TETRA TECH

MEMO

To:	Mr. Jim Ford, NRDP
From:	Mr. William H. Craig, LHG, Tetra Tech
Date:	July 21, 2016
Subject:	Data Gap Investigation – Silver Bow Creek and Blacktail Creek Corridors

This technical memorandum presents results of soil, sediment, surface water, groundwater, and pore water sampling pertaining to characterization of mine wastes located at the Blacktail Creek (BTC) Berm area and within the historical floodplain deposits associated with the BTC and Silver Bow Creek (SBC) riparian corridors. The sampling results are being utilized to address data gaps and satisfy design needs for the integration of restoration with remedy of mining and mineral processing wastes in the SBC and BTC Corridors **(Figure 1; Appendix A)** and to support integration of restoration design. Removal of wastes is described in the 2006 Butte Priority Soils Operable Unit (BPSOU) Record of Decision (ROD) Section 12.3.3.2 (EPA 2006a) which requires excavation of contaminated sediment, streambanks, and floodplain wastes from the reach of Blacktail Creek just above the confluence with upper Silver Bow Creek down to the reconstructed floodplain and stream channel in Lower Area One, and the 2015 Preliminary Conceptual Restoration Plan (Confluence, 2015). Field methods and procedures used in this data gap investigation generally followed procedures outlined in the draft final sampling and analysis plan (SAP) and quality assurance project plan (QAPP) (Tetra Tech 2016a).

BACKGROUND

In 1983, the State of Montana filed a lawsuit in federal District Court against the Atlantic Richfield Co. (ARCO) for injuries to the natural resources in the Upper Clark Fork River Basin, which extends from Butte to Milltown, Montana. The *Montana v. ARCO* lawsuit, brought under federal and state Superfund laws, sought damages from ARCO, contending that decades of mining and smelting in the Butte and Anaconda areas had greatly harmed natural resources in the basin and deprived Montanans of the use of these resources.

The state settled *Montana v. ARCO* through a series of settlement agreements, or consent decrees, completed and approved by the court in 1999, 2005 and 2008. One of the three injured areas in the Upper Clark Fork River Basin covered under the 2008 settlement agreement was the Butte Area One (BAO) injured groundwater and surface water site.

The 2008 *Montana v. ARCO* Consent Decree allocated $28.1 million, plus interest, to restore, replace or acquire the equivalent of the injured groundwater and surface water of BAO. Then-Governor Schweitzer created the Butte Natural Resource Damage Restoration Council (BNRC) to give the citizens of Butte a strong voice in how this fund should be spent. The nine member volunteer council, with assistance from the NRDP, developed the 2012 Butte Area One Final Restoration Plan (BNRC 2012) to guide the expenditure of these funds. It was approved by the governor in January 2013.

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Injury to groundwater in BAO has been demonstrated by the occurrence of concentrations of contaminants (including cadmium, zinc, iron, lead, copper, arsenic and sulfate) that exceed drinking water standards in the alluvial aquifer. The areal extent of the known contamination above drinking water standards of the alluvial aquifer is about one square mile and extends from the Parrot Tailings area down gradient along the SBC channel. The highest known concentrations of dissolved contaminants in groundwater coincide with wastes from the Parrot Tailings area and the BRW. Other waste areas known as the Diggings East and Northside Tailings also contain waste materials that are leaching contaminants into the groundwater which discharges to adjacent surface waters. In Lower Area One (LAO), west of Montana Street, some of the mine waste tailings were previously removed by ARCO; however, some slag, tailings, and other wastes from the BRW and Colorado Smelter remain in place and have the potential to leach contaminants to ground and surface water.

The discharge of contaminated mine wastes, groundwater and surface water to SBC and BTC in BAO results in floodplain, surface water and instream sediment contamination. Surface runoff from storms and snowmelt carry hazardous substances from waste sources to the Creeks through surface drainages and the stormwater collection system.

The BAO Plan calls for removal of mine wastes left in place along the floodplain of upper Silver Bow Creek through BAO, with an allocation of $10 million towards that removal. The BAO Plan identifies these wastes, which include the Parrot Tailings, Diggings East, Northside Tailings, and other isolated areas of mine wastes in the Blacktail and Upper Silver Bow Creek floodplains, as the primary sources supplying inorganic contaminants to the alluvial groundwater, surface water, and in-stream sediment resources within the Upper Silver Bow Creek corridor. The 2015 Preliminary Conceptual Restoration Plan (PCRP), issued by NRDP for public input in February 2015, focused on the Upper Silver Bow Creek corridor. The June 2016 draft Parrot Tailings Waste Removal Amendment addresses the removal of the Parrot Tailings waste. This technical memorandum presents results related to the BTC Berm area and historical floodplain deposits associated with the BTC and SBC riparian corridors.

SITE DESCRIPTION

BTC receives the majority of its base flow contributions from Summit Valley groundwater in Butte, Montana. The stream intersects both the BAO injured area restoration site and BPSOU, and is a focal point for past and current remediation and restoration activities. The SBC and BTC Corridors study area that is the focus of this data gap investigation extends from below the LAO boundary on lower SBC (west of Montana Street), through the BAO and the confluence of BTC, and continues upstream above the BAO along BTC to Father Sheehan Park above Harrison Avenue (**Figure 2; Appendix A**).

In 1879, the first large-scale mineral processing smelter (Colorado Smelter) was built on SBC, at the west end of the valley. Between 1879 and 1888, at least three more smelters of consequence (BRW, Parrot Smelter and Montana Ore Purchasing Company (M.O.P)) were constructed upstream of the Colorado Smelter, which significantly altered the geomorphology and hydrology of both SBC and the lower portion of BTC. A fifth smelter of consequence, the Bell Smelter, located west of present day Harrison Avenue on the north bank of BTC, was constructed in 1881; and reached a peak production of approximately 30 tons per day in 1883 (primarily silver ore). Production quickly tapered and the smelter was dismantled sometime in the early 1890s.

Water demands during this period increased dramatically, and the stream channels were altered significantly to keep up with the demand. At least three dams were constructed on upper SBC and the confluence area for tailings impoundment and water clarification. The dam at Montana Street (Weed, 1904) was constructed for settlement of tailings from upstream smelters and resulted in significant ponding on both sides of the stream.

Over time, mining and smelting waste materials aggraded in the SBC and BTC channels and floodplain, causing frequent and substantial flooding (Meinzer, 1914). In an attempt to mitigate flooding issues, berms made mostly of readily available waste were constructed throughout the confluence area. The known waste area referred to as the BTC Berm, is an historic remnant of these flood control berms.

PREVIOUS SITE INVESTIGATIONS

Data characterizing contaminated materials in the vicinity of the Blacktail berm are limited. In May 2013, the Montana Bureau of Mines and Geology (MBMG) conducted trenching, test pit, and borehole investigations in known and suspected mine waste areas of the BTC and SBC confluence in Butte (MBMG 2014a). In particular, the BTC Berm area was evaluated for contaminant concentrations and volumes of impacted sediments. This work was done to quantify the aerial extent and depth of tailings and impacted sediments. Its purpose was to provide an updated characterization and volume estimate of tailings and mining impacted sediments for the State of Montana. Five soil borings were advanced in the BTC Berm to characterize the subsurface material.

The MBMG 2014a report concluded the following:

- The BTC Berm contained tailings/impacted soils (T/IS) that exceeded criteria for constituents of concern (COC) concentrations established in the 2013 MBMG study's SAP.
- T/IS in the BTC Berm is not overlain by thick units of fill material as those at the Diggings East Tailings site. They are closer to the surface, and surficial at times.
- The majority of soil samples collected just above the water table in the BTC Berm, exceeded the COC criteria. Therefore, it was recommended that any potential future removal boundaries include soils down to the water table.
- The majority of organic silt samples met the classification of impacted sediment.
- The average concentrations of arsenic and lead in tailings samples from the BTC Berm area were comparable to the average concentrations of arsenic and lead in Parrot Tailings samples (Tucci, 2010). However, concentrations of average copper concentrations in tailings samples from the BTC Berm, as well as zinc concentrations, were greater than the average copper and zinc concentrations in Parrot Tailings samples.
- In total, T/IS and potential removal volumes for the BTC Berm was estimated at 14,000 cubic yards.

During baseflow conditions in 2011, the MBMG conducted a continuous bromide tracer injection in the BTC and upper SBC confluence area on behalf of the NRDP (MBMG 2014b). The work evaluated streamflow, chemistry, metals loading, and groundwater and surface-water interactions in a reach of stream impacted by more than a century of mining and milling related activities, land development, land use change, and streambed manipulation. The continuous tracer injection test was performed using a sodium bromide solution with a bromide concentration of 22.5 percent wt./wt. to obtain creek bromide concentrations of roughly 3 milligrams per liter (mg/L). Manual measurements of discharge were obtained at 15 sites over a total stream length of 10,500 feet using a SonTek Flow Tracker®. Steady-state conditions with respect to bromide were reached after 11 hours of injection. The tracer results were combined with synoptic sampling of main stem, tributary, and drive point piezometer data. Samples from 30 groundwater wells, 17 main stem locations, 8 tributary locations, and 5 drive point piezometer locations in the BTC streambed and two wetland sites were analyzed for bromide, common cations and anions, and 36 minor and trace analytes. The MBMG 2014b report concluded the following:

- Results from the tracer injection and manual Flow Tracker® measurements were consistent, and suggest that discharge in BTC between Oregon Avenue and George Street increased by 2.2 cubic feet per second (cfs); approximately 22 percent.
- Wetlands located adjacent to BTC received the majority (99 percent) of recharge from local groundwater sources, and contributed 39 percent of the flow increase observed in the studied reach of BTC (Oregon Avenue to George Street).
- The remaining baseflow contributions (61 percent) in BTC were groundwater inputs into the stream.
- Results of the tracer study also indicate that two reaches of BTC are non-gaining reaches, and may be net-losing reaches (MBMG 2014b). Gains in stream flow were not observed in SBC, from a point just downstream of Slag Wall Canyon at surface sample site SS-06 to the pumping vault on upper SBC.
- Results from metals loading assessments indicate that while there appears to be source areas for copper and zinc loading to the stream, concentrations of contaminants of concern (arsenic, cadmium, copper,

lead, and zinc) remained below Circular DEQ-7 (DEQ 2012) acute and chronic life standards for dissolved concentrations throughout the study area (MBMG 2014).

  - Total recoverable copper and zinc concentrations were elevated in surface water samples collected from the BTC reach from near the Lexington Avenue overpass to the confluence of BTC with SBC.
  - Surface water samples collected from one main stem, one wetland, and two tributary samples exceeded Circular DEQ-7 acute and chronic life standards for total copper, while the two tributary samples exceeded Circular DEQ-7 acute and chronic life standards for total zinc.
  - The sources of total recoverable copper and zinc to this area of BTC are thought to be either bed sediment loads or nearby streambank sediment (i.e., BTC Berm) or loading from historic Grove Gulch discharges.

- Surface water samples collected from the two wetlands, located along BTC in the BTC Berm area, exhibited water quality with elevated concentrations of copper and zinc. Both of the wetlands contributed measurable flow into BTC and are potential point sources.
- Concentrations of contaminants in the groundwater that recharges the wetlands near Lexington Avenue were not assessed during this investigation. Therefore, groundwater entering the wetlands could not be ruled out as a potential source.

PREVIOUSLY IDENTIFIED DATA GAPS

In order to fill data gaps in information concerning the extent and magnitude of T/IS and to obtain additional data necessary for integration of restoration with remedy, Tetra Tech conducted a limited soil, surface water and groundwater investigation within the SBC and BTC Corridors focused on the following data gaps identified in the Preliminary Conceptual Restoration Plan (PCRP) (Confluence 2015):

- Further define extent and magnitude of T/IS within floodplain soils to assess waste areas and depths;
- Characterize the near-surface aquifer to quantify construction dewatering requirements;
- Evaluate COCs in the in-stream and pond sediments, surface water and the stream banks within the SBC and BTC Corridors to identify potential contaminant loading;
- Collect additional groundwater quality data to define the extent of alluvial impacts and their potential impacts on post-restoration groundwater and surface water quality; and
- Evaluate metals loading from alluvial aquifers to SBC and BTC riparian corridors.

PURPOSE AND OBJECTIVES

The purpose and objectives of the SBC and BTC Corridors investigation were to:

- Evaluate surface water, in-stream and pond sediment, and floodplain soils in areas within the SBC and BTC Corridors that were not previously investigated;
- Confirm the lateral and vertical extent of the contamination that may require remedial action(s);
- Complete groundwater monitoring of selected monitoring wells to gather pre-construction aquifer and groundwater quality data; and
- Evaluate contaminant loading to SBC and BTC riparian corridors.

In order to meet the site investigation purpose and objectives, the draft final SAP and QAPP (Tetra Tech 2016a) was developed to address data gaps and obtain and analyze data to make sound decisions regarding the restoration efforts within the SBC and BTC Corridors. The draft final SAP outlined the sampling approach, procedures, instrumentation, and analytical requirements for each location and media sampled. The QAPP defined the data quality objectives (DQOs) for this and similar projects that are being conducted for NRDP for BAO and related work.

Soil sample results are compared to Streamside Tailings Operable Unit (SST OU) field screening criteria. The SST OU is adjacent to BPSOU, addressing SBC after it leaves BPSOU.

Water quality sample results are compared to Montana Department of Environmental Quality Circular DEQ-7 standards. In-stream and pond sediment pore water samples are compared to DEQ-7 surface water and groundwater standards.

Sediment sample results are compared to the EPA Region 3 BTAG Freshwater Sediment Screening Benchmarks, which serve as a Tier 1 screening tool to indicate if sediment contaminant concentrations may indicate potential adverse effects. Montana is located within EPA Region 8, which currently has no sediment screening numbers and uses many of the same reference values relied upon by Region 3 BTAG.

Groundwater sample results are compared to DEQ-7 groundwater standards.

FLOOD PLAIN SOILS AND MINE WASTE SAMPLING AND ANALYSIS

Three different methods were used to sample and characterize subsurface mine waste deposits, impacted soil, and miscellaneous fill materials deposited in and around the BTC berm area and floodplain. Seventeen test pits were excavated, screened and sampled in the locations shown on **Figure 2** (**Appendix A**). In addition, three direct push technologies (DPT) soil borings were advanced in the berm area and wetland pond #1 (**Pond #1**; **Figure 2**) in order to access deeper subsurface soils at depths below the maximum excavation depths from the test pits. Multiple samples were collected from each test pit and DPT boring based on the various material types encountered and XRF screening results. Lastly, fourteen stream bank soil and opportunity samples were collected by hand tools and sampled for the same constituents as the test pits and DPT borings (**Figure 3; Appendix A**). Logging and screening procedures were followed as described in the draft SAP, except as noted:

- Two additional test pits were excavated at the discretion of the Tetra Tech field geologist and approval of the Tetra Tech project manager.

- Five opportunity samples were collected; one sample was collected in the Slag Canyon portion of SBC, two from the BTC berm area on the south side of the creek, one from the banks of Grove Gulch, and one from an island located in the eastern end of wetland pond #3 (**Pond #3; Figure 3**).

- Only four samples, plus one duplicate, were selected for SPLP, ABA, NAG-pH analysis out of 61 test pit and DPT boring natural samples. This ratio is less than the 20% specified in the SAP and was inadvertent. Only two SPLP, ABA, NAG-pH samples were collected from 14 natural bank soil samples. This ratio is also slightly less than the 20% specified in the SAP.

- DPT boring sample designations followed the SAP naming procedures (e.g. BTC-WS-03 (2-5)-BT) however it should be noted that the soil boring lithology consisted of more than just organic rich wetland sediment layers as evidence by the DPT logs and the soil type naming designations (OB, AL, BC, YT, and BT).

  XRF screening of soils generally followed the procedures specified in the SAP except for thoroughly drying and sieving to a 10-mesh prior to analysis. In order to conduct the investigation in a timely and efficient manner a field decision to forego preparing and drying XRF samples in the field was made by the supervising geologist.

- Test pit logs, DPT boring logs, XRF field screening tables, and field sampling notes are included in **Appendix B. Table 1** (**Appendix C**) presents results of the total metals analyses with sample results that exceed the SST OU floodplain soil screening criteria (Pioneer 2011) highlighted in yellow. **Figure 2** presents the highest total metals results for each sample test pit and DPT sample point; soil screening criteria exceedances are indicated in red. Bank and opportunity soil sample results are summarized in **Table 2** (**Appendix C**), with sample results that exceed EPA Region III Biological Technical Assistance Group (BTAG) Freshwater Sediment Screening Benchmarks (EPA 2006b) highlighted in yellow. EPA established a hierarchy for selection of freshwater sediment screening benchmarks:

- Preference was given to benchmarks based on chronic direct exposure, non-lethal endpoint studies designed to be protective of sensitive species;
- Values derived by statistical- or consensus-based evaluation of multiple studies were given first priority;
- Equilibrium partitioning values were selected for contaminants with 2.0< log Kow <6.0 if empirical values based on multiple studies were not available;
- Absent consensus or equilibrium partitioning values, single study toxicity values were selected; and
- Marine values were used for freshwater only if a suitable freshwater value did not exist.

Figure 3 presents the highest total metals results for each bank and opportunity sample location, with bank soil sample results that exceed EPA Freshwater Sediment Screening Benchmark criteria indicated in red.

As summary of the results and discussion follows:

- Arsenic: Total arsenic concentrations of the 41 test pit samples, 10 DPT samples, and 14 bank and opportunity soil samples ranged from 7 to 1,080 milligrams per kilogram (mg/kg). Stream bank soil samples (note not actually in-stream sediment) were screened to EPA Region III BTAG Freshwater Sediment Screening Benchmarks due to their proximity to the streams. All 14 stream bank soil and opportunity samples exceeded the Freshwater Sediment Screening Benchmark of 9.8 mg/kg. As a comparison, 27 of 61 natural soil samples from test pits and DPT soil borings exceeded the SST OU screening criteria of 200 mg/kg for arsenic. The high concentrations of arsenic amongst the various soil types (overburden, black and yellow colored tailings deposits, black clay, and alluvium) appears to be randomly distributed, though overburden/fill and alluvium appear to exhibit much lower concentrations on average than obvious mine waste or tailings deposits.

- Cadmium: Total cadmium concentrations ranged from 1.1 to 70.2 mg/kg in all the soil samples analyzed. Thirteen of 14 natural bank and opportunity soil samples exceeded the EPA Freshwater Sediment Screening Benchmark of 0.99 mg/kg. Ten test pit and DPT boring samples and one opportunity bank soil sample exceeded the SST OU floodplain soils screening criteria of 20 mg/kg. All of the exceedances but two were samples collected from alluvium.

- Copper: Total copper concentrations in test pit, DPT, and stream bank soil samples ranged from 36 to 20,400 mg/kg. The highest copper concentration measured was from test pit 1 in alluvium from 10-11.5 feet bgs depth. All 14 stream bank soil and opportunity samples exceeded the EPA Freshwater Sediment Screening Benchmark criteria of 31.6 mg/kg. Twenty-six test pit and DPT boring samples and three stream bank soil and opportunity samples exceeded the SST OU floodplain soils screening criteria of 1,000 mg/kg.

- Lead: Total lead concentrations in test pit, DPT, and stream bank soil samples ranged from 20 to 3,570 mg/kg. Similar to copper, the highest lead concentration measured was from test pit 1 in alluvium from 10-11.5 feet bgs depth. Nine test pit and DPT boring samples and two stream bank soil and opportunity samples exceeded the SST OU floodplain soils screening criteria of 1,000 mg/kg. Thirteen of 14 natural bank and opportunity soil samples exceeded the Freshwater Sediment Screening Benchmark of 35.8 mg/kg.

- Zinc: Total zinc concentrations in test pit, DPT, and stream bank soil samples ranged from 78 to 22,000 mg/kg. The highest zinc concentration measured was from test pit 2 in alluvium from 3-4 feet bgs depth. Thirty-six test pit and DPT boring samples and six bank soil and opportunity samples exceeded the SST OU floodplain soils screening criteria of 1,000 mg/kg. Thirteen of 14 natural bank and opportunity soil samples exceeded the Freshwater Sediment Screening Benchmark of 121 mg/kg.

- XRF Screening: XRF results were used primarily to select soil sample intervals for laboratory analysis from various lithologies encountered and from soil horizons suspected to be impacted from mine wastes such as oxidized staining. XRF results were not used to compare to soil criteria. In general XRF results are lower than the total metals values measured in the laboratory; however for most of the COC metals,

the XRF screening results (**Table 3; Appendix C**) compare within the same order of magnitude of the total metals lab analyses. The RPD between XRF and laboratory total metals ranged from 0 to over 300%. The mean RPDs for As, Cd, Cu, Pb, and Zn were 74%, 89%, 74%, 75% and 82%, respectively. The RPD variability is likely due to multiple factors. One common factor often cited is matrix or instrument interferences, as interferences may affect detection limits and precision of the instrument. Other common interferences are as follows (EPA 2004):

- Moisture content above 20% may interfere with sample analysis as moisture alters the soil matrix in relation to the XRF calibration matrix. Given the expedited time frame for sample collection, XRF analysis, and selection and submittal of samples for laboratory analysis, samples were not thoroughly dried prior to analysis, and thus, may have had moisture content above 20%. XRF samples were not screened with a 10-mesh sieve prior to analysis. In contrast, laboratory total metals samples were first dried by the laboratory prior to sieving to 10-mesh size and analysis. Also note that the extractable total metals concentrations are reported by the laboratory on a dry weight basis not as received (i.e. the XRF analysis).
- Chemical matrix effects such as iron absorption of copper x-rays, etc.
- Position of samples in front of the probe window; which results in natural variability in the sample results based upon the position of the instrument and the vector of the narrow X-ray beam. This type of sampling bias is similar to sub-sample selection by the laboratory prior to extractable analysis; the laboratory only takes a small portion of the prepared sample for extraction.
- Instrument resolution limitations may result in problems analyzing some elements, such as the instrument's inability to resolve energy differences. For example, the arsenic peak may overlap with the lead peak and the instrument may not accurately calculate the concentrations. This may particularly be the case where there is a lead-to-arsenic ratio of 10 to 1 or more as the lead peak will overwhelm the arsenic peak.
- RPD variability may also be due the sample selection and field screening process itself, particularly during the test pit investigation where samples from the same depth but opposite walls of the test pit may represent differing material types, such as dealing with miscellaneous fill material/overburden deposits. Some of the XRF material descriptions differ from the laboratory sample material designations.
- The length of time the sample was analyzed. Given the expedited manner in which the field work was conducted, each of the XRF-Field sample was analyzed with the XRF for 75 seconds. A greater analysis time of 120 to 180 seconds may have resulted in better correspondence (i.e. lower RPDs) between the XRF and laboratory results.

- Field Quality Control Samples: Based on a comparison of natural and blind field duplicate samples taken on a 5% frequency (1 per 20 natural samples) during bank and opportunity sampling, test pit excavation, and DPT boring for total metals analysis, the relative precision for the sampling methods can be qualitatively assessed based on the RPD between the two samples. The mean RPDs for As, Cd, Cu, Pb, and Zn were 69%, 34%, 65 %, 58%, and 44%, respectively. The RPD variability is likely due to multiple factors. One common factor often cited is matrix or instrument interferences, as interferences may affect detection limits and precision of the instrument. Other common interferences for the natural and blind field duplicate samples, which are similar to the XRF sample variability are:

  - Sample matrix effects such as sample heterogeneity, uniformity, and particle size.
  - Chemical matrix effects identified or attributable to the ICP/MS laboratory analysis.
  - Sample selection/splitting effects in the field methods; particularly in dealing with blind duplicate samples selected from the DPT borings since the amount of sample needed by the laboratory precludes exact sample splitting over a specified sample interval from a macro-liner DPT sample.

- Waste Removal Volume Estimation: Based on results of the test pits, DPT borings, and stream bank soil samples along with in-stream and pond sediment samples, a removal volume was made using the following assumptions, previous estimations details are also provided:

- The berm and large pond/wetland area (**Pond #1; Figure 2**) was the only portion covered in the PCRP (Confluence 2015); the estimated removal volume was 14,000 cubic yards (CY) (MBMG 2014b).
- An alternative initial removal volume estimate was presented in the draft Conceptual Remediation Plan Cost Estimate (CRPCE) (Tetra Tech 2016b) for NRDP under Task Order #5 used an assume removal depth of 4 feet below the base of the sediment/surface water interface and the estimated depth to groundwater. The estimated removal volume for the CRPCE BTC Berm and Pond area was 149,290 CY covering approximately 14.6 acres.
- Mine waste, impacted soil, fill material, and the native black clay soil horizon which underlies most of the BTC berm area is impacted with BAO COC metal levels that exceed SST OU floodplain soils screening criteria and should be targeted for removal. In some places, there may be more than one black clay soil horizon. The depth to the deepest occurrence of black clay at each sample location (DPT boring, existing well log, test pit) was chosen as the base of excavation for removal volume estimation purposes.
- The ground surface elevations used to estimate thickness of impacted materials was based off a LIDAR survey provided by the City of Butte.
- The small wetland pond (**Pond#2; Figure 2**) located between the KOA campground and Kaw Avenue overpass, and north of the walking path should no longer be targeted for removal because historical mining related impacts to this wetland are now considered minimal (sediment, surface water and pore water impacts are at or near background levels).
- The northern bank/berm and walkway along BTC from Kaw Avenue to the BTC/SBC confluence should be targeted for removal because the stream bank materials as well as the bulk of the berm materials sampled (garbage, mine waste, tailings, etc.) greatly exceeded screening criteria.

Based on contamination, the revised estimated volume for the BTC Berm area after applying the additional site data, revising the assumptions and kreiging the base surface elevation is 100,185 CY. **Figure 4** (**Attachment A**) shows the outline and approximate depths.

Table 4 (**Appendix C**) presents results of the physical and chemical characteristics, nutrients (nitrate), Synthetic Precipitation Leaching Procedure (SPLP), acid-base accounting (ABA), and net acid generating (NAG) pH analysis for floodplain soils and mine waste. The SPLP extraction method followed the standard EPA method protocol resulting in an extraction fluid pH of 5.0 +/- 0.05. SPLP and ABA analyses were performed on four of 61 test pit and DPT boring samples; BTC-TP-01 (8.5-9.5)-BT, BTC-TP-07 (4.5-5)-AL, BTC-TP-17 (2.5-3.5)-GC, and BTC-WS-02 (5-11)-BC. **Table 5** (**Appendix C**) present results of the physical and chemical characteristics, nutrients (nitrate), ABA, SPLP, and NAG pH analysis for bank soil samples. SPLP and ABA analyses were performed on two of sixteen bank soil samples; BTC-SBS-02S (0-12”), and GG-OSBS-01 (0-12”).

The relationship between SPLP leachate and total metals concentrations differ by the constituent, the type of mineralization and strength of the sorption to substrate. The total metal concentration (mg/kg) is the total amount of potential load to the environmental, while the SPLP leaching concentration (mg/L) represents the desorption/dissolution of that metal upon exposure to acidic-water. However, since the relative amount/ratio of soil and water in the laboratory SPLP testing (EPA method 1312 calls for a 20:1 water to rock ratio) is not the same as the actual amount/ratio observed in the field, a distribution coefficient/multiplier is needed, which is referred to as the soil water partition coefficient K*d*. Because of this fact, estimated field leachate concentrations (C*l*) must be calculated by their respective SPLP and their total metal concentrations through the development of soil water-partition coefficients (K*d*) for each constituent and each major lithologic unit. This calculated field leachate concentration (C*l*) can then be compared to calculated leachate criterion (L*c*) established from DEQ Circular-7 water quality standards. While comparisons of SPLP leachate to surface water quality standards for floodplain soil/mine waste leaching to groundwater then discharging to surface water can provide a qualitative assessment of metals leaching they cannot be directly compared without further geochemical analysis. Development of soil water partition coefficients (K*d*) and estimated field leachate concentrations (C*l*) for each SPLP sample was outside the scope of this study. Therefore, **Tables 4** and **5** compare SPLP leachate concentration to surface water human health standards (HHS; DEQ Circular 7) for qualitative comparison purposes.

In addition to the SPLP leachate qualitative analysis for leaching potential, ABA analysis provides a rough guide as to the potentially acid generating (PAG) nature of sediment and, therefore, provides an estimate whether acidic drainage/leachate may occur.

Results of the SPLP and ABA analysis are summarized as follows:

- Arsenic, lead, and mercury SPLP extractions were the three COCs that exceeded their respective HHS for surface water in test pit, DPT boring, and bank soil samples. Note that SPLP extraction is run as dissolved (extract is filtered as per the method) and surface water standards are based on total metals. Also note that only two lead and no mercury sample results from surface water or groundwater sampling were above their respective water quality standards; therefore the SPLP procedure only provides an assessment of the leaching potential to water resources and not the actual fate and transport mechanisms or impacts. *In situ* geochemical processes determine the fate and transport effects of desorption and leachate migration/mixing. In layman's terms, SPLP leachate concentrations measured in the laboratory are not equivalent to actual field for a variety of reasons.

- No samples were considered potentially acid generating using the Price method (Price et al 1997) (i.e. no samples exhibited total sulfur greater than 0.3%) or the BLM method (no samples resulted in a NP:AP < 3 and NNP < -20 tons/kton).

- Saturated paste pH for test pit, DPT boring, and bank soil samples ranged from 3.8 to 8.1 S.U. with the majority of samples in the moderately acidic and neutral range (5.6 to 6.0 S.U. is moderately acidic, 6.1 to 6.5 S.U. is slightly acidic, and 6.6 to 7.3 S.U. is neutral). Also note that NAG pH can used as a secondary screening tool to provide an estimate of pH upon complete oxidation of all sulfides, thus providing a method for calibrating the effect of sulfides on acid contribution.

IN-STREAM SEDIMENT AND WETLAND POND SEDIMENT SAMPLING AND ANALYSIS

The in-stream sediment and pond sediment sampling portion of the data gap site investigation of the SBC and BTC riparian corridors consisted of collecting and sampling sediment at 18 stream and three pond stations, plus one opportunity pond sediment sample (**Figure 5; Appendix A**); with the in-stream sediment samples corresponding to the station number and a 'SS' designation and the pond sediment samples corresponding to station number with a 'PS' designation. These sample locations were co-located with surface water sampling and with pore water sampling and were sampled concurrently on March 7 through 15, 2016. Field sampling and analysis procedures followed the procedures put forth in the SAP; with the following key points and notable exceptions:

- In-stream sediment and pond sediment samples were screened by the laboratory as received (i.e. wet) to a No. 230 mesh (<63 µm) fraction for metals analysis prior to drying for moisture content and extraction.

- Sediment sample collection was limited to 0 to 12 inches below sediment/water interface. Sampling the deeper sediment sample intervals of 24 to 36 inches below grade as proposed in the SAP with an AMS® sludge and sediment sampler was not possible in the stream channels due to the coarse nature of the streambed sediments and only possible at one pond sediment location (BTC-PS-01) due to the cohesive nature of the fine grained pond sediments. Multiple attempts to sample the deeper depth interval resulted in little- to no-return and eventually broke the sampler on two separate occasions.

- Multiple in-stream sediment sample points were collected from two surface water station locations (BTC-SS-7 and BTC-SS-8) to determine the spatial variability within the stream channel deposits at stations. Two samples were collected from BTC-7; one in the approximate center of the stream channel (BTC-SS-7) and one from the channel nearest the north bank (BTC-SS-07N). Three samples were collected from BTC-8; BTC-SS-8 was collected from the center portion of the stream channel, BTC-SS-8S from nearest the south bank, and BTC-SS-8N from nearest the north bank.

- One opportunity pond sediment sample (BTC-OSS-01) was collected from a wetland pond discharge channel (western end of pond #3) from 0 to 12" depth interval.

- In-stream sediment and pond sediment sample results were compared to EPA Region III BTAG Freshwater Sediment Screening Benchmarks.

In-stream sediment and pond sediment sampling field notes are included in **Appendix B**. **Table 6** (**Appendix C**) presents results of the total metals analyses with sample results that exceed the EPA BTAG Freshwater Sediment Screening Benchmarks (EPA 2006) highlighted in yellow. **Figure 5** presents the highest total metals results for each sample point; BTAG Freshwater Sediment Screening Benchmarks exceedances are indicated in red. A summary of the results and discussion follows:

- Arsenic: Total arsenic concentrations in the twenty six in-stream sediment and pond sediment samples ranged from 22 to 4,410 milligrams per kilogram (mg/kg). All twenty six natural in-stream and pond sediment samples exceeded the EPA BTAG Freshwater Sediment Screening Benchmark for arsenic of 9.8 mg/kg. By comparison only five in-stream sediment samples and three pond sediment samples exceeded the SST OU soil screening threshold concentration of 200 mg/kg. Both shallow (0 to 12 inches) and deep (24 to 36 inches) sediment samples exceeded the screening criteria for location BTC-PS-01. All three in-stream sediment samples from SBC stream reach exceeded screening criteria; including the highest arsenic sample result measured which was from SBC-SS-02. Note that the in-stream sediment sample from Grove Gulch (GG-SS-01) also exceeded the screening criteria.

- Cadmium: Total cadmium concentrations ranged from 1.0 to 26 mg/kg. All of the in-stream sediment and pond sediment samples exceeded the EPA BTAG Freshwater Sediment Screening Benchmark for cadmium of 0.99 mg/kg; however several of the in-stream sediment samples standout: Sample SBC-SS-02 (0-12") from the SBC reach contained 26 mg/kg total cadmium, sample BTC-PS-01 (0-12") from wetland pond #1 contained 21.8 mg/kg, and sample BTC-PS-01 (24-36") contained 23.2 mg/kg.

- Copper: Total copper concentrations in the in-stream sediment and pond sediment samples ranged from 194 to 10,500 mg/kg. Streambed concentration were highest in three SBC reach sample locations and lower (downstream) BTC sample locations. Note that the streambed sediment sample from Grove Gulch also exceeded the screening criteria. All twenty six natural in-stream sediment and pond sediment samples exceeded the BTAG Freshwater Sediment Screening Benchmark for copper of 31.6 mg/kg, and six in-stream sediment and two pond sediment samples exceeded the SST OU floodplain screening criteria of 1,000 mg/kg.

