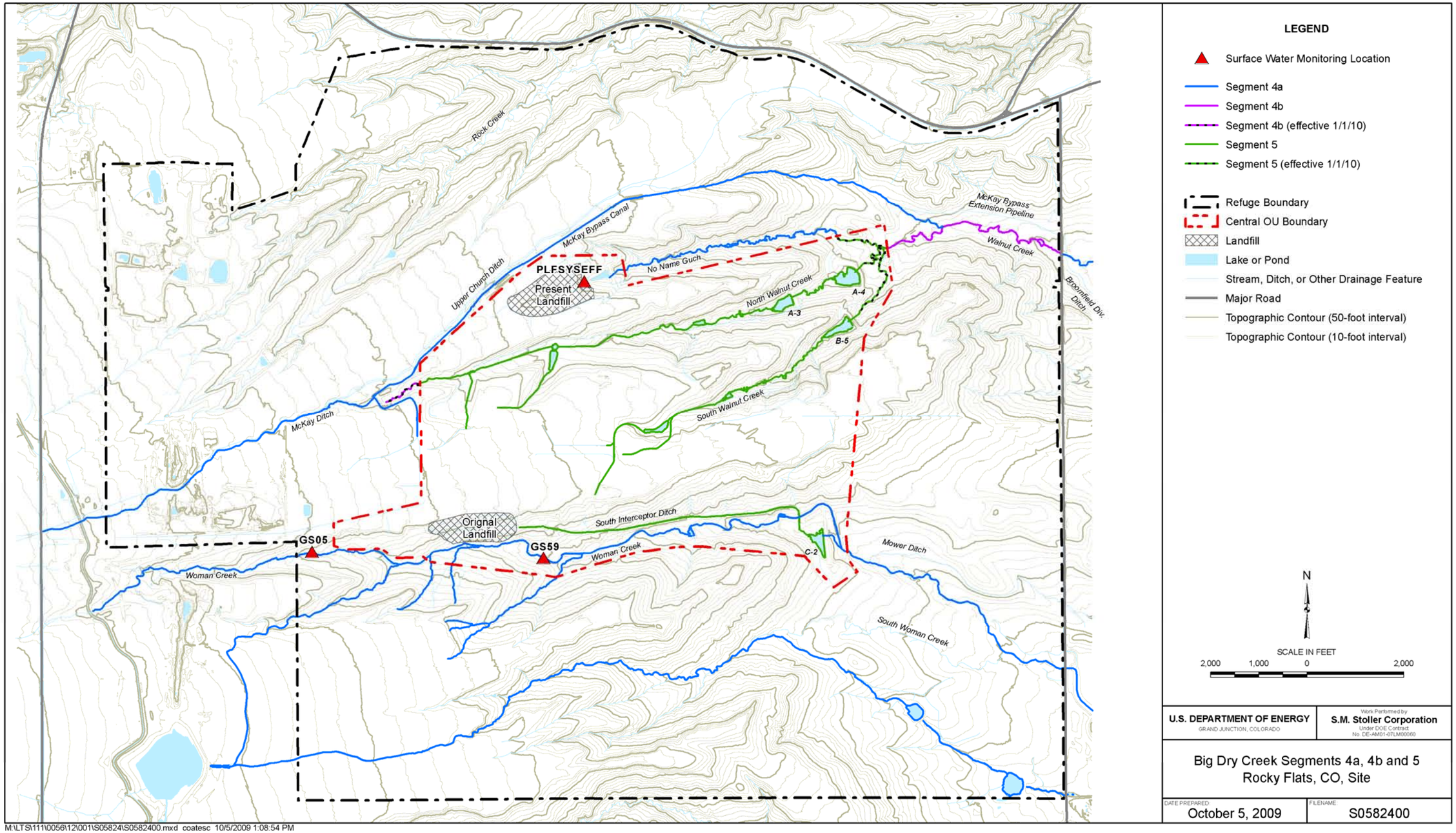

Figure 2–1. Big Dry Creek Segments 4a, 4b, and 5

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Further consultation with the WQCD lead to its agreement that segment 5 should not be reclassified and would remain recreation class N. But the WQCD decided to proceed with recommending reclassification of segment 4b to class P, because the majority of the segment is on Refuge land, and the Refuge will be open to the public within the next 20 years.[2]

Prior to the hearing, WQCD and Rocky Flats staff consulted on recommending to the WQCC to change the segment 4b and 5 descriptions if segment 4b was reclassified to recreation class P, with the goal of ensuring the portions that would retain recreation class N were within the COU. The WQCC adopted the change to recreation class P for segment 4b and the change to the segment descriptions.

Figure 2–1 shows the portions of segments 4b and 5 that are being moved from one segment to the other.

