



## - TECHNICAL MEMORANDUM -

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DATE: 9 September 2013

TO: Mike Holzwarth, Steve Christian, Gordon Criswell – PPL Montana, LLC

FROM: Al Hilty, Rich Labbe – Hydrometrics, Inc.

SUBJECT: **ADDENDUM -- SOUTH FORK COW CREEK DIVERSION SEDIMENT REMOVAL**

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### *Executive Summary*

This technical memorandum is an addendum to the earlier technical memorandum *INTERIM REPORT -- SOUTH FORK COW CREEK DIVERSION SEDIMENT REMOVAL* (Hydrometrics, Inc., March 5, 2013), which served as an interim report of sediment removal activities from the South Fork Cow Creek (SFCC) Diversion pond south of the Units 3 & 4 Effluent Holding Pond (3&4 EHP) at the PPL Montana Colstrip Steam Electric Station. The SFCC Diversion was installed in late 2004 to contain water impacted by process water from the 3&4 EHP known as the SFCC Seep. The system operated as such: a small earthen dam was constructed across the drainage downstream of the seep; pumping and water conveyance equipment was installed upstream of the dam; and impounded water was pumped to the 3&4 EHP. As flow from the seep subsided, use of the SFCC Diversion capture system was reduced and later discontinued. Salts contained in unconsolidated sediments upstream of the SFCC Diversion were dissolving in precipitation runoff water, as evidenced by high concentrations of total dissolved solids in ponded water quality samples taken from above the dam. Approximately 320 cubic yards of unconsolidated sediments were removed from upstream of the SFCC Diversion in January 2013. Upon removal of the sediments, free water was observed issuing to the drainage above the diversion dam. A water quality sample was collected; results of which indicated probable process water impacts. Specific Conductance (SC), Total Dissolved Solids (TDS), sulfate,

boron, and chloride concentrations in the sample were 7,130  $\mu\text{mhos/cm}$ , 7,900 mg/L, 5,290 mg/L, 6.42 mg/L, and 88 mg/L, respectively. Staff from the Colstrip-SES environmental department tracked the source of the impacted water to a leaky unused pipeline up-gradient of the SFCC Diversion Dam. Specifically, the leak originated at a valve housed below ground in a vault constructed of corrugated metal pipe (CMP). The leaks were repaired and the valves and CMP vault were removed. This addendum serves as the final report on activities conducted under the Work Plan *SOUTH FORK COW CREEK DIVERSION SEDIMENT REMOVAL* (Hydrometrics, October 23, 2012).

## ***Introduction***

PPL field personnel noticed water issuing from the ground in a tributary to South Fork Cow Creek (SFCC) 9/27/2004. The site was thereafter referred to as the SFCC Seep. At the request of PPL, representatives of Hydrometrics visited the site on 9/28/2004 and began investigating the source and evaluating alternatives to control further migration of the water (Hydrometrics, June 2005). The SFCC Diversion was installed in late 2004 to contain impacted water from the SFCC Seep. A small earthen dam was constructed across the drainage downstream of the SFCC Seep. Pumping and water conveyance equipment was installed upstream of the dam and impounded water was pumped to the 3&4 EHP.

Evaluation of the source of the seep, which included excavating test pits, indicated that water was issuing from the SFCC Seep at an elevation consistent with the base of the Rosebud Coal stratigraphic unit. Aerial photographs for the area showed a potentially wetted area at the SFCC Seep in both 2003 and 2004 (Hydrometrics, June 2005). This timing is coincident with water reduction inventory efforts by PPL, which included flooding of Cells F and H to increase evaporation. Surveyed elevations of the top of the slurry wall, made in two test pits adjacent to Cell F, indicated that the high water mark in the cell was lower than the top of the slurry wall. This suggested that flow over the top of the wall likely did not occur. PPL altered their management strategy of cells F and H to include a maximum fill level that would not cause seepage in SFCC and implemented a paste deposition protocol to decrease permeability of the ponds. Reinforced polypropylene liners with underdrain collection systems have since been installed in cells F and H.

Salts contained in unconsolidated sediments upstream of the SFCC Diversion were dissolving in precipitation runoff water, as evidenced by high concentrations of total dissolved solids in ponded water quality samples. Removal of the unconsolidated sediments upstream of the SFCC Diversion was recommended to remove the source material for elevated dissolved constituents. The procedure for sediment removal was outlined in the Work Plan *SOUTH FORK COW CREEK DIVERSION SEDIMENT REMOVAL* (Hydrometrics, October 23, 2012). The location of the SFCC Diversion Dam and sediment removal area is presented in Figure 1.