- Lead: Total lead concentrations in streambed sediment and pond sediment samples ranged from 125 to 1,420 mg/kg. Total lead concentrations were highest in the Grove Gulch sample location (highest measured), the three SBC reach sample locations, and the wetland pond #1 location (BTC-PS-01; both depths). All twenty six in-stream sediment and pond sediment samples exceeded the BTAG Freshwater Sediment Screening Benchmark for lead of 35.8 mg/kg.

- Mercury: Mercury was detected in five samples with concentrations ranging from 0.99 to 6.0 mg/kg. The Mercury Freshwater Sediment Screening Benchmark is lower than the analytical method reporting limit.

- Zinc: Total zinc concentration in in-stream and pond sediment samples ranged from 232 to 6,510 mg/kg. Total zinc concentrations were highest in the pond sediment samples (highest measured), the Grove Gulch sample location, the three SBC reach sample locations, and the BTC reach sample locations below Grove Gulch. All twenty six in-stream sediment and pond sediment samples exceeded the BTAG Freshwater Sediment Screening Benchmark for zinc of 121 mg/kg.

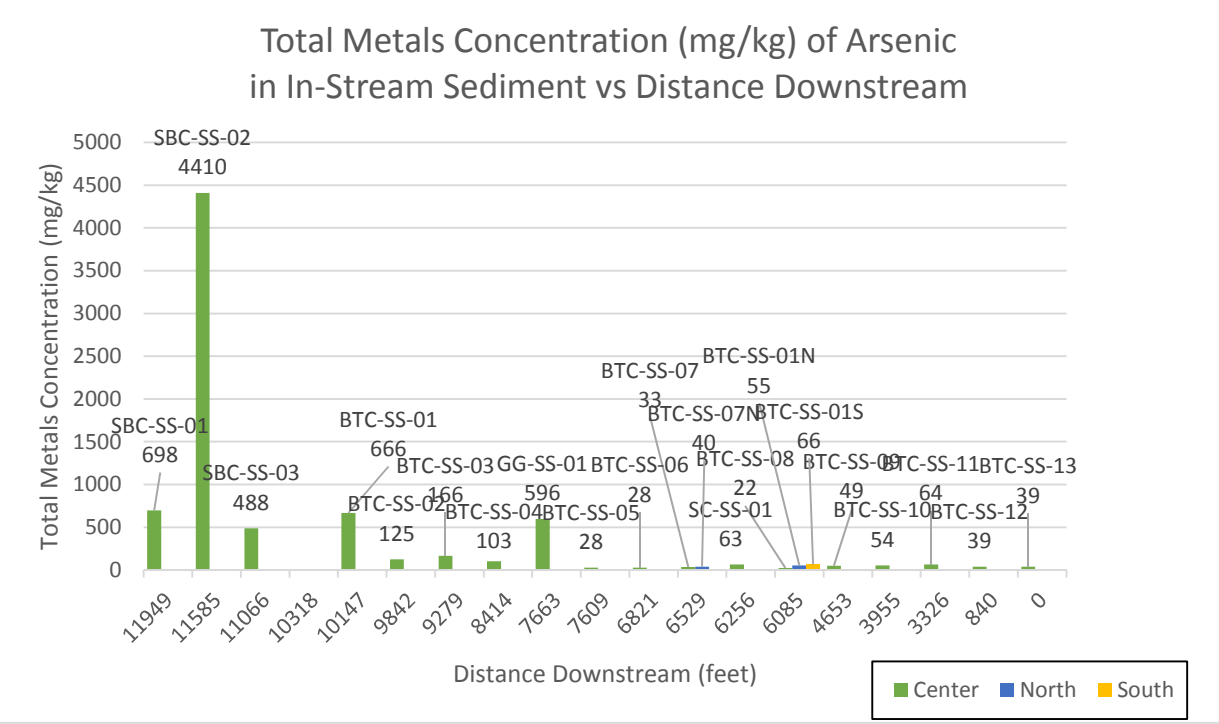
- Other Metals: Other metals concentrations measured in in-stream and pond sediment samples exceeded the BTAG Freshwater Sediment Benchmarks. These benchmark failures include chromium (43.4 mg/kg;

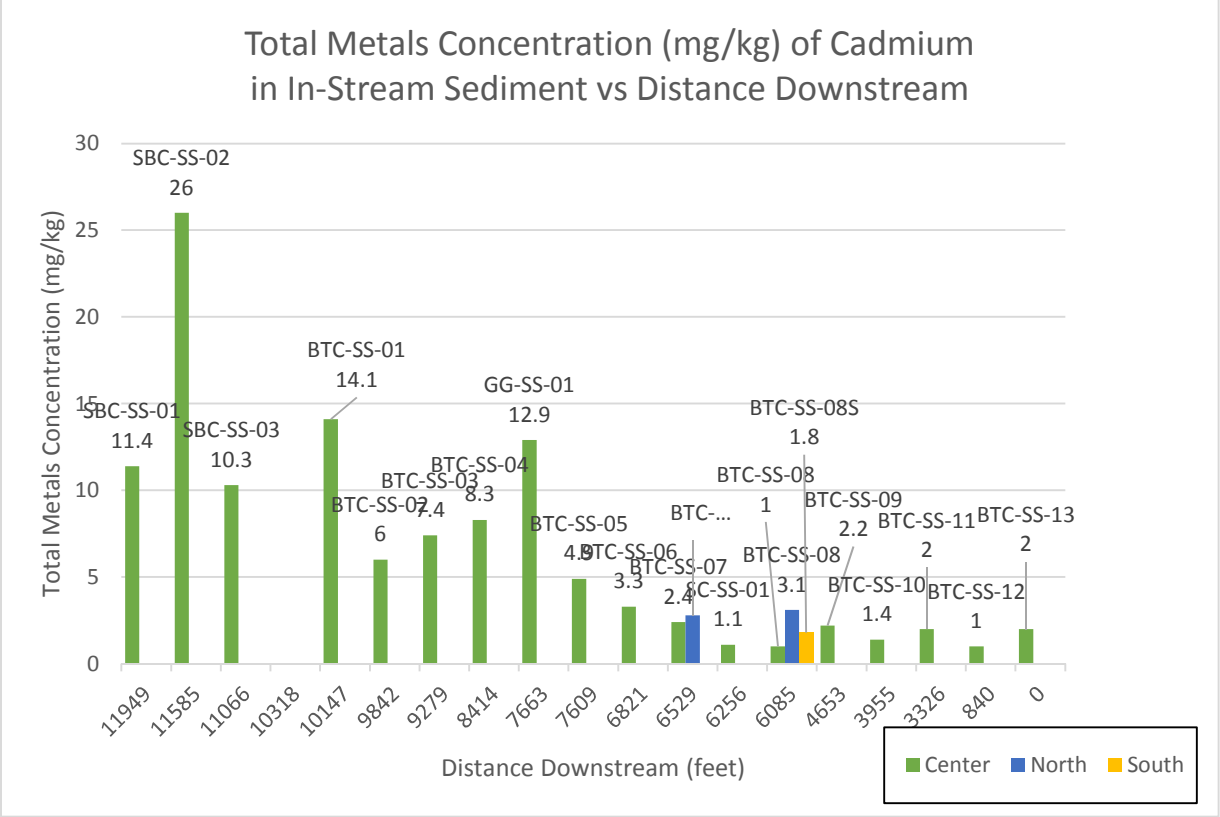
17 of 26 samples), iron (20,000 mg/kg; all twenty six samples), and manganese (460 mg/kg; 21 of 26 samples). Some of these exceedance may be naturally occurring due to the location of BTC and SBC (Butte mineralized zone), and in the case of the pond samples, may be a result of natural wetland bog/pond conditions.

- Field Quality Control Samples: Based on a comparison of natural and blind field duplicate samples taken on a frequency greater than 5% (2 per 26 natural samples) during in-stream sediment and pond sediment sampling, the relative precision for the sampling method can be qualitatively assessed based on the RPD between the two samples. The mean RPDs for As, Cd, Cu, Pb, and Zn were 42%, 23%, 29 %, 29%, and 18%, respectively. The RPD variability is likely due to multiple factors. One common factor often cited is matrix or instrument interferences, as interferences may affect detection limits and precision of the instrument. Other common interferences for the natural and blind field duplicate samples are:

    - Sample matrix effects such as sample heterogeneity, uniformity, and particle size.
    - Chemical matrix effects identified or attributable to the ICP/MS laboratory analysis.
    - Sample selection/splitting effects from the field method.

- In general, total metals appear to concentrate in the in-stream sediments from the mouth of Grove Gulch down to the confluence with SBC and continue downstream through Slag Canyon and Butte Reduction Works area. In addition, metals appear to concentrate in pond sediments in two of the three wetland ponds. Plots of total metals versus distance downstream from the upper-most in-stream sediment sample location above Father Sheehan Park on BTC illustrate the increasing concentration of metals in sediment, particularly below the mouth of Grove Gulch and the Kaw/Lexington Avenue overpass. The increasing metals load to BTC below the mouth of Grove Gulch indicate that a possible source of metals to BTC is the Grove Gulch tributary and the former zinc mill site located in its headwaters. Other metals trend somewhat differently with obvious increases noted downstream of the former Bell Smelter site on BTC just downstream of Harrison Avenue as well as below the mouth of Grove Gulch. Dissolved metals transport in groundwater and precipitation on the mineral grains of the in-stream sediments and pond sediments can also not be discounted as a potential source of metals loading to the SBC and BTC riparian corridors since the gaining reaches of BTC and SBC correspond to the reaches below the Kaw/Lexington Avenue Overpass and mouth of Grove Gulch.




Total Metals Concentration (mg/kg) of Cadmium
in In-Stream Sediment vs Distance Downstream
Total Metals Concentration (mg/kg)
Distance Downstream (feet)
Center
North
South
SBC-SS-02 26
SBC-SS-01 11.4
SBC-SS-03 10.3
BTC-SS-01 14.1
BTC-SS-02 6
BTC-SS-03 7.4
BTC-SS-04 8.3
GG-SS-01 12.9
BTC-SS-05 4.9
BTC-SS-06 3.3
BTC-SS-07 2.4
BTC-... 2.4
SC-SS-01 1.1
BTC-SS-08 1
BTC-SS-08 3.1
BTC-SS-08S 1.8
BTC-SS-09 2.2
BTC-SS-10 1.4
BTC-SS-11 2
BTC-SS-12 1
BTC-SS-13 2
11949
11585
11066
10318
10147
9842
9279
8414
7663
7609
6821
6529
6256
6085
4653
3955
3326
840
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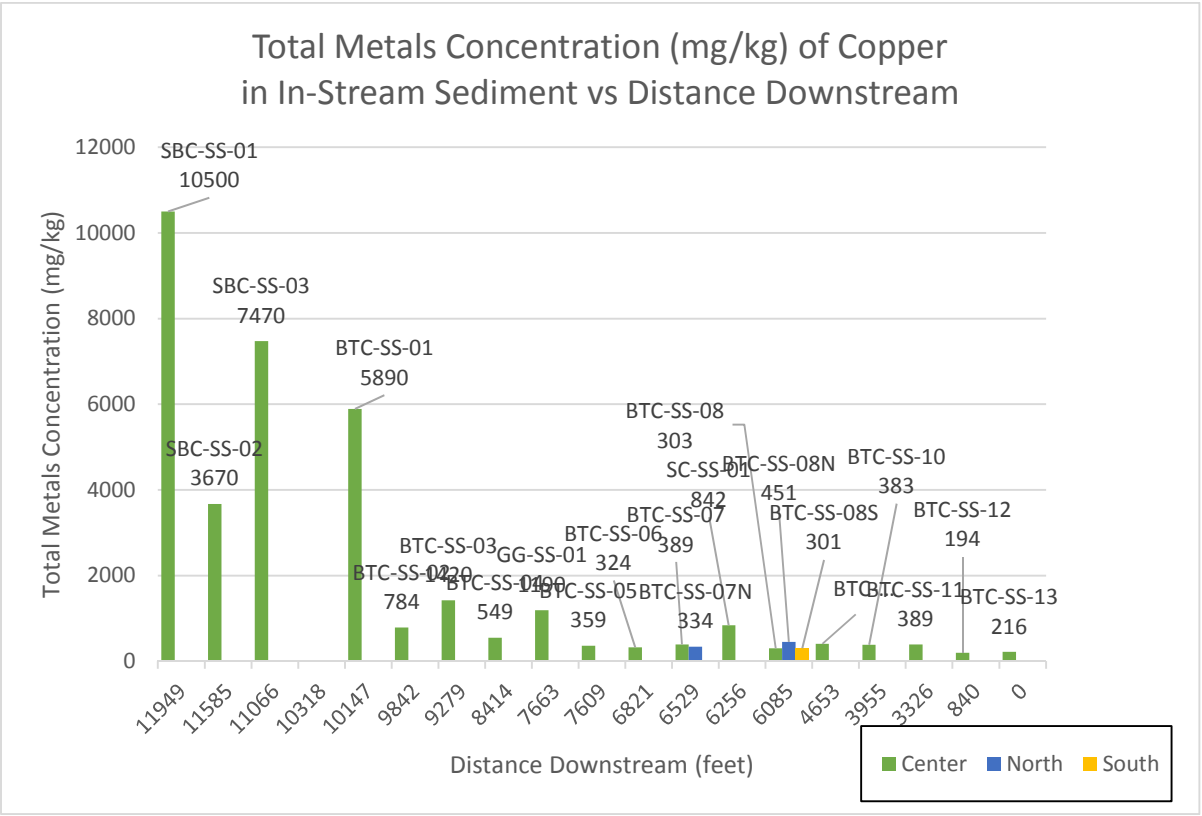
Total Metals Concentration (mg/kg) of Copper
in In-Stream Sediment vs Distance Downstream
Total Metals Concentration (mg/kg)
Distance Downstream (feet)
Center
North
South
SBC-SS-01 10500
SBC-SS-03 7470
BTC-SS-01 5890
SBC-SS-02 3670
BTC-SS-08 303
SC-SS-01 842
BTC-SS-08N 451
BTC-SS-10 383
BTC-SS-07 389
BTC-SS-08S 301
BTC-SS-12 194
BTC-SS-06 324
BTC-SS-03 784
GG-SS-01 549
BTC-SS-05 359
BTC-SS-07N 334
BTC-SS-11 389
BTC-SS-13 216
11949
11585
11066
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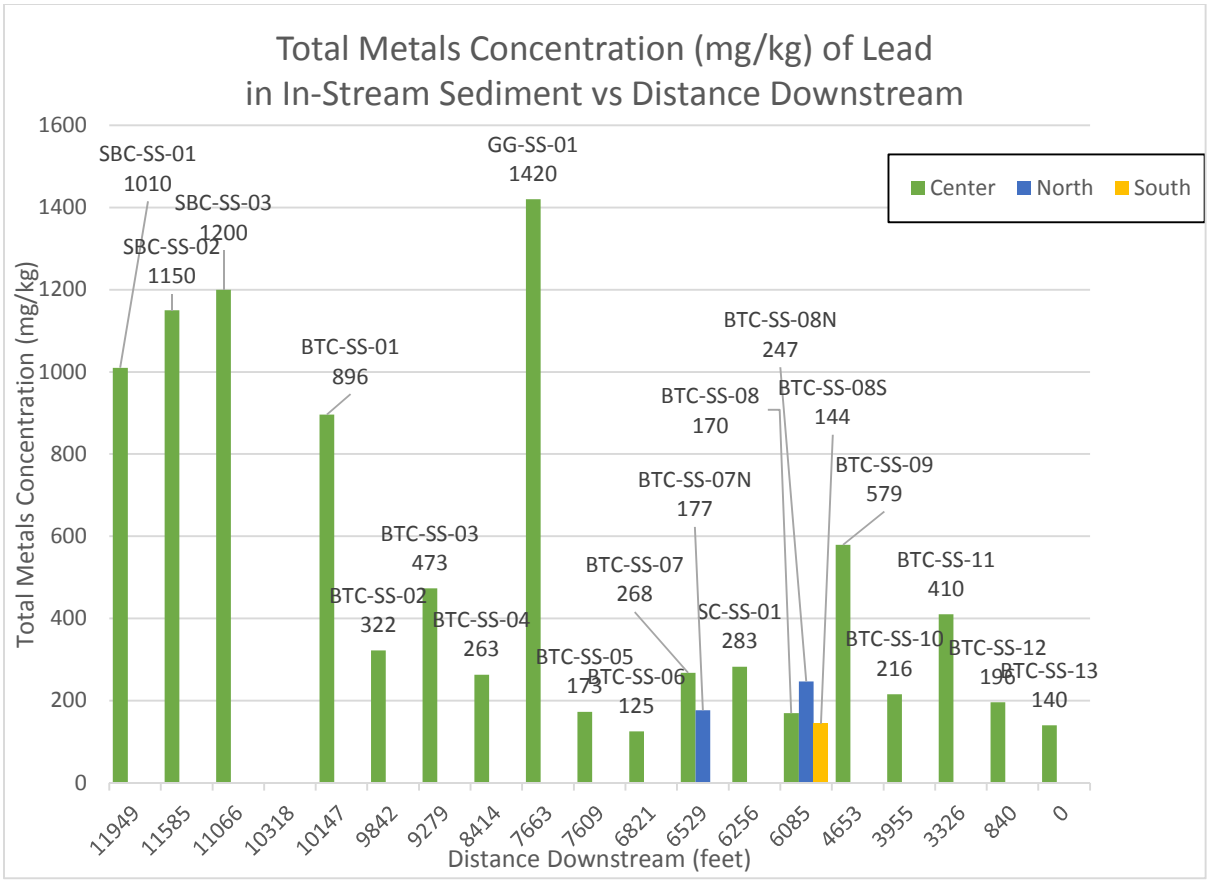

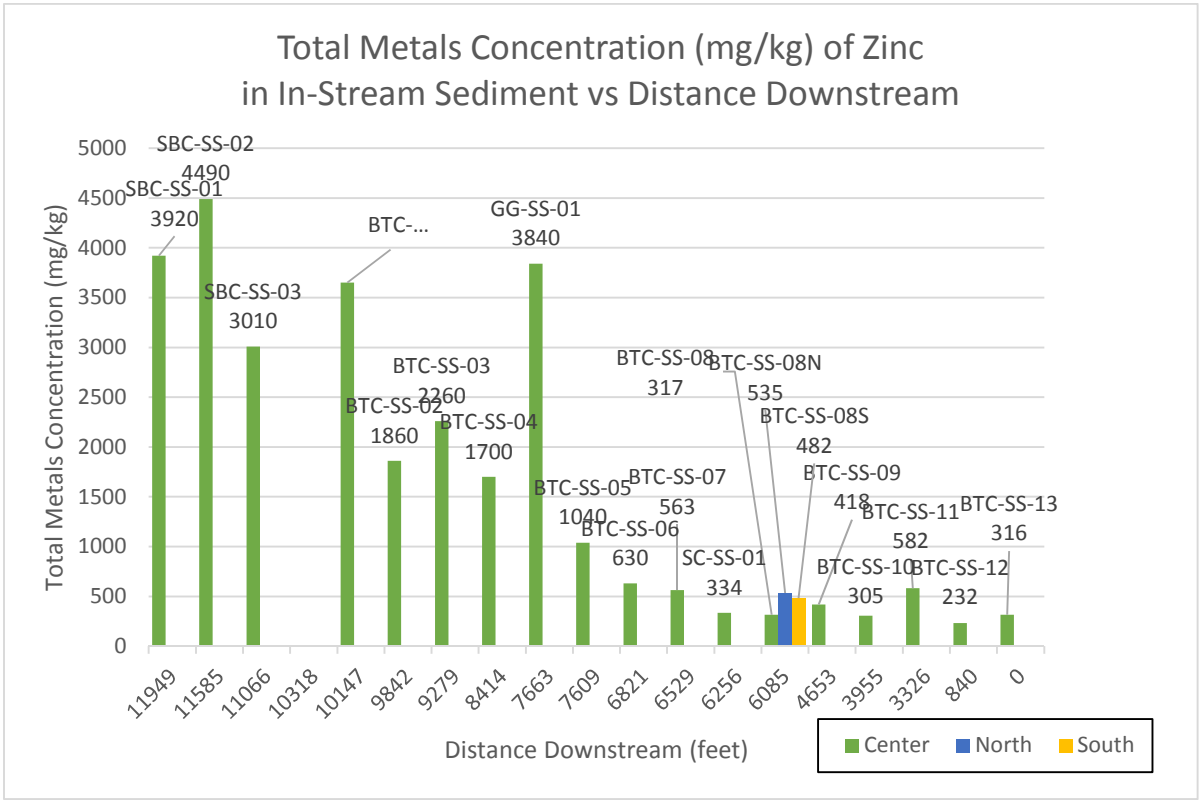

Table 7 (**Appendix C**) presents results of the physical and chemical characteristics, nutrients, ABA, SPLP, and NAG pH analysis. SPLP and ABA analyses were performed on five of twenty six (approximately 20%) of the in-stream and pond sediment samples (SBC-SS-02, SBS-SS-03, BTC-SS-08S, BTC-SS-11, and BTC-SS-13).

The relationship between SPLP leachate and total metals concentrations differ by the constituent, the type of mineralization and strength of the sorption to substrate. **Table 7** compares SPLP leachate concentration to surface water human health standards (HHS; Circular DEQ-7). Three of five SPLP leachate samples exceeded the HHS for arsenic of 0.010 mg/L, and four of five samples exceeded the HHS for lead of 0.015 mg/L. While comparisons of SPLP leachate to surface water quality standards for in-stream sediment and pond sediment leaching potential can provide a useful qualitative tool to assess metals leaching potential; they cannot be directly compared without further geochemical testing and analysis.

ABA analysis provides a rough guide as to the PAG nature of sediment and, therefore, provides an estimate whether acidic drainage may occur. One in-stream sediment sample (SBS-SS-03 (0-12”) is considered potentially acid generating using the Price method; it contains total sulfur greater than 0.3%. It is also qualified as potentially acid generating using the BLM method; the ratio of NP:AP was less than 3 and the NNP was less than -20 tons/kton.

The saturated paste pH for in-stream and pond sediment samples ranged from 6.5 to 7.5 S.U., which is considered neutral; however the NAG-pH on two of the SBC in-stream sediment samples was considerably lower than the saturated paste pH indicating that the sulfide content of the sediment has the potential to drive the soil pH to acidic conditions (pH of 5.6 and 4.4 S.U.) upon complete oxidation of all sulfides.

SURFACE WATER SAMPLING AND ANALYSIS

The surface water and pond water sampling portion of the data gap site investigation was conducted by Tetra Tech on March 8 through March 16, 2016. Surface water and pond water sample locations correspond to eighteen surface and three pond water sample stations presented on **Figure 6** (**Appendix A**); with the stream surface water samples corresponding to the station number and a ‘SW’ designation and the pond water samples corresponding to station number with a ‘PD’ designation. These sample locations were co-located with in-stream sediment and pond sediment sampling and with streambed and pond pore water sampling. Field sampling and analysis procedures followed the procedures put forth in the SAP. Surface water and pond water sampling field notes are included in **Appendix B**.

Results of field parameters, physiochemical, common anions, common cations, nutrients and physical parameters that were measured and/or analyzed are presented in **Table 8** (**Appendix C**). The pH (as measured by the laboratory) of surface waters ranged from 7.4 to 8.7 S.U.; with the lowest pH corresponding to a sample collected from the Slag Canyon portion of SBC (SBS-SW-01). Note that the dissolved oxygen meter was malfunctioning and that even though values presented in **Table 8** correlate well with temperatures; the measured values for some of the samples exceed oxygen solubility limits. The low temperatures measured are understandable given the early spring sampling event and are more likely reflective of the time of day sampling took place rather than due to some groundwater / surface water interaction; though some thermal enhancement from groundwater is likely occurring in gaining sections of SBC, BTC, and the wetland ponds. ORP values ranged from 17 to 335 mV; from near neutral potential to oxidizing.

Results of the total metals and dissolved metals concentrations measured in the surface water and pond water samples are presented in **Table 9** (**Appendix C**) and **Table 10** (**Appendix C**), respectively Results of surface water and pond water sampling were compared to Circular DEQ-7 water quality standards. Chronic and acute aquatic life standards that are hardness dependent were calculated for each sample and were compared to the total metals concentration (**Table 9**). Concentrations that exceeded the surface water quality standards are highlighted yellow in **Table 9**, and highlighted in various shades of red (dark red color for HHS, red color for the acute aquatic life standard, and pink color for the chronic aquatic life standards) on **Figure 6** (**Appendix A**). A summary of the results follow:

- Arsenic: The total metal concentration of arsenic in eighteen surface water and three pond water samples ranged from 0.003 to 0.021 mg/L. Arsenic in surface water exceeded the human health based water quality standard of 0.010 mg/L in two wetland ponds samples but no other surface water samples; BTC-PD-01 contained 0.021 mg/L total arsenic and BTC-PD-01 contained 0.012 mg/L total arsenic.

- Cadmium: The total metal concentration of cadmium in surface water and pond water samples ranged from <0.00003 to 0.00067 mg/L. Cadmium in surface water exceeded the chronic aquatic life standard of 0.0003 mg/L in one surface water sample; BTC-PD-02 contained 0.00067 mg/L.

- Copper: The total metal concentration of copper in surface water and pond water samples ranged from 0.003 to 0.021 mg/L. Copper in surface water exceeded the acute and chronic aquatic life standards in two wetland pond water samples but not in any stream water samples. BTC-PD-01 contained 0.018 mg/L total copper and BTC-PD-02 contained 0.021 mg/L total copper.

- Iron: The total metal concentration of iron in surface water and pond water samples ranged from 0.25 to 1.55 mg/L. Iron in surface water exceeded the chronic aquatic life standard of 1.0 mg/L in six stream and pond water natural samples.

- Lead: The total metal concentration of lead in surface water and pond water samples ranged from 0.0004 to 0.0104 mg/L. Lead in surface water exceeded the chronic aquatic life standard in two pond water samples but did not fail any other lead water quality standards in any other samples. BTC-PD-01 contained 0.0049 mg/L total lead and BTC-PD-01 contained 0.0104 mg/L total lead.

- Field Quality Control Samples: Based on a comparison of natural and blind field duplicate samples taken on a frequency greater than 5% (2 per 21 natural samples) during surface water sampling, the relative precision for the sampling method can be qualitatively assessed based on the RPD between the two samples. The mean RPDs for As, Cd, Cu, Pb, and Zn were 0%, 9%, 9%, 0%, and 3%, respectively. The RPD differences were all with the allowable range as stipulate in EPA's National Functional Guidelines for Inorganic Superfund Data Review (EPA 2014).

- Based on these results, surface water with the highest concentration of total metals of arsenic, cadmium, copper, and lead were from wetland pond samples (BTC-PD-01 and BTC-PD-02) located immediately west of Kaw Avenue within the BTC Berm area and not from the active stream channels or tributary channels within the study area.

IN-STREAM AND POND SEDIMENT PORE WATER SAMPLING

The in-stream sediment pore water and pond sediment pore water sampling portion of the data gaps site investigation of the SBC and BTC riparian corridors consisted of collecting and analyzing 53 natural in-stream sediment pore water samples from within the active stream channels and 4 pond sediment pore water samples from three wetland ponds.

Samples were collected using a push-point interstitial water sampler "wand" at specified depths of 12 and 36 inches below the sediment/water interface on March 8 through 16, 2016. Pore water sampling points were co-located with surface water and sediment sample stations (1 through 13). However at each station pore water sample were collected from the stream channel nearest both banks for a total of 4 pore water samples collected at each station (where feasible). In-stream and pond sediment pore water sample locations correspond to eighteen surface and two pond water sample stations presented on **Figure 7 (Appendix A)**; with each in-stream sediment pore water sample designated by the letters "SBC- or BTC-", for Silver Bow Creek and Blacktail Creek Corridors area; "SPW-" for the in-stream sediment pore water sample; followed by the consecutive number of the sample; then either "N" for northern bank or "S" for southern bank; followed by the depth designation of the sample (in inches). Each in-stream sediment pore water sample collected from the tributaries was designated by the letters "GG- or SC-", for tributaries Grove Gulch and Sand Creek and "SPW-" for the stream pore water sample; followed by the location number of the sample; then the bank location "N", "S", "E", "W"; followed by the depth designation (in inches). Each interstitial pore water sample from the wetland pond sediments was designated by the letters "BTC-", for the Blacktail Creek area; "WPPW-" for wetland pond pore water; then the number of the sample labeled consecutively; followed by the sample depth (in inches). In-stream and pond sediment pore water sampling field notes are included in **Appendix B**. Field sampling and analysis procedures followed the procedures put forth in the SAP; with the following key points and notable exceptions:

- It was not possible to sample some of the proposed streambed and pond pore water sites due to the coarse nature of the streambed substrate in the active stream channels (push point refusal), and due to clogging the sampler 'wand' with mud/muck at other refusal locations (particularly wetland pond #3). Thirteen in-stream and two wetland pond sediment pore water proposed sample points were not able to be sampled using the push-point interstitial water sampler. Multiple attempts at each refusal point were made prior to deeming the point unsuccessful.

- It was not possible to measure depth to water inside of the push-point metal tube during pore water sampling as proposed in the SAP due to the small diameter of the tube. Therefore it was impossible to determine relative vertical gradients at each sample point compared to the hydraulic head in the surface water body being sampled (stream or pond). Even though vertical gradients could not be quantified, anecdotal evidence of artesian head at some of the sample points (Blacktail Creek: BTC-SPW-04 (36") and Sand Creek: SC-SPW-01E (36")) indicate that upward vertical gradients exist which may correspond to gaining reaches of stream. Other anecdotal evidence of the gaining reaches within the lower BTC drainage are the discharge flows out of the two wetland ponds located north of the creek on either side of the Kaw/Lexington Avenue overpass. There were no other sources of surface water flow into the two ponds as observed in March 2016; therefore any discharge out of the ponds into BTC is attributable to groundwater discharge into the wetland ponds.

- Even though pore water samples were analyzed for dissolved metals, like groundwater, they are being compared to surface water quality standards as well as groundwater standards because in gaining reaches of stream, the surface water and sediments are the receptors from both groundwater and pore water discharge. Some of the surface water quality standards are hardness dependent; therefore hardness values used to calculate chronic and acute standards for pore water samples were based on hardness of the receiving waters nearest the sample point (i.e. nearest surface water quality samples).

- The accuracy of the field measurement results for dissolved oxygen (DO) is suspect due to sampling methodology. During surface water sampling values measured with the DO meter exceeded the feasible range of dissolved oxygen over the range of temperatures measured.

Results of field parameters, physiochemical, common anions, common cations, nutrients and physical parameters that were measured and/or analyzed are presented in **Table 11 (Appendix C)**. The pH of pore waters ranged from 4.2 to 7.7 (as measured in the laboratory); with the lowest pH corresponding to a sample collected from the Slag Canyon/Butte Reduction Works portion of SBC. Note that the dissolved oxygen meter was malfunctioning/reading out of range and the values presented in **Table 11** are suspect. ORP values ranged from 17 to 335 mV; from near neutral potential to oxidizing.

Results of the dissolved metals concentrations measured in the in-stream and pond sediment pore water samples are presented in **Table 12 (Appendix C)**. Results of stream water and pond pore water sampling were compared to DEQ Circular 7 surface water quality standards for total metals and DEQ Circular 7 groundwater quality standards for dissolved metals. Chronic and acute aquatic life standards for pore water that are hardness dependent were calculated for each sample based on the nearest receiving surface water sample result for hardness. Stream and pond pore water concentrations that exceeded the surface water quality standards are highlighted yellow in **Table 12** and are shown in **Figure 7**.

A summary of the results and discussion follows:

- Arsenic: Total arsenic concentrations of the 57 natural in-stream and pond sediment pore water samples ranged from <0.001 to 5.1 milligrams per liter (mg/L). Eighteen of 53 in-stream and 2 of 4 pond sediment pore water samples exceeded the water quality standards. Most of the exceedances were based on the human health standard (HHS) of 0.01 mg/L; however some of the samples exceeded the HHS and the acute and chronic standards (0.34 and 0.15 mg/L, respectively). The depth integrated results, where sampled, were interesting. In almost all sample sets, water quality standards that exceeded water quality criteria at the shallow depth (12 inches) also exceeded criteria at the deep depth (36 inches). The highest arsenic sample results measured were from pore water collected in the Slag Canyon portion of SBC and corresponding to the sample location nearest the north bank. Another interesting observation is the

results from the Grove Gulch sample location; neither pore water samples (both sample depths) exceeded the surface water quality standard even though the arsenic sediment sample from this location exceeded the BTAG sediment criteria.

- Cadmium: Dissolved cadmium concentrations ranged in pore water from <0.00003 to 0.155 mg/L. Seven of 53 in-stream sediment pore water and 1 of 4 pond sediment pore water samples exceeded the surface water quality standard. Sample SBC-SPW-02N (12") and SBC-SPW-02N (36") from the Slag Canyon reach of SBC contained the highest pore water results for dissolved cadmium of 0.155 and 0.109 mg/L, respectively.

- Copper: Dissolved copper concentrations in in-stream and pond sediment pore water samples ranged from <0.002 to 39.7 mg/L. Five of 53 in-stream sediment pore water and 1 of 4 pond sediment pore water samples exceeded the DEQ-7 surface water quality standards (two in-stream sediment pore water samples exceeded the HHS and the remainder of the samples exceeded the chronic and/or acute standards). The pore water sample concentrations were highest in the Slag Canyon reach of SBC nearest the north bank (SBC-SPW-02N; both depths), one of the lower BTC locations nearest the south bank (BTC-SPW-02S at 36 inches), and in the wetland pond #1 location (BTC-WPPW-01 at 12 inches).

- Iron: The dissolved iron concentrations in pore water samples ranged from <0.02 to 633 mg/L. Twenty eight of 53 in-stream sediment pore water and 3 of 4 pond sediment pore water samples exceeded the chronic aquatic life standard.

- Lead: The dissolved lead concentrations in streambed and pond sediment pore water samples ranged from <0.0003 to 0.0096 mg/L. The pore water sample from the Slag Canyon portion of SBC (SBC-SPW-02N (36")) and the wetland pond #1 pore water sample (BTC-WPPW-01 (12")) exceeded the chronic aquatic life standards.