The Statement of Basis and Purpose, Regulation 38, section 38.37 C., for the classification change is excerpted below:

> The Department of Energy (DOE) provided information supporting the appropriateness of retaining the recreation N use classification for the portion of Big Dry Creek Segment 5 located within the Central Operable Unit (COU) in its responsive pre-hearing statement. The Hazardous Materials and Waste Management Division confirmed this information to be accurate. Recreational activities are currently prohibited within the COU and are expected to continue to be prohibited for the next 20 years. The final record of decision for the Rocky Flats Site, the Rocky Flats Legacy Management Agreement (RFLMA), and the environmental covenants currently prohibit recreational uses for the COU. Fences, "no trespassing" signs, and operational controls currently prevent public access to the COU. A portion of Big Dry Creek Segment 5, North Walnut Creek from its source to the western edge of the COU, lies outside of the COU. DOE proposed and the Commission agreed to move this portion of North Walnut Creek from Segment 5 to Segment 4b. Additionally, DOE proposed and the Commission agreed to move a portion of Big Dry Creek Segment 4b, which lies inside the COU, to Segment 5. Based on conditions that have changed from those originally limiting the recreational use in an existing Use Attainability Analysis, the following segment was converted from Recreation Class 2 to Recreation Class P with a 205/100 ml *E. coli* standard: Big Dry Creek Segment 4b.

2.3 Pond Operations

Five constructed ponds collect and manage surface-water runoff at the Site.[3] The ponds are grouped together in series based on the drainage in which they are located, with the A-Series Ponds in North Walnut Creek, the B-Series Ponds in South Walnut Creek, the C-Series Ponds in Woman Creek, and the Landfill Pond in No Name Gulch. Ponds A-4, B-5, and C-2 are referred

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[2]Pursuant to Regulation 31.13 section 1.a, Class P (Potential Primary Contact Use) means surface waters have the potential to be used for primary contact recreation. This classification shall be assigned to water segments for which a reasonable level of inquiry has failed to identify any existing primary contact uses of the water segment, but primary contact uses may potentially occur in the segment within the next 20-year period. Pursuant to Regulation 31.5 (32), "PRIMARY CONTACT RECREATION" means recreational activities where the ingestion of small quantities of water is likely to occur. Such activities include but are not limited to swimming, rafting, kayaking, tubing, windsurfing, water-skiing, and frequent water play by children.

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

to as “terminal ponds” because they are the farthest downstream ponds in their respective drainages, and because they are the ponds from which water is discharged off Site. Off-Site discharges of water from the terminal ponds are currently performed using a batch-release method.

In March 2009, the Site completed the breach of Dams A-1 and A-2 in North Walnut Creek and Dams B-1, B-2, B-3, and B-4 in South Walnut Creek. The reconfiguration eliminates the dams from ongoing monitoring and maintenance as required by the Colorado Office of the State Engineer and returns the stream reaches to a more natural system, while preserving existing wetlands and habitat.

The breaching involved constructing grouted boulder-lined “notches” (Figure 2–2) with adjustable stoplog structures (Figure 2–3) that allow water to flow through the remaining structures while still maintaining the wetland areas upstream. Once vegetation is reestablished, streamflows will ultimately be routed through the notched structures, instead of being diverted around these ponds through the remaining bypass pipelines (A-Series and B-Series Bypass Pipelines).

Figure 2–2. Completed Notch at Dam B-2

Figure 2–3. Completed Stoplog Structure at Dam A-2

During CY 2009, the Site performed four terminal pond discharges (one each at B-5 and C-2; two at A-4). Pond A-3 was discharged to Pond A-4 three times in CY 2009 (Table 2–1). As of December 31, 2009, the Landfill Pond and Ponds A-3, A-4, B-5, and C-2 were holding a total of approximately 15.3 million gallons (15.5 percent of total capacity).

Table 2–1. CY 2009 Pond Water Discharges and Transfers

Discharge/Transfer	Dates	Volume (million gallons)
Pond A-3 to A-4	4/20−4/30/09	12.67
Pond B-5 to S. Walnut Cr.	5/19−6/6/09	12.62
Pond A-4 to N. Walnut Cr.	5/23−6/5/09	9.10
Pond C-2 to Woman Cr.	5/26−6/4/09	4.84
Pond A-3 to A-4	6/6−6/29/09	9.76
Pond A-3 to A-4	11/6−11/19/09	2.19
Pond A-4 to N. Walnut Cr.	12/12−12/21/09	7.17

As described in Section 3.1.2.11, pre-discharge samples were collected during CY 2009 at Ponds A-4, B-5, and C-2 prior to discharge. All predischarge sample results indicated that water quality was acceptable for discharge. Subsequent Point of Compliance (POC) sampling during discharge also indicated acceptable water quality for the discharged water (see Section 3.1.2.1). The valves at Ponds A-4, B-5, and C-2 were all successfully exercised through their full travel at the end of each discharge. The Landfill Pond valve was also periodically exercised during CY 2009; the Landfill Pond is normally operated in a flow-through configuration.

Routine dam inspections, pond-level measurements, and piezometer measurements were performed as scheduled during the year. Annual dam mowing and vegetation removal was completed in September. Semiannual or quarterly (as applicable to specific dams) movement monument surveys and inclinometer readings were also performed as scheduled.