Approximately 320 cubic yards of sediment were removed from up-gradient of the SFCC Diversion Dam and placed in the 3&4 EHP. A narrative of sediment removal activities and results of soil/sediment geochemical samples are included in the original Interim Report (Hydrometrics, March 5, 2013). As noted in the earlier report, water issuing up-gradient of the SFCC Diversion Dam was observed at the conclusion of sediment excavation and removal activities. This key observation was further investigated and is discussed in this addendum, which is the final report on SFCC Diversion Dam Sediment Removal.

### ***Results***

Water collected from upstream of the SFCC Diversion Dam on 12/12/2012 at its apparent point of emergence had a field SC of 8,135  $\mu\text{mhos/cm}$ ; but flow from the point of issuance was minimal (estimated at less than 0.5 gpm). Winter conditions including snow cover, freezing temperatures, and freeze/thaw patterns made it difficult to characterize water upstream of the SFCC Diversion Dam throughout late winter/early spring. An attempt to collect a sample was made after a period of thaw on 2/25/2013. Although some standing water was impounded behind the dam, no flow was observed issuing from the sediment removal area. Field SC measurements made on 2/25/2013 ranged from 1,200  $\mu\text{mhos/cm}$  to 7,800  $\mu\text{mhos/cm}$ . A representative sample could not be collected because of the inconsistent SC coupled with the lack of flow. Under spring thaw conditions, flow was identified and a water quality sample was collected on 4/4/2013. The sample was analyzed for the list of parameters included in Table 1.

**Table 1. Water Quality Results from Upstream of SFCC Diversion Dam**

Analyte	Results <sup>1</sup>
pH (s.u.)	8
SC (µmhos/cm at 25 °C)	7130
TDS (measured at 180 °C)	7900
Calcium (Ca), dissolved	432
Magnesium (Mg), dissolved	927
Ca:Mg	0.47
Sodium (Na), dissolved	547
Potassium (K), dissolved	8
Bromide (Br)	1
Bicarbonate (HCO <sub>3</sub> )	205
Carbonate (CO <sub>3</sub> )	ND
Sulfate (SO <sub>4</sub> )	5290
Chloride (Cl)	88
Total Alkalinity as CaCO <sub>3</sub>	168
Boron (B), dissolved	6.42
Selenium (Se), dissolved	0.045
Mercury (Hg), dissolved	ND
Nitrate + Nitrite, as N	22.3

<sup>1</sup>All results in mg/L unless otherwise specified

sample collected on 4/4/2013

Results of the sample were consistent with process water impacts. Values of typical process water indicator parameters were: (SC) = 7,130 µmhos/cm; Total Dissolved Solids (TDS) = 7,900 mg/L; sulfate = 5,290 mg/L; boron = 6.42 mg/L; chloride = 88 mg/L; and calcium to magnesium ratio (Ca:Mg) = 0.47.

### ***Repair of Leaky Pipeline***

Personnel from PPL Montana LLC's Colstrip-SES Environmental Department tracked the source of the impacted water to a leaky unused pipeline upgradient of the SFCC Diversion Dam. Specifically, the leak originated at a valve housed below ground in a vault constructed of corrugated metal pipe (CMP). The discontinued pipeline was connected to the active pipeline that distributes captured groundwater from SFCC to the 3&4 EHP. The leaks were repaired and

the valves and CMP vault were removed. The location of the pipeline and removed valve vault are shown in relation to the SFCC Diversion Dam and point of issuance of the impacted water in Figure 1.

No further issuance of water to the ground surface above the SFCC Diversion has been observed since the repair of the leaky valves took place. Note also that surface water was not allowed to pass beyond the SFCC Diversion Dam from the date of discovery of the surface water issuance until it was verified that the issuance was stopped. The culvert at the site was plugged throughout the spring; and impounded water was removed to the 3&4 EHP. Most of the water removed was either snowmelt or storm water runoff.

### ***Conclusions and Recommendations***

Two potential sources of dissolved constituents to surface and groundwater in the SFCC drainage were removed by excavating sediments with increased levels of soluble salts and repairing the leaky captured groundwater return pipeline upstream of the SFCC Diversion Dam. Recommendations for additional work upstream of the diversion are as follows:

- It is recommended that the excavated area be re-vegetated, if possible, using PPL's typical rangeland seed mix. Establishment of vegetation in this area would limit erosion of the bedrock surface in the area. Note however, that native vegetation was very sparse in the project drainage prior to discovery of the SFCC seep and construction of the SFCC Diversion.
- No additional evaluation is recommended upstream of the SFCC Diversion Dam.



SEDIMENT REMOVAL AREA



3-INCH PIPELINE  
DRAINED AND  
CAPPED

6-INCH PIPELINE TO 384 EHP

3-INCH PIPELINE TO LIFT  
STATION LEFT IN PLACE

SFCC DIVERSION DAM

**LEGEND**

-  Point of Water Issuance
-  CMP with Leaky Pipeline

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**LOCATION OF LEAKY PIPELINE AND  
POINT OF WATER ISSUANCE**

FIGURE  
**1**