- Zinc: The dissolved zinc concentrations in streambed and pond sediment pore water samples ranged from <0.008 to 95 mg/L. Four of 53 in-stream sediment pore water and 1 of 4 pond sediment pore water samples exceeded the DEQ-7 surface water quality standards. The highest concentration for zinc was found in the Slag Canyon reach of SBC nearest the north bank (SPBS-SPW-02N), from both depths.

- In general dissolved contaminants in pore water appears to be highest in sections of streams or wetland ponds that contain elevated contaminants in sediment, with notable exceptions such as Grove Gulch (sediment pore water did not exceed surface water quality standards) or in a few upstream reaches on BTC that are only marginally impacted with respect to streambed metals yet exceed the arsenic surface water quality standard (2 samples), the copper standard (1 sample), and the iron standard (multiple samples). Also note that the iron concentrations in pore water may not be related to mining activities, as any reducing conditions due to decay of organic material in groundwater or pore water can mobilize naturally occurring iron.

GROUNDWATER SAMPLING AND ANALYSIS

Tetra Tech conducted the groundwater sampling portion of the data gap site investigation on 32 existing wells between March 7 through March 11, 2016 and on three newly installed DPT piezometers on April 8, 2016. In addition, MBMG collected 12 split samples concurrent with Tetra Tech sampling for laboratory analysis on March 7, 2016. Groundwater sampling and analysis followed the procedures and analysis list presented in the draft SAP with the following exceptions:

- Three wells were not sampled: Wells BPS07-9A (abandoned), MF-1 (casing obstruction), MT98-3 (casing obstruction).
- Two additional wells were sampled: Replacement wells AMW-13B2 and BT99-4 were sampled at MBMG's suggestion.

- Groundwater split samples AMW-13A, AMW-13B, AMW-13B2, AMW13C, BT98-01, BT98-05, BT99-01, BT99-04, GS-29D, GS-29SR, MT98-05, and MT98-06 were collected by MBMG

Appendix B provides groundwater sampling field logs. **Figure 7** (**Appendix A**) shows the groundwater sampling locations. **Table 11** (**Appendix C**) presents field parameters and laboratory physical parameters and **Table 12** (**Appendix C**) presents the dissolved metals analytical results. Circular DEQ-7 groundwater quality exceedances on **Table 12** are shaded yellow. **Figure 7** also presents the dissolved metals results for each sampling point and compares them to Circular DEQ-7 groundwater water quality standards. Exceedances are highlighted in red.

Groundwater sampling results are discussed as follows:

- Arsenic: Concentrations of dissolved arsenic in groundwater from the 35 wells/piezometers ranged from <0.001 to 0.302 mg/L. Eight natural groundwater samples with concentrations ranging from 0.013 to 0.302 mg/L, exceeded the water quality standard (HHS; 0.01 mg/L) in wells/piezometers located between the BTC berm area and Slag Wall Canyon reach adjacent to the BRW. These include piezometer BTC-DPT-01 and wells AMW-11, GS-29D, BPS07-08A, BPS07-14A, BPSO7-15A, BPS07-25, and FP98-1. Arsenic in groundwater did not exceed the water quality standard in wells north or east of the BTC berm area with the exception of wells MF-10 (0.019 mg/L) and BPS07-24 (0.001 mg/L) in the Diggings East Area.

- Cadmium: Concentrations of dissolved cadmium in groundwater from the 35 wells/piezometers sampled ranged from <0.0001 to 0.037 mg/L. The highest concentrations were measured in water from wells FP98-1 (0.037 mg/L) in the BRW area and in BPS07-24 (0.0175 mg/L) in the Diggings East Area, Cadmium groundwater concentrations exceeded the Circular DEQ-7 standard for groundwater in 5 of 35 natural groundwater samples.

- Copper: Concentrations of dissolved copper in groundwater ranged from <0.002 to 0.667 mg/L. The highest concentrations of the wells sampled were found in BPS07-24 (0.667 mg/L), FP98-1 (0.531 mg/L), and in GS-29SR (0.505 mg/L). Copper did not exceed the Circular DEQ-7 standard for groundwater in any of the wells sampled.

- Lead: Dissolved lead in groundwater was detected in two wells, BPS07-14A (0.0013 mg/L) and BTC-DPT-01 (0.0005 mg/L). Lead did not exceed the Circular DEQ-7 standard for groundwater in any of the wells sampled.

- Zinc: Concentrations of dissolved zinc in groundwater sampled from the 35 wells/piezometers ranged from <0.008 to 24.1 mg/L. The highest concentrations of dissolved zinc were found in groundwater samples from BRW wells BPS07-14A (4.07 mg/L) and FP98-1 (24.1 mg/L) and Diggings East wells MF-10 (16 mg/L) and BPS07-24 (4.05 mg/L). Zinc groundwater concentrations exceeded the Circular DEQ-7 standard for groundwater in 4 of 35 natural groundwater samples.

- Iron and Manganese: Groundwater sample concentrations for iron ranged from <0.02 to 17.5 mg/L. There is no Circular DEQ-7 standard for iron in groundwater; although many sample concentrations would exceed the secondary drinking water MCL of 0.300 mg/L. Groundwater sample concentrations for manganese ranged from <0.02 to 56.9 mg/L. There is no groundwater Circular DEQ-7 standard for manganese, though concentrations were quite high in several samples which would certainly exceed the secondary drinking water MCL of 0.050 mg/L.

- Field Quality Control Samples: Based on a comparison of natural and blind field duplicate samples taken on a frequency greater than 5% (2 per 36 natural samples) during surface water sampling, the relative precision for the sampling method can be qualitatively assessed based on the RPD between the two samples. The mean RPDs for As, Cd, Cu, Pb, and Zn were 5.4%, 1.7%, 0.4%, 0%, and 1.4%, respectively. The RPD differences were all with the allowable range as stipulate in EPA's National Functional Guidelines for Inorganic Superfund Data Review (EPA 2014). Groundwater split samples collected by MBMG compared favorably, generally within 10% or less of the concentrations measured and analyzed by Tetra Tech.

- Based on these results, groundwater with the highest concentrations of arsenic, cadmium, and/or zinc were observed in three primary areas of the BAO during this data gap investigation. These include SWC/BRW area, SBC/BTC confluence and BTC Berm area, and Northside Tailings/Diggings East areas.

Groundwater east of Lexington Avenue did not exceed water quality standards for the metals analyzed during this investigation.

AQUIFER TESTING AND ANALYSIS

Tetra Tech conducted two, limited-duration, single-well pumping tests on Blacktail Creek Berm Area monitoring well AMW-11 (GWIC# 161962) (**Figure 7**) on April 28, 2016. The purpose of the testing was to determine aquifer properties that would be expected to occur during construction dewatering.

Well AMW-11 was selected to be representative of the site because the well is located on the BTC Berm which is comprised of a mixture of soil types and fill material prevalent throughout the berm area. The screened interval for the well is 4 to 14 feet below ground surface (bgs) (**Appendix B**). The completion log for the well indicates the material type in the screened interval of the well consists of sandy silt, clay, sand, silt and slag fill, and silty sand (in sequential order). The static water level measured in the well immediately preceding the pumping test was approximately 5.5 feet bgs, which corresponds with the water level recorded on the well completion log.

A portable Grundfos™ Rediflo-2 submersible pump was used to pump the well at an approximate rate of 2.5 gallons per minute (gpm), which was determined to be the maximum sustainable pumping rate for the available hydraulic head and the permeability of the upper-most alluvial aquifer beneath the BTC Berm area. In addition to the submersible pump, the test well was also fitted with a transducer and data logger to measure and record aquifer response to pumping withdrawals. The SAP indicated that other nearby monitoring wells and piezometers were to be monitored for drawdown; however, no aquifer responses were noted in other wells, therefore the aquifer testing was limited to single-well observations.

The pumping test data was analyzed with aquifer testing software (Aqtesolv 4.5 Professional). A total aquifer thickness of 10 feet was used in the aquifer test analysis and calculations. Theis (1935) and Cooper-Jacob (1946) analysis methods were utilized, and both analyses assumed unconfined conditions. Results are summarized below, and **Appendix D** provides graphical curve matches of the data:

Method[1]	Aquifer Thickness (in feet)	Transmissivity (ft^2/day)	Hydraulic Conductivity[2] (ft/day)
Cooper-Jacob 1	10	501.7	50.2
Cooper-Jacob 2	10	781.2	78.1
Theis 1	10	499.6	50.0
Theis 2	10	582.0	58.2
Mean Value		**591**	**59**

Notes: [1]Methods of analysis were based on assumption of unconfined conditions and using two sets of time versus drawdown data (test 1 and test 2).
[2]Hydraulic conductivities were calculated from the transmissivity of the aquifer based off of a best-fit curve or line match of the time versus drawdown data and an assumed aquifer thickness of 10 feet; where the hydraulic conductivity K=transmissivity T/aquifer thickness b.
ft^2 /day – square feet per day
ft/day – feet per day

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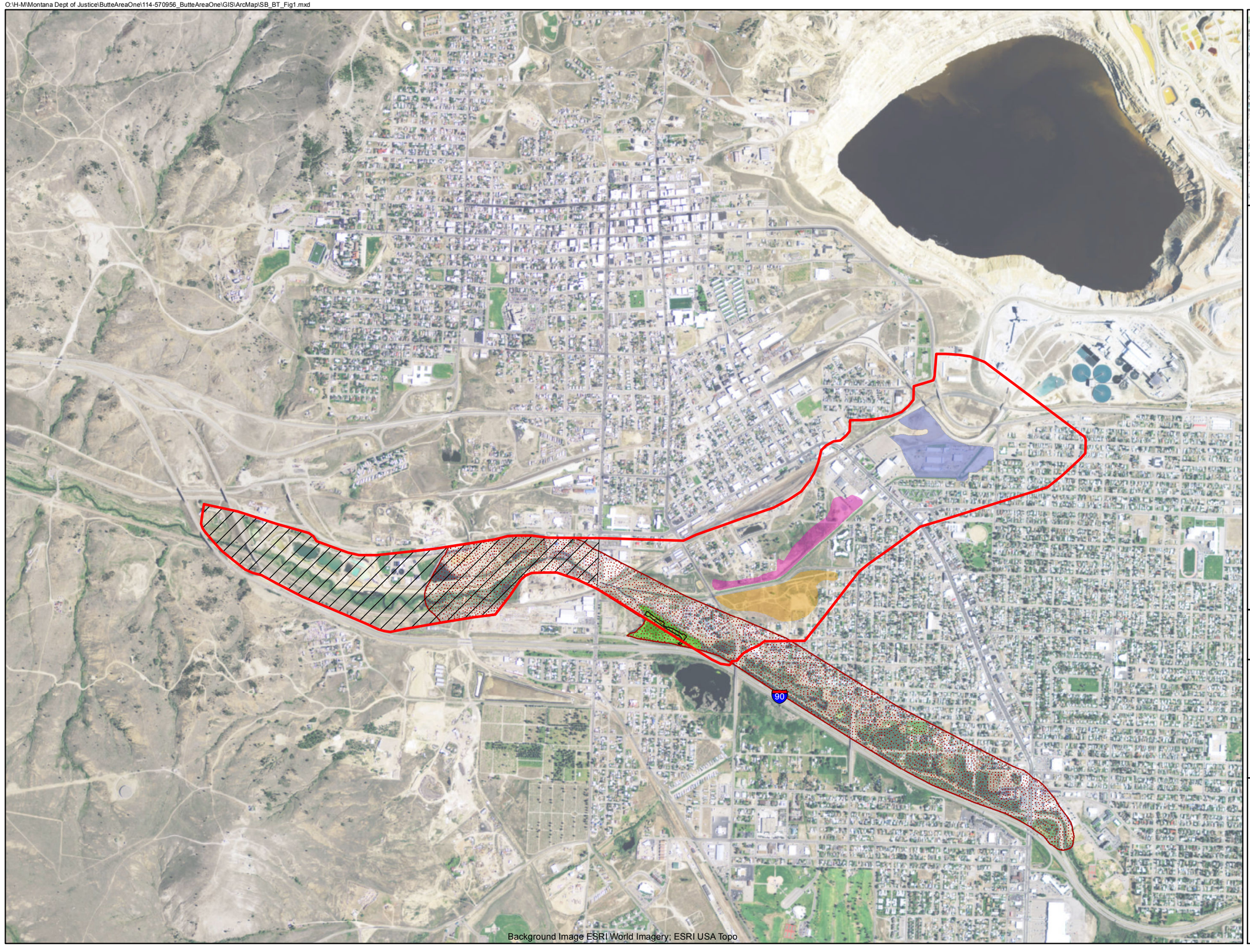
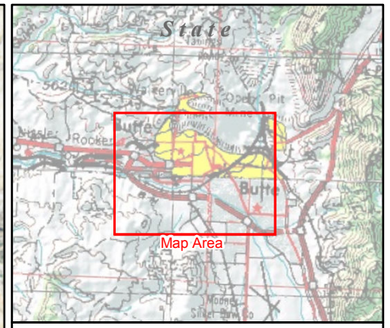
APPENDIX A
FIGURES

O:\H-M\Montana Dept of Justice\ButteAreaOne\114-570956_ButteAreaOne\GIS\ArcMap\SB_BT_Fig1.mxd



Background Image ESRI World Imagery; ESRI USA Topo



Legend

- Butte Area 1 Boundary
- Lower Area 1 (Subunit of BAO)
- Silver Bow Cr. and Blacktail Cr. Corridor Study Area
- Parrot Tailings Removal Area
- Northside Tailings
- Diggings East Tailings
- Berm
- Impacted Wetland Sediments

TETRA TECH

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12/9/2015

Butte Area One
Removal / Restoration
Removal Areas
Butte, Montana

Figure 1

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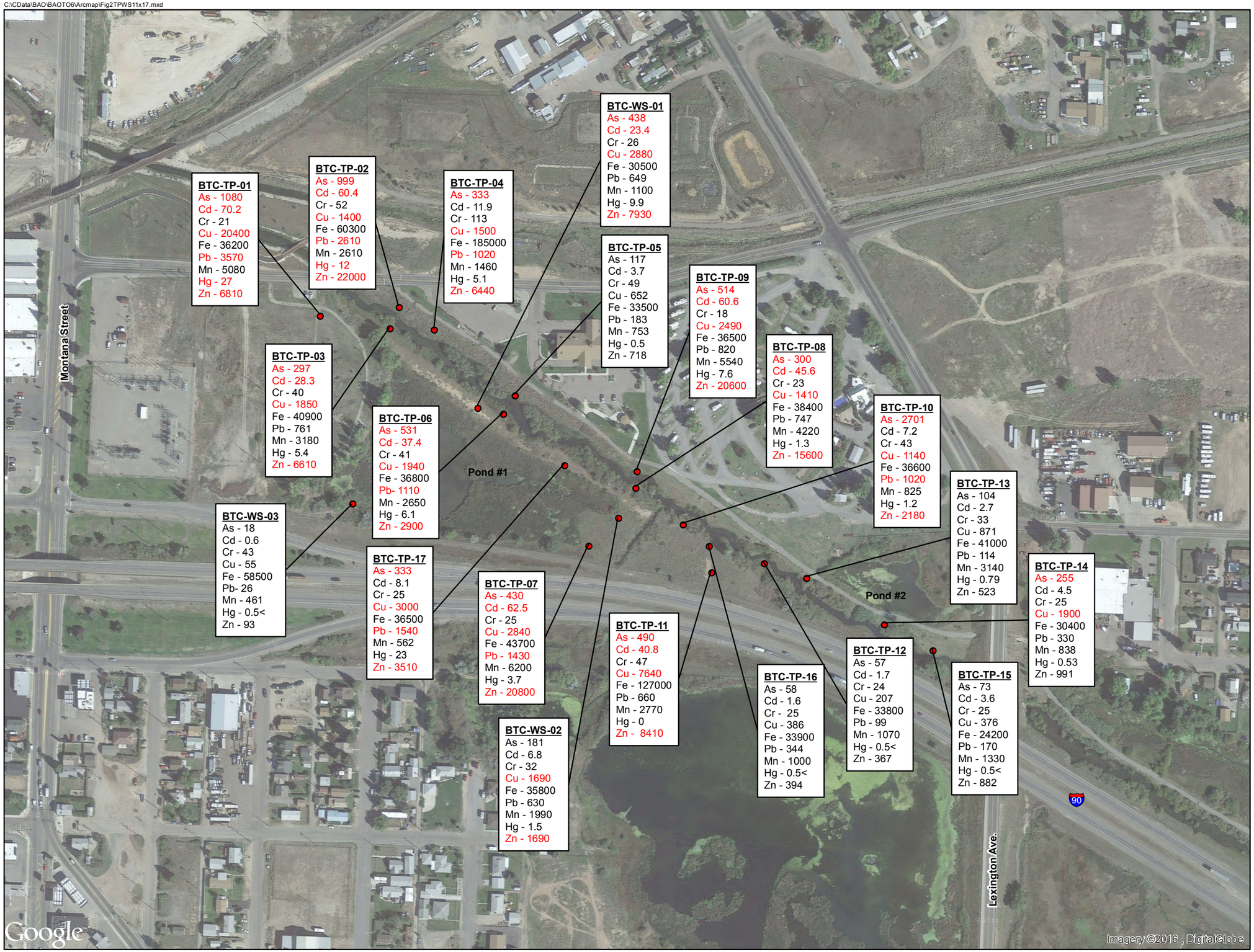

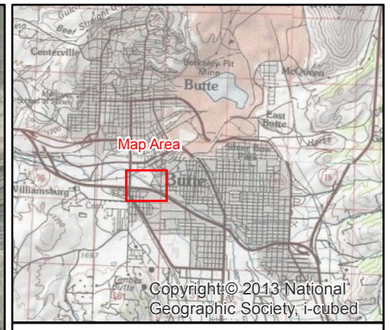

Sample Location
(Units in mg/kg)

Screening Criteria (mg/kg)	
Arsenic	200
Cadmium	20
Chromium	*
Copper	1000
Iron	*
Lead	1000
Manganese	*
Mercury	10
Zinc	1000

** - Not established*

Screening Criteria utilized in site investigations from Field Screen Criteria and Procedures Phase 7 and 8 Remedial Action, SST OU Subarea 4, Reaches R and S (Pioneer 2011)

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7/20/2016

Floodplain Soils / Mine Wastes Sampling
Silver Bow Creek and Blacktail Creek Corridors

Figure 2

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SBC-OSBS-01
As - 85
Cd - 6.8
Cr - 34
Cu - 618
Fe - 28000
Pb - 348
Mn - 1970
Hg - 0.5<
Zn - 1740

BTC-SBS-01
As - 111
Cd - 6.7
Cr - 27
Cu - 988
Fe - 28200
Pb - 1290
Mn - 2060
Hg - 2.5
Zn - 2060

BTC-SBS-02
As - 108
Cd - 9.6
Cr - 21
Cu - 2390
Fe - 26300
Pb - 365
Mn - 2130
Hg - 0.98
Zn - 3120

BTC-SBS-03
As - 51
Cd - 3
Cr - 17
Cu - 393
Fe - 19100
Pb - 117
Mn - 571
Hg - 0.5<
Zn - 903

BTC-SBS-04
As - 70
Cd - 3.9
Cr - 25
Cu - 376
Fe - 24000
Pb - 215
Mn - 883
Hg - 0.5<
Zn - 1140

BTC-SBS-05
As - 15
Cd - 1.1
Cr - 18
Cu - 107
Fe - 18600
Pb - 38
Mn - 316
Hg - 0.5<
Zn - 306

BTC-SBS-09
As - 54
Cd - 2.7
Cr - 23
Cu - 293
Fe - 25400
Pb - 126
Mn - 775
Hg - 0.5<
Zn - 658

BTC-OSBS-03
(BTC-SBS-02 4/13/16 in lab rpt)
As - 356
Cd - 69.8
Cr - 21
Cu - 2390
Fe - 26300
Pb - 1170
Mn - 3840
Hg - 0.98
Zn - 21700

BTC-OSBS-01
As - 237
Cd - 10.6
Cr - 32
Cu - 1400
Fe - 33900
Pb - 393
Mn - 1110
Hg - 0.94
Zn - 1840

BTC-SBS-06
As - 51
Cd - 1.6
Cr - 24
Cu - 238
Fe - 29000
Pb - 94
Mn - 1110
Hg - 0.5<
Zn - 358

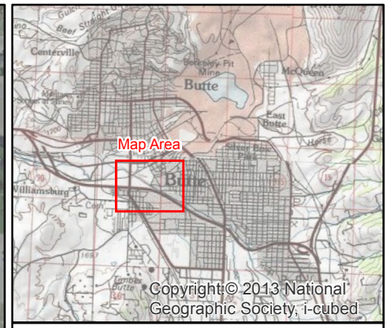
BTC-SBS-07
As - 59
Cd - 1.5
Cr - 24
Cu - 215
Fe - 31100
Pb - 97
Mn - 686
Hg - 0.5<
Zn - 389

BTC-SBS-08
As - 66
Cd - 3.2
Cr - 22
Cu - 368
Fe - 25400
Pb - 112
Mn - 658
Hg - 0.5<
Zn - 445

GG-OSBS-01
As - 10
Cd - 0.5<
Cr - 32
Cu - 49
Fe - 52000
Pb - 20
Mn - 385
Hg - 0.5<
Zn - 84

BTC-OSBS-02
As - 78
Cd - 1.8
Cr - 27
Cu - 449
Fe - 31300
Pb - 287
Mn - 701
Hg - 0.5<
Zn - 415

Montana Street
Lexington Ave.
Pond #1
Pond #2
Pond #3
90



Sample Location
(Units in mg/kg)

Freshwater Sediment Screening Benchmarks (EPA)	
Arsenic	9.8
Cadmium	0.99
Chromium	43.4
Copper	31.6
Iron	20,000
Lead	35.8
Manganese	460
Mercury	0.18
Zinc	121

EPA Region III BTAG Freshwater Sediment Screening Benchmarks 8/2006

Hierarchy for Selection of Freshwater Sediment Benchmarks
- Preference was given to benchmarks based on chronic direct exposure, non-lethal endpoint studies designed to be protective of sensitive species
- Values derived by statistical- or consensus-based evaluation of multiple studies were given first priority
- Equilibrium partitioning values were selected for contaminants with 2.0< log Kow <6.0 if empirical values based on multiple studies were not available
- Absent consensus or equilibrium partitioning values, single study toxicity values were selected

TETRA TECH

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7/21/2016

Bank and Opportunity Soil Sampling

Silver Bow Creek and Blacktail Creek Corridors

Figure 3

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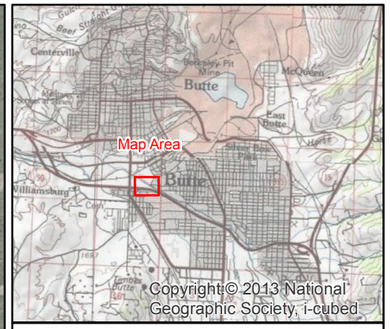

- Sample Location
  Depth to Bottom of
  Black Clay (feet)
- \+ Grid Point Interpolated Depth
  to Bottom of Black Clay (feet)
  (NAD 83 Montana State Plane, ltl. feet)
- Depth Contour
  1 foot contour Interval
- Blacktail Berm Area

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7/20/2016

Vertical Extent of Contamination

**Silver Bow Creek and
Blacktail Creek Corridors**

Figure 4

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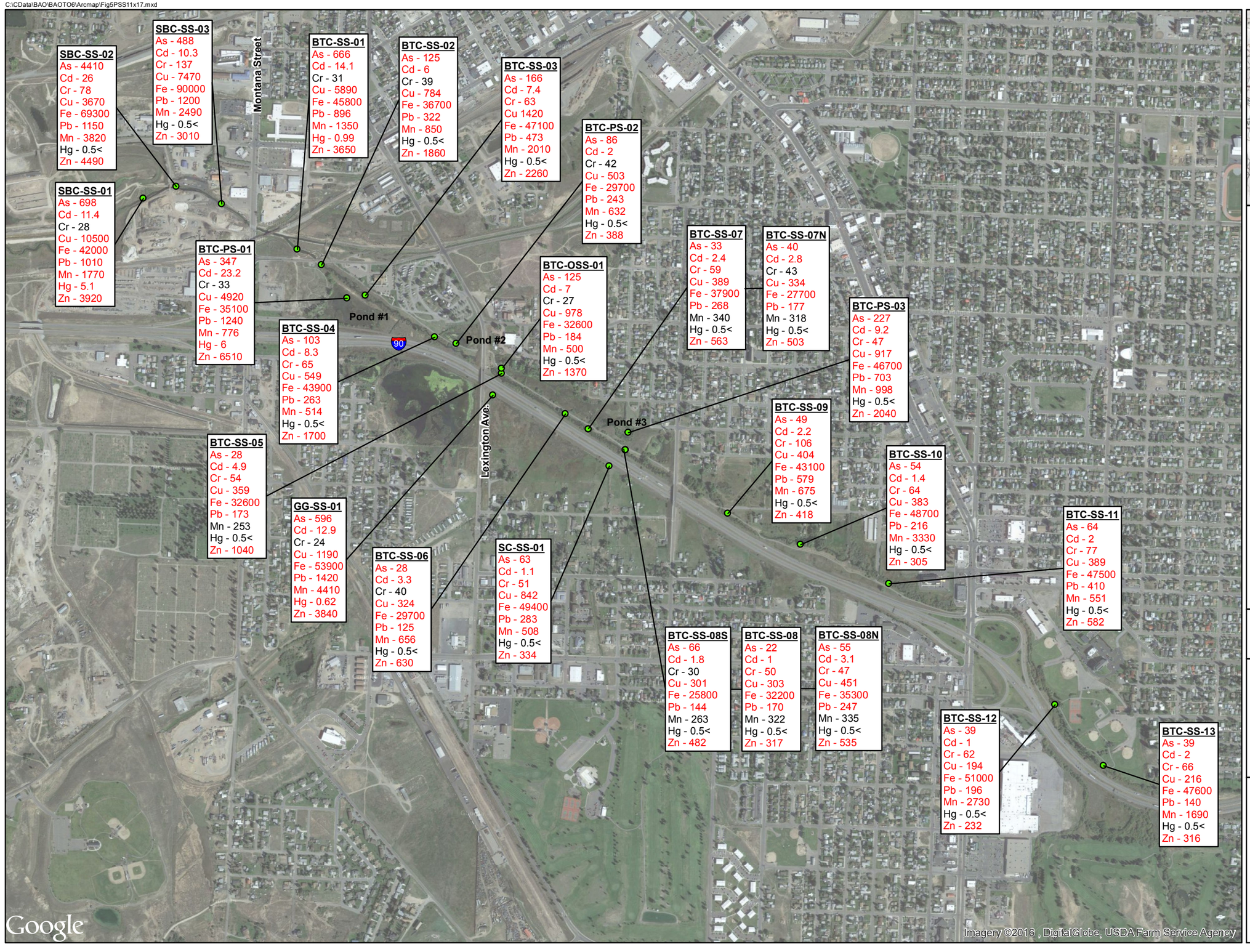

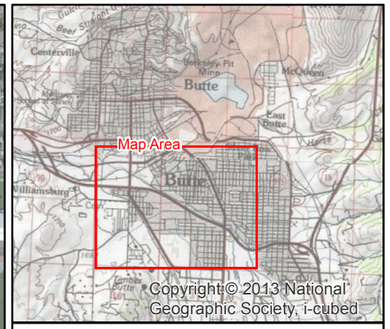

Sample Location
(Units in mg/kg)

Freshwater Sediment Screening Benchmarks (EPA)	
Arsenic	9.8
Cadmium	0.99
Chromium	43.4
Copper	31.6
Iron	20,000
Lead	35.8
Manganese	460
Mercury	0.18
Zinc	121

EPA Region III BTAG Freshwater Sediment Screening Benchmarks 8/2006

Hierarchy for Selection of Freshwater Sediment Benchmarks
- Preference was given to benchmarks based on chronic direct exposure, non-lethal endpoint studies designed to be protective of sensitive species
- Values derived by statistical- or consensus-based evaluation of multiple studies were given first priority
- Equilibrium partitioning values were selected for contaminants with 2.0< log Kow <6.0 if empirical values based on multiple studies were not available
- Absent consensus or equilibrium partitioning values, single study toxicity values were selected

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In-Stream and Pond Sediment Sampling

Silver Bow Creek and Blacktail Creek Corridors

Figure 5

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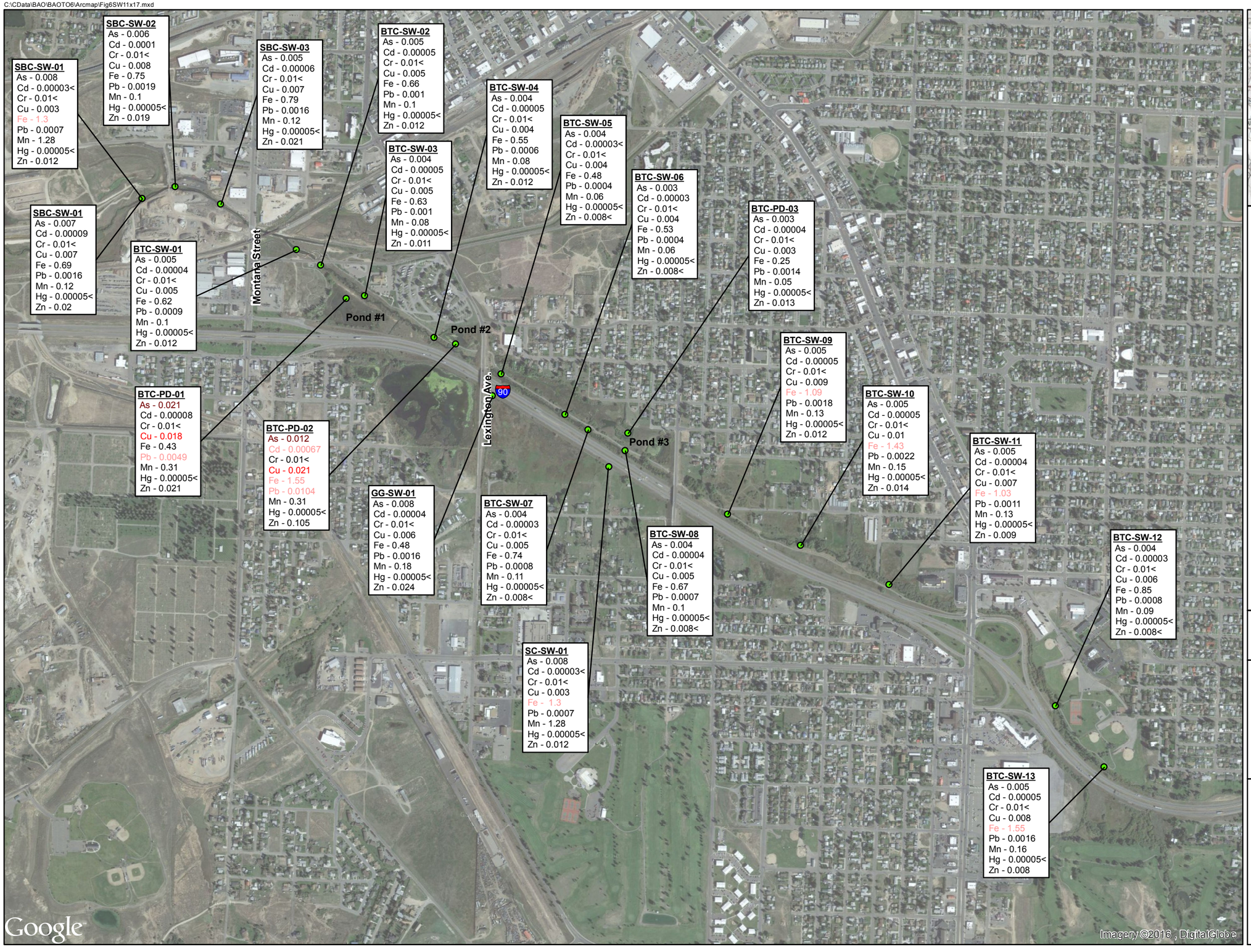

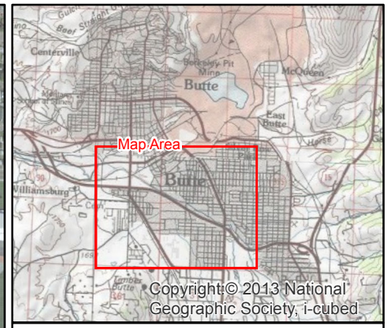

Sample Location
(Units in mg/L, analyzed and reported as total metals)

Exceedances are based on MDEQ Circular DEQ-7 Water Quality Human Health Standard, Acute Standard and/or Chronic Standard (October 2012).

Value exceeds Human Health Standard
Value exceeds Acute Standard
Value exceeds Chronic Standard

	HHS	Acute	Chronic
Arsenic	0.01	0.34	0.15
Cadmium	0.005	0.00052*	0.000097*
Chromium	0.1	0.579*	0.0277*
Copper	1.3	0.00379*	0.00285*
Iron	--	--	1
Lead	0.015	0.01398*	0.000545*
Manganese	--	--	--
Mercury	0.05	0.0017	0.00091
Zinc	2	0.037*	0.037*

Notes: MDEQ Circular 7 Water Quality Standards converted from µg/L (parts per billion) to mg/L (parts per million)

* Hardness dependent metals aquatic life standards are based on an assumed hardness of 25 mg/L. Please refer to the surface water total metals results table for sample specific hardness dependent standards.