In compliance with the State of Colorado Rules and Regulations for Dam Safety and Dam Construction, a registered professional engineer conducted a formal dam safety inspection for Dams A-3, A-4, B-3, and C-2 and the Landfill Dam in October−November. All inspected dams received a "satisfactory" condition rating and a recommended safe storage level of "full." Several recommendations to improve dam safety were made:

- Monument and inclinometer data for Dam B-5 continue to indicate potential downstream creep and settlement; monument and inclinometer monitoring should continue at the increased quarterly frequency;
- Visual inspection of the downstream slopes at A-4, B-5, and C-2 should be made regularly for slumping or bulging;
- If future inclinometer readings at A4-I1 continue to be influenced by the concrete collar, it should be removed;
- Two very shallow cracks on the north end of the crest of C-2 should be monitored for further changes;
- Rodent activity has increased at A-4, B-5, and C-2; this activity should be monitored closely and controlled if necessary;
- Sediments should be regularly removed from the toe drains at A-3; and
- Spaces between the piezometer/inclinometer pads and the ground surface were noted at some locations; these spaces should be backfilled.

2.4 Landfills

The annual report of the results of inspections, monitoring data, and maintenance activities for the PLF and OLF is provided below.

2.4.1 Present Landfill

The PLF consists of an approximately 22-acre engineered RCRA Subtitle C–compliant cover over a former sanitary and construction debris landfill. A diversion channel surrounds the landfill and diverts stormwater runoff away from the landfill to No Name Gulch. The landfill has a passive seep interception and treatment system (the Present Landfill Treatment System [PLFTS]), installed to treat landfill seep water and Groundwater Intercept System (GWIS) water

that discharges into the Landfill Pond. A gas extraction system is also built into the landfill and allows subsurface gas to vent to the atmosphere.

Subsidence and consolidation at the PLF is monitored by visually inspecting the surface of the landfill cover for cracks, depressions, heaving, and sinkholes. The landfill final construction site conditions are used as a baseline for comparisons made during Site inspections. In addition to the visual inspection, settlement monuments are used to evaluate the actual settlement at these specific locations compared to the expected settlement calculated in the final design. Nine settlement monuments were installed across the top of the landfill cap, and an additional six monuments are located on the east face of the landfill. The monuments were monitored quarterly for the first year and annually thereafter.

Inspections and monitoring tasks follow the format and protocol established in the PLF M&M Plan and include groundwater and surface-water monitoring, and monitoring subsidence and consolidation, slope stability, soil cover, vegetation, stormwater management structures, and erosion in surrounding features so that corrective actions can be taken in a timely manner. Monthly inspections were initiated in October 2005. Quarterly inspections were initiated in the fourth quarter of CY 2007 as described in RFLMA Contact Record 2007-08.

2.4.1.1 Inspection Results

Four inspections were performed at the PLF in CY 2009. The inspection process followed the format and protocol established in the PLF M&M Plan. No significant problems were observed during these inspections. Appendix C contains the landfill inspection forms for the fourth quarter of CY 2009; earlier 2009 inspection forms are included in the applicable quarterly reports.

PLF area surface-water and groundwater monitoring, and operation of the PLFTS, is covered in those respective sections of this report.

2.4.1.2 Slumps

On February 13, 2007, a slump was discovered on the south-facing hillside just east of the PLF. The slump is not on the PLF, and engineering review determined that it does not impact the PLF cover. The slump was likely caused by heavy snow conditions and influenced by the post-closure lower water levels in the Landfill Pond. Therefore, regrading the slump is not necessary; however, deep-rooted plants were planted in the slump area to promote stabilization. There were no significant changes to the slumping area in CY 2009.

2.4.1.3 Settlement Monuments

The annual survey was completed in January and December 2009. Results of the settlement monument survey indicate that settling at each monument does not exceed expected settlement calculated in the final design and does not trigger any maintenance activity under the PLF M&M Plan.

2.4.2 Original Landfill

The OLF consists of an approximately 20-acre soil cover over a former solid sanitary and construction debris landfill. The final cover consists of a 2-foot-thick Rocky Flats Alluvium soil cover that was constructed over both a regraded surface and a buttress fill, and revegetated. The original surface was regraded to provide a consistent slope. A 20-foot-high, 1,000-foot-long soil mass buttress fill was placed at the toe of the landfill. Erosion is controlled by a series of diversion berms that carry storm water runoff away from the cover to channels on the east and west perimeter of the cover.

The OLF is inspected monthly in accordance with the OLF M&M Plan (DOE 2009a).

2.4.2.1 Inspection Results

Twelve inspections were performed at the OLF in CY 2009. The inspection process followed the format and protocol established in the OLF M&M Plan. Appendix C contains the landfill inspection forms for the fourth quarter of CY 2009; earlier 2009 inspections forms are included in the applicable quarterly reports.

OLF area surface-water and groundwater monitoring is covered in those respective sections of this report.

2.4.2.2 Settlement Monuments

The settlement monuments were surveyed in March, June, September, and December 2009. Survey data indicate that settling at each monument does not exceed expected settling calculated in the final design and does not trigger any maintenance activity under the OLF M&M Plan.