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7/20/2016

Surface Water Sampling

Silver Bow Creek and Blacktail Creek Corridors

Figure 6

C:\CData\BAO\BAOTO6\Arcmap\Fig7PW11x17.mxd

SBC-SPW-03N
As - 0.005
Cd - 0.00179
Cr - 0.01<
Cu - 0.064
Fe - 0.02
Pb - 0.0013
Mn - 0.71
Hg - 0.00005<
Zn - 0.148

BTC-SPW-01N
As - 0.028
Cd - 0.00003<
Cr - 0.01<
Cu - 0.002<
Fe - 12.1
Pb - 0.0003<
Mn - 1.59
Hg - 0.00005<
Zn - 0.008<

BTC-WPPW-01
As - 0.215
Cd - 0.00913
Cr - 0.01<
Cu - 0.915
Fe - 66.2
Pb - 0.0044
Mn - 5.79
Hg - 0.00037
Zn - 1.21

BTC-SPW-03N
As - 0.07
Cd - 0.00003<
Cr - 0.01<
Cu - 0.002<
Fe - 17.6
Pb - 0.0003<
Mn - 2.71
Hg - 0.00005<
Zn - 0.008<

BTC-WPPW-02
As - 0.009
Cd - 0.00003<
Cr - 0.01<
Cu - 0.002<
Fe - 3.67
Pb - 0.0003<
Mn - 3.56
Hg - 0.00005<
Zn - 0.008<

BTC-SPW-05N
As - 0.002
Cd - 0.00047
Cr - 0.01<
Cu - 0.004
Fe - 0.02<
Pb - 0.0003<
Mn - 0.02<
Hg - 0.00005<
Zn - 0.095

SBC-SPW-01N
As - 0.055
Cd - 0.00003<
Cr - 0.01<
Cu - 0.002<
Fe - 4.95
Pb - 0.0003<
Mn - 7.06
Hg - 0.00005<
Zn - 0.008<

BTC-SPW-03S
As - 0.198
Cd - 0.00003<
Cr - 0.01<
Cu - 0.005
Fe - 71.5
Pb - 0.0009
Mn - 6.06
Hg - 0.00005<
Zn - 0.008<

BTC-SPW-05S
As - 0.026
Cd - 0.00003<
Cr - 0.01<
Cu - 0.002<
Fe - 25.9
Pb - 0.0003<
Mn - 5.07
Hg - 0.00005<
Zn - 0.008<

BTC-SPW-06N
As - 0.056
Cd - 0.00003<
Cr - 0.01<
Cu - 0.004
Fe - 10
Pb - 0.0003<
Mn - 4.94
Hg - 0.00005<
Zn - 0.008<

SBC-SPW-01S
As - 0.937
Cd - 0.00003<
Cr - 0.01<
Cu - 0.002<
Fe - 7.87
Pb - 0.0003<
Mn - 8.34
Hg - 0.00005<
Zn - 0.008<

BTC-SPW-02N
As - 0.044
Cd - 0.00003<
Cr - 0.01<
Cu - 0.004
Fe - 18.2
Pb - 0.0003<
Mn - 2.36
Hg - 0.00005<
Zn - 0.008<

BTC-SPW-04N
As - 0.002
Cd - 0.00003<
Cr - 0.01<
Cu - 0.002<
Fe - 11
Pb - 0.0003<
Mn - 4.3
Hg - 0.00005<
Zn - 0.008<

BTC-SPW-06S
As - 0.007
Cd - 0.00003<
Cr - 0.01<
Cu - 0.002<
Fe - 7.84
Pb - 0.0003<
Mn - 0.83
Hg - 0.00005<
Zn - 0.008<

BTC-SPW-09N
As - 0.002
Cd - 0.00003<
Cr - 0.01<
Cu - 0.004
Fe - 0.02<
Pb - 0.0003<
Mn - 0.02<
Hg - 0.00005<
Zn - 0.008<

SBC-SPW-02N
As - 5.1
Cd - 0.155
Cr - 0.01<
Cu - 39.7
Fe - 633
Pb - 0.0096
Mn - 17.6
Hg - 0.00005<
Zn - 95

BTC-SPW-02S
As - 0.013
Cd - 0.00398
Cr - 0.01<
Cu - 0.604
Fe - 2.56
Pb - 0.0017
Mn - 0.63
Hg - 0.00005<
Zn - 0.506

BTC-SPW-04S
As - 0.018
Cd - 0.00003<
Cr - 0.01<
Cu - 0.003
Fe - 3.72
Pb - 0.0007
Mn - 0.41
Hg - 0.00005<
Zn - 0.008<

GG-SPW-01E
As - 0.006
Cd - 0.00003<
Cr - 0.01<
Cu - 0.002<
Fe - 0.64
Pb - 0.0003<
Mn - 0.05
Hg - 0.00005<
Zn - 0.008<

BTC-SPW-07N
As - 0.002
Cd - 0.00033
Cr - 0.01<
Cu - 0.002<
Fe - 0.02<
Pb - 0.0003<
Mn - 0.02<
Hg - 0.00005<
Zn - 0.121

BTC-SPW-09S
As - 0.029
Cd - 0.00003<
Cr - 0.01<
Cu - 0.003
Fe - 14.3
Pb - 0.0003<
Mn - 1.32
Hg - 0.00005<
Zn - 0.008<

BTC-SPW-11N
As - 0.003
Cd - 0.00007
Cr - 0.01<
Cu - 0.014
Fe - 2.98
Pb - 0.0003<
Mn - 0.44
Hg - 0.00005<
Zn - 0.015

BTC-SPW-12N
As - 0.001<
Cd - 0.00003<
Cr - 0.01<
Cu - 0.005
Fe - 0.02<
Pb - 0.0003<
Mn - 0.02<
Hg - 0.00005<
Zn - 0.008<

BTC-SPW-11S
As - 0.003
Cd - 0.00003<
Cr - 0.01<
Cu - 0.005
Fe - 1.31
Pb - 0.0003<
Mn - 1.21
Hg - 0.00005<
Zn - 0.008<

BTC-SPW-12S
As - 0.004
Cd - 0.00003<
Cr - 0.01<
Cu - 0.004
Fe - 10.7
Pb - 0.0003<
Mn - 0.52
Hg - 0.00005<
Zn - 0.008<

BTC-SPW-08N
As - 0.008
Cd - 0.00003<
Cr - 0.01<
Cu - 0.003
Fe - 9.13
Pb - 0.0003<
Mn - 0.06
Hg - 0.00005<
Zn - 0.008<

BTC-SPW-10N
As - 0.014
Cd - 0.00003<
Cr - 0.01<
Cu - 0.006
Fe - 18.5
Pb - 0.0003<
Mn - 0.54
Hg - 0.00005<
Zn - 0.008<

SC-SPW-01E
As - 0.002
Cd - 0.00006
Cr - 0.01<
Cu - 0.007
Fe - 0.02<
Pb - 0.0003
Mn - 0.02<
Hg - 0.00005<
Zn - 0.011

BTC-SPW-08S
As - 0.001
Cd - 0.00003<
Cr - 0.01<
Cu - 0.002<
Fe - 1.81
Pb - 0.0003<
Mn - 0.04
Hg - 0.00005<
Zn - 0.008<

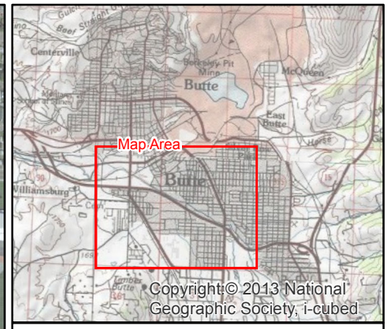
BTC-SPW-10S
As - 0.002
Cd - 0.00003<
Cr - 0.01<
Cu - 0.006
Fe - 0.02<
Pb - 0.0003<
Mn - 0.02<
Hg - 0.00005<
Zn - 0.008<

BTC-SPW-13N
As - 0.001<
Cd - 0.00003<
Cr - 0.01<
Cu - 0.004
Fe - 0.02<
Pb - 0.0003<
Mn - 0.02<
Hg - 0.00005<
Zn - 0.008<

BTC-SPW-13S
As - 0.001<
Cd - 0.00003<
Cr - 0.01<
Cu - 0.005
Fe - 0.88
Pb - 0.0003
Mn - 0.2
Hg - 0.00005<
Zn - 0.008<

Montana Street
Lexington Ave.
90

Google
Imagery ©2016 , DigitalGlobe



- Sample Location (Units in mg/L, analyzed and reported as dissolved metals)

Exceedances are based on Human Health Standard, Acute Standard and/or Chronic Standard.

Value exceeds Human Health Standard
Value exceeds Acute Standard
Value exceeds Chronic Standard

	HHS	Acute	Chronic
Arsenic	0.01	0.34	0.15
Cadmium	0.005	0.00052*	0.000097*
Chromium	0.1	0.579*	0.0277*
Copper	1.3	0.00379*	0.00285*
Iron	--	--	1
Lead	0.015	0.01398*	0.000545*
Manganese	--	--	--
Mercury	0.05	0.0017	0.00091
Zinc	2	0.037*	0.037*

Notes: MDEQ Circular 7 Water Quality Standards converted from µg/L (parts per billion) to mg/L (parts per million)

* Hardness dependent metals aquatic life standards are based on an assumed hardness of 25 mg/L. Please refer to the pore water dissolved metals results table for sample specific hardness dependent standards.

TETRA TECH

N
W E
S
1:12,000
Feet
0 245 490 980

7/20/2016

In-Stream and Pond Sediment Pore Water Sampling

Silver Bow Creek and Blacktail Creek Corridors

Figure 7

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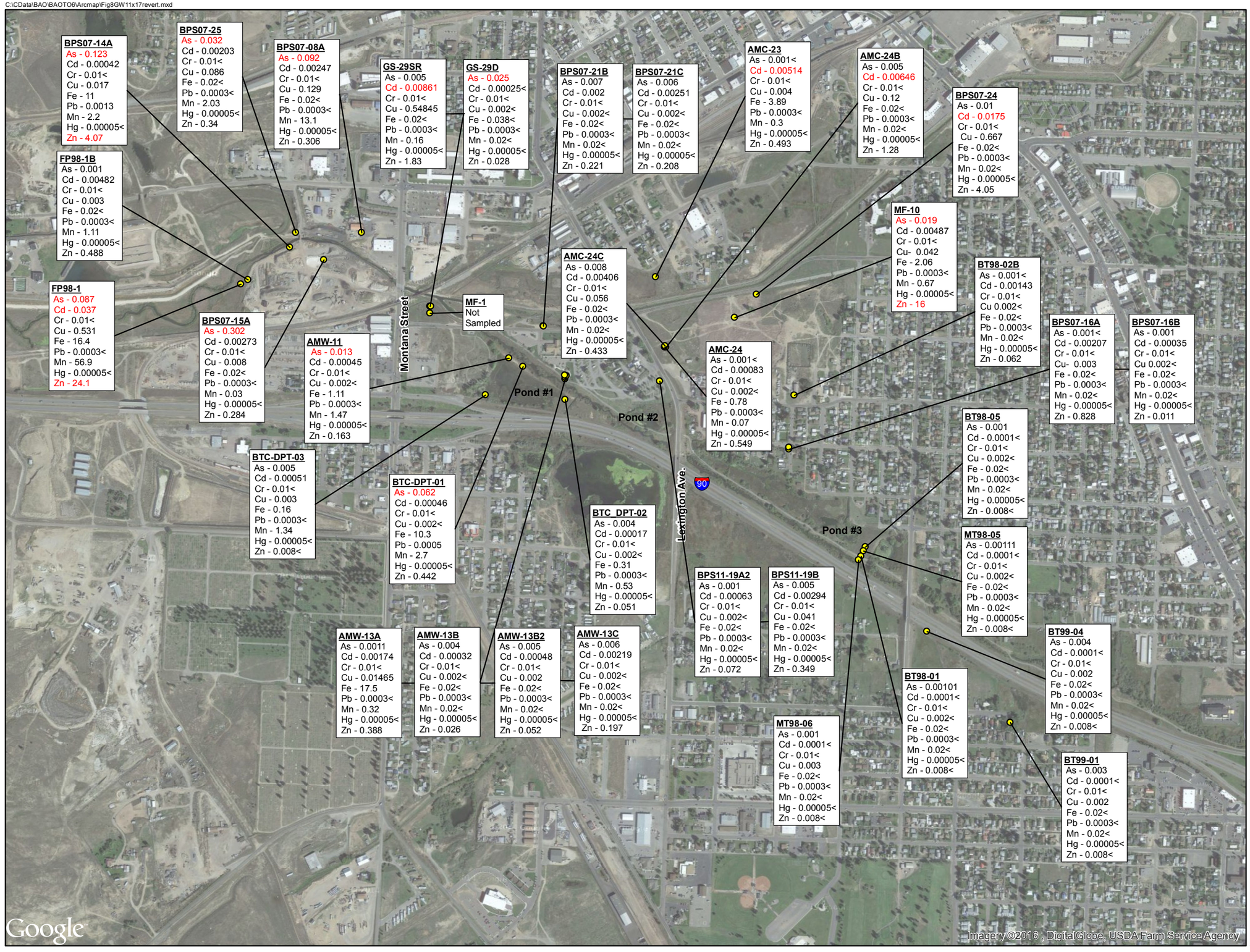
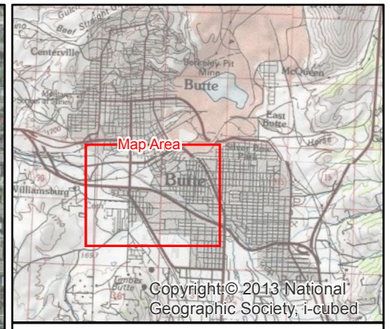




Monitor Well Location
(Units in mg/L, analyzed and reportetd as dissolved metals)

Groundwater Standards	
MT DEQ-7 (mg/L)	
Arsenic	0.01
Cadmium	0.005
Chromium	0.1
Copper	1.3
Iron	*
Lead	0.015
Manganese	*
Mercury	0.002
Zinc	2

** - Not established*

TETRA TECH

N
W E
S

1:10,000

Feet

0 212.5 425 850

7/19/2016

Groundwater Sampling

Silver Bow Creek and Blacktail Creek Corridors

Figure 8

APPENDIX B
FIELD LOGS, FORMS, WELL LOGS

Tetra Tech
303 Irene Street
Helena, MT 59601
Phone: (406) 443-5210

WELL INSTALLATION LOG

Boring BTC-DPT-01

Project: SBC-BTC Data Gap Investigation		**Rig:** GeoProbe 5400	**Location** N: 1197718.70886 ft **Coordinates:** E: 650736.254727 ft	
Project Number: 114-571057		**Boring Diameter:** 1 in	**System:** MT S.P. (E) **Datum:** NAD83	**Ground Surface Elevation:** 5404.4 ft
Date Started: 4/7/16	**Date Finished:** 4/7/16	**Drilling Fluid:** None	**Abandonment Method:** N/A	**Area:** Black Tail Creek Berm Area
Drilled by: WET Enviroprobe Services **Logged by:** R. Reed		**Comments:** Boring converted to Piezometer BTC-PZ-01		

Depth (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	PID	Lithology	Material Description	Well Construction
1–6			50				SAND with clay, Overburden, moist, light brown to gray, medium to coarse grained, subangular, sandy tailings mixture with intermittant silt and clay layers, saturated at 5 ft bgs.	Flush mount completion with manhole cover. 3/8" Bentonite Chips
6–13			47				Clayey SILT with sand, Overburden, very moist to saturated, dark grayish brown, 15-20% very fine-grained sand, intermittant sand and clayey layers.	10/20 Colorado Silica Sand Prepacked 1.4" OD - 3/4" ID Screen
13–14			85				CLAY with silt and sand, Black Clay, moist, black to dark gray, medium plasticity, organic rich, slight smoky odor.	
14–20			40				Silty SAND, Alluvial Sediments, very moist, dark gray, fine to coarse grained, subangular, intermittant sandy silt-silty sand with trace fine-grained gravel. At 16 ft bgs - gray to orange medium-grained sand with trace fine-grained gravel, quartz rich rock fragments.	

Boring Depth: 20.0 ft, *Elevation: 5384.4 ft*

Water Level Observations		
After Drilling:	During Drilling: 10.0 ft After Drilling: 11.8 ft	Remarks: After development, went dry during sampling.

BORING LOG + WELL - MDT_REVISED_2009+.GDT - 6/17/16 15:36 - N:\STAFF\RHIANNA\BAO SBC-BTC\BTC-SBC LOGS.GPJ

Tetra Tech
303 Irene Street
Helena, MT 59601
Phone: (406) 443-5210

WELL INSTALLATION LOG

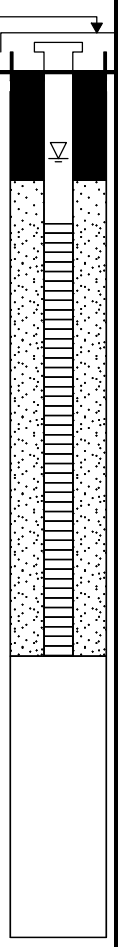
Boring BTC-DPT-02

Project: SBC-BTC Data Gap Investigation		**Rig:** GeoProbe 5400	**Location** N: 1198093.458 ft **Coordinates:** E: 650443.7433 ft	
Project Number: 114-571057		**Boring Diameter:** 1 in	**System:** MT S.P. (E) **Datum:** NAD83	**Ground Surface Elevation:** 5406.8 ft
Date Started: 4/7/16	**Date Finished:** 4/7/16	**Drilling Fluid:** None	**Abandonment Method:** N/A	**Area:** Black Tail Creek Berm Area
Drilled by: WET Enviroprobe Services **Logged by:** R. Reed		**Comments:** Boring converted to Piezometer BTC-PZ-02		

Depth (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	PID	Lithology	Material Description
1							Grass, moist, topsoil.
2							Silty SAND, Overburden, moist to saturated, grayish brown, fine to medium grained, with debris (glass, brick fragments, wood chips) and organic material, sandy silt at 1 ft bgs, saturated at 2 ft bgs.
3			53				At 2 ft bgs (3rd recovery attempt) - fine to medium-grained sand (possible tailings). Some silty material, micaceous.
4							
5							CLAY with sand, Black Clay, soft to medium stiff, moist to very moist, dark gray to black, medium plasticity, lenses of very fine to fine-grained sand, organic material from 4-5 ft bgs.
6							
7							
8			85				
9							
10							
11							
12							SAND with gravel, Alluvial Sediments, saturated, orange to gray, fine to coarse grained, subangular, slight orange coloration from 13 to 13.5 ft bgs, then gray. Orange to orange-brown from 15 to 20 ft bgs.
13			100				
14							
15							
16							
17							
18			100				
19							
20							

Boring Depth: 20.0 ft, *Elevation: 5386.8 ft*

Well Construction



Water Level Observations		
After Drilling:	During Drilling: 2.0 ft	Remarks: At time of development
	After Drilling: 1.0 ft	

Tetra Tech
303 Irene Street
Helena, MT 59601
Phone: (406) 443-5210

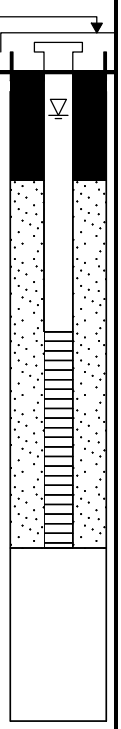
WELL INSTALLATION LOG

Boring BTC-DPT-03

Project: SBC-BTC Data Gap Investigation		**Rig:** GeoProbe 5400	**Location** N: 1197386.49859 ft **Coordinates:** E: 650482.708618 ft	
Project Number: 114-571057		**Boring Diameter:** 1 in	**System:** MT S.P. (E) **Datum:** NAD83	**Ground Surface Elevation:** 5407.0 ft
Date Started: 4/8/16	**Date Finished:** 4/8/16	**Drilling Fluid:** None	**Abandonment Method:** N/A	**Area:** Black Tail Creek Berm Area
Drilled by: WET Enviroprobe Services **Logged by:** R. Reed		**Comments:** Boring converted to Piezometer BTC-PZ-03		

Depth (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	PID	Lithology	Material Description
1			60				Debris, trash, leaves, grass.
2							SAND, Tailings, loose, very moist to saturated, light yellowish gray, fine to coarse grained, subangular, granitic sand. At 1.5 ft bgs - gray tailings. At 2 ft bgs - dark gray tailings.
3							
4							
5							
6			60				SILT with clay and sand, Black Clay, soft, saturated, yellowish brown, low plasticity.
7							
8							Silty SAND, saturated, fine grained, dark orange coloration.
9							SAND, Tailings, loose, saturated, fine to medium grained, subangular to angular, quartz rich granitic sand, 5-10% fine-grained gravel.
10							
11							
12			68				Silty SAND, saturated, fine grained, intermittant silt lenses, 25% coarse-grained sand. No recovery below 15 ft bgs.
13							
14							
15							

Well Construction



Boring Depth: 15.0 ft, *Elevation: 5392.0 ft*

Water Level Observations		Remarks: At time of development
▽ During Drilling: 1.0 ft		
▼ After Drilling:	▼ After Drilling: -1.5 ft	

3/16/16 J. Armstrong

REMEASURE WLS IN WELLS

Well ID	DTW
AMW-13A	11.38'
AMW-13B	10.46'
AMW-13C	9.61'
AMC-24	10.63'
AMC-24B	10.29'
AMC-24C	8.89'
GS-295	6.63'
GS-291	78.08'
BPS-07-16A	7.49'
BPS-07-16B	No access (no tools)
BT98-1	8.82'
MT98-6	3.25'
MT98-5	4.07'
BT98-5	8.85'

4-7-16 DPT BORINGS, PIEZO INSTALL

OBJECTIVE: ADVANCE 3 DIRECT PUSH BORINGS + INSTALL 3 PIEZOS

WEATHER: CLEAR, 38°

PERSONNEL: RHIANNA REED, DON MAY (TE) TY DEBOD (WET/ENVIRO PROBE SVCS)

0800 MEET ONSITE @ CONFLUENCE. WALK LOCATIONS TO CHECK ACCESS.

0815 H&S MEETING

0835 SET UP ON BERM EAST OF AMW-11

BORING ID: BTC-DPT-01

0845 CALIBRATE XRF

0855 START PUSHING. USING 5 FT LENGTH SLEEVES, 1.375" DIAMETER PVC.

0930 GW @ 55' BGS.

1000 TD = 15 FT. SATURATED MATERIAL PLUGGING UP SLEEVES/RODS. SEVERAL ATTEMPTS TO ADVANCE MADE.

1020 CONFIRM WITH BILL - MATERIAL CHANGE - USING PRE-PACKED 3/4" ID. DIAMETER SCREEN, 1.4" O.D.,

1040 TY HEADS TO SHOP TO P/UP PREPACKED SCREENS + FLUSH MOUNT COMPLETIONS.

1100 ONSITE, SETTING UP TO BUILD PIEZO.

1130 15-20' SLEEVE COLLECTED, SETTING WELL @ 15' bgs

YReed 4-7-16

Rite in the Rain

4-7-16 BTC DPT BORINGS/PIEZO INSTALLATION
PULLING YMR 4-7-16

1140 SETTING PIEZO AT 20', 15.5', 10FT SCREEN, CHANGE FROM SAP, B.CRAIG OKAY.

1150 WELLSCREEN BOTTOM: 15.5'. ADDING 10/20 COLORADO SILICA SAND.

1200 TOP OF SAND 4.5', ADDING 3/8" HOLE PLUG BENTONITE CHIPS

1205 PULL RIG FORWARD FOR SAMPLING - COLLECTING MATERIAL FROM ADDITIONAL BORINGS TO FULFILL SAMPLE REQUIREMENTS.

1245 STARTING 3RD BORING FOR SAMPLE RECOVERY.

1300 SAMPLE BTC-WS-01(18-20')

1305 SAMPLE BTC-WS-01(12.5-15')

1310 SAMPLE BTC-WS-01(6-8')

1315 SAMPLE BTC-WS-01 (2.5-4') - 4th BORING TO COLLECT SUFFICIENT SAMPLE.

1330 CLEAN UP SITE, WORK ON WELLCOMPLETION PREPPING IT TO DO CONCRETE TOMORROW

1345 SET UP ON EAST SIDE OF WETLAND, BTC-DPT-02

1355 START PUSH.

1440 TD=20 FT. BUILDING PIEZOMETER W/ 5' SCREEN @ #

JRR 4-7-16

4-7-16 BTC DPT/PIEZO INSTALLATION

1505 UNABLE TO COMPLETE/SET WELL DUE TO HEAVING SANDS. START COLLECTING MATERIAL FROM BORING #2

1535 WELL SET AT BOTTOM DEPTH 13.5'bgs. IN 2ND BORING

1545 START 3RD BORING

1605 SAMPLE BTC-WS-02(11-17.5') DUP COLLECTED @ 1953.

1620 BLACK CLAY SAMPLED, BTC-WS-02(5-11) + SPLP SUITE

1630 VADOSE ZONE FILL/WETLAND MATERIAL SAMPLED, BTC-WS-02(0-2.5').

TY WORKING TO PREP WELL COMPLETION.

1700 OFFSITE

JrReed 4-7-16

Rite in the Rain

4-8-16 Butte BTC DPT/PIEZO INSTALLATION

OBJECTIVE- FINISH 3RD DPT BORING & INSTALL PIEZOMETER, DEVELOP WELLS

PERSONNEL: A. REED, D. MAY, TY DEBOO

WEATHER- COLD, HIGH OF 70°

0730 MEET @ MONTANA AVE EXIT, SCOPE OUT SITE & SET UP. H&S MTG

0800 DRILLING

0820 DRILLED TO 15FT - UNABLE TO ADVANCE DUE TO CRUSHED GRANITE MATERIAL PLUGGING UP RODS. ATTEMPTING TO SET WELL

0845 - NOT ABLE TO SET WELL DUE TO HEAVING SANDS.

0850 BORING #2 - COLLECTING MATL,

0905 ONLY MADE 10 FT ON 2ND BORING ATTEMPT START ATTEMPT #3.

0925 ~~THE SAMPLE COLL~~ YRR 4-8-16 PIEZOMETER SET IN 3RD BORING AT 11 FT. 5 FT SCREEN.

0930 SAMPLE BTC-WS-03(2-5) GT YRR 4-8

0935 SAMPLE BTC-WS-03(5-7.5) BC YT

0940 SAMPLE BTC-WS-03(10.5-15) BC

0945 FINISHING WELL, FLUSH MOUNT COMPLETION + CLEAN UP AREA

0950 FIELD BLANK COLLECTED

YRR 4-8-16

4-8-16 Butte DPT/PIEZO INSTALLATION

1005 WL IN BTC-DPT-03: 1.7 TOC

1020 WELL COMPLETED. MOB RIG TO BTC-DPT-02+01 FOR COMPLETION. DON MAY STAYING AT DPT-03 TO DEVELOP AND SAMPLE.

1025 ONSITE AT BTC-DPT-02 01 YRR 4-8-16

1035 WL: 5.4 ft TOC (TOC IS = ground surface) MOB TO BTC-DPT-02

1115 PIEZOMETER MONUMENT COMPLETED STICK UP: 3.2' WL: 4.38' TOC OR 1.03' BGS.

1135 DEVELOPING WELL WITH 3/4" DISPOSABLE BAILER.

1150 PUMPING WELL WITH PERISTALTIC PUMP.

1230 SAMPLE BTC-DPT-02 + 040816-DUP TY BAILING BTC-DPT-01

1245 PUMPING BTC-DPT-01. TD=15.49'

1255 WL 11.8', GOING DRY

TY DEBOO OFFSITE

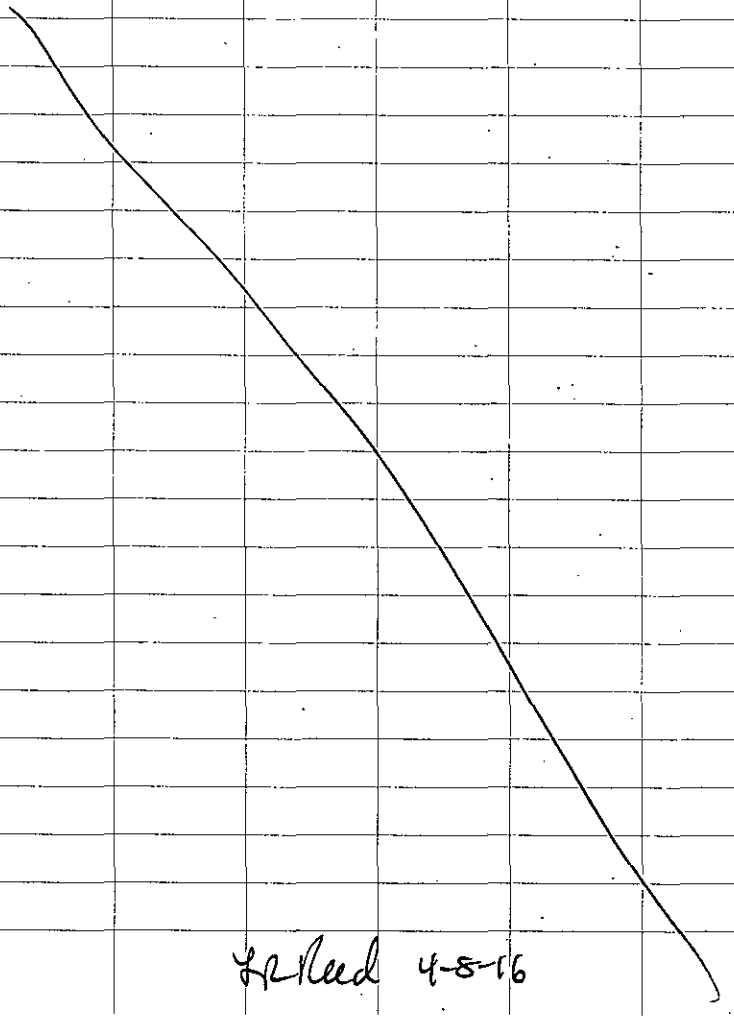
1300 DON MAY OFFSITE

1315 WELL DRY. LETTING RECHARGE BEFORE SAMPLING

1.7 BGS

YRR 4-8-16

4-8-16 BUTTE DPT/PIEZO INSTALLATION
1325 WL: 5.65' TOC
1330 WL: 5.5' TOC
1335 SAMPLE BTC-DPT-01, CLEAN UP SITE
1400 OFFSITE TO HELENA



LR Reed 4-8-16

4-12-16 TEST PITTING BTC
OBJECTIVE - EXCAVATE TEST PITS + SAMPLE MATERIAL
WEATHER - SUNNY, PARTIAL CLOUDS
PERSONNEL - RHIANNA REED, CONNOR McHUGH PAT HUNTER, HUNTER BROS
0800 MEET PAT HUNTER ONSITE @ CHAMBER OF COMMERCE. EVALUATE UTILITY MARKINGS, DISCUSS ACCESS OF EXCAVATOR.
~~SET UP~~ DAR LLR 4-12-16
0845 SYSTEM CHECK ON XRF
SETTING UP ON BTC-TP-01
0850 DIGGING BTC-TP-01
0900 SAMPLE BTC-TP-01 (3-4) FILL
0930 SAMPLE BTC-TP-01 (6.75-8.5) PT
0955 SAMPLE BTC-TP-01 (8.5-9.5) BT
1015 BILL CRAIG (TT) ONSITE
1100 ~~DIGG~~ DAR MOB TO BTC-TP-02
1120 SCRAPE SURFACE OF GROUND AT CREEK LEVEL - YELLOW-ORANGE MATERIAL PRESENT. DIGGING BACK UP SLOPE
1200 SAMPLE BTC-TP-02 (1.5-2) ~~FILL~~ PT DAR 4-12-16
1205 SAMPLE BTC-TP-02 (2-3) BT

LR Reed 4-12-16

4-12-16 BTC TESTPITTING.