2.4.2.3 Geotechnical Investigation and Repairs

Conditions that warranted further repair and that triggered further investigation were found at the OLF beginning in 2007, as documented in the RFLMA quarterly and annual reports for 2007 and quarterly reports for 2008 (DOE 2007c, 2007d, 2008f, 2008e, 2008c, 2008d, 2009f). These conditions involved the localized slumping and settling of the OLF cover, seeps observed to daylight intermittently on the cover, and the development of a continuous seep at the eastern toe of the buttress (identified as Seep 8). In addition, ponding in lengths of the diversion berm channels from precipitation and snowmelt runoff were observed, and a topographic survey showed that portions of the diversion berms did not meet the minimum OLF M&M Plan–specified 2-foot height. DOE notified CDPHE and EPA of the observed conditions, and the parties discussed actions to address them. DOE continued monitoring conditions and made minor repairs as provided by the OLF M&M Plan, adding and compacting soil to localized areas to maintain berm and cover integrity.

CDPHE approved an OLF Action Plan on July 16, 2007. The OLF Action Plan included Phase 1 (near-term) repair, Phase 2 geotechnical investigation, and Phase 3 design and construction for long-term repair. Phase 1 repairs to address localized differential settlement, slumping, and surface cracks were made in 2007 by filling, grading, and compacting.

CDPHE approved the Phase 2 *Rocky Flats Site Original Landfill Geotechnical Investigation/Engineering Work Plan* (Work Plan) (DOE 2007e) on November 30, 2007. The goal of the Work Plan was to determine subsurface conditions and the possible causes of observed localized slumping and settling of the OLF cover, and to develop feasible alternatives for mitigating the localized areas of slope instability. The investigation also considered the possible impacts of the seeps and the maintenance of berm heights and channel slopes to ensure adequate water run-on and runoff controls.

Investigation fieldwork for Phase 2 began in December 2007 and was completed in April 2008. Work began with a geophysical survey to help determine the thickness and extent of waste placement and to aid in positioning investigative test pits and boreholes. Next, eight test pits, approximately 20 feet long and 11 to 13 feet deep, and a ninth test pit, approximately 20 feet long and 3 feet deep, were excavated. Seven boreholes, approximately 28 to 39 feet deep (into bedrock), were drilled to obtain continuous core samples and to install inclinometers to accurately measure movement. Throughout the work, a geologist made field observations, and laboratory analyses were conducted to determine mechanical properties of the test pit and borehole samples.

The *Rocky Flats Original Landfill Geotechnical Investigation Report* (Geotech Report) (Tetra Tech 2008) describes the Phase 2 work performed and concludes that a clay layer containing organic materials at or near the bedrock contact appears to be a weak interface area. As described in the Geotech Report, modeling predicts small-scale instability due to percolating moisture that lubricates this weak interval. The OLF buttress is providing stability as intended, and there is no large-scale instability predicted; therefore, the observed conditions do not appear to indicate a need for urgent or major responses.

CDPHE notified DOE on June 24, 2008, that the Geotech Report, having met the criteria agreed to in the Work Plan for the investigation, was acceptable. A summary of the results of the OLF Action Plan implementation and the path forward is included in RFLMA Contact Record 2008-07, approved by CDPHE on September 2, 2008 (Appendix G). The construction to complete the necessary repairs and to implement design changes was completed in November 2008, and the as-built surveys for inclusion in the revised OLF M&M Plan were completed in March 2009. Construction of approved design changes and repairs and maintenance activities were performed as described below.

Diversion Berm Height

Minimum heights are based on subdrainage areas calculated for 200-foot lengths of each berm, and the minimum calculated height to convey the 1,000-year, 24-hour event. This provides freeboard capacity to convey the 100-year, 24-hour event, which is a design criterion for the berms. Approximately 24 percent of the total berm lengths had soil added to the top to meet this minimum height (which will represent the required berm height). This approach will minimize the impact to established vegetation because it will not require wholesale regrading or use of heavy construction equipment. Soil was added to raise berm heights in September and November 2008. The as-built topographic survey completed after this work will serve as a baseline for continued observation of berms for future maintenance. Inspections and future topographic surveys will be used to identify areas that require additional soil to maintain minimum heights.

Diversion Berm Channels

Channels were regraded as needed during the berm height construction, based on observations of significant ponding, to promote drainage to the perimeter channels. This included installing a gravel drain at the western end of Diversion Berm 3 to improve drainage below Seep 4 into the West Perimeter Channel. Inspections and future topographic surveys will be used to identify areas of ponding or slopes that indicate channel areas may be conducive to ponding.

Seep 7 Drain Extension

As discussed in previous quarterly reports for CY 2009, the planned adjustment to the eastern edge of the Seep 7 drain extension was completed this year. The adjustment involved hand-excavation and opening the geotextile fabric to make the area porous to water along the eastern edge of the drain. Hand-excavation to a depth of approximately 1.5 feet to expose two approximately 5-foot lengths along the drain edge was conducted to access the geotextile fabric. The fabric was cut open, the opening was covered with permanent erosion matting and crushed rock, and the excavated soil was replaced. The work was performed on July 23 and August 19, 2009. After completion, the area was frequently observed throughout the rest of year.

A new area of Seep 7 located approximately 10 feet southwest of inclinometer 82608 started to show some surface expression of seep water in November 2009. The location appears to be on the edge of the Seep 7 drain and is likely being caused by the overlapping of geotextile fabric, which prevents seep water from entering the drain as designed. The seep area is being periodically observed during routine and nonroutine landfill inspections. Repairs similar to those described above may be completed during the spring or summer if necessary.