1210 SAMPLE BTC-TP-02(3-4)-AL

1220 SAMPLE BTC-TP-02(0-1)-FILL

1230 BACKFILLING

1340 DIGGING BTC-TP-04 ADJACENT

1300 SAMPLE BTC-TP-04(3-3.5)-BC

1315 SAMPLE BTC-TP-04(1-2)-FILL

1320 SAMPLE BTC-TP-04(2.5-3)-YT

1330 BACKFILLING

1350 DIGGING BTC-TP-05

1420 SAMPLE BTC-TP-05(3-4)-BC

1445 BACKFILLING TP-05

1500 DIGGING BTC-TP-09

~~1505 SAMPLE BTC-TP-09(3-3.5)-BC~~ SRA 4-12-16

T R CRAIG OFFSITE

1510 SAMPLE BTC-TP-09(4-4.5)BC

1520 SAMPLE BTC-TP-09(3-3.5) YT

1540 SAMPLE BTC-TP-09(2-2.5)-Clay

DID NOT SAMPLE FILL

1557 TAKE 041216-FB

1600 TAKE 041216-RB OFF TROWEL

1605 DIGGING BTC-TP-13

1628 SAMPLE BTC-TP-13(0-1)-fill

1630 SAMPLE BTC-TP-13(2.5-3)-YT

1635 SAMPLE BTC-TP-13(3-3.5)-BC

RR Reed 4-12-16

4-12-16 BTC TEST PITTING

1640 SAMPLE BTC-TP-14(4-4.5)-AL

1650 BACKFILL.

1700 DIGGING TP-14

1720 SAMPLE BTC-TP-14(1-2)-FILL*

1725 SAMPLE BTC-TP-14(2-3)-BC

~~1734~~ COLLECTED 041216-DUP ON FILL SNTGLNAL, @ "2005"

1740 BACKFILLING TP-13/14 SRA 4-12-16

1800 DIGGING TP-15

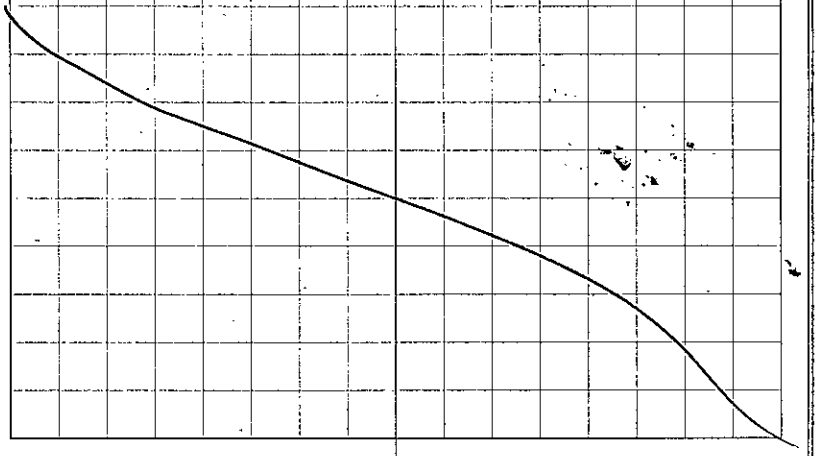
1820 SAMPLE BTC-TP-15(1-2)-FB

1825 SAMPLE BTC-TP-15(2-3)-BC

1830 SAMPLE BTC-TP-15(3-3.5)-AL

1840 BACKFILLING TP-15

1905 OFFSITE.



SRA 4-12-16

4-13-16 Butte BTC Test Pitting

OBJECTIVE- CONTINUE TEST PITTING ON S SIDE OF BLACKTAIL CREEK

WEATHER - SNOW, INTERMITTANT WINTRY MIX

PERSONNEL - R REED, C. McHUGH, P. HUNTER

0730 MEET ONSITE @ PARKING AREA SNOWING HEAVILY. H+S MEETING - TOPIC - WORKING IN WET CONDITIONS

0800 MOB OUT ONTO BERM AFTER SNOW FALL DIMINISHES

0815 DIGGING BTC-TP-03

0830 SAMPLE BTC-TP-03 (3-3.5) - AL

0831 SAMPLE BTC-TP-03 (1.5-2) - ~~AL~~ NC?

0832 SAMPLE BTC-TP-03 (1-1.5) - YT

0835 SAMPLE BTC-TP-03 (0-1) - OB

0850 BACKFILL

0915 GRAB 3' SAMPLE AT BTC-SBS-02

0920 SAMPLE BTC-SBS-02S (3')

0925 BACKFILL SBS-02

0935 DIGGING BTC-TP-06

0942 SAMPLE BTC-TP-06 (2-2.5) AL

0945 SAMPLE BTC-TP-06 (1.7-2) - BC

0947 SAMPLE BTC-TP-06 (1-1.8 - YT

0950 SAMPLE BTC-TP-06 (0-1) - OB

1025 BACKFILL BTC-TP-06

YRR 4-13-16

4-13-16 BUTTE BTC TEST PITTING

1035 DIGGING BTC-TP-08

1050 SAMPLE BTC-TP-08 (3-5) AL

1052 SAMPLE BTC-TP-08 (2-2.5) BC

1055 SAMPLE BTC-TP-08 (1-2) OB

1130 BACKFILLING TP-08, SCOPE OUT DITCH FOR ACCESS TO EAST BERM

1135 DIGGING BTC-TP-07

1140 SAMPLE BTC-TP-07 (1-2) OB

1150 SAMPLE BTC-TP-07 (... see note at end)

1215 PAT HUNTER MOB GRABBING PIPE AT PARKING AREA FOR DITCH CROSSING

1245 CROSSING DITCH... SET UP ON TP-10

1300 DIGGING BTC-TP-10

1320 SAMPLE BTC-TP-10 (1-2) - OB

1322 SAMPLE BTC-TP-10 (3-4) - OB (EXTRA)

1337 SAMPLE BTC-TP-10 (4-5) - AL

1350 BACK FILL + MOB TO TP-11

1400 SAMPLE BTC-TP-11 (1-2) - OB - ORANGE SAND

1405 SAMPLE BTC-TP-11 (2-3) - OB

1415 CONTINUE DIGGING TO BELOW ORANGE SAND

1442 SAMPLE BTC-TP-11 (0-1) - OB Black clay/debris

~~1500 BACKFILL BTC TP-11. CALL B. CRAIG,~~ YRR 4-13-16

DIRECTED TO TRENCH AROUND TP-11 TO DELINEATE

YR Reed 4-13-16

4-13-16 BUTTE BTC TEST PITTING

1520 START DIGGING SHALLOW TRENCH AT SOUTH END OF BARE GROUND SURROUNDING/NEAR TP-11.

~~1525~~ 1ST TRENCH 15 FT FROM MDT FENCE ALONG I-90. TAILINGS OR ORANGE SAND LAYER PRESENT

1525 2ND TRENCH 10 FT FROM FENCE ORANGE SAND PRESENT, LESS.

1530 BACKFILLING TRENCHES. LGNTH E-W OF ~~TAB~~ 4-13 ORANGE SAND ≈ 27 FT (BY PACE)

1600 TRENCHING ~~OF~~ AREA ON CREEK SIDE ORANGE SAND PRESENT

1615 TRENCH CLOSER TO CREEK ≈ 20 FT NO COLOR. ADVANCING OPPORTUNITY SAMPLE TO GW.

1630 SAMPLE ~~BTC-TP-13~~ 16 (1-2)-OB

~~1635~~ SAMPLE BTC-TP-~~13~~ 16 (6-7)-OB

TEST PIT IS ALL FILL SAND, CONCRETE, BRICK TO GW AT 6 FT, TD = 7 FT BLACK SAND AT 6 FT, CLAYEY. NATIVE?

1645 BACKFILLING + MARKING POINTS

MOB 1710 MOB TO BERM BETWEEN

LRR 4-13-16

4-13-16 BUTTE BTC TEST PITTING

TP-06 + TP-08 FOR BERM TRENCH

1725 SAMPLE BTC-TP-14(1-2)-OB

1727 SAMPLE BTC-TP-14(2.5-3.5)-GC

1730 SAMPLE BTC-TP-14(3.5-4.5)-BC

~~1800~~ FINISH TRENCHING FROM HIGH POINT OF BERM TO CATTAILS, NORTH ≈ 25 FT FROM STREAMSIDE.

ORANGE SANDY "TAILS" LAYER (MANGA) PINCHES OUT TOWARD CREEK.

TOPSOIL THICKEST AT CENTER OF BERM + PINCHES OUT AT FLOODPLAIN

TRENCH LENGTH ≈ 35 FT

1810 SAMPLE BTC-TP-14(0.5-1)-YT

1820 BACKFILL TRENCH + TP-14 LOCATION

1845 MARK POINTS, EXCAVATOR DEMOB OUT OF BERM AREA

1915 R.REED, C.MCHUGH OFFSITE. NOTES:

* EXTRA SAMPLES AT BTC-TP-07:

- BTC-TP-07(4.5-5)-AL @ 1150 + DUPLICATE, SPLP
- BTC-TP-07(4-4.5)-AL @ 1152
- BTC-TP-07(5-5.5)-AL @ 1200

SAMPLE @ 1413 - BTC-TP-11(6.5-7)-BC

→ TEST PIT TP-12 DUG AT 1430

-BTC-TP-12(1.3-2)-AL SAMPLED @ 1438

4-13-16

Rite in the Rain

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Butte Area One Sample Date 3-7-16 Time: 1715 Well ID: AMW-13A

Personnel: PM BQ Weather: Sunny & warm

Casing Diameter/Type: 4" ~~X~~" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 16.73 Depth to Water 11.30 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [X] Submersible Pump, [ ] Low Flow peri pump

.653 0.163 gal./ft * = one casing volume 7.88 3.52 gals. x 3 = purge volume ~~2.6028~~ gals. 10.6

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 1530 PURGE RATE: ≈ 1L/min SET PUMP: _____

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
1540	6.07	46.4	7.49	118.4	186		
1550	6.66	42.7	7.32	129.0	192		
1600	6.65	33.8	7.30	110.1	242		
1610	6.11	24.6	7.49	95.3	350		
1620	6.20	4.6	7.56	68.5	~~5E3~~ 513		
1630	6.79	3.3	9.01	-18.4	2067		
1640	6.73	3.2	8.38	1.5	1043		
1650	6.51	3.5	7.94	9.7	878		
1700	6.57	3.4	7.98	0.2	957		
1715	6.63	3.0	8.01	-7.6	1004		

TOTAL GALLONS: 10.6

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [ ] Submersible Pump, [ ] Low Flow, [X] Other: Peri Pump Sample Type: [X] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [ ] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	11M100991	3-7-16
SC	_____	_____
ORP	_____	_____
DO	_____	_____

Decontamination

Potable Water: Yes [X] No [ ] Nitric Acid: Yes [X] No [ ]

Liquinox: Yes [X] No [ ] DI Water: Yes [X] No [ ]

Methanol: Yes [ ] No [X] Steam: Yes [ ] No [X]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Butte Sample Date 3-8-16 Time: 0825 Well ID: AMW-13B

Personnel: DM, BQ Weather: Cloudy cold

Casing Diameter/Type: 2" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 37.8 Depth to Water 10.43 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [✓] Submersible Pump, [ ] Low Flow

.163 gal./ft * = one casing volume 4.4 gals. x 3 = purge volume 13.38 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 0800 PURGE RATE: .5gpm SET PUMP: 30

EVACUATION DATA

Time	pH	DO %	Temp	ORP	SC	TURBIDITY	DTW
0807	6.91	130.0	9.60	37.6	317		
0814	7.08	34.3	9.72	30.6	316		
0818	7.11	25.7	9.73	26.4	317		
0821	7.14	58.4	9.49	25.6	315		

TOTAL GALLONS: 13

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [✓] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	see COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]				
[ ]				

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	11M 100991	3-8-16
SC		
ORP		
DO		

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Butte Area 1 Sample Date 3-8-16 Time: 0910 Well ID: AMW-13B2

Personnel: DM, BQ Weather: Cloudy cold 30°

Casing Diameter/Type: 2" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 40 Depth to Water 11.55 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [ ] Submersible Pump, [ ] Low Flow

.163 gal./ft * = one casing volume 4.6 gals. x 3 = purge volume 13.9 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 0850 PURGE RATE: ½ gpm SET PUMP: 34

EVACUATION DATA

Time	pH	DO mg/L	Temp	ORP	SC	TURBIDITY	DTW
0857	7.07	5.70	9.70	57.1	316		
0902	7.05	3.32	9.72	41.7	328		
0907	7.04	5.64	9.59	33.9	329		
0910	7.04	2.75	9.72	37.0	329		

TOTAL GALLONS: 15

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [✓] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	see coc			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	11M100991	3-8-16
SC	_____	_____
ORP	_____	_____
DO	_____	_____

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: _____

TETRA TECH

GROUNDWATER S .G LOG

Project: Battle Area 7 Sample Date 3-8-16 Time: 1000 Well ID: AMW-13C

Personnel: D M B Q Weather: Clear, cold

Casing Diameter/Type: 2" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 84' Depth to Water 9.63 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [ ] Submersible Pump, [ ] Low Flow

.163 gal./ft * = one casing volume 12.1 gals. x 3 = purge volume 36.4 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 0935 PURGE RATE: 1 SET PUMP: 45

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
940	6.56	1.92	9.72	49.0	773		
950	6.57	1.27	9.94	28.6	768		
1000	6.58	1.19	9.94	26.8	769		

TOTAL GALLONS: 25

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [ ] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	see COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [ ] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	11M100991	3-8-16
SC	_____	_____
ORP	_____	_____
DO	_____	_____

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Butte Apx 7 Sample Date 3-8-16 Time: 1220 Well ID: MF-10

Personnel: DM BQ Weather: Snowing

Casing Diameter/Type: 4" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 14 Depth to Water 9.23 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [✓] Submersible Pump, [ ] Low Flow

.653 gal./ft * = one casing volume 3 gals. x 3 = purge volume 9.3 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 1101 PURGE RATE: ~5 gpm SET PUMP: 12'

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
1104	5.85	4.30	6.63	100.3	745		
1108	6.19	1.43	7.77	61.1	718		
1112	6.31	9.3	8.16	45.5	686		
1120	6.41		8.07	36.3			
1200	6.40	1.42	8.76	34.5	655		
1218	6.39	1.41	8.74	34.0	650		
1220	6.37	1.40	8.71	33.2	648		

TOTAL GALLONS: 4.5

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [✓] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	See COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	11M100991	3-8-16
SC	_____	_____
ORP	_____	_____
DO	_____	_____

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Butte Area 1 Sample Date 3-8-16 Time: 1420 Well ID: AMC-24C

Personnel: DM BQ Weather: Snow

Casing Diameter/Type: 2" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 20 Depth to Water 8.91 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [✓] Submersible Pump, [ ] Low Flow

.163 gal./ft * = one casing volume 9.9 gals. x 3 = purge volume 29.8 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 1348 PURGE RATE: 1 gpm SET PUMP: 25

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
1351	6.41	0.32	9.42	85.7	1147		
1356	6.30	0.31	9.57	83.1	1164		
1401	6.31	0.31	9.00	80.3	1164		
1406	6.35	0.33	9.60	77.6	1160		
1411	6.35	0.30	9.00	76.3	1165		
1416	6.33	0.30	9.62	76.0	1167		
1421	6.33	0.30	9.62	76.0	1166		

TOTAL GALLONS: 30

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [✓] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	See COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]				
[ ]				

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	11M100991	3-8-16
SC		
ORP		
DO		

Decontamination

Potable Water: Yes [ ] [✓] No [ ] Nitric Acid: Yes [ ] [✓] No [ ]

Liquinox: Yes [ ] [✓] No [ ] DI Water: Yes [ ] [✓] No [ ]

Methanol: Yes [ ] No [ ] [✓] Steam: Yes [ ] No [✓]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Butte Area 1 Sample Date 3-8-16 Time: _____ Well ID: BPS07-24

Personnel: DM BQ Weather: Snowing

Casing Diameter/Type: ~~PVC~~ 2" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 20 Depth to Water 7.81 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [ ] Submersible Pump, [ ] Low Flow

.163 gal./ft * = one casing volume 10 gals. x 3 = purge volume 30 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 1251 PURGE RATE: 1½ gpm SET PUMP: 25

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
1255	6.45	1.00	8.94	91.3	2311		
1300	6.14	0.32	9.38	93.7	2328		
1305	6.11	0.30	9.42	92.8	2331		
1310	6.12	0.29	9.42	92.2	2330		
1315	6.12	0.29	9.42	91.0	2332		

TOTAL GALLONS: 30

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [ ] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	per COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Eaton Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	LLM 105991	3-8-16
SC	_____	_____
ORP	_____	_____
DO	_____	_____

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Bottle Area 1 Sample Date 3-8-16 Time: 1525 Well ID: AMC-24B

Personnel: DM BQ Weather: snow showers

Casing Diameter/Type: 2" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 50 Depth to Water 10.31 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [~~x~~] Submersible Pump, [ ] Low Flow Peri pump

.163 gal./ft * = one casing volume 6.5 gals. x 3 = purge volume 19 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 1440 PURGE RATE: _____ SET PUMP: _____

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
1452	7.10	0.34	9.91	-228.8	1224		
1457	6.87	0.32	9.13	-168.2	1287		
1502 ~~1502~~	6.84	0.32	8.99	-132.5	1328		
1515	6.45	0.31	8.90	-20.1	1345		
1525	6.43	0.31	8.98	-20.2	1330		

TOTAL GALLONS: 10

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [ ] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	see COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	11M100991	3-8-16
SC	2	
ORP		
DO		

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Bitter Creek 1 Sample Date 3-8-16 Time: 1625 Well ID: AMC-24

Personnel: DM BQ Weather: Snow showers

Casing Diameter/Type: 6" steel Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 28' Depth to Water 10.65' ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [✓] Submersible Pump, [ ] Low Flow

1.469 gal./ft * = one casing volume 25 gals. x 3 = purge volume 76 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 1545 PURGE RATE: 300 ml/min SET PUMP: _____

2.5 ml/5gal
5 ml/10gal
2.5 ml/casing
25gal

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
1551	7.75	1.08	8.82	-133.6	471		
1555	7.44	0.36	8.79	-88.6	496		
1607	6.66	3.30	9.75	-2.2	505		
~~1619~~	~~7.24~~	~~10.03~~	~~3.30~~	~~4.75~~	-		
~~1631~~							
1619	6.57	2.10	9.85	9.8	513		
1631	6.45	2.15	9.90	15.3	515		

TOTAL GALLONS: _____

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [✓] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	see COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [✓] ~~Yes~~, [ ] No

Meter	Serial No.	Calibration Date
pH	1IM100991	3-8-16
SC		
ORP		
DO		

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Battle Area 1 Sample Date 3-9-16 Time: 0905 Well ID: FP98-1B

Personnel: DM BQ Weather: Partly cloudy + cool

Casing Diameter/Type: 2" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 47 Depth to Water 24.07 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [✓] Submersible Pump, [ ] Low Flow

.163 gal./ft * = one casing volume 3.7 gals. x 3 = purge volume 11.2 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 0847 PURGE RATE: 1 gal/min SET PUMP: 23

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
0851	6.53	3.48	10.29	80.1	1067		
0855	6.64	3.59	10.35	73.1	1067		
0858	6.65	2.24	10.40	67.1	1072		
0902	6.66	2.12	10.46	59.8	1075		

TOTAL GALLONS: 13

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [✓] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	see COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	1IM100991	3-9-16
SC	_____	_____
ORP	_____	_____
DO	_____	_____

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Butte Area 1 Sample Date 3-9-16 Time: 0945 Well ID: FP98-1

Personnel: DM BQ Weather: partly cloudy cool

Casing Diameter/Type: 2" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 7.3 Depth to Water 6.26 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [✓] Disp. Polyethylene Bailer, [ ] SST Bailer, [ ] Submersible Pump, [ ] Low Flow

.163 gal./ft * = one casing volume .163 gals. x 3 = purge volume _____ gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 0925 PURGE RATE: _____ SET PUMP: _____

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
0935	6.16	0.69	3.41	132.9	4090		
0937	6.04	0.60	3.38	142.6	4125		
0942	6.03	0.57	3.41	142.1	4119		
0945	6.03	0.57	3.43	142.3	4131		

TOTAL GALLONS: _____

WELL SAMPLING

Sampling Method: [✓] Disposable Poly Bailer, [ ] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	11M100991	3-9-16
SC	_____	_____
ORP	_____	_____
DO	_____	_____

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Butte Area 1 Sample Date 3-9-16 Time: 1032 Well ID: BPSOT-14A

Personnel: DM, BQ Weather: cloudy cool

Casing Diameter/Type: 2" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 36 Depth to Water 20.85 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [✓] Submersible Pump, [ ] Low Flow

.163 gal./ft * = one casing volume * 8 gals. x 3 = purge volume 2.5 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 1025 PURGE RATE: .8 gal/min SET PUMP: 24

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
1028	6.77	2.32	8.92	-14.4	1227		
1030	6.79	0.42	9.03	-34.5	1221		
1032	6.81	21.13	9.11	-41.1	1217		
1034							

TOTAL GALLONS: 6

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [✓] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	See COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	1/M100991	3-9-16
SC	_____	_____
ORP	_____	_____
DO	_____	_____

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [ ] No [✓]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Butte Area 1 Sample Date 3-9-16 Time: _____ Well ID: BPSOI-15A

Personnel: DM BQ Weather: Cloudy & cool

Casing Diameter/Type: 2" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 35 Depth to Water 19.61 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [✓] Submersible Pump, [ ] Low Flow

.163 gal./ft * = one casing volume 2.5 gals. x 3 = purge volume 2.5 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 1100 PURGE RATE: 1.5 min/gal SET PUMP: 25

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
1104	6.80	0.37	9.77	41.0	2153		
1106	6.72	0.33	9.94	47.1	2145		
1109	6.67	0.32	9.98	52.6	2140		
1112	6.64	SEE	COMMENTS				
1115	6.63	2.97	10.02	103.7	2139		

TOTAL GALLONS: 8

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [ ] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	see COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	11M100991	3-9-16
SC	_____	_____
ORP	_____	_____
DO	_____	_____

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: HANDHELD YSI HANDHELD UNIT WHILE MEASURING (CAUSES PUMP TO FLUX. PERHAPS LOOSE CONNECTION IN UNIT may need insp. D.O.

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Butte Area 1 Sample Date 3-9-16 Time: _____ Well ID: BPS07-8A

Personnel: DM, BQ Weather: cloudy & cool

Casing Diameter/Type: 2" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 17 Depth to Water 10.13 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [✓] Submersible Pump, [ ] Low Flow

.163 gal./ft * = one casing volume 1.1 gals. x 3 = purge volume 3.3 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 1148 PURGE RATE: 1/2 gpm / gpd SET PUMP: 15

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
1150	6.59	0.29	9.53	117.0	2789		
1152	6.56	0.28	9.78	119.7	2746		
1154	6.59	0.27	9.98	116.9	2693		

TOTAL GALLONS: 5

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [ ] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [✓] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	see COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	11M100991	3-9-16
SC	_____	_____
ORP	_____	_____
DO	_____	_____

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: Duplicate 030916-DUP collected here

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Battle River 1 Sample Date: 3-9-16 Time: _____ Well ID: BPS07-25

Personnel: DM DB Weather: cloudy + cool

Casing Diameter/Type: 2" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 91 Depth to Water: ~~12.51~~ DTW 10.77 ft water

Screen: _____ Depth to Product: _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [✓] Submersible Pump, [ ] Low Flow

.163 gal./ft * = one casing volume 13 gals. x 3 = purge volume 39 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 1240 PURGE RATE: 1 gpm SET PUMP: 75

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
1245	7.17	22.69	9.94	98.3	1238		
~~1250~~							
1314							
~~1324~~							
1256	6.95	1.06	9.95	95.9	1238		
1300	6.94	0.89	9.93	95.0	1239		
1306	6.93	0.76	9.93	94.0	1237		
1312	6.92	0.70	9.92	93.2	1238		
1324	6.91	0.63	9.92	91.2	1237		

TOTAL GALLONS: 43

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [✓] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	See COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	1IM100991	3-9-16
SC	_____	_____
ORP	_____	_____
DO	_____	_____

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Butte area 1 Sample Date 3-9-16 Time: 1530 Well ID: GS-290

Personnel: DMay BQ Weather: partly cloudy + cool

Casing Diameter/Type: 4" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 190 Depth to Water 5.80 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [✓] Submersible Pump, [ ] Low Flow

.653 gal./ft * = one casing volume 120 gals. x 3 = purge volume 360 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 1420 PURGE RATE: ~~5 5gpm~~ 4 SET PUMP: ~~25~~ 100

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
1508	7.74	3.21	9.44	14.9	1490		
1510	7.72	2.66	9.41	16.9	1490		
1515	7.66	2.32	9.59	23.7	1490		
1520	7.54	2.20	9.81	24.5	1490		
1525	7.52	2.09	10.48	24.3	1490		
1530	7.57	2.10	10.58	23.5	1490		

TOTAL GALLONS: 4.5

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [✓] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	1/M 100991	3-9-16
SC		
ORP		
DO		

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: well dewy down to 22 in 8 min reset @100

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Buttle Area 1 Sample Date 3-9-16 Time: 1622 Well ID: GS-295

Personnel: DM BQ Weather: partly cloudy cool

Casing Diameter/Type: 4" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 13 Depth to Water 6.65 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [✓] Submersible Pump, [ ] Low Flow

6 gal./ft * = one casing volume 4 gals. x 3 = purge volume 12 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 1606 PURGE RATE: 1 gpm SET PUMP: 11

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
1608	5.90	0.77	5.50	146.0	288		
1610	5.99	0.58	5.77	148.5	285		
1612	5.99	0.48	7.26	148.6	407		
1616	6.29	0.44	7.59	135.6	431		
1620	6.32	0.41	7.82	131.8	435		

TOTAL GALLONS: 13

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [✓] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	see COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	1CM100991	3-9-16
SC		
ORP		
DO		

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Butte Area 1 Sample Date 3-10-16 Time: 0810 Well ID: MT98-6

Personnel: DM BQ Weather: clear & cool

Casing Diameter/Type: ~~3~~ 2" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 13 Depth to Water 3.39 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [✓] Submersible Pump, [ ] Low Flow

0.163 gal./ft * = one casing volume 1.63 gals. x 3 = purge volume 4.89 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 0800 PURGE RATE: 1 gal/min SET PUMP: 10'

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
803	6.43	95.0	8.58	140.8	244		
805	6.77	4.46	8.04	124.1	238		
807	6.81	3.14	8.64	121.6	239		
810	6.83	2.30	8.61	116.2	240		

TOTAL GALLONS: 6

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [✓] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	see COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]				
[ ]				

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	IM100991	3-10-16
SC		
ORP		
DO		

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Butte Area 1 Sample Date 3-10-16 Time: 0836 Well ID: MT98-05

Personnel: DM BP Weather: cloudy & cool

Casing Diameter/Type: 2" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 13 Depth to Water 4.18 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [✓] Submersible Pump, [ ] Low Flow

.163 gal./ft * = one casing volume 1.4 gals. x 3 = purge volume 4.3 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 0830 PURGE RATE: 1gal/min SET PUMP: 10

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
0830	6.85	10.16	7.08	110.5	396		
832	6.79	4.63	7.53	102.4	397		
834	6.76	4.05	7.607	98.4	400		
836	6.75	3.99	7.71	96.8	401		

TOTAL GALLONS: 6

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [✓] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	see COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	11M100991	3-10-16
SC		
ORP		
DO		

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Butte Area 1 Sample Date 3-10-16 Time: 0915 Well ID: BT98-01

Personnel: DM BQ Weather: Partly cloudy cool

Casing Diameter/Type: 4" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 25 Depth to Water 8.90 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [x] Submersible Pump, [ ] Low Flow

.653 gal./ft * = one casing volume 10.5 gals. x 3 = purge volume 34 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 0856 PURGE RATE: 2 gal/min SET PUMP: 20

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
858	6.91	3.60	8.56	93.1	238		
900	6.93	3.17	9.49	80.5	229		
902	6.93	2.79	9.80	80.3	229		
~~906~~	6						
906	6.92	2.86	10.01	78.3	230		
910	6.92	2.96	10.09	75.8	233		
0915	6.92	2.98	10.14	71.9	236		

TOTAL GALLONS: 35

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [x] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [x] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	See COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [x] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other Lancaster Energy Chain-of-Custody: [x] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	1LM160991	3-10-16
SC	_____	_____
ORP	_____	_____
DO	_____	_____

Decontamination

Potable Water: Yes [x] No [ ] Nitric Acid: Yes [x] No [ ]

Liquinox: Yes [x] No [ ] DI Water: Yes [x] No [ ]

Methanol: Yes [ ] No [x] Steam: Yes [ ] No [x]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Butler Assn 1 Sample Date 3-10-16 Time: 0942 Well ID: BT98-5

Personnel: DM BQ Weather: clearing + cool

Casing Diameter/Type: 4" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 25 Depth to Water 8.90 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [X] Submersible Pump, [ ] Low Flow

~~2~~ 6.53 gal./ft * = one casing volume 10.5 gals. x 3 = purge volume 31.5 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 0930 PURGE RATE: 4.5 gpm SET PUMP: 15

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
933	6.91	3.83	10.15	76.2	266		
935	6.87	4.12	10.23	73.7	297		
940	6.84	4.44	10.27	71.0	322		

TOTAL GALLONS: 50

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [X] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [X] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	see COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]				
[ ]				

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [X] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	11M10094	3-10-16
SC		
ORP		
DO		

Decontamination

Potable Water: Yes [X] No [ ] Nitric Acid: Yes [X] No [ ]

Liquinox: Yes [X] No [ ] DI Water: Yes [X] No [ ]

Methanol: Yes [ ] No [X] Steam: Yes [ ] No [X]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Pittsburg 1 Sample Date: 3-10-16 Time: 1030 Well ID: BT99-4

Personnel: DM BQ Weather: partly cloudy windy cool

Casing Diameter/Type: 4" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 15 Depth to Water 11.32 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [✓] Submersible Pump, [ ] Low Flow

.653 gal./ft * = one casing volume 2.4 gals. x 3 = purge volume 7.2 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 1020 PURGE RATE: 1 gpm SET PUMP: 13

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
1023	6.99	8.94	6.63	61.8	583		
1025	7.04	7.64	6.78	60.2	581		
1027	7.61	6.85	7.30	59.3	578		
1029	7.21	6.77	7.28	55.9	577		

TOTAL GALLONS: 7

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [✓] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	see CoC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL; [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	11M180991	3-10-16
SC		
ORP		
DO		

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: This well replaces BT98-4

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Butte Area 7 Sample Date 3-10-16 Time: 1119 Well ID: BT99-1

Personnel: DM BQ Weather: cloudy & cool

Casing Diameter/Type: 4" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 12.51' Depth to Water 5.54 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [✓] Submersible Pump, [ ] Low Flow

.653 gal./ft * = one casing volume 4.15 gals. x 3 = purge volume 13.7 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 1106 PURGE RATE: 1gpm SET PUMP: 11

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
1107	7.55	30.46	6.87	69.2	507		
1110	6.96	4.21	7.41	74.6	511		
1112	6.85	3.41	7.45	70.9	513		
1117	6.84	2.99	7.47	63.5	513		

TOTAL GALLONS: 15

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [✓] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	see COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Encore Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	11M10099	3-10-16
SC	_____	_____
ORP	_____	_____
DO	_____	_____

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Butte Area 1 Sample Date 3-10-16 Time: 1209 Well ID: BT98-02B

Personnel: PM, BQ Weather: cloudy windy cool

Casing Diameter/Type: 2" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 39 Depth to Water 9.80 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [✓] Submersible Pump, [ ] Low Flow

.163 gal./ft * = one casing volume 4.7 gals. x 3 = purge volume 14.2 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 1150 PURGE RATE: 1gpm SET PUMP: 20

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
1154	8.166	1.161	10.44	28.1	598		
1157	7.14	0.52	10.47	75.9	662		
1202	6.54	0.38	10.48	79.3	669		
1204	6.44	0.39	10.48	79.2	669		

TOTAL GALLONS: 16

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [✓] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	See COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [✓] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]				
[ ]				

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	11M100991	3-10-16
SC		
ORP		
DO		

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Butte Area 1 Sample Date 3-10-16 Time: 1250 Well ID: BPSD7-16B

Personnel: DM BO Weather: cloudy cool

Casing Diameter/Type: 2" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 40 Depth to Water 7.41 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [✓] Submersible Pump, [ ] Low Flow

0.163 gal./ft * = one casing volume 5.3 gals. x 3 = purge volume 15.9 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 1233 PURGE RATE: 1gpm SET PUMP: 18

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
1236	6.90	105.04	10.10	54.4	279		
1240	6.98	5.88	10.40	46.5	279		
1245	7.01	5.41	10.39	45.4	279		
1250	7.02	5.41	10.39	45.3	279		

TOTAL GALLONS: 16

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [✓] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	See COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	11M100991	3-10-16
SC		
ORP		
DO		

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Bottle Area 1 Sample Date 3-10-16 Time: 1316 Well ID: BR507-16A

Personnel: DM BQ Weather: cloudy windy cool

Casing Diameter/Type: 2" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 20 Depth to Water 7.52 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [ ] Submersible Pump, [ ] Low Flow

0.163 gal./ft * = one casing volume 2 gals. x 3 = purge volume 6 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 1309 PURGE RATE: 1 SET PUMP: 10

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
1311	6.32	2.06	0.104	91.5	462		
1313	6.17	3.31	0.101	96.7	463		
1315	6.12	1.88	0.102	96.2	462		

TOTAL GALLONS: 7

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [✓] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	per COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	11M100991	3-10-16
SC		
ORP		
DO		

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Pettet Area 1 Sample Date 3-10-16 Time: 1420 Well ID: BPS11-19A2

Personnel: DM BQ Weather: cloudy windy cool

Casing Diameter/Type: 2" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 43 Depth to Water 4.11 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [✓] Submersible Pump, [ ] Low Flow

.163 gal./ft * = one casing volume 6.3 gals. x 3 = purge volume 19 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 1359 PURGE RATE 1 gpm SET PUMP: 15

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
1401	7.04	7.65	9.83	36.8	427		
1406	6.84	6.27	10.26	68.1	460		
1412	6.63	6.00	10.28	70.8	469		
1418	6.60	5.88	10.30	71.6	464		

TOTAL GALLONS: 22

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [✓] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	See COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	11M100991	3-10-16
SC		
ORP		
DO		

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Battle Area 1 Sample Date 3-10-16 Time: 1510 Well ID: BPS 11-19B

Personnel: DM BQ Weather: cloudy windy cool

Casing Diameter/Type: 2" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 67 Depth to Water 2.64' ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [✓] Submersible Pump, [ ] Low Flow

.0164 gal./ft * = one casing volume 10 gals. x 3 = purge volume 30 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 1446 PURGE RATE: 1.9 gpm SET PUMP: 20

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
1450	7.00	4.0	10.23	60.	860		
1457	6.37	0.42	10.24	101.5	950		
1500	6.36	0.43	10.24	101.9	951		
1510	6.34	0.39	10.23	103.4	951		
1514	6.35	0.35	10.24	103.7	953		

TOTAL GALLONS: 30

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [✓] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

See COC

	Parameter	Sample Container	Preservative	
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]				
[ ]				

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	11M100991	3-10-16
SC		
ORP		
DO		

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Butte Area 1 Sample Date 3-11-16 Time: _____ Well ID: MF-1

Personnel: DM BQ Weather: cloudy fresh snow

Casing Diameter/Type: 4" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 14' Depth to Water 5.30 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [✓] Submersible Pump, [ ] Low Flow

.653 gal./ft * = one casing volume 5.6 gals. x 3 = purge volume 17 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: _____ PURGE RATE: _____ SET PUMP: 10

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW

TOTAL GALLONS: _____

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [✓] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other Lancaster Chain-of-Custody: [ ] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	11M100991	3-11-16
SC	_____	_____
ORP	_____	_____
DO	_____	_____

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: obstruction in casing ≈3'

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Butte Sample Date 3-11-16 Time: 0908 Well ID: BPS07-21C

Personnel: DM BQ Weather: Cloudy

Casing Diameter/Type: 2" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 81 Depth to Water 12.66 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [✓] Submersible Pump, [ ] Low Flow

.163 gal./ft * = one casing volume 11 gals. x 3 = purge volume 33 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 0839 PURGE RATE: 1.25 gpm SET PUMP: 25

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
842	6.17	4.84	9.69	83.5	759		
844	6.44	2.52	9.92	76.9	881		
848	6.52	1.67	10.03	64.0	816		
854	6.56	1.32	10.05	55.0	812		
906	6.55	1.22	10.060	51.0	813		

TOTAL GALLONS: 37

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [ ] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	see COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other Lancaster Chain-of-Custody: [ ] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	11M100991	3-11-16
SC		
ORP		
DO		

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Butler Area 1 Sample Date 3-11-16 Time: 0940 Well ID: BPS07-21B

Personnel: DM BQ Weather: cloudy cool

Casing Diameter/Type: 2" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 47' Depth to Water 13.45 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [✓] Submersible Pump, [ ] Low Flow

* 1.63 gal./ft * = one casing volume 5.4 gals. x 3 = purge volume 16 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 0924 PURGE RATE: 1gpm SET PUMP: 22

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
928	6.46	10.31	9.72	56.0	1010		
930	6.58	3.02	9.75	50.9	513		
935	6.64	3.22	9.75	49.3	480		
940	6.66	3.09	9.75	47.8	457		

TOTAL GALLONS: 16

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [✓] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	see COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	11M 160991	3-11-16
SC		
ORP		
DO		

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Butte Area 1 Sample Date 3-11-16 Time: 1020 Well ID: AMW-11

Personnel: DM BQ Weather: Clearing + cool

Casing Diameter/Type: 2" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 15.5 Depth to Water 6.14 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [✓] Submersible Pump, [ ] Low Flow

*.163 gal./ft * = one casing volume 1.5 gals. x 3 = purge volume 4.5 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 1010 PURGE RATE: 5 gpm SET PUMP: ~12

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
1012	7.10	7.71	4.97	-44.5	422		
1014	7.27	1.64	5.17	-58.9	409		
1016							
1018	7.24	1.19	5.17	-58.5	413		
1020	7.23	1.18	5.17	-58.3	412		

TOTAL GALLONS: 6

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [ ] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [✓] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	see COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	11M 100 991	3-11-15
SC		
ORP		
DO		

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: 031116 - DUP collected

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: Batte Area 1 Sample Date: 3-11-16 Time: 1100 Well ID: AMC-23

Personnel: DM, BQ Weather: clearing + cool

Casing Diameter/Type: 6" steel Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 30 Depth to Water 8.15 ft water

Screen: _____ Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [✓] Submersible Pump, [ ] Low Flow

1.469 gal./ft * = one casing volume 33 gals. x 3 = purge volume 100 gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 1555 PURGE RATE: 4.5gpm SET PUMP: 25'

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
3-10-16							
1559	8.13	1.68	7.80	-171.6	1102		
1602	7.98	1.26	7.80	-154.9	1104		
3-11-16							
pump on 10:50 19gpm 1055	6.99	3.4	9.06	-22	1502		
1100	6.92	7.1	9.22	-21.8	1498		

TOTAL GALLONS: ≈ 30 3-10 10 3-11

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [✓] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
	See COC			
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[ ]	Methane	(1) 40 ml VOA	Hydrochloric acid	
[ ]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[ ]	_____	_____	_____	
[ ]	_____	_____	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other Lancaster Energy Chain-of-Custody: [✓] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	10M100997	3-11-16
SC		
ORP		
DO		

Decontamination

Potable Water: Yes [✓] No [ ] Nitric Acid: Yes [✓] No [ ]

Liquinox: Yes [✓] No [ ] DI Water: Yes [✓] No [ ]

Methanol: Yes [ ] No [✓] Steam: Yes [ ] No [✓]

Comments: purged 3-10-16 30gal DTW 22' let recover overnight Sampled 3-11-16

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: BTC DPT/Piczo Sample Date 4-8-16 Time: _____ Well ID: BTC-DPT-01

Personnel: R.Reed Weather: sunny, clear

Casing Diameter/Type: 3/4" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 14.9' Depth to Water 5.4 ft ft water

Screen: 5-15 ft Depth to Product _____

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [ ] Submersible Pump, [ ] Low Flow

_____ gal./ft * = one casing volume _____ gals. x 3 = purge volume _____ gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 1245 PURGE RATE: @ 1 L/MIN SET PUMP: _____

DEVELOPMENT PURGING

EVACUATION DATA

WL @ 1255 11.8' toc

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
1310	9.05	5.06	9.46	32.2	1	clear	WL
1315	8.10	5.30	12.57	26.2	5	clear	DRY

TOTAL GALLONS: _____ Sampled @ 1335.