Inclinometers

As discussed in the quarterly report for second quarter CY 2009, seven inclinometers were installed in boreholes at the OLF in 2008 as part of the geotechnical investigation (Figure 2–4).

Figure 2–4. Original Landfill Observed Surface Cracking Location and Inclinometer Locations

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Movement of the inclinometers has been monitored approximately monthly since installation. During the fourth quarter 2009, the inclinometers were monitored on October 28, November 25, and December 29. Inclinometers deflect based on lateral movement of the ground in which the inclinometer is located, and can deflect enough to cause the inclinometer tube to break. Once an inclinometer tube breaks, it will no longer be monitored. Inclinometer monitoring data provide information on localized soil movement and serve to focus periodic inspections of the soil cover surface for signs of potential instability, such as cracking, vertical displacement, and slumping. A deflection of more than 1 inch is used as a trigger for evaluation of the data by a qualified geotechnical engineer. The engineer determines the significance of the deflection in relation to recommendations for maintenance or repairs to address potential instability in accordance with the OLF M&M Plan (DOE 2009a). The modification to the OLF M&M Plan, discussed in Section 1.4, revises the text as appropriate to recognize the implementation of the remedy under RFLMA, and the completion of the geotechnical investigation work was discussed in the quarterly report for second quarter CY 2009 (DOE 2009d).

Since the inclinometer measurements taken on July 22, 2009, very little deflection of the inclinometers was noted in the remainder of 2009. This indicates that the localized movement associated with the area of the three inclinometers on the west side of the OLF, between diversion Berms 1 and 3 (inclinometers 82208I, 82308I, and 82408I), which showed approximately 1.5 to 2.25 inches deflection in the second quarter, did not continue through the rest of the year.

The deflection appears consistent with the findings of the geotechnical investigation that there is an organic layer near the bedrock surface that is a weak zone for the overlying soil, especially if it becomes lubricated by subsurface moisture. Seeps 4 and 7 also showed significant moisture and had surface expressions during this period as well. As described in Contact Record 2008-07, the West Perimeter Channel was regraded, and a channel drain was added in 2008 to improve the stability of the western side of the OLF cover.

A qualified geotechnical engineer has evaluated the inclinometer data, and the *Technical Memorandum Regarding Instrumentation and Monitoring at the Rocky Flats OLF* that discusses the evaluation is included as Appendix E.

West Perimeter Channel Side Slope Stability

The area generally between the western ends of Diversion Berms 1 and 3 was regraded by cutting and filling to lessen the OLF side slope and improve stability. The construction was completed in November 2008. The existing gravel drain between Diversion Berms 1 and 2 was located and tied in to an extension of the gravel drain to the southern end of the perimeter channel. The Diversion Berm 3 gravel drain was also tied in to the extension of the gravel drain to the southern end of the perimeter channel.

Other Repairs and Maintenance

Localized slumping, differential settling, and cracks have been observed in the area between Berms 1and 2 on the western end of the OLF cover. Repairs to the cracks and slumps have been addressed by adding soil, regrading, and compacting as specified in the OLF M&M Plan. The localized cracking in the Berm 1 area, as discussed in the *Quarterly Report of Site Surveillance*

and Maintenance Activities, Third Quarter Calendar Year 2009 (DOE 2010c), continued to be monitored throughout the fourth quarter. No further movement was observed during the inspections.

A subcontractor installed approximately 1,000 feet of wattles on the OLF in October 2009. The locations of the wattles were predetermined by the Site ecologist prior to installation.

2.5 Groundwater Plume Treatment Systems Maintenance

The system-specific summaries below focus on the maintenance and operation of the Mound Site Plume Treatment System (MSPTS), the East Trenches Plume Treatment System (ETPTS), and the Solar Ponds Plume Treatment System (SPPTS) during CY 2009. Refer also to previous quarterly reports from 2009 (DOE 2009e, 2009d, 2010c).

Details of the monitoring of the systems, including the PLFTS, are presented in Section 3.1.2.10, and interpretations related to system operation and the corresponding contaminant plumes are provided in Section 3.1.5.3.

2.5.1 Mound Site Plume Treatment System

Routine maintenance activities continued at the MSPTS through CY 2009. These activities included weekly raking of the media and inspection of influent- and effluent-flow conditions. Air in the instrumentation vault was monitored periodically as a conservative health and safety practice.

The effluent distribution piping that returns treated groundwater to the subsurface became clogged several times during CY 2009, requiring manual snaking of the pipes. Flowrates through the system and water levels within the treatment cells indicated gradual clogging of the zero-valent iron (ZVI) media, and flow through Cell 1 was changed to upflow configuration on February 25, 2009. (By operating in downflow, the clogging media could result in water overtopping that cell.) The system remained configured for series flow, in which water flows upward through Cell 1 and then downward through Cell 2. Water levels within the cells toward the end of CY 2009 indicated that Cell 2 might also be starting to clog. The flow configuration may be changed in 2010 to parallel upflow to force water through the clogging media and prevent water from overtopping the cells. Media replacement and plumbing upgrades, potentially similar to those installed at the ETPTS in 2009 (Section 3.1.5.3), are being planned for CY 2010.

2.5.2 East Trenches Plume Treatment System

Routine maintenance activities continued at the ETPTS through the first 9 months of CY 2009. This included weekly raking of the media and inspection of influent- and effluent-flow conditions. Routine inspections included atmospheric monitoring in the instrumentation vault as a conservative health and safety measure. This maintenance was halted to perform media replacement activities and significant plumbing upgrades in late CY 2009; see Section 3.1.5.3 for a complete description of these upgrades.

As reported in the 2008 Annual Report (DOE 2009g), during that year flow was configured so that water passed through Cell 2 before Cell 1 due to increased clogging of Cell 1. This

configuration caused airlocks to develop, requiring frequent flushing of the between-cell piping to prevent Cell 2 from overtopping. On April 14, 2009, flow was reconfigured so that water flowed up through Cell 1 and then down through Cell 2. The between-cell instrumentation piping was also bypassed to prevent the clogging of filters and flowmeters associated with upflow configuration observed in CY 2007 (DOE 2008d, 2009g). Flow continued in this configuration until the cells were de-watered to prepare for media replacement and plumbing upgrades (Section 3.1.5.3).

2.5.2.1 Operations Associated with Media Replacement and Plumbing Upgrades

This section summarizes information regarding the operations associated with the media replacement and plumbing upgrades. For a complete description of these upgrades, including schematics, see Section 3.1.5.3.

De-watering of the cells began September 9, 2009, so that samples of the ZVI media could be collected for waste characterization purposes. The Cell 1 ZVI sample was collected September 14, and the Cell 2 sample was collected September 15. System flow was restored for a short time after these samples were collected but was shut off again September 16, and the cells were de-watered as completely as possible over the next week. Construction activities commenced September 21, and telemetered instruments were disconnected September 22 to prepare for the plumbing upgrades. The system was off-line for the duration of the project, which was completed November 9. Water levels within the collection trench sump were closely monitored during this time to determine if temporary water management measures would be necessary until system flow could be restored. The collection trench, however, provided adequate storage capacity for all intercepted water, and no temporary measures were required. Treatment system operation resumed November 9, and automated data transmission resumed November 12.

After the media replacement and plumbing upgrades, routine operations included monitoring water levels, flowrates, and line pressures. Raking of the media was discontinued: since the media replacement and upgrades were completed, untreated water enters the bottom of each cell, and any crusting that might occur at the point of initial water contact with ZVI would be inaccessible. Problems associated with this crusting are not anticipated, however, because the media design was altered to improve flow within the cells (Section 3.1.5.3).

2.5.3 Solar Ponds Plume Treatment System

This section addresses the operation and optimization of the SPPTS. Routine inspections included monitoring water levels, line pressures, power consumption, and flowrates, and cleaning flowmeters. Phases II and III were completed during CY 2009 and introduced significant changes to system design and operation. For a complete description of these upgrades, including system schematics, see Section 3.1.5.3.

NOTE: It is strongly recommended that the following information be read in conjunction with the aforementioned section for better understanding, because all optimization tasks and changes that were made to system operation were implemented to support the objectives discussed in that text.

2.5.3.1 Phase I Operation

Phase I components continued to operate through CY 2009. Routine inspections of these components include monitoring water levels, power usage, and pump operation. During construction of Phase II/III components, water levels within the concrete ITS Sump (ITSS) rose above the overflow line, requiring temporary water management measures to dewater the sump. Water was pumped from the ITSS return line into Cell 1 of the original SPPTS. SPPTS flow estimates for this construction period can be seen on Figure 2–5, which represents system effluent—the combined contributions of ITSS and the original groundwater collection trench.