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [ ] Submersible Pump, [ ] Low Flow, [✓] Other: Peri Pump Sample Type: [✓] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative	
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid	
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid	
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid	
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid	
[✓]	Methane	(3) 40 ml VOA	Hydrochloric acid	
[✓]	Sulfate	(1) 250 ml poly plastic	None	
[ ]	HACH	(1) 1-liter poly plastic	None	
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid	Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid	
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid	
[ ]	PAHs	(2) 1-liter amber glass	None	
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid	
[ ]	Total Metals	(1) 500ml poly	Nitricacid	
[✓]	diss metals	(1) 250 ml poly	_____	
[✓]	anions, etc.	1L poly	_____	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other Lancaster Chain-of-Custody: [ ] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	_____	_____
SC	_____	_____
ORP	_____	_____
DO	_____	_____

Decontamination

Potable Water: Yes [ ] No [ ] Nitric Acid: Yes [ ] No [ ]

Liquinox: Yes [ ] No [ ] DI Water: Yes [ ] No [ ]

Methanol: Yes [ ] No [ ] Steam: Yes [ ] No [ ]

Comments: _____

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: _____ Sample Date 4-8-16 Time: _____ Well ID: BTC-DPT-02

Personnel: R. Reed Weather: sunny, clear 70°

Casing Diameter/Type: 3/4" PVC Measuring Point Description: TOC North Side

Well Depth (feet below measuring point): 13 ft Depth to Water 8.03 BGS ft water

Screen: 8 8-13 ft Depth to Product NA

WELL EVACUATION

Method: [ ] Mechanical Bailer, [ ] Galvanized Bailer, [ ] PVC Bailer, [ ] Disp. Polyethylene Bailer, [ ] SST Bailer, [ ] Submersible Pump, [ ] Low Flow

_____ gal./ft * = one casing volume _____ gals. x 3 = purge volume _____ gals.

SCH 40 Pipe * 2" well = 0.163 gal./ft. 4" well = 0.653 gal./ft. 6" well = 1.469 gal./ft. 8" well = 2.611 gal./ft. Any Well C feet in diameter = 5.875 x C^2

START TIME: 1150 PURGE RATE: 0.5 L/MIN SET PUMP: _____

start development pumping

EVACUATION DATA

Time	pH	DO	Temp	ORP	SC	TURBIDITY	DTW
1205	7.18	0.00	9.11°C	-10.1	317	clear	—
1210	7.27	0.00	9.09	-28.1	326	clear	—
1215	7.90	0.00	9.32	-31.5	323	clear	—
1220	7.77	0.00	9.35	-40.3	322	clear	—
1225	7.76	1.60	9.31	-22.1	323	clear	—
1230	7.78	1.70	9.37	-16.6	325	clear	—

TOTAL GALLONS: _____ Sampled 1230

WELL SAMPLING

Sampling Method: [ ] Disposable Poly Bailer, [ ] Submersible Pump, [ ] Low Flow, [ ] Other: Peri Pump Sample Type: [ ] Natural, [ ] Duplicate, [ ] Field Blank

	Parameter	Sample Container	Preservative
[ ]	BTEX	(2) 40 ml VOA	Hydrochloric acid
[ ]	MTBE	Extracted from BTEX VOA	Hydrochloric acid
[ ]	GRO as Gasoline	(2) 40 ml VOA	Hydrochloric acid
[ ]	DRO as Diesel	(2) 1-liter amber glass	Sulfuric acid
[X]	Methane	(1) 40 ml VOA	Hydrochloric acid
[X]	Sulfate, ~~anions etc~~	(1) 250 ml poly plastic	None
[ ]	HACH	(1) 1-liter poly plastic	None
[ ]	Lead	(1) 125 ml poly plastic	Nitric acid Filtered: [ ] Yes, [ ] No
[ ]	VPH	(3) 40 ml VOA	Hydrochloric acid
[ ]	EPH	(2) 1-liter amber glass	Hydrochloric acid
[ ]	PAHs	(2) 1-liter amber glass	None
[ ]	VOC'S	(3) 40 ml VOA	Hydrochloric acid
[ ]	Total Metals	(1) 500ml poly	Nitricacid
[X]	diss. metals	(1) 250 mL poly	nitric acid
[ ]	anions, etc	(1) 1L poly	

Laboratory: STL: [ ] Arvada, CO, [ ] Austin, TX, [ ] Northern Analytical Other ~~Lancaster~~ Energy Lab Helena Chain-of-Custody: [X] Yes, [ ] No

Meter	Serial No.	Calibration Date
pH	_____	_____
SC	_____	_____
ORP	_____	_____
DO	_____	_____

Decontamination NA

Potable Water: Yes [ ] No [ ] Nitric Acid: Yes [ ] No [ ]

Liquinox: Yes [ ] No [ ] DI Water: Yes [ ] No [ ]

Methanol: Yes [ ] No [ ] Steam: Yes [ ] No [ ]

Comments: Hannah H198FF4 F0023233

TETRA TECH

GROUNDWATER SAMPLING LOG

Project: ~~USFS PARIS WORK CENTER~~ Sample Date: 4-8-16 Sample Time: 1130 Well ID/Sample ID: BTC-DPT-03

Personnel: DM RE Weather Clear & warm

Casing Diameter/Type: ~~2" PVC~~ 3/4 Measuring Point Description: TOC - North

Well Depth (feet below measuring point): 11 Depth to Water 1.7' ft water

Screen: 6-11 Depth to Product N/A

WELL EVACUATION

Method:, [ ] QED Low Flow, [x] Other: Peristaltic Pump low flow

Start Time: 1100 Purge Rate: 355ml 40 sec Pump Depth: 10'

Comments: clear in 5 min

EVACUATION DATA

TIME	pH	TEMP	DO	ORP	SPC uS/cm	TURBIDITY	DTW	CUMM. PURGE VOLUME
UNITS								
1115	(6.7)	7.16	0	127.8	738			
1120	6.72	7.4	0	64.0	633			
1125	6.76	7.5	0	44.0	(63)			
1130	6.76	7.4	0	43.0	(63)			

Amount Purged: sampled 1130

WELL SAMPLING

Sampling Method: [{ QED Low Flow, [x] Other: Peristaltic Pump Sample Type: [✓ Natural, [ ] Duplicate, [ ] Field Blank [ ] MS/MSD

	Parameter	Method	Sample Container	Preservative
X	8 RCRA Metals + Cu, Zn	6020/7471	1 – 500 ml HDPE	Nitric acid
X	SVOCs	8270D	2 – 1 L Amber glass	None
X	PCP	8321A	2 – 40 mL VOA	None

Laboratory: Test America Airbill#: Chain-of-Custody: (x] Yes, [ ] No

Meter	Model No.	Calibration Date
Hanna		
Turbidity	2100P	

Decontamination				
Potable Water:	Yes [x]	No [ ]	10% Nitric Acid:	Yes [X]	No [ ]
Liquinox:	Yes [x]	No [ ].	DI Water:	Yes [x]	No [ ]
10% Methanol:	Yes [x]	No [ ]	Steam	Yes [ ]	No [x]

Comments:

Ted Duaime - MBMG
406-496-4157 office

Bill
327-3228

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3/7/16 —

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Project Butte Area One
Blacktail Creek + Silverbow Creek
Corridoors Area Study

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CONTENTS

PAGE

3/7/16 Silver Bow Creek + Blacktail Creek

1230 Arrive Butte Visitor Center
Ted Duaime arrival followed by rest of crew

Weather: sunny, sl. breeze ~40°F

1300 Safety Meeting + SAP briefing
Rhianna, Natalie, Don, Connor, Brooks-TL
Ted Duaime - MBMG

1315 Jeremy - MBMG on site for SAP review

1335 Transfer equipment, go through bottles.

1430 Don + Brooks off to sample GW

1500 Done w/prep. - move to 1st site
W/of Slag Canyon

1600 Arrive SBC-01 near asphalt plant
Photos 1, 2

1645 SBC-SS-01 (0-12") Minimal recovery in 3 cores (only 1/2 of 3 cores has sample)

~~1650~~ ~~SBC-SS-01 (24-36")~~ unable to get recovery

1655 SBC-SW-01 Surface water

1730 Back at truck to filter SW sample

1615 off site

MJ 3/7/16

Silver Bow Creek + Blacktail Creek 3/8/16

0730 off site - Overcast, ~28°F, light wind

0730 Rhianna on site
Connor onsite

0840 Talked to Wenda at lab - Shipping Metals bottles for SW and more
Chain of Custody

0830 Talked to Bill Craig re: project, access etc. Try location near Slag Wall close to truck

0845 Calibrating meter + decon
- pH probe inop - won't calibrate.
getting one shipped for delivery tomorrow

0910 Left msg for Pat/DOJ to call

0925 Arrive Slag wall Canyon area
Skipping SBC-02 for now + finishing ~~SBC~~ SBC-01

0935 Collect SBC-SW-03
T = 2.23 °C
SC = 253 µS/cm²
DO = 16.53 mg/L
pH = ~~5.03~~ 4.52 pH prob may not be reading accurate
ORP = 221.3

1055 Collect SBC-SS-03 (0-12") ABA/SPLP *
max recovery in tubes = 6"-8", 6 drive attempts

MJ 3/8/16

3/8/16 Silver Bow Creek + Blacktail Creek

1115 Done sediment sampling – took 3.25 hours including decon

1120 Decon

1125 brief lunch break – Overcast, light snow, 28°F, light wind

1135 Prep for pore water

Stream width = 13.9'

Stream center depth = 13.5"

Right bank (North) water depth = ~10"

Left bank (South) water depth = ~14"

1220 Collect SBC-SPW-03 (N) (12") Pore water North side

No 36" pore water due to refusal

T = 5.57°C

SC = 1062 µs/cm²

DO = 2.8 mg/L

pH = 6.61 s.u

ORP = 143.7

No pore water on South side due to refusal at 1-3" depth, even a couple feet from slag bank

1250 Done sampling – decon

MT 3/8/16

Silver Bow Creek + Blacktail Creek 3/8/16

1300 Talked to Jerry Armstrong – left message for Bill

– Jerry – difficulty w/ sampling

1340 At BTC-01 just east of confluence

Collect BTC-SW-01

T = 2.97°C

SC = 277 µS/cm²

DO = 18.65 mg/L

pH = 7.03 su

ORP = 131.8

1430 Talked to Pat-DNRC re: access

1445 Collect BTC-SS-01 (0-12")

still limited recovery - between 5-6" max but mostly <3". 6 drives to get enough for 1L + 8oz

1500 Collect BTC-SPW-01 (N) (12")

T = 3.41°C

SC = 400 µS/cm²

DO = 5.69 mg/L

pH = 6.88

ORP = -61.4

MT 3/8/17

6

3/8/17 Silver Bow Creek + Blacktail Creek

Stream width = 23'

N (Right) bank edge = 5' @ Porewater

1535 Advance new porewater probe to 36" N (R side)

1545 pumped 36" probe for 10 min - no water just silty muck coming out of peristaltic tubing - tiny spurts

1605 station BTC-02 by gage station

1610 Collect SW sample:

BTC-SW-02

T = 3.63 °C

SC = 280 µS/cm²

Do = 17.31 mg/L

pH = 7.12

ORP = 32.0

Gage Station 1.10 on staff gage

-Slide hammer broken, collected sample w/bucket

1650 Collect BTC-SPW-02S(12")

Rhianna to O'Keefe's to get slide hammer fixed

1715 Collect BTC-SS-02(0-12")

1730 Pack coolers - Rhianna to deliver to Energy tonight

1800 Done for day

MM 3/8/16

Silver Bow Creek + Blacktail Creek 3/9/17

0750 M Morrow + B. Drake on site

0800 Don, Rhianna on site

0850 Back to BTC-2 (location to finish pore water at S side (L side) - battery van dead on Peristaltic - need to get field parameters

0915 Jim Ford on site

0920 Jim Ford off site

Pore water station BTC-SPW-02S not pumping as well as yesterday - getting more muddy water w/lots of bubbles in tubing - sections of muddy water

BTC-SPW-02S (12") Field parameters

T = 2.99°C

pH = 6.95

ORP = -88.7 mV

Do = 0.77 mg/L

SC = 1038 µS/cm

0930 Start pumping at 36" - possible sand interval

MM 3/9/16

3/9/16 Silver Bow Creek & Blacktail Creek

0935 Collect BTC-SPW-025(36")
pH = 6.96
ORP = 30.7 mV
DO = 0.00
SC = 670 µS/cm
T = 4.37 °C

0945 Installing pore sampler near on North bank at 12" - location slightly upstream from S bank
BTC-SPW-02N(12")
pH = 7.19
ORP = -72.7
DO = 1.84 mg/L
SC = 1080 µS/cm
T = 4.20 °C
Water depth 8" at sample port

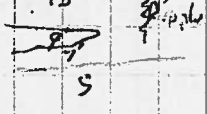
1025 Stop/done sampling 12" pore water
-Stream width at North pore location to South bank = 22.2'
-Stream width at South pore location = 17.6'

mg 3/9/16

Silver Bow Creek & Blacktail Creek 3/9/16

1050 BTC-SPW-02N(36")
pH = 7.71
ORP = -181.3 mV
DO = 0.00 mg/L - flashing
SC = 859 µS/cm
T = 8.40 °C
5 sample time
1100 obtained ~1/4 Liter of water-sediment in 1L poly. will let settle and filter for metals
* BTC-SPW-02N(36") Dissolved Metals only *
1140 Meet w/Brad Holmes

1155 SBC-SPW-01S(12") South bank
Water depth = 7"
18' stream width to island, ~8' from island to bank (island = 9' wide)
1200 Collect SBC-SPW-01S(12")
pH = 7.14
ORP = -76.2 mV
DO = 0.64 mg/L
SC = 3885 µS/cm
T = 4.92 °C
1215 Tried 36" on south side - unable to advance



mg 3/9/16

Brian McRae

3/9/16 Silver Bow Creek + Blacktail Creek

1220 Collect SBC-SPW-01N (12") 4' wasted depth
pH = 7.45
ORP = -84.7 mV
DO = ~~2.34~~ 1.66 mg/L
SC = 1270 µS/cm
T = 3.95 °C

1230 No advancement to 36" on N side at SBC-01, too rocky

1300 TO ~~SBC-SPW~~ SBC-02 in canyon

1310 Collect SBC-SW-02 slag wall canyon E of bridge to asphalt plant
pH = 7.63
ORP = 71.9 mV ~~µS/cm~~
DO = 4.91 mg/L
SC = 594 µS/cm
T = 4.96 °C

1320 Collect SBC-SPW-02N (12")
pH = 5.03
ORP = 119.2 mV
DO = 0.31 mg/L
SC = 5961 µS/cm
T = 4.99 °C

mf 3/9/16

Silver Bow Creek + Blacktail Creek 3/9/16

1330 Collect SBC-SS-02 (0-12")
coarse sand, few silt
Channel width = 19'
N side depth 8" deep water
S side depth 6" depth

1340
~~1405~~ Collect SBC-SPW-02N (36")
pH = 5.52
ORP = 89.5 mV
DO = 0.82 mg/L
SC = 4655 µS/cm
T = 5.67 °C

1350 Collect SBC-SPW-02S (12")
pH = 7.09
ORP = 5.1 mV
DO = 0.97 mg/L
SC = 5267 µS/cm
T = 4.75 °C

1405 Collect SBC-SPW-02S (36")
pH = 7.16
ORP = 8.6 mV
DO = 0.86 mg/L
SC = 5362 µS/cm
T = 5.26 °C

mf 3/9/16

Rite in the Rain

3/9/16 Silver Bow Creek + Blacktail Creek

1515 at BTC-03

1520 BTC-SW-03
T = 5.7 °C
pH = 7.77
SC = 560 µS/cm
ORP = 78.8 mV
DO = 4.3

1530 BTC-SPW-03N(12")
pH = 7.00
ORP = -4.4 mV
DO = 0.57 mg/L
SC = 2455 µS/cm
T = 4.15°C

~~15~~

1550 Not able to recover water from 36" depth

1600 Collect BTC-~~SB~~SS-03(0-12")
silty sand w/organics

Weather: partly sunny, 36° F, light wind

mj 3/9/16

Silver Bow Creek + Blacktail Creek 3/9/16

1605 BTC-SPW-035(12")
pH = 6.92
ORP = -34.2 mV
DO = 0.38 mg/L
SC = 2393 µS/cm
T = 4.09 °C

1620 BTC-SPW-035(36")
pH = 7.77
T = 7.36 °C
ORP = -157.1 mV
SC = 1253 µS/cm
DO = - (blinking 0.0)
* Dissolved Metals only *

1700 BTC-SBS-01N(0-12") North bank near west end of pond NoXRF
wet, dk brown silty loam w/organics

1710 BTC-SBS-02S(0-12") South side of BTC near "beaver slide" NoXRF * SPLP
silty sand - sandy silt w/organics - saturated

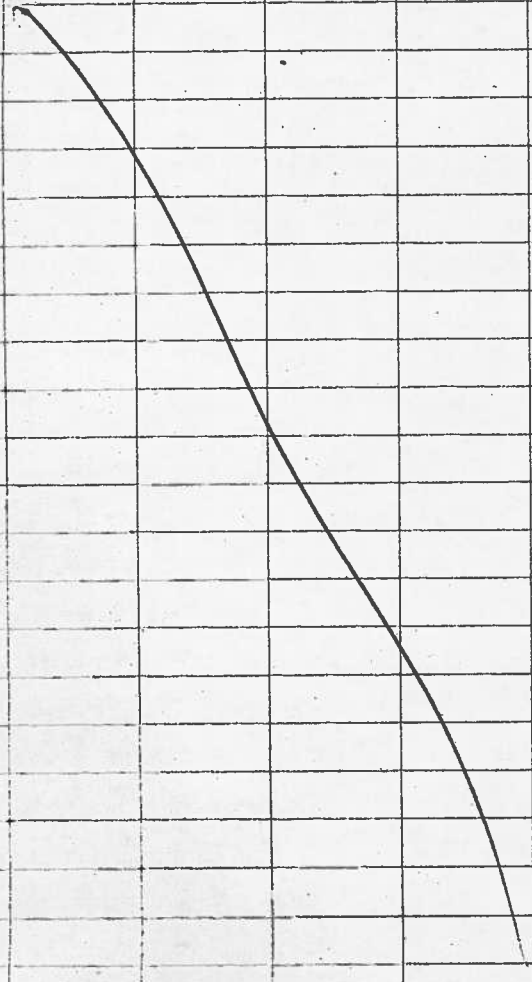
1730 BTC-SBC-03S(0-12") South side near BTC-SW-03 * Visible tailings present. Tailings visible near BTC-SBS-02 also, eroding off berm.
→ wet to saturated → no XRF

mj 3/9/16

3/9/16 Silver Bow Creek + Blacktail Creek

1750 Back to truck
pack up, COCs, ice coolers

1805 off site



MJ 3/9/16

Silver Bow Creek + Blacktail Creek 3/10/16

0730 on site GW crew on site also
Safety meeting

0800 MOL to BTC-04 on BTC near
north end of small east pond

0820 Sample BTC-SW-04
Water parameters-
Temp: 3.58 °C
pH: 7.28
ORP: 135.3 mV
DO: 3.52 mg/L
EC: 587 µS/cm

0835 Sample BTC-SPW-04N (12")
water depth = 2.5"

(2000) Duplicate: 031016-DUP
T = 4.37 °C
pH = 7.24
ORP = -40.1 mV
DO = 0.62 mg/L
SC = 2373 µS/cm

MJ 3/10/16

Rotten to the Ruin

3/10/16 Silver Bow Creek + Blacktail Creek

0830 Attempted pore water from north side at 36" - no water

0840 Collect BTC-SS-04 (0-12")
water depth 2.5"

0855 Field parameters BTC-SPW-04S (12")
T: 5.96 °C
pH: 7.94
ORP -24.9 mV
DO: 0.84 mg/L
C: 665 µS/cm

0915 Sample BTC-SPW-04S (12")
diss. metals only

0920 Pumping BTC-04 from 36" (S. side)
water coming out of sampler without pumping. Water depth 4"

0925 Water quality parameters BTC SPW-04S (36")
T = 6.95°C
pH = 7.41
ORP -107.4 mV
DO = 0
CC = 565

mj 3/10/16

Silver Bow Creek + Blacktail Creek 3/10/16

0930 Sample BTC-SPW-04S (36")
Stream width = 22.8'

0950 Collect Rinsate blank - Pore water
- ran distilled water through pore probe, tubing + filter (dissolved metals)
031016-RB

0955 Collect Field blank - Pore water -
distilled directly from gallon container to bottle - total metals
031016-FB

1020 Lexington Avenue - checking access for GG + SC stations

1035 Set up at GG-01 Grove Gulch
Collect GG-SW-01
pH = 7.37
ORP = 79.2 mV
DO = 3.68 mg/L
sc = 738 µS/cm
T = 2.38 °C

Collected from S side - inside water

1100 Collect GG-SPW-01W (0-12")
* Dissolved only - recovered ~100 mL * Water depth = 1"

mj 3/10/16

3/10/16 Silver Bow Creek + Blacketail Creek

1115 move to E bank for 36" due to silts/sands vf

GG-SPW-01E(36") Water depth = 4"

1120 Collect GG-SS-01(0-12") location - Black Stringers

Stream width 6'

1119 Water Qual. Parameters

pH: 6.88

ORP = -97.9 mV

DO = 0.14 mg/L

EC: 560 µS

T = 4.98°C

1120 Sample GG-SPW-01E(36")

1130 Pulling water from a 12"

Water Qual. Parameters

pH = 6.90

ORP -75.4 MV

DO = 0.86 MS/L

cond ~~0.86~~ 583 µS

T 4.50°C

1135 Sample GG-SPW-01E(12")

1200 Mob equipment to Sand Creek culvert South side of freeway.

MJ 3/10/16

3/10/16 Silver Bow Creek + Blacktail Creek

1220 Water quality parameters

pH: 7.15

ORP: 35.3 MV

DO: 2.50 mg/L

cond: 1367 µS

T: 7.02°C

Location in pasture area

1225 Sample SC-SW-01

1235 Sample SC-SS-01(0-12")

1240 Pore water sample pumping from East bank. 12" depth 31

pH: 7.43

ORP 17.3 mV

DO 0.35 mg/L

cond 711 µS

T 8.05 °C

Sample SC-SPW-01E(12")

1245 Attempting 36" sample

Water quality parameters

T: 5.23 °C

pH: 7.30

ORP 27.8 MV

DO 1.36 mg/L

cond 698 µS

MJ 3/10/16

Rite in the Rain

3/10/16 Silver Bow Creek & Blacktail Creek

1250 Sample SC-SPW-01E (36")
Pore Water ~~coming~~ flowing out of sampler
Channel width: 9.5 ft

1405 Collect BTC-SW-05
pH: 8.04
T: 6.41 °C
ORP: 61.2 mV
DO: 5.67 mg/L
cond: 596 µS

1415 Pumping 12" pore water
1420 Sample BTC-SPW-05N (12")
pH = 7.69
ORP = 59.6 mV
DO = 2.27 mg/L
SC = 579 µS/cm
T = 8.34 °C

N side bank is very silty - silt flat
1425 Collect BTC-SS-05 (0-12") Silty Sand/Sandy Silt
(1900) Duplicate 031016-DUP
1430 Pumping BTC-SPW-05N (36")
pH 7.43 T: 9.53 °C
ORP 74.4 mV DO 1.83 mg/L
cond: 546 µS

MJ 3/10/16

3-10-16 Silver Bow Creek & Blacktail Creek

1440 Sample BTC-SPW-05N (36")
1453 ~~Attempting to pump~~ Pumping BTC-SPW-05S (12")
3-10-16

Bank on freeway side

1505 Sample BTC-SPW-05S (12")
T = 5.50 °C DO: 0.50 mg/L
pH: 6.67 ORP -16.4 mV
cond 1748 µS
1513 Pumping BTC-SPW-05S (36")
muddy material.
T = 6.06 °C ORP: -96.3 mV
pH: 7.12 cond 356 µS
DO: 0.32 mg/L
1520 Sample BTC-SPW-05S (36")
Water Depth = 5.5" Channel width 4.9.2'

1550 Collect BTC-05S-01 (0-12")
Opportunity sediment sample
small channel w/staff gage near
BTC-05 station
Black silty sand w/gravel & organics

MJ 3/10/16

3-10-16 Silver Bow Creek + Blacktail Creek

1615 Collect BTC-SW-06

pH = 7.31
ORP = 23.3 MV
DO = 3.80 MG/L
SC = 555 µS/cm
T = 6.29 °C

1625 Collect BTC-SPW-06N (0-12")

pH = ~~7.32~~ 7.43
ORP = ~~-30.5~~ -20.5
DO = ~~3.84~~ 2.05 mg/L
~~SC~~ C = 1945 µS/cm
T = 5.17 °C

1630 Collect BTC-SS-06 (0-12"), ~~depth 5"~~ ~~SRR 3/10/16~~

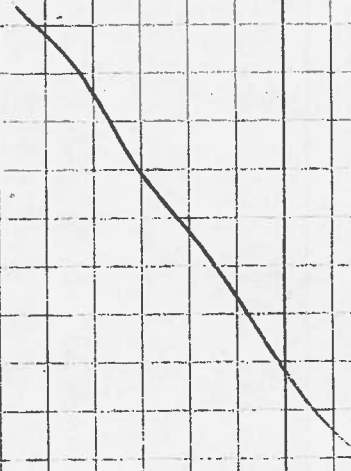
~~Attempt~~ Attempt to collect BTC-SPW-06S (36")
NOTE No water, too silty.

1635 Pumping BTC-SPW-06S (12"), depth 5"
T = 5.50 °C
pH: 7.27
ORP -87.8 mV
DO: 0.45 mg/L
Cond: 850 MS

MG 3/10/16

3-10-16 Silver Bow Creek + Blacktail Creek

1645 Sample BTC-SPW-06S (12")
1655 Pumping BTC-SPW-06S (36")
1700 T = 6.61 °C depth: 1"
pH = 7.11
ORP = -94.4
DO = 0
cond = 840 MS
1700 Sample BTC-SPW-06S (36")
channel width: 32.5'
1730 Back at trailer
1800 OFF site



MG 3/10/16

Rain

3/11/16 Silver Bow Creek + Blacktail Creek

0730 Both crews on site - loading trucks
Weather: overcast, ~30°F

0800 Arrive BTC-07 station downstream of channel from north wetland, near red roof "Butte Wildlife and Bird Sanctuary" sign
Stream width = 24'

0830 BTC-SW-07 Sample
pH = 7.23
ORP = 111.9 mV
DO = 3.79 mg/L
sc = 535 µS/cm
T = 3.08 °C

0845 BTC-SPW-07N (0-12")
Water depth = 1"
pH = 7.65
ORP = 86.3 mV
DO = 1.42 mg/L
Sc = 611 µS/cm
T = 5.95 °C

MJ 3/11/16

Silver Bow Creek + Blacktail Creek 3/11/16

0855 Collect BTC-SPW-07N (36") 1" water depth
pH = 7.24
ORP = 95.4 mV
DO = 0.53 mg/L
Sc = 594 µS/cm
T = 7.23°C

0900 Collect BTC-SS-07 (0-12") sand

0925 Collect BTC-SS002N (0-12") sand
- No recovery for 24-36" sample. Slide hammer method not working (tried again after got new top and tried both drive bits) Back to shovel + bucket method to get sediment sample

0945 No pore water recovery on south bank (highway side) for 12" and 36" depths; no sediment pore water co-located sample

MJ 3/11/16

Rita Rain

3/11/16 Silver Bow Creek + Blacktail Creek

1000 AT BTC-08 station

1010 Collect BTC-SW-08 channel width = 33'
pH = 7.07
ORP = 124.1 mV
DO = 4.48 mg/L
sc = 528 µS/cm
T = 3.45 °C

1020 Collect BTC-SPW-08N (12") 2" water depth
probe set between 12-15" - was muddy right at 12"
pH = 7.40
ORP = ~~-30.5~~ -45.6
DO = 1.27
SC = 493
T = 5.95

1035 Collect BTC-SPW-08N (36") 2" water depth
pH = 7.37
ORP = -104.5 mV
DO = 0.79 mg/L
SC = 473 µS/cm
T = 7.27 °C

1040 Sample BTC-S
0-12" adj. to BTC-SPW-08N

3/11/16 MJF

Silver Bow Creek + Blacktail Creek 3/11/16

1050 Pumping BTC-SPW-08S (12")
pH = 6.88
ORP = -20.1 mV
DO = 2.30 mg/L
cond = 528 µS
°C = 5.95

1100 Sample BTC-SPW-08S (12")

1105 Sample BTC-SS-08 (0-12") * SPLP/ABN NAGPH
from middle of channel

1110 Sample BTC-SS-08S (0-12")
adj. to BTC-SPW-08S (12")

1115 Pumping BTC-SPW-08S (36")
pH: 7.18
ORP: -58.1 mV 4" water depth
DO = F
COND = 507 µS
T = 6.85 °C

1120 Sample BTC SPW-08S (36")

1135 Rinsate blank - shovel used
for collecting sediment
03/11/16-RB

1140 Field blank - sediment
03/11/16-FB

MJF 3/11/16

3-11-16 Silver Bow Creek + Blacktail Creek

1200 set up at pond area N of BTC and E of Lexington Ave.

1215 Surface water readings on E side of pond (station BTC-PD-03)
pH = 7.39 DO = 7.11 mg/L
ORP = 57.4 mV cond = 828 µS
T = 7.39°C

1230 Pore water samples attempted on several on multiple locations around bank of pond. No sample could be collected due to fines.

1225 Surface water sample BTC-PD-03 collected

1240 Sediment sample BTC-PS-03(0-12") collected from peninsula of pond.

1300 GPS locations. Head to trailer.

1315 PACK SAMPLES FOR LAB DELIVERY

1430 OFFSITE TO HELENA, ENERGY LABS.

MRJ 3/11/16

3-14-16 Silver Bow Creek, Blacktail Creek Data Gaps Investigation

OBJECTIVE = CONTINUE PORE WATER, SURFACE WATER + SEDIMENT SAMPLING.