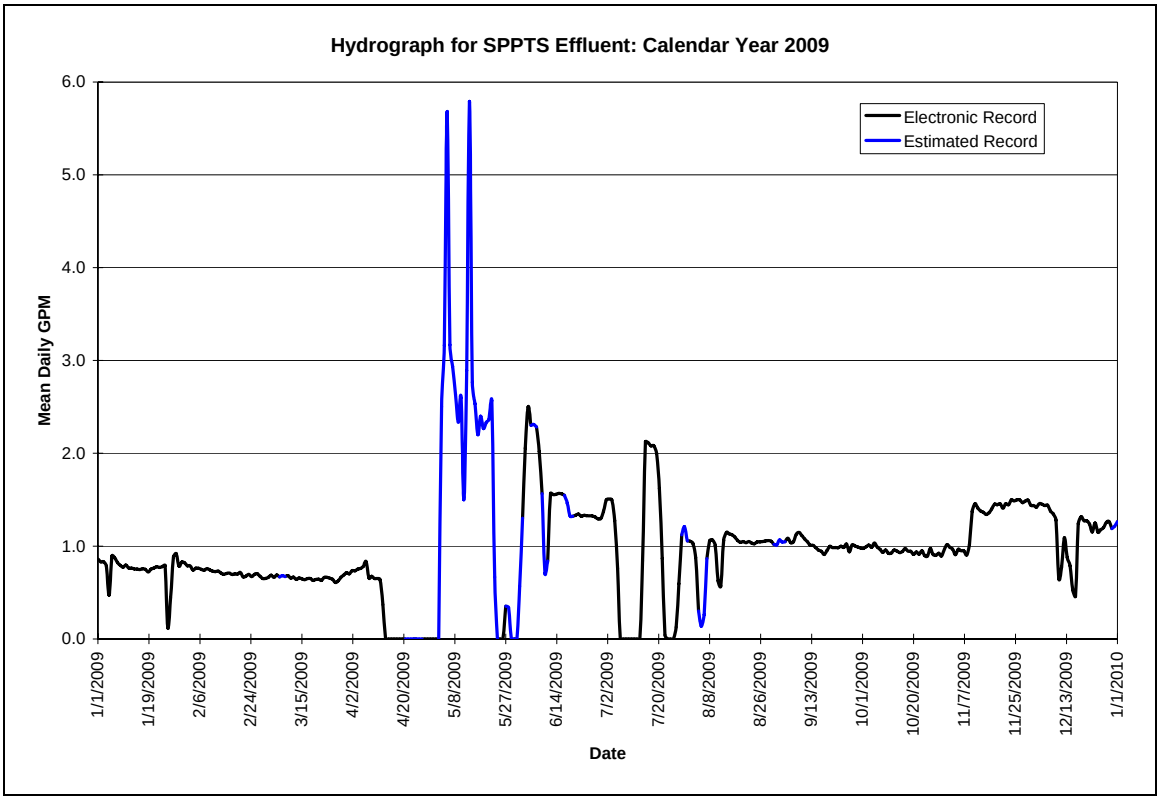

Figure 2–5. Hydrograph for SPPTS for CY 2009

Two pipe breaks occurred on the ITSS return line during CY 2009. The first was discovered April 22 and occurred at a PVC coupler just downstream of the flexible hose connection exiting the concrete sump. Following excavation to evaluate and define the location of the break, the coupler was repaired on May 1; temporary water management measures resumed May 4. The second break was discovered August 3 and occurred at a threaded PVC connection to a buried valve. It was repaired August 5, and the ITSS pump resumed operation that same day. Throughout the year, the ITSS pump timer was adjusted as necessary to keep water levels within acceptable limits.

A flowmeter was installed on the effluent line (SPOUT) within the ITSS Battery Vault on July 23 to more closely monitor effluent flow conditions.

2.5.3.2 Phase II/III Operation and Optimization

This section addresses operation and optimization activities of the Phase II and Phase III components. For a more complete description of these components, see Section 3.1.5.3. During construction of the Phase II and III upgrades, temporary lines were put in place to keep water from backing up in the collection trench. A line transferred water from SPIN into the original SPPTS Cell 1 distribution gallery via the influent line vent riser installed within Cell 1. SPPTS flow estimates for this construction period can be seen on Figure 2–5; as noted above in the text on Phase I, the hydrograph represents the combined contributions of ITSS and the original groundwater collection trench.

Immediately after construction was completed, flowrates were the first components to be optimized. Adjusting flowrates is accomplished by varying both the control voltage delivered to the pumps installed within SPIN (which delivers water to the Phase II cell) and the Metering Vault (which delivers water to Cells A and B), and valve position downstream of those pumps. Determining the correct combination of voltage and valve position was a trial and error process; the pumps occasionally stalled overnight until this ideal combination was discovered. This occurred because of a slight voltage drop when the sun goes down; the resulting voltage had to be sufficient to continue to power the pump against the pressures represented by the valve settings. Turning up the voltage eliminates the stalling action but also results in higher flow rates than might be desired. Therefore, these two effects had to be carefully balanced to achieve project objectives and maintain operation.

Optimization efforts were primarily confined to adjusting flow rates for the first month of system operation. As discussed in Section 3.1.5.3, the system was off-line for the month of July while repairs were made to the system after the failure of the collection sump. During that time temporary lines were put in place to keep the Phase II cell on-line, and small batches of water were added to Cells A and B. Cell A received three batches of water (219 gallons on July 14, 85 gallons on July 16, and 150 gallons on July 20), while Cell B received one (80 gallons on July 20). In late July, a proportional control valve was installed on the SPIN line just before it enters the Phase II cell in order to better control valve position. The system was re-started on August 6, and on several occasions the pumps stalled overnight while the correct combinations of control voltage and valve position were determined.

Shortly after flow through the system resumed, water was observed trickling out of a weephole near the top of the Cell 1 influent vent riser. This was attributed to water backing up in the Cell 1 distribution gallery pipes due to biofouling within those pipes. This trickle created a puddle on the surface of the soil and wood-chip overburden of the original treatment cells. Methods for mitigating this biofouling are being evaluated.

Citrate dosing was doubled on August 13 because of decreasing U treatment within the Phase II cell, and was subsequently discontinued completely on August 26 due to concerns that addition of citrate might be interfering with U treatment. A tracer test was conducted on this cell in October 2009 to determine if short-circuiting of the media could be a contributing factor to decreased U treatment. This test and the problems associated with U treatment are discussed in more detail in Section 3.1.5.3.