WEATHER: SNOW, INTERMITTENT, HIGH 36°F

PERSONNEL: R. REED, C. McHUGH, JERRY ARMSTRONG

0800 ONSITE @ TRAILER. UNLOAD + RESTOCK SUPPLIES

1030 ONSITE AT BTC-09, EAST OF OREGON AVE OVERPASS.

1100 COLLECT SURFACE WATER SAMPLE BTC-SW-09. PARAMETERS:
pH = 6.90, ORP = 137.4 mV
DO = 2.71 mg/L cond: 530 µS, T = 2.60°C

1120 COLLECT BTC-SPW-09N(12") @ 7" depth. WQ PARAMETERS:
pH = 7.38, T = 4.34°C, ORP = 108.2 mV
DO = 1.08 mg/L, cond = 573 µS

1125 Unable to advance to 36"

1130 COLLECT BTC-SS-09(0-12"), 9" deep

1140 SAMPLE BTC-SPW-09S(12")
pH: 7.21, T = 6.06°C, ORP = -74.0 mV

1155 COLLECT BTC-SPW-09S(36"), 2" depth

RR Reed 3-14-16

3-14-16 BTC, SBC DATA GAP INVESTIGATION

WQ PARAMETERS FOR BTC-SPW-09S(36"):
pH = 7.21, T = 6.06 °C, ORP = -74.0 mV,
DO = 0.46 mg/L, cond = 758 µS
Channel width = 32 FT

1215 ONSITE @ BTC-10, SAMPLING JUST EAST OF FENCE

1225 SAMPLE SURFACE WATER BTC-SW-10 + 031416-DUP* (0800)

WQ PARAMETERS: T = 3.46 °C, pH = 7.35
ORP = 50.2 mV, DO = 4.60 mg/L, cond = 675 µS

1250 COLLECT SED. SAMPLE BTC-SS-10(0-12")

1255 COLLECT BTC-SPW-10S(12"), 1" deep *

WQ PARAMETERS: T = 5.96 °C, pH = 7.30
ORP = 36.6 mV, DO = 1.72 mg/L, cond = 961 µS

1330 COLLECT BTC-SPW-10S(36")

WQ PARAMETERS: T = 6.71 °C, pH = 7.06
ORP = 49.9 mV, DO = 1.52 mg/L, cond = 898 µS
CHANNEL WIDTH: 29 FT

1350 COLLECT BTC-SPW-10N(12"), depth 7"

WQ PARAMETERS: T = 4.50 °C, pH = 6.99,
ORP = 9.8 mV, DO = 1.46 mg/L, cond = 1198 µS

1405 COLLECT BTC-SPW-10N(36")

* 031416-DUP ~~031416-DUP~~ COLLECTED, @ 2000 hrs 3-14-16

KRead 3-14-16

3-14-16 BTC, SBC DATA GAP INVESTIGATION

WQ PARAMETERS: T = 4.66 °C, pH = 7.02
ORP = -45.6 mV, DO = 0.61 mg/L, cond = 602 µS

1500 COLLECT BTC-SW-11

WQ PARAMETERS: T = 3.67 °C, pH = 7.28
ORP = 45.6 mV, DO = 4.58 mg/L, cond = 521 µS

1515 COLLECT BTC-SPW-11S (12"), 1" deep
KR 3-14-16

WQ PARAMETERS: 4.58 °C, pH = 7.21
ORP = 18.1 mV, DO = ~~2.00~~ 1.96 mg/L, cond = 1333 µS
KR 3-14-16

1520 COLLECT BTC-SS-11(0-12") + SPLP

1535 COLLECT BTC-SPW-11S(36")

WQ PARAMETERS: T = 5.41 °C, pH = 7.18
ORP = 14.4 mV, DO = 2.18 mg/L, cond = 975 µS

1550 COLLECT BTC-SPW-11N(12"), 2" deep

WQ PARAMETERS: T = 4.06 °C, pH = 7.26
ORP = 16.5 mV, DO = 2.02 mg/L, cond = 698 µS

1640 COLLECT BTC-SPW-11N(36")

WQ PARAMETERS: T = 3.87 °C, pH = 6.72
ORP = 30.5 mV, DO = 1.03 mg/L, cond = 672 µS
CHANNEL WIDTH:

1700 RINSATE BLANK 031416-RB + FIELD BLANK 031416-FB COLLECTED

1730 STORE SAMPLES, UNPACK TRUCK OFFSITE.

KRead 3-14-16

3-15-16 BTC, SBC DATA GAPS INVESTIGATION

OBJECTIVE: CONTINUE CREEK SAMPLING AND SEDIMENT SAMPLING

WEATHER – 24°F, PARTIALLY CLOUDY, 40% CHANCE OF SNOW

PERSONNEL: R.REED, C.McHUGH, J.ARMSTRONG

0730 ONSITE AT TRAILER, PACK UP FOR SAMPLING

0800 ONSITE @ FATHER SHEEHAN PARK

0830 SET UP ON BTC-12

0840 COLLECT BTC-SW-12 + 031516-DUP AT 1235. WQ PARAMETERS:

pH: 7.17, ORP: 119.4 mV, DO: 4.35 mg/L

cond: 477 mS, T: 1.43°C

0915 COLLECT BTC-SPW-12N (12") + 031516-DUP @ 835 850 (SPW-2-15-16)

WQ PARAMETERS: T: 3.78°C, pH: 7.39, ORP: 99.9 mV, DO: 1.83 mg/L, cond: 1082 mS

0930 COLLECT BTC-SS-12 (0-12") + 031516-DUP @ 0600

0950 REFUSAL AT 36", NO SAMPLE

1005 PUMPING BTC-SPW-12S (12")

WQ PARAMETERS: 3.48°C, pH: 7.10, ORP: -60.6 mV, DO: 0.17 mg/L, cond: 1204 mS

1010 COLLECT BTC-SPW-12S (12"), 8" deep

HRR 3-15-16

3-15-16 BTC, SBC DATA GAPS INVESTIGATION

1030 COLLECT BTC-SPW-12S (36"), channel: 6.68' WIDTH

WQ PARAMETERS: T: 3.43°C, pH: 7.26 cond: 521 mS, DO: 0.16 mg/L, ORP: 105.4 mV

1055 COLLECT 031516-FB

1056 COLLECT 031516-RB

1200 ONSITE @ TRAILER, STOCKING UP ON SUPPLIES. J. ARMSTRONG PICKING UP SUPPLIES

1230 @ COLLECT BTC-SBS-04N (0-12")

1250 @ COLLECT BTC-SBS-05S (0-12") + 031516-DUP @ 1857

1300 COLLECT 031516-FB + 031516-RB

1310 COLLECT BTC-SBS-06N (0-12")

1335 COLLECT BTC-SBS-08 (0-12")

1340 COLLECT BTC-SBS-07 (0-12") FAR WESTERN

1355 COLLECT BTC-SBS-09 (0-12") WITH 031516-DUP @ 1753

1405 031516-FB + 031516-RB TAKEN.

1410 CHANGE pH/ORP PROBE ON YSI 556

1425 CALIBRATE YSI

1435 SAMPLE POND #2 - BTC-PD-02 (surf. water)

WQ PARAMETERS: T: 5.35°C, pH: DO: 9.55 mg/L, cond: 334 mS, ORP: 334.8 mV

1515 COLLECT WQ PARAMETERS, T: 2.64°C pH: 7.42 DO: 2.75, cond: 383 mS, ORP: 120 mV

HRR 3-15-16

3-15-16 BTC, SBC DATA GAP INVESTIGATION

1520 COLLECT BTC-WPPW-02(12") depth 1"

1535 PUMPING BTC-WPPW-02(36")

1545 SAMPLE BTC-WPPW-02(36")

WQ PARAMETERS: T= 1.98 °C, DO= 0.99 mg/L

pH: 7.05, cond: 995 µS, ORP: 117.6 mV

1613 031516-FB COLLECTED

1615 031516-RB COLLECTED

1610 BTC-PS-02 (12") COLLECTED

1625 ONSITE @ FATHER SHECHAN PARK, BTC-13

1640 SAMPLE BTC-SW-13

WQ PARAMETERS: T= 2.38°C, pH= 7.64

ORP= 277.3, cond.= 935 µS, DO= 8.97 mg/L

1650 SAMPLE BTC-SPW-13N(12")

WQ PARAMETERS: T= 5.45°C, pH=6.15

cond= 446 µS, ORP= 262.7 mV, DO= 5.25

1700 SAMPLE BTC-SS-13 + SPEC SONDE

1715 SAMPLE BTC-BSPW-13N(36"), 5" deep

WQ PARAMETERS: T= 5.45 °C, pH= 7.38

ORP= 253.6 mV, DO= 1.61 mg/L, cond: 416 µS

1730 SAMPLE BTC-SPW-13S(12") 5.5" deep

WQ PARAMETERS: T=2.56°C, pH=7.06,

DO= 0.94 mg/L, ORP: 129.4 mV

18 ft channel WIDTH

JRReed 3-15-16

3-15-16 BTC, SBC DATA GAP INVESTIGATION

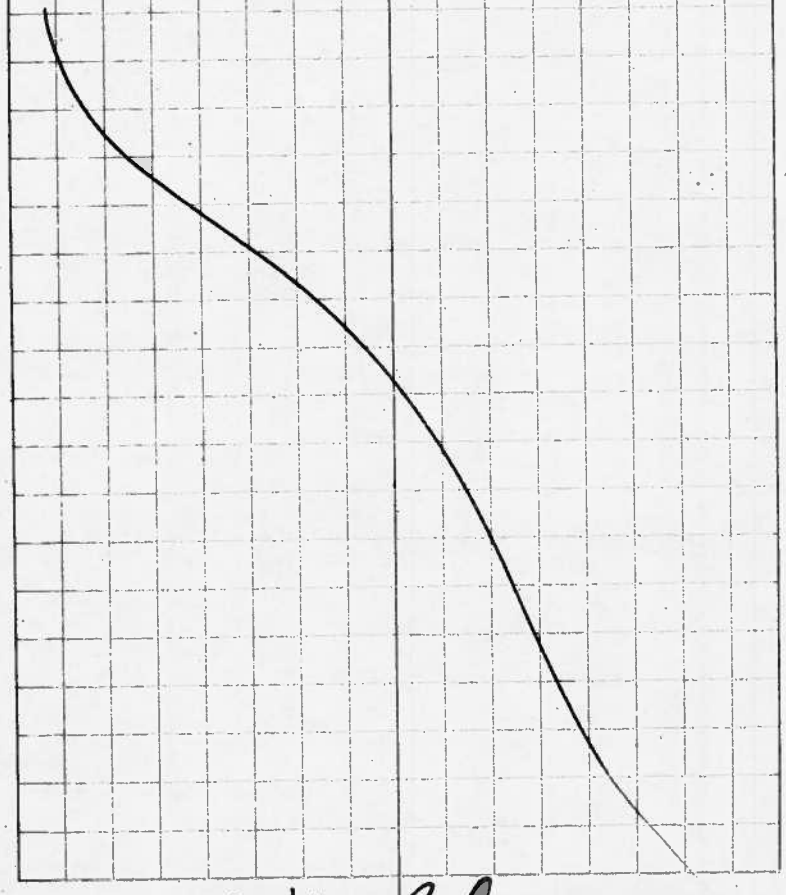
1750 SAMPLE BTC-SPW-13S(36")

WQ PARAMETERS: T= 4.0°C, pH: 7.05

COND: 268 µS, DO: 0.95 mg/L, ORP: 194.5 mV

1800 FINISHED UNLOADING TRUCKS,

PACKING SAMPLES ON ICE. ALL OFFSITE



JRReed 3-15-16

3-16-16 SBC, BTC DATA GAPS INVESTIGATION

OBJECTIVE - COLLECT OPPORTUNITY + LAST PORE/SEDIMENT SAMPLES

WEATHER: PARTIALLY CLOUDY, COLD

PERSONNEL: R. REED, C. McHUGH, J. ARMSTRONG

0730 ONSITE @ TRAILER, LOAD SUPPLIES

0800 CONFER ON LOCATIONS FOR SAMPLES

0840 COLLECT SBC-OSBS-01 IN SLAG WALL CANYON BANK SAMPLE

0930 COLLECT BANK SAMPLE GG-OSBS-01 ADJACENT TO GG-SPW-01

0940 ONSITE AT POND #1, ASSESS WETLAND ICE, SAFETY, CALIBRATE YSI 556

1005 SAMPLE BTC-PD-01, SURFACE WATER

WQ PARAMETERS: T= 0.88 pH= 9.18

COND: 431 mS, DO: 26.69 ORP: 240.2 mV

1055 SAMPLE BTC-WPPW-01 (0-12")

WQ PARAMETERS: pH: 6.80, T=1.6°C

DO = 1.14 mg/L, cond: 252 mS, ORP: 273.2

1120 SAMPLE BTC-WPPW-01 (36")

WQ PARAMETERS: 0.97°C, pH=7.02

cond: 1346 mS, DO= 1.19 mg/L, ORP= -26.2 mV

1130 SAMPLE BTC-PS-01 (0-12")

1200 SAMPLE BTC-PS-01 (24-36")

RR 3/16/16

3-16-16 SBC, BTC DATA GAPS INVESTIGATION

1310 SAMPLE BTC-OSBS-01 (0-12")

1330 SAMPLE BTC-OSBS-02 (0-12")

1345 BACK AT TRAILER, UNLOAD SUPPLIES, PACK SAMPLES & TRAILER.

1500 OFFSITE.

RReed 3-16-16

MONTANA WELL LOG REPORT

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Other Options

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View hydrograph for this site
View field visits for this site
View water quality for this site
View scanned well log (11/1/2011 3:28:22 PM)

Site Name: ANACONDA MINERALS CO * AMC-23
GWIC Id: 5018

Section 1: Well Owner(s)

1) ANACONDA MINERALS COMPANY (MAIL)
N/A
BUTTE MT 59701 [10/06/1982]

Section 2: Location

Township	Range	Section	Quarter Sections
03N	08W	24	NE¼ NE¼ SE¼

County
SILVER BOW

Geocode

Latitude	Longitude	Geomethod	Datum
45.996141351	112.530120068	SUR-GPS	NAD83

Ground Surface Altitude	Method	Datum	Date
5448.26			

Measuring Point Altitude	Method	Datum	Date Applies
5448.26			1/1/1983

Addition **Block** **Lot**

Section 3: Proposed Use of Water

MONITORING (1)

Section 4: Type of Work

Drilling Method: CABLE TOOL
Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Wednesday, October 06, 1982

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	31	6

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
0	33.5	6	0.25			STEEL

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
19	29	6			PERFORATED CASING

Annular Space (Seal/Grout/Packer)

There are no annular space records assigned to this well.

Section 7: Well Test Data

Total Depth: 33.5
Static Water Level: 3
Water Temperature:

Bailer Test *

10 gpm with _ feet of drawdown after _ hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level 20 feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

2 FOOT SAND PLUG IN BOTTOM OF CASING

Section 9: Well Log

Geologic Source

110ALVM - ALLUVIUM (QUATERNARY)

From	To	Description
0	1	TOPSOIL
1	6	RED SAND WITH CLAY
6	14	BLACK SWAMP MUD AND SAND
14	20	SAND AND CLAY
20	23	SAND AND GRAVEL WITH CLAY
23	26	FINE SAND
26	31	SAND AND GRAVEL--WATER

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: W. F. KENTFIELD
Company: OKEEFE DRILLING CO
License No: WWC-459
Date Completed: 10/6/1982

O'KEEFE DRILLING COMPANY
P.O. BOX 3810 - 4 MILE ROAD
BUTTE, MONTANA 59702
494-3310

03N 08W 24 DAD

NAME ANACONDA MINERALS COMPANY

WELL NUMBER: 24
WELL LOCATION: Butte, Montana
LEGAL DESCRIPTION: SW ¼ SW ¼ SW ¼, SEC. 24, RANGE 3-N, TOWNSHIP 8-W

DATE: STARTED 10/5/82
COMPLETED 10/5/82

DRILLER: W. F. KENTFIELD
DRILL RIG: Bucyrus-Erie ??W
METHOD: Percussion cable tool
BITS:

M: 5034

03N 08W 24 DAD

DIAMETER	6"		
DEPTH	25'		
CASING 6 5/8" x .250	FROM 0'	TO 28'	
PLASTIC LINER	FROM --	TO --	
DRIVE SHOE	6"		
PERFORATIONS	FROM 13'	TO 23'	
WELL SCREEN	--		
GALLONS PER MINUTE	40		
STATIC WATER LEVEL	6½'		
PUMPING LEVEL	15'		

FROM	TO	FORMATION		SWL
0'	10'	Old dump, fill		
10'	15'	Black swamp and sand	Water	
15'	20'	Red sand and clay		
20'	25'	Sand and gravel	Water	

DEVELOPED BY: bailing
VOLUME HELD BY BAILER: 15 gallons
DEPTH TO WATER WHILE BAILING: 6½ feet
VOLUME OF WATER BAILED: 15 gallons
PRODUCTION RATE: 40 gallons-per-minute
REMARKS: 2' sand plug in bottom of casing

M: 5034

Buckley, Luke

From: Smith, Garrett
Sent: Tuesday, August 24, 2010 3:51 PM
To: Buckley, Luke
Cc: Tucci, Nicholas
Subject: New Well Logs
Attachments: BPS New Well Logs.pdf

Hi Luke-
I have some new well logs that need to be entered into GWIC (see attached pdf).
I have included the GWIC numbers below, as well as the total depth, screen interval, and the elevations are converted to NGVD29 (since they're NAVD88 on the logs).
Thanks

Garrett

		NGVD29			
Well Name	*GWIC ID*	*TOC Elev*	*Ground Elev*	*TD (ft)*	*Screen Int. (ft)*
AMC-24C	**255974**	**5450.417**	**5448.47**	**83.5**	**69-79**
AMW-13C	**255975**	**5449.958**	**5448.338**	**84**	**60-70**
BPS07-21C	**257404**	**5452.471**	**5452.801**	**87**	**65-80**
BPS07-24	**257403**	**5451.721**	**5450.331**	**71**	**58-68**

MONTANA WELL LOG REPORT

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Other Options

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Plot this site in State Library Digital Atlas
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View hydrograph for this site
View field visits for this site
View water quality for this site
View scanned well log (11/1/2011 3:29:25 PM)

Site Name: ARCO * AMW-13
GWIC Id: 137597

Section 1: Well Owner(s)

1) ARCO (MAIL)
N/A
N/A N/A N/A [08/25/1993]

Section 2: Location

Township	Range	Section	Quarter Sections
03N	08W	24	NW¼ SW¼ NE¼ SE¼

County: SILVER BOW
Geocode:

Latitude	Longitude	Geomethod	Datum
45.993589459	112.533094451	SUR-GPS	NAD83

Ground Surface Altitude	Method	Datum	Date
5454.97	SUR-GPS	NGVD29	3/8/2005

Measuring Point Altitude	Method	Datum	Date Applies
5450.39			3/4/1994

Addition: **Block:** **Lot:**

Section 3: Proposed Use of Water

MONITORING (1)

Section 4: Type of Work

Drilling Method: HOLLOWSTEM AUGER
Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Wednesday, August 25, 1993

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	16	4

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2.5	2	0				STEEL
-2	15.5	4				PVC

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
5	15	4		0.010 IN	SCREEN-CONTINUOUS-PVC
15	15.5	4			BOTTOM CAP

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	3	BENTONITE	
3	3.5	100 MESH COLORADO SILICA SAND	
3.5	16	16/30 COLORADO SILICA SAND	

Section 7: Well Test Data

Total Depth: 16
Static Water Level: 10.4
Water Temperature:

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

CASING ELEVATION: 5450.39' LOGGED BY: RICHARD GRAF MSPC
N741488.51149 / E1229400.09438

Section 9: Well Log

Geologic Source

111FILL - HOLOCENE MAN-DEPOSITED FILL MATERIALS

From	To	Description
0	0.5	SANDY SILT DARK BROWN (10YR 3/3) 55% FINES 40% FINE SAND 5% MED SAND SOFT LOW PLASTICITY MOIST ROOTLETS FILL
0.5	2.5	SILTY SAND BROWN (10YR 5/3) 40% FINES 30% FINE SAND 15% MED SAND 10% COARSE SAND TRACE FINE GRAVEL LOOSE MOIST FILL MATERIAL (CHARCOAL GLASS WOOD TAILINGS?) OXIDATION ZONES IN COARSE FRACTION. FILL
2.5	3	NO RECOVERY
3	5.2	SILTY SAND AS ABOVE FILL
5.2	16	NO RECOVERY SOIL TOO LOOSE TO STAY IN SAMPLER RESIDUE ON SAMPLER INDICATES FINE BLACK SOIL WITH "REDUCING" ODOR
16	20	FROM CUTTINGS OF AUGER FLIGHTS: SILTY CLAY BLACK (10YR 2/1) 755 FINES 10% FINE SAND 5% MED TO COARSE SAND VERY SOFT WET IN REDUCING IN ODOR HIGH ORGANIC CONTENT 10% FIBERIOUS PLANT MATERIAL

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:
Company: OKEEFE DRILLING CO
License No: -
Date Completed: 8/25/1993

MONTANA WELL LOG REPORT

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Other Options

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Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View hydrograph for this site
View field visits for this site
View water quality for this site

Site Name: ATLANTIC RICHFIELD * AMW-13B
GWIC Id: 240863

Section 1: Well Owner(s)

1) ATLANTIC RICHFIELD (MAIL)
317 ANACODA RD
BUTTE MT 59701 [12/07/2007]

Section 2: Location

Township	Range	Section	Quarter Sections
03N	08W	24	SW¼ SW¼ NE¼ SE¼

County SILVER BOW **Geocode**

Latitude	Longitude	Geomethod	Datum
45.993623385	112.533136476	SUR-GPS	NAD83

Ground Surface Altitude	Method	Datum	Date
5449.44	SUR-GPS	NGVD29	11/17/2008

Measuring Point Altitude	Method	Datum	Date Applies
5450.79	MAP	NGVD29	11/17/2008

Addition **Block** **Lot**

Section 3: Proposed Use of Water

MONITORING (1)

Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Friday, December 07, 2007

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	40	7

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
0	27	2	0.154		FLUSH THREAD	PVC

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
27	28.5	2		0.020 IN	SCREEN-CONTINUOUS-PVC

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	25	BENTOINTE	
25	40	SILICA SAND	

Section 7: Well Test Data

Total Depth: 40
Static Water Level: 10
Water Temperature:

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source

111SNGR - SAND AND GRAVEL (HOLOCENE)

From	To	Description
0	7	SAND AND SILT
7	22	CLAY AND SILT
22	25	GRAVEL
25	35	GRAVEL WITH SAND AND SILT
35	40	MEDIUM GRAVEL

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: CLAY PARSONS
Company: PARSONS DRILLING
License No: MWC-362
Date Completed: 12/7/2007

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

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View water quality for this site
View scanned well log (11/1/2011 3:29:57 PM)
View scanned update/correction (11/1/2011 3:30:35 PM)

Site Name: ATLANTIC RICHFIELD BPSOU * AMW-13C
GWIC Id: 255975

Section 1: Well Owner(s)

1) ATLANTIC RICHFIELD (MAIL)
N/A
N/A N/A N/A [No Date]

Section 2: Location

Township	Range	Section	Quarter Sections
03N	08W	24	NW¼ SW¼ NE¼ SE¼

County SILVER BOW **Geocode**

Latitude	Longitude	Geomethod	Datum
45.993654902	112.533157883	SUR-GPS	NAD83

Ground Surface Altitude	Method	Datum	Date
5452.547			

Addition **Block** **Lot**

Section 3: Proposed Use of Water

MONITORING (1)

Section 4: Type of Work

Drilling Method: HOLLOWSTEM AUGER
Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Wednesday, May 12, 2010

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	84	8

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-1.6	71.7	2				PVC

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
71.7	81.7	2		0.020 IN	SCREEN-CONTINUOUS-PVC

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	2	QUICKRETE	
2	67.8	GROUT WITH BENTONITE	
67.8	84	10-20 COLORADO SILICA SAND	

Section 7: Well Test Data

Total Depth: 84
Static Water Level: 10.42
Water Temperature:

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source
Unassigned

From	To	Description
0	4	TOPSOIL, BLACK, DAMP
4	6	SAND AND SILT, FILL
6	14	GRAVEL, COBBLES, POOR RETURNS, FILL, TRASH, GLASS MINIMAL RETURNS
14	15.5	ORGANIC SILT, WET, SLIGHTLY COHESIVE, BLACK, ODOR
15.5	19	NO RETURNS
19	20	SPT SILT, SANDY, WET, BLACK ML
20	21	SAND, MED, WET, OX, RED SP
21	24	NO RETURNS
24	25.5	SPT SAND, WELL GRADED SW
25.5	26	GRAVEL FRAGMENT AND SAND SP
26	29	NO RETURNS
29	31	SPT SAND, COARSE TO FINE LIGHT BROWN, ? HEAVE SP
31	34	SILTY SAND SLURRY, BLACK SM
34	35.5	SPT SAND, SILTY SP-SM
35.5	36	GRAVEL IN SILTY MATRIX

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: STEVE MALKOVICH
Company: OKEEFE DRILLING CO
License No: MWC-380
Date Completed: 5/12/2010

Site Name: ATLANTIC RICHFIELD BPSOU
GWIC Id: 255975
Additional Lithology Records

From	To	Description
36	39	NOTE: AUGER CHATTER 34' - 37'BGS GRAVEL OR COBBLES NO RETURNS
39	41	SPT 39'-40'3" ?HEAVE/SLOUGH SAND WITH GRAVEL SP
41	44	AUGER - MINIMAL RETURNS, SOME BLACK SLURRY
44	47	SPT SAMPLES - HEAVE/SLOUGH 45'2"-46', GRAVEL AND SAND GP-SP, GRAVEL, SOME BROKEN SOME SUBROUNDED
47	49	AUGER, 12 GALLONS SLURRY RETURNS
49	51	SPT SAMPLES, HEAVE/SLOUGH 1.5' CLAY, DENSE COHESIVE, BROWN
51	54	AUGER - NO RETURNS
54	57	SPT CLAY, DENSE, COHESIVE BROWN, ORANGE STREAK AT 55' CL-CH
57	59	AUGER 7 GALLONS SLURRY
59	60	SPT CLAY, DENSE, COHESIVE
60	61	SAND, SILTY SP-SM
61	61.5	ROCK FRAGMENT WITH SILT
61.5	64	AUGER 5 GALLONS SLURRY 61'5"-63' GRAVEL - RIG CHATTER
64	66	SPT INTERBEDDED SANDY SILT AND CLAY ML-CL, DENSE BROWN
66	68	SPT SILTY SAND TO SANDY SILT DENSE, BROWN, SLIGHTLY COHESIVE SM-ML
68	69	AUGER 13 GALLONS SLURRY
69	70.5	SPT SILT SANDY, DENSE, RED BROWN ML
70.5	71	CLAY, DENSE, COHESIVE BROWN CL-CH
71	71.5	SAND WITH SOME SILT SP
71.5	72.5	SAND, SILTY SM-ML
72.5	73	CLAY, DENSE, COHESIVE CL-CH
73	74	AUGER
74	75.4	CLAY, SANDY DENSE, COHESIVE CL. AUGER, HARDER DRILLING
75.4	76	SAND, SILTY, MICA HIGHLY OXIDIZED. AUGER, HARDER DRILLING.
76	76.2	SIH2 OXIDATION. AUGER, HARDER DRILLING
76.2	76.5	SILT TO GRAVEL SIZE PARTICLES, CAN CRUSH WITH FINGERS. AUGER, HARDER DRILLING.
76.5	79	AUGER, HARDER DRILLING.
79	80.4	COARSE SAND AND FINE GRAVEL WITH SOME 1/2 INCH SW
80.4	81.6	SAND, SP
81.6	82.4	SILT, SANDY, DENSE, OXIDATION ML
82.4	84	15 GALLONS SLURRY FROM 79-84
84	85.7	SILT DENSE, OXIDIZED ML, ABUNDANT MICA
85.7	87.2	ROCK FRAGMENTS, OXIDIZED MICA AND QUARTZ IN CRYSTALLINE MATRIX BEDROCK 86' BGS

MONTANA WELL LOG REPORT

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Other Options

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Plot this site in Google Maps
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View water quality for this site

Site Name: ATLANTIC RICHFIELD * AMC-24B
GWIC Id: 240858

Section 1: Well Owner(s)

1) ATLANTIC RICHFIELD (MAIL)
317 ANACONDA RD
BUTTE MT 59701 [12/04/2007]

Section 2: Location

Township	Range	Section	Quarter Sections
03N	08W	24	NE¼ SE¼

County SILVER BOW **Geocode**

Latitude	Longitude	Geomethod	Datum
45.994440078	112.529674107	SUR-GPS	NAD83

Ground Surface Altitude **Method** **Datum** **Date**

Addition **Block** **Lot**

Section 3: Proposed Use of Water

MONITORING (1)

Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Tuesday, December 04, 2007

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	50.5	7

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
0	39	2	0.154		FLUSH THREAD	PVC

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
39	49	2		0.020 IN	SCREEN-CONTINUOUS-PVC

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	37	BENTONITE	
37	50.5	SILICA SAND	

Section 7: Well Test Data

Total Depth: 50.5
Static Water Level: 8.9
Water Temperature:

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source

111SNGR - SAND AND GRAVEL (HOLOCENE)

From	To	Description
0	1.5	BROWN LOAMY SAND
1.5	4	CONCRETE, BRICK RUBBLE
4	28	BROWN FINE SAND
28	50.5	COARSE SAND AND GRAVEL, OXIDIZED WET

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: CLAY PARSONS
Company: PARSONS DRILLING
License No: MWC-362
Date Completed: 12/4/2007

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

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Plot this site in Google Maps
View hydrograph for this site
View field visits for this site
View water quality for this site

Site Name: ATLANTIC RICHFIELD * BPS07-08A
GWIC Id: 240866

Section 1: Well Owner(s)

1) ATLANTIC RICHFIELD (MAIL)
317 ANACONDA RD
BUTTE MT 59701 [01/07/2008]

Section 2: Location

Township	Range	Section	Quarter Sections
03N	08W	24	SE¼ NW¼

County
SILVER BOW

Geocode

Latitude	Longitude	Geomethod	Datum
45.996943507	112.540476327	SUR-GPS	NAD83

Ground Surface Altitude	Method	Datum	Date
5446.16	SUR-GPS	NGVD29	2/11/2008

Addition **Block** **Lot**

Section 3: Proposed Use of Water

MONITORING (1)

Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Monday, January 07, 2008

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	20	7

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
0	7.5	2	0.154		FLUSH THREAD	PVC

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
7.5	17	2		.020	SCREEN-CONTINUOUS-PVC

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	7.5	BENTOINTE	
7.5	20	SILICA SAND	

Section 7: Well Test Data

Total Depth: 20
Static Water Level: 10
Water Temperature:

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source

110SNGR - SAND AND GRAVEL (QUATERNARY)

From	To	Description
0	6.5	FILL, SAND, COBBLES ASPHALT,CONCRETE
6.5	15	COARSE SAND AND FINE GRAVEL,MOIST
15	20	NO RETURNS

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: CLAY PARSONS
Company: PARSONS DRILLING
License No: MWC-362
Date Completed: 1/7/2008

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View hydrograph for this site

Site Name: ATLANTIC RICHFIELD * BPS07-14A
GWIC Id: 248555

Section 1: Well Owner(s)

1) ATLANTIC RICHFIELD (MAIL)
317 ANACONDA RD
BUTTE MT 59701 [06/11/2008]

Section 2: Location

Township	Range	Section	Quarter Sections
03N	08W	24	NE¼ NE¼

County
SILVER BOW

Geocode

Latitude	Longitude	Geomethod	Datum
45.996523731	112.542975733	SUR-GPS	NAD83

Ground Surface Altitude **Method** **Datum** **Date**

Addition **Block** **Lot**

Section 3: Proposed Use of Water

MONITORING (1)

Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Wednesday, June 11, 2008

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	31.5	7

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
2	16	2	0.154		FLUSH THREAD	PVC-SDR 17

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
16	26	2		.020	SCREEN-CONTINUOUS-PVC

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
2	14	BENTONITE	
14	26	SILICA SAND	

Section 7: Well Test Data

Total Depth: 26
Static Water Level: 17.5
Water Temperature:

Air Test *

5 gpm with drill stem set at 26 feet for _ hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source
Unassigned

From	To	Description
0	15	SLAG, BLACK TO DARK BROWN
15	20	SLAG BLACK
20	25	SLAG
25	31.5	MIXED SLAG AND SAND

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: CLAY PARSONS
Company: PARSONS DRILLING
License No: MWC-362
Date Completed: 6/11/2008

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

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View water quality for this site

Site Name: ATLANTIC RICHFIELD * BPS07-15A
GWIC Id: 248557

Section 1: Well Owner(s)

1) ATLANTIC RICHFIELD (MAIL)
317 ANACONDA RD
BUTTE MT 59701 [06/13/2008]

Section 2: Location

Township	Range	Section	Quarter Sections
03N	08W	24	NE¼ SW¼

County
SILVER BOW

Geocode

Latitude	Longitude	Geomethod	Datum
45.996255074	112.541749813	SUR-GPS	NAD83

Ground Surface Altitude	Method	Datum	Date
5455.07	SUR-GPS	NGVD29	

Addition **Block** **Lot**

Section 3: Proposed Use of Water

MONITORING (1)

Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Friday, June 13, 2008

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	36	7

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	15	2	0.154		FLUSH THREAD	PVC-SDR 17

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
15	35	2		020	SCREEN-CONTINUOUS-PVC

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
2	12	BENTONITE	
12	35	SIICA SAND	

Section 7: Well Test Data

Total Depth: 36
Static Water Level: 16
Water Temperature:

Air Test *

5 gpm with drill stem set at 36 feet for _ hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source

111FILL - HOLOCENE MAN-DEPOSITED FILL MATERIALS

From	To	Description
0	10	NO RETURN
10	12	BLACK SLAG
12	15	DARK GRAY SLAG
15	20	DARK GRAY SLAG
20	30	NO RETURNS
30	34	GRAVELS
34	35	CLAYS

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: CLAY PARSONS
Company: PARSONS DRILLING
License No: MWC-362
Date Completed: 6/13/2008

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

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View field visits for this site
View water quality for this site

Site Name: ATLANTIC RICHFIELD * BPS07-21B
GWIC Id: 253710

Section 1: Well Owner(s)

1) ATLANTIC RICHFIELD (MAIL)
307 ANACONDA RD
BUUTE MT 59701 [12/18/2009]

Section 2: Location

Township	Range	Section	Quarter Sections
03N	08W	24	NW¼ SE¼

County / **Geocode**

SILVER BOW

Latitude	Longitude	Geomethod	Datum
45.994844226	112.533986415	SUR-GPS	NAD83

Ground Surface Altitude **Method** **Datum** **Date**

Addition **Block** **Lot**

Section 3: Proposed Use of Water

MONITORING (1)

Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Friday, December 18, 2009

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	47	7

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
0	33	6	0.25		WELDED	A53B STEEL
0	35.5	0.8			FLUSH THREAD	PVC-SCHED 120

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
35.5	45.5	2		0.020 IN	SCREEN-CONTINUOUS-PVC

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	33	BENTONITE	
33	47	SILICA SAND	

Section 7: Well Test Data

Total Depth: 47
Static Water Level:
Water Temperature:

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

33 FT CASING LEFT IN THE GROUND BENTONITE CHIPS TO SURFACE AND OUTER ANNULAS OF CASING FLUSH MOUNT CEMENTED IN

Section 9: Well Log

Geologic Source

Unassigned

From	To	Description
0	2	FILL LTERED QTZ MONZONITE TO 3
2	7	FILL SAND AND GRAVEL,METAL,GLASS
7	10	FILL,FINEGRAINED,LOOSE SOIL,BLACK,MOIST,MINOR PAPER DEBRIS
10	15	ROCK FRAGMENTS,ANGULAR WITH SAND AND SILT,WET,BLACK SM WITH GRAVEL
15	20	SILT AND SAND,WET BLACK ML
20	25	SILT AND SAND,WET BLACK ML
25	30	SILT AND SAND,WET BLACK SM-ML
30	35	SILT,COHESIVE,WET BROWN ML-MH
35	40	GRAVEL,SUB ROUNDED TO SUBGRANULAR,WET,BROWN SP
40	45	SAND,FINE GRAINED WET,BROWN GP
45	47	SAND WITH SOME SILT SP-ML

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: CLAY PARSONS
Company: PARSONS DRILLING
License No: MWC-362
Date Completed: 12/18/2009

03N08W24BD

PIONEER TECHNICAL SERVICES, INC.
BUTTE, MONTANA

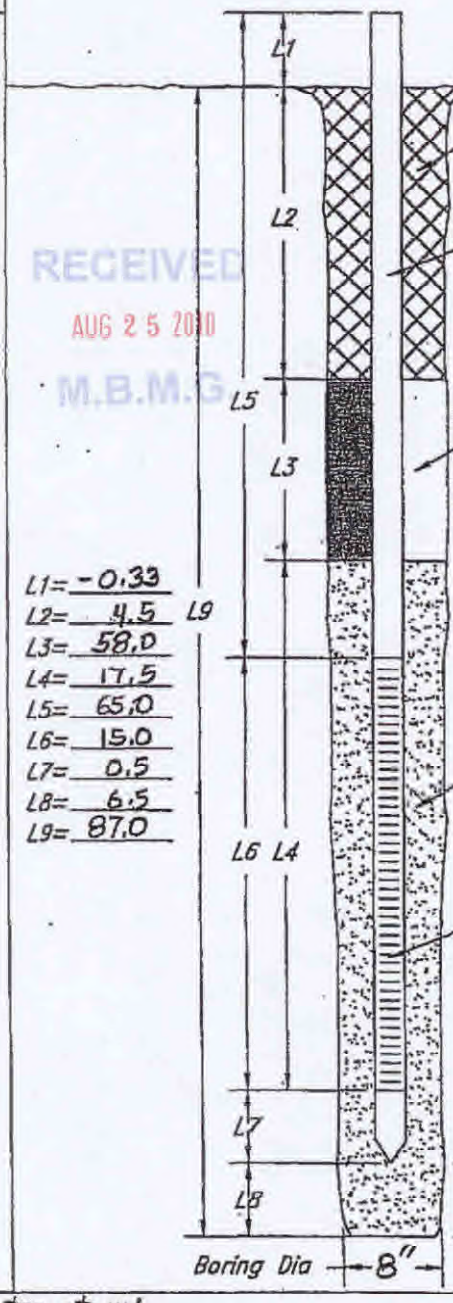
SOIL BORING LOG & WELL CONSTRUCTION DETAILS

Project: BPSOU Groundwater Deep Wells Soil Boring/Well Number: BPSOU7-21C
Location: 651095.71 N; 1197903.98E Date: 8/3/10 - 8/4/10 Time Start/Finish: 0925/1130
Driller: Steve Malkovich Drilling Company: O'Keefe Drilling
Drilling Method: Hollow Stem Auger with Split Spoon Sampler

Depth to Water: _____ Logged By: Will Goldberg (PTS)

	Soil Boring Log	PID READING (PPM)
0	Water Knife to 6'bgs Sand, gravel, wood and assorted debris	
5		
6	no auger returns	
9	SPT 2-1-2 0.1' recovery	
10	grass, sand, glass	
	no auger returns	
14	SPT 7-13-9, 1.3' recovery	
15	Peat, dark gray to black Interbedded sand & silty sand	
	no auger returns	
19	SPT 4-4-5 Clay, cohesive	
20	wet, roots, trace mica CH-OH	
	no auger returns	
24	SPT 5-10-17 0.9' recovery	
25	Sand, medium, minor ox, SP	
	no auger returns	
29	3" split spoon; sand, fine	
30	to medium, trace gravel, wet SW	
	sand, silty, dense, ox, red brn, SP	
	2" SPT Sand, med to coarse, some	
	sub angular to sub rounded	
33	gravel, SP plt 6.6, SC 48"	
	no auger returns	
	SPT Sand, silty, SM	

Well Type: _____



Ground elev.= 5457.01
TOC elev.= 5456.68

Backfill/Grout Type: Bentonite chips with concrete at surface

Casing Type/Size/Dia.: PVC/blank/2inch

Seal elev.= 5452.51

Seal Type: Bentonite Grout

Filter Pack elev.= 5394.51

Top of Screen elev.= 5392.01

Filter Pack Type/Size: 10-20 Colorado Silica Sand

Screen Type/Size/Dia: PVC/20slot/2inch

Bottom of Well elev.= 5376.51

Bottom of Boring elev.= 5370.01

L1= -0.33
L2= 4.5
L3= 58.0
L4= 17.5
L5= 65.0
L6= 15.0
L7= 0.5
L8= 6.5
L9= 87.0

Remarks: Driller 1st reported water at 14'
Note: Flush Mount Casing; PVC 0.33' below top flush mount cover

Signature: _____

M:257404

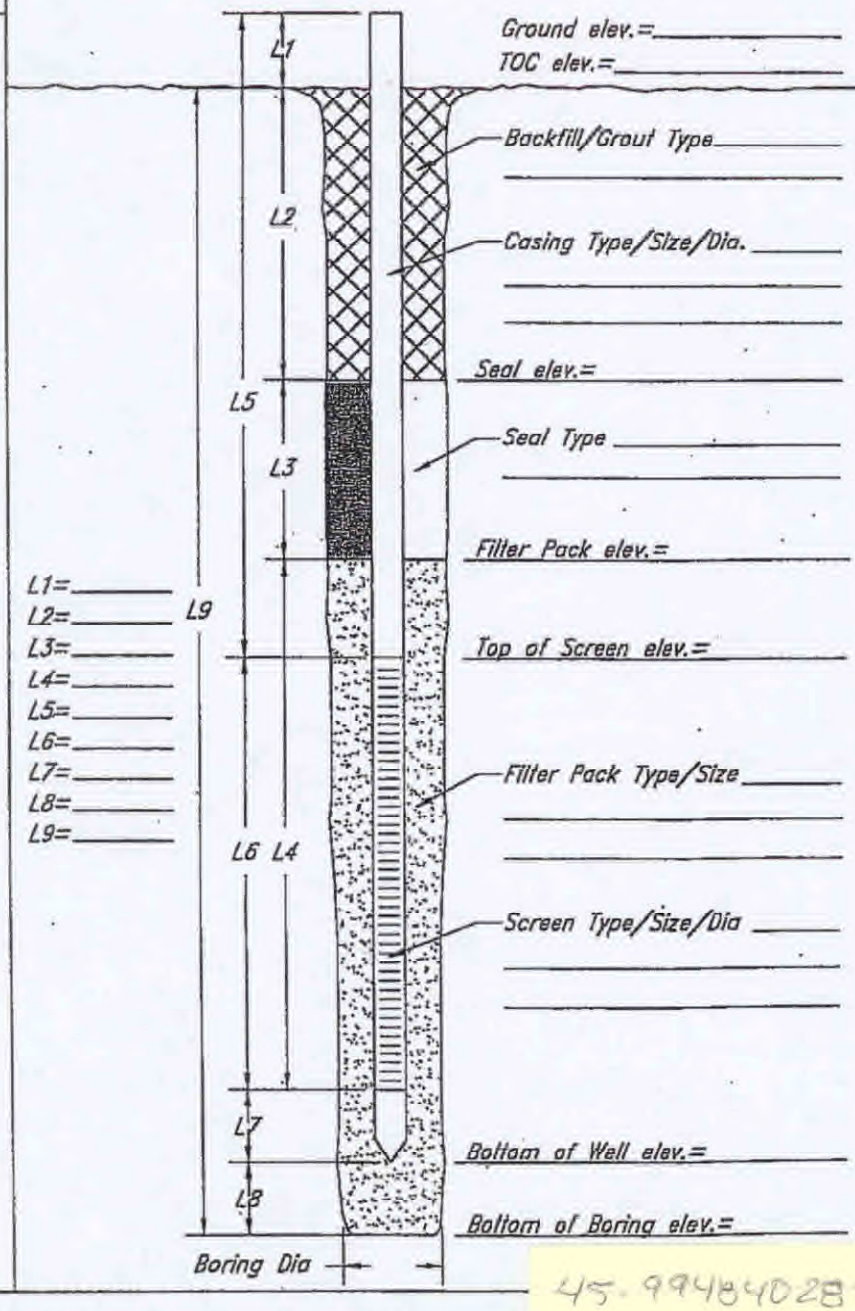
PIONEER TECHNICAL SERVICES, INC.

SOIL BORING LOG & WELL CONSTRUCTION DETAILS

Project: BPSOU Groundwater Deep Wells Soil Boring/Well Number: BPSD7-21C
Location: _____ Date: _____ Time Start/Finish: _____
Driller: Steve Malkovich Drilling Company: O'Keefe Drilling
Drilling Method: Hollow Stem Auger with Split Spoon Sampler
Depth to Water: _____ Logged By: Will Goldberg (PTS)

	Soil Boring Log	PID READING (PPM)
35	pH 6.67, SC 422 Sand, med grain with sub angular to subrounded gravel to 3/4" interbeds of magnetite SP	
38	no auger returns	
40	Medium sub rounded gravel in silty sand matrix, very	
40.4	dense. Cohesive fine fractio pH 6.54 SC 384	
	no auger returns	
44		
45	Sand, silty, dense, brown some mica, trace fine gravel, to 1/2" size, SM	
47	no auger returns pH 6.31, SC 438	
49		
50	Silt, sandy, cohesive, dense light brown	
51	Sand, silty, w angular gravel	
52.3	very loose, wet, brown, SM	
53	Sand, silty, dense to v dense SM	
54	No auger returns	
55	sand, silty, dense, with 1 2" gravel SM	
	probable some sample is caved/heave pH 6.73 SC 772	
58	No auger returns	
59		
60	Interbedded gray silt and oxidized fine sand, dense	
61	SM - ML	
	No auger returns	
64	Sand, medium, some silt SP	
65		
65.9	sand, silty with gravel SM-SP	
	medium to fine gravel, GP	
67.7	Fine to medium Sand SW	
	Sand, silty with gravel SM	
	pH 6.79. SC 800	
	Sand, fine to med. with trace	

Well Type: _____



Remarks: _____

Signature: _____

45.994840287
112.533966792
03N 08W 24

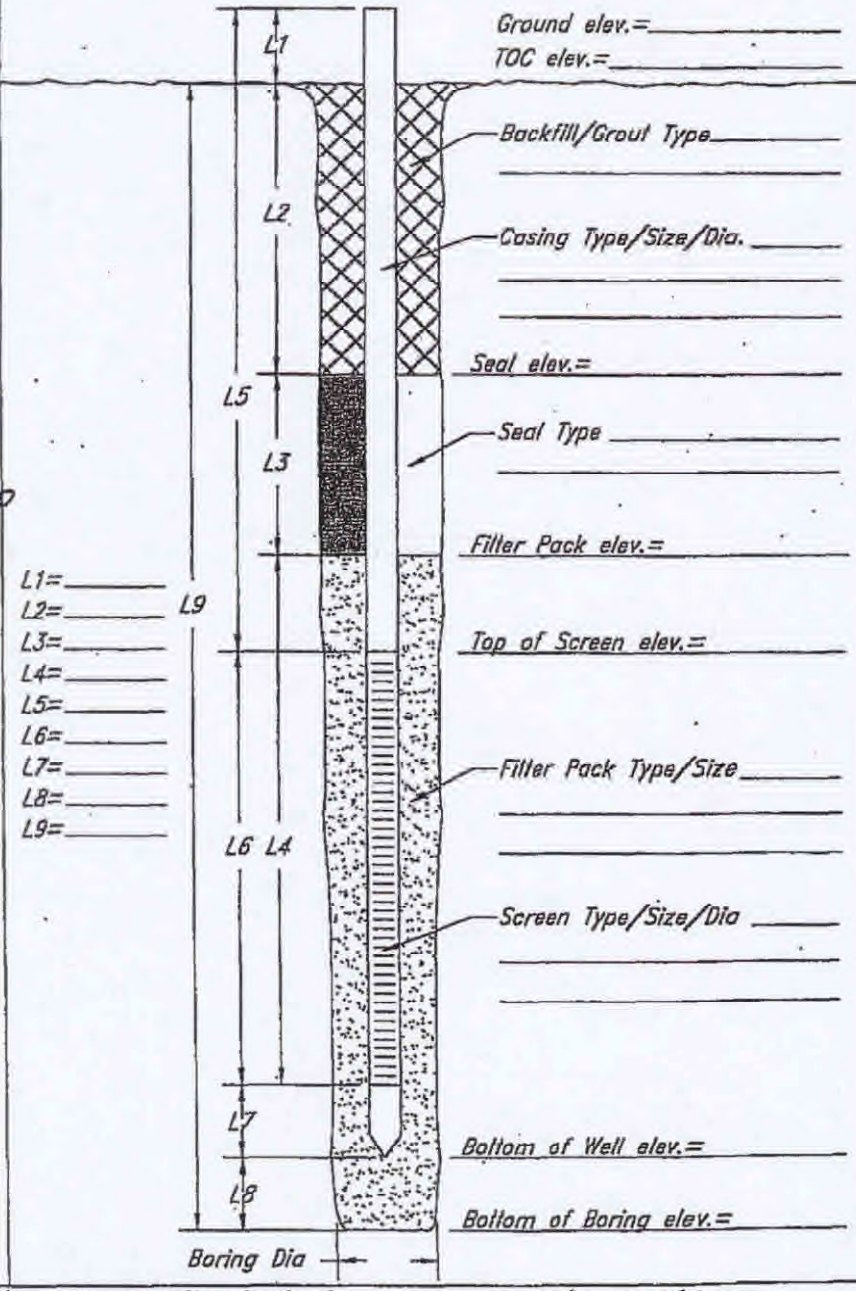
PIONEER TECHNICAL SERVICES, INC.
BOISE, MONTANA

SOIL BORING LOG & WELL CONSTRUCTION DETAILS

Project: BPSOU Groundwater Deep Wells Soil Boring/Well Number: BPSO7-21C
Location: _____ Date: _____ Time Start/Finish: _____
Driller: Steve Malkovich Drilling Company: O'Keefe Drilling
Drilling Method: Hollow Stem Auger with Split Spoon Sampler
Depth to Water: _____ Logged By: Will Goldberg (PTS)

	Soil Boring Log	PID READING (PPM)
70	medium to coarse sub.	
71	angular gravel; trace silt	
72	Sand, fine to med, dense SP	
	Driller reports harder drilling at 73' bgs	
74	Sand, medium, light brown SP	
75	Sand, fine to med., OX, mica red brown SW	
76.5	sand, fine to med, with angular to subrounded gravel PH 6.87 SC 731	
	No Auger Returns	
79	Sand; medium, black OX, SP	
80	silt, dense, cohesive, ML-MH	
81	large quartz fragment	
83	Sand, fine-medium ? cave, SW pH 6.90 SC 740	
85	Sand, silty, brown SM	
86	Sand, silty, SM-ML ? cave	
88	Some slurry at collar	
89	Silt, with some zones of	
90	sandy silt, cohesive,	
91	med. dense ML-MH	
	cave in 5 ft.	
	Large fine grained qtz fragment (? aplite)	
	Sand at bottom sampler	

Well Type: _____



L1= _____
L2= _____
L3= _____
L4= _____
L5= _____
L6= _____
L7= _____
L8= _____
L9= _____

Remarks: Drilling finished 8/3 & well constructed BH. TD on 8/4 97' bgs

Signature: Will Goldberg

Buckley, Luke

From: Smith, Garrett
Sent: Tuesday, August 24, 2010 3:51 PM
To: Buckley, Luke
Cc: Tucci, Nicholas
Subject: New Well Logs
Attachments: BPS New Well Logs.pdf

Hi Luke-
I have some new well logs that need to be entered into GWIC (see attached pdf).
I have included the GWIC numbers below, as well as the total depth, screen interval, and the elevations are converted to NGVD29 (since they're NAVD88 on the logs).
Thanks

Garrett

		NGVD29			
Well Name	*GWIC ID*	*TOC Elev*	*Ground Elev*	*TD (ft)*	*Screen Int. (ft)*
AMC-24C	**255974**	**5450.417**	**5448.47**	**83.5**	**69-79**
AMW-13C	**255975**	**5449.958**	**5448.338**	**84**	**60-70**
BPS07-21C	**257404**	**5452.471**	**5452.801**	**87**	**65-80**
BPS07-24	**257403**	**5451.721**	**5450.331**	**71**	**58-68**

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Return to menu
Plot this site in State Library Digital Atlas
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View field visits for this site
View water quality for this site
View scanned well log (11/1/2011 3:35:44 PM)

Site Name: ARCO * AMW-11
GWIC Id: 161962

Section 1: Well Owner(s)

1) ARCO (MAIL)
N/A
BUTTE MT 59701 [09/14/1993]

Section 2: Location

Township	Range	Section	Quarter Sections
03N	08W	24	SE¼ SE¼ NW¼ SE¼

County
SILVER BOW

Geocode

Latitude	Longitude	Geomethod	Datum
45.994037881	112.53512929	SUR-GPS	NAD83

Ground Surface Altitude	Method	Datum	Date
5449.81	SUR-GPS		3/9/2005

Measuring Point Altitude	Method	Datum	Date Applies
5445.14			7/30/2004

Addition **Block** **Lot**

Section 3: Proposed Use of Water

MONITORING (1)

Section 4: Type of Work

Drilling Method: HOLLOW STEM AUGER
Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Tuesday, September 14, 1993

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	15.5	2

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	14	2				PVC

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
4	14	2		0.010 IN	SCREEN-CONTINUOUS-PVC

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	3	BENTONITE	
3	3.5	100 MESH SILICA SAND	
3.5	15.5	16/30 COLORADO SILICA SAND	

Section 7: Well Test Data

Total Depth: 14
Static Water Level: 5.54
Water Temperature:

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source
111SNGR - SAND AND GRAVEL (HOLOCENE)

From	To	Description
0	1.2	SANDY SILT - DARK BROWN (10YR 4/3) 75% NONPLASTIC FINES 25% FINE TO COARSE ANGULAR SAND SOFT SLIGHTLY MOIST TO MOIST FILL
1.2	1.8	SILTY CLAY - GRAYISH BROWN (10YR 5/2) 100% MODERATELY PLASTIC FINES SOFT MOIST TO WET MODERATELY OXIDIZED - FILL
1.8	2	NO RECOVERY
2	4	NO RECOVERY - OUTSIDE OF SPOON APPEARS TO BE SMEARED WITH CLAY
4	4.8	SANDY SILT - DARK BROWN (10YR 4/3) 75% NONPLASTIC FINES 25% FINE TO COARSE ANGULAR SAND SOFT MOIST TO WET - FILL?
4.8	5.9	CLAY - VERY DARK GRAY (10YR 3/1) 95% MODERATELY PLASTIC CLAY 5% FINE SAND ABUNDANT ORGANICS ALLUVIUM?
5.9	6	SILT - GRAY (10YR 5/1) 95% NONPLASTIC FINES 5% FINE ANGULAR SAND SOFT WET ABUNDANT ORGANICS ALLUVIUM OR FILL?
6	6.8	SAND - REDDISH BROWN 10% FINES 30% MEDIUM SUBANGULAR SAND 30% COARSE SUBANGULAR SAND WELL GRADED POORLY SORTED LOOSE WET FILL?
6.8	7.5	SILT AND SLAG - DARK GRAY (10YR 4/1) 50% NONPLASTIC FINES 50% BROKEN SLAG FILL
7.5	8	NO RECOVERY
8	9	SILTY SAND - DARK GRAY (10YR 4/1) WITH REDDISH MOTTLING 25% FINES 40% FINE SUBANGULAR SAND 15% MEDIUM SUBROUND SAND 20% COARSE SUBROUND SAND WELL GRADED POORLY SORTED LOOSE WET - ALLUVIUM?
9	12	NO RECOVERY
12	12.3	SILTY SAND - DARK GRAYISH BROWN (10YR 5/2) 20% FINES 60% FINE ANGULAR SAND 10% MEDIUM SUBANGULAR SAND 10% COARSE SUBROUND SAND POORLY SORTED

		MODERATELY TO POORLY GRADED LOOSE WET - ALLUVIUM
12.3	14	NO RECOVERY

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:	
Company:	OKEEFE DRILLING CO
License No:	-
Date Completed:	9/14/1993

MONTANA WELL LOG REPORT

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Other Options

Return to menu
Plot this site in State Library Digital Atlas
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View hydrograph for this site
View field visits for this site
View water quality for this site

Site Name: ATLANTIC RICHFIELD * BPS07-16A
GWIC Id: 248566

Section 1: Well Owner(s)

1) ATLANTIC RICHFIELD (MAIL)
317 ANACONDA RD
BUTTE MT 59701 [06/17/2008]

Section 2: Location

Township	Range	Section	Quarter Sections
03N	07W	19	SW¼ SW¼

County: SILVER BOW
Geocode:

Latitude	Longitude	Geomethod	Datum
45.992065694	112.525227866	SUR-GPS	NAD83

Ground Surface Altitude: **Method**: **Datum**: **Date**:

Addition: **Block**: **Lot**:

Section 3: Proposed Use of Water

MONITORING (1)

Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Thursday, June 19, 2008

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	24	7

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	10	2	0.154		FLUSH THREAD	PVC-SDR 17

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
10	20	2		0.020 IN	SCREEN-CONTINUOUS-STAINLESS

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	8	BENTOINTE	
8	20	SILICA SAND	

Section 7: Well Test Data

Total Depth: 20
Static Water Level: 7.5
Water Temperature:

Air Test *

2 gpm with drill stem set at 20 feet for _ hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source

Unassigned

From	To	Description
0	7	NO RETURNS
7	10	FINE SAND
10	20	COARSE SAND

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: CLAY PARSONS
Company: PARSONS DRILLING
License No: MWC-362
Date Completed: 6/19/2008

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View hydrograph for this site
View field visits for this site
View water quality for this site

Site Name: ATLANTIC RICHFIELD * BPS07-16B
GWIC Id: 248565

Section 1: Well Owner(s)

1) ATLANTIC RICHFIELD (MAIL)
317 ANACONDA RD
BUTTE MT 59701 [06/16/2008]

Section 2: Location

Township	Range	Section	Quarter Sections
03N	07W	19	SW¼ SW¼

County
SILVER BOW

Geocode

Latitude	Longitude	Geomethod	Datum
45.992109077	112.525228459	SUR-GPS	NAD83

Ground Surface Altitude **Method** **Datum** **Date**

Addition **Block** **Lot**

Section 3: Proposed Use of Water

MONITORING (1)

Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Monday, June 16, 2008

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	40	7

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	30	2	0.154		FLUSH THREAD	PVC-SDR 17

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
30	40	2		0.020 IN	SCREEN-CONTINUOUS-PVC

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
-2	28	BRNTONITE	
28	40	SILICA SAND	

Section 7: Well Test Data

Total Depth: 40
Static Water Level: 7.15
Water Temperature:

Air Test *

5 gpm with drill stem set at 40 feet for _ hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source
Unassigned

From	To	Description
0	10	NO RETURN
10	15	COARSE AND FINE SAND
15	20	FINE GRAVEL AND SAND
20	30	FINE GRAVEL AND SAND
30	35	SANDY SILT
35	40	FINE GRAVEL AND FINE SAND

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: CLAY PARSONS
Company: PARSONS DRILLING
License No: MWC-362
Date Completed: 6/16/2008

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Return to menu
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View hydrograph for this site
View field visits for this site
View water quality for this site
View scanned well log (8/27/2010 1:18:35 PM)

Site Name: BUTTE PRIORITY SOILS * BPS07-24
GWIC Id: 257403

Section 1: Well Owner(s)

1) BUTTE PRIORITY SOILS OPERABLE UNIT (MAIL)
N/A
BUTTE MT N/A [No Date]

Section 2: Location

Township	Range	Section	Quarter Sections
03N	07W	19	

County SILVER BOW **Geocode**

Latitude	Longitude	Geomethod	Datum
45.995811629	112.526570706	SUR-GPS	NAD83

Ground Surface Altitude	Method	Datum	Date
5454.54			

Addition **Block** **Lot**

Section 3: Proposed Use of Water

MONITORING (1)

Section 4: Type of Work

Drilling Method: HOLLOW STEM AUGER WITH SPLIT SPOON SAMPLER
Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Thursday, August 05, 2010

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	71	8

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-1.4	59.4	2				PVC

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
59.4	69.4	2		20	SCREEN-CONTINUOUS-PVC

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	2	CONCRETE	N
2	54.7	BENTONITE GROUT	N
54.7	71	COLORADO SILICA SAND / 10-20	N

Section 7: Well Test Data

Total Depth: 71
Static Water Level: 6
Water Temperature:

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source
Unassigned

From	To	Description
0	8.5	WATER KNIFE - FILL SOIL, ROCK, CONCRETE, WOOD, ASSORTED DEBRIS. PH 6.16, SC 2024, WL 6' BGS
8.5	10.5	ORGANIC CLAY, COHESIVE, WET BLACK SANDY CLAY, COHESIVE GREEN ABUNDANT MICA
10.5	13.5	NO AUGER RETURNS
13.5	15	SAND, SILTY, WET, BLACK SIN SAND WITH SILT, SP-SM LIGHT BROWN
15	18.5	PH 6.8, SC 916. NO AUGER RETURNS
18.5	20.5	CLAY WITH SOME SAND, COHESIVE BLACK CH-, 0.1 FOOT SILTY SAND, HIGHLY OXIDIZED, NO PYRITE, MICA, RED BROWN
20.5	23.5	PH 6.41, SC 847, NO AUGER RETURNS
23.5	24.5	SPT 1.4' RECOVERY, VERY LOOSE SAND - PROBABLE HEAVE 0.1' SILTY SAND IN SITU RECOVERED
24.5	28.5	NO AUGER RETURNS
28.5	29	SPT REFUSAL AT 30.2', 1.5' RECOVERY. SAND WITH BROKEN GRAVEL, SP
29	33.5	PH 6.47, SC 960.6. NO AUGER RETURNS
33.5	33.8	SPT SAMPLE 24" RECOVERY 1.7' HEAVE SAND SW, MED-COARSE GRAVEL, BROKEN INTACT WELL-ROUNDED, GP. PH 6.3, SC 1634
33.8	38.3	NO AUGER RETURNS
38.3	39	SAND, SILTY, OXIDIZED SM
39	39	CLAY, DENSE, COHESIVE, GRAY CH-CL

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: STEVE MALKOVICH
Company: OKEEFE DRILLING CO
License No: MWC-380
Date Completed: 8/5/2010

Site Name: BUTTE PRIORITY SOILS
GWIC Id: 257403
Additional Lithology Records

From	To	Description
39	40	BROKEN LARGE GRAVEL
40	43.5	PH 6.38, SC 1619 NO AUGER RETURNS
43.5	44	SPT SAMPLE 0.4' HEAVE SAND, ANGULAR, STRONG, OXIDATION, RED BROWN
44	44.5	SILT, SANDY, DENSE, NON-COHESIVE, ML
44.5	48.5	PH 6.26, SC 1850, NO AUGER RETURNS
48.5	50	LARGE SPT SAMPLE 0.8' CAVE, 1.2' NATIVE SOIL SILT WITH SAND, COHESIVE
50	53.5	PH 6.36, SC 1719, NO AUGER RETURNS
53.5	56.5	LARGE SPT AND SMALL SPT. SILT, SANDY, DENSE, COHESIVE, DRY IN CENTER, BROKEN, ML
56.5	58.5	PH 6.36, SC 1650, NO AUGER RETURNS
58.5	59.5	FINE SAND, SOME SILT, LOOSE SP
59.5	60.5	SAND, SOME SILT, TRACE GRAVEL, DENSE, LIGHT BROWN, SW
60.5	61.5	FINE SAND TO SILTY SAND, DENSE NON-COHESIVE, ML - SM
61.5	63.5	@58.5, PH 6.37, SC 2025, NO AUGER RETURNS
63.5	64	SAND, SILTY, MED DENSE, SM
64	64.5	SAND WITH GRAVEL, SOME SILT, VERY DENSE SP
64.5	65.6	SAND, SILTY TO SILT, SANDY DENSE, COHESIVE BROWN
65.6	68.5	PH 6.5, SC 1845 @65.6' NO AUGER RETURNS
68.5	69.6	FINE SAND WITH SILT, SM
69.6	70.5	SILT AND FINE SAND, SLIGHTLY COHESIVE, MED DENSE ABUNDANT MICA, ML
70.5	71	PH 6.44, SC 2006 @68.5' BGS. SAND, SILTY, DENSE, TRACE FINE GRAVEL, SUB ROUNDED SM-SP
71	73.5	NO AUGER RETURNS

03N 08W 24 BDC

PIONEER TECHNICAL SERVICES, INC.

SOIL BORING LOG & WELL CONSTRUCTION DETAILS

Project: Butte Reduction Works Well Soil Boring/Well Number: BPS07-25
Location: 742781.6N, 1227090E NAD27 Date: 10/9/10 Time Start/Finish: 1000/1430
Driller: Clay Parsons Drilling Company: Parsons Drilling Inc
Drilling Method: Air Rotary with casing hammer
JEFFERSON Co.
Depth to Water: 9.3' bgs Logged By: Will Gobbers

Soil Boring Log	FID READING (PPM)
Fill, brown sandy loam	
Mill tailings, soft gray, wet SM-ML	
More cohesive at depth ML	
Coarse sand and fine to medium gravel, subangular to sub-rounded, wet SP-GP	
Fine sand, abundant mica, wet;	
possible bedrock hard to advance casing	

Well Type: Monitor Well

Concrete Ground elev. = 5448.92
TOC elev. = 5449.03
Backfill/Grout Type: Open Annulus between 6" steel and PVC
Casing Type/Size/Dia.: PVC/Blank/2 inch
Seal elev. = 5445.29
Seal Type: 3/8 inch bentonite chips
Filter Pack elev. = 5437.59
Top of Screen elev. = 5434.03
Filter Pack Type/Size: 10-20 Colorado Silica Sand
Screen Type/Size/Dia: PVC 20 slot/2 inch
Bottom of Well elev. = 5423.53
Bottom of Boring elev. = 5415.59
Boring Dia — 6"

L1 = 0.11
L2 = 3.30
L3 =
L4 = 13.56
L5 = 15.00
L6 = 10.00
L7 = 0.50
L8 = 7.94
L9 = 33.00

RECEIVED
DEC 01 2010
M.B.M.G.

Remarks: 8 feet steel casing in the ground
Bottom of hole is filled with cave & heaving sand and gravel
Elevations NAVD 88
Signature: Will Gobbers

M: 259208

PIONEER TECHNICAL SERVICES, INC.

Well Log

Well Name: BPS11-19A2

Project: 2011 BPSOU MWIP | Location: Butte, Montana

Well Owner: Atlantic Richfield Co. | Depth to Water: 4.53 ft | Date: 2/15/2012 Time: 10:47

Drilled by: Environmental West	Silica Sand Size: 10-20	Casing Type/Dia: PVC/2.0"	Screen Slot Size: 0.020"
Drilling Method: Roto-Sonic	Bentonite Seal: 3/8" chips	Screen Type/Length: PVC Machine Slot/10'	Borehole Dia: 6.0"

Depth (ft) | Elevation (NGVD 29) | Lithology Log | Lithology Description

Well Construction

TOC Elevation: 5445.55 ft (NGVD 29)
5449.91 ft (NAVD 88)

Logged by: W. Goldberg

Stickup: 0.49 ft

Ground Level

Surface Completion: Flush

Elevation (NGVD 29)	Depth (ft)	Lithology Description
5,445	0	FILL, TRASH, SAND, GLASS, WOOD
	5	NO RECOVERY
5,440		WELL GRADED SAND, VERY CLEAN, SW, SUBANGULAR TO SUBROUNDED GRAINS. WATER BEARING AS PER C. COOVER
5,435	10	SANDY SILT, ML
		WELL GRADED SAND, WITH 6" SANDY SILT LAYER AT 12.5'. WATER BEARING AS PER C. COOVER
5,430	15	NO RECOVERY
		FINE TO MEDIUM SAND, ABUNDANT MICA, SW. WATER BEARING AS PER C. COOVER
5,425	20	COHESIVE CLAY, OLIVE
		FINE TO MEDIUM SAND, SUBANGULAR TO SUBROUNDED, TRACE SILT, SOME OXIDATION. WATER BEARING