Power problems were encountered as temperatures dropped and periods of sunlight shortened in November and December 2009. (Power problems of a similar nature were also an issue in the winter of 2008, as reported in DOE 2009g.) This caused erratic instrument readings, diminished dosing pump performance, and pumps stalling overnight. Voltage regulators were added to the 12-volt and 24-volt power distributions in November, and the SPIN pump system was reconfigured in December to run off 36-volt power. These changes eliminated the problems associated with insufficient power.

As temperatures dropped in November, a corresponding decrease in water temperatures was observed within system components. To reduce heat loss from the treatment cells, insulation was added to the hatch covers of the SPIN Vault, Metering Vault, Cell A, and Cell B in November. Foam insulation was also added to the Phase II ZVI cell in December, but in this case it was floated on the water surface to maximize its effectiveness.

A flow loop consisting of clear PVC was added to the Cell A recirculation line in mid-November to allow closer observation of biofilm development. The MicroCg (MCG) dosing rate was increased from approximately 28 milliliters (mL) of MCG per gallon (gal) of influent to 85 mL/gal on November 9, and was subsequently reduced to 62 mL/gal on December 7. Trisodium phosphate was added to the MCG supply on December 18 to supply the necessary phosphorous nutrient.

Flow through Cell B was reduced beginning in November to increase hydraulic residence time within the cell. This required the addition of water in small batches, since the desired flow rates were too low to achieve with the current pump, valve, and flow meter configuration. See Section 3.1.5.3 for a more complete description of this flow batching.

Optimization of these components will continue in 2010, and a path forward for Phase IV will also be developed during that time.

2.6 Erosion Control and Revegetation

The existing erosion controls are maintained and repaired to protect the bare soil areas until the vegetation can stabilize the soil. Areas lacking sufficient vegetation cover are assessed, and typically reseeded; however, in some cases, soil amendments are added to help establish the native vegetation. Additional information on the revegetation activities conducted at the Site during 2009 is provided in Section 3.2.2.3 of this annual report.

2.6.1 Erosion Control

Maintenance, repair, replacement, and monitoring of the Site erosion control features continued through 2009, as needed. Assessing the erosion control is especially important following the high wind events that are common at the Site and after significant precipitation events. Typical repairs included restaking (or weighting with rocks) wattles or erosion blankets that had loosened. The *Erosion Control Plan for the Rocky Flats Property Central Operable Unit* (DOE 2007b) was followed for various projects conducted in 2009. The plan addresses the regulatory approach, monitoring inspections, and the applicability and scope of erosion control activities at the Site. It outlines the responsibilities, BMPs, and implementation aspects for erosion control activities before, during, and after projects.

2.7 General Site Maintenance and Operations

The Site is managed and maintained, and activities are conducted, pursuant to DOE's jurisdiction and control responsibilities. These activities help maintain the general condition of the Site through BMPs. The Site is assessed both according to a schedule and continuously. Highlights of the routine and nonroutine maintenance and operations are described below.

2.7.1 Road Upgrades

2.7.1.1 Emergency Repairs

On April 20, 2009, an emergency inspection of the Site was conducted following a 3.2-inch precipitation event received over the weekend. Site roads showed minor erosion damage in a few locations. It was determined that repairs to these areas could not wait until the Roads 2009 Project scheduled to be completed in August. A Spring Road Repairs Project was immediately planned to prevent further erosion problems. The spring road repairs were completed on May 6. Several Site road locations that were eroded during the recent precipitation events were regraded and compacted. Additional roadbase was added in some locations where erosion was substantial.

2.7.1.2 Annual Road Upgrades

The Roads 2009 Project was initiated on August 25. Various Site roads were regraded, had roadbase applied, and were compacted according to the engineering specifications and drawings. The project was completed on September 10. Installation of all the required erosion controls was completed and approved by the Site ecologist. The surfactant that seals the roads was applied on September 10.

Additional ¾-inch angular rock was applied to the Ridge Road and SPPTS road on November 2. The added rock will help stabilize the roads, especially following precipitation events. The road upgrades to the SPPTS road and project area were completed on November 24. Additional drainage mechanisms will be evaluated if necessary.

2.7.2 Snow Fence

Build-up of snow on the OLF cover can lubricate weak layers in the subsurface when it melts, perpetuating movement (slumping) of the landfill cover. It was determined that the best way to prevent snow from accumulating on the landfill cover was to install sections of snow fence along the top of the OLF.

The snow fence project was initiated on October 19. The subcontractor drilled all of the holes to support installation of the h-braces that anchor the snow fence. T-posts were also installed between the h-brace locations to help secure the fence. The snow fence project was completed on November 2. All nine sections were successfully installed. One additional section of snow fence was ordered to splice the ends where the fence was too short. The ends of the snow fence that needed additional snow fence to fill gaps were completed November 20.

2.7.3 Site Security

A USFWS officer has been assigned to the Rocky Flats Site to perform nonroutine security evaluations as well as respond to any security issues encountered by Site personnel.

Four shotgun shells were found on the northeast end of the OLF on November 2, 2009. On November 4, the operations manager met with the USFWS officer assigned to the Rocky Flats Site and collected the shell casings for possible evidence. An e-mail was sent to Site staff alerting them to the possible hazard along with instructions on the appropriate response if a person with a gun is encountered at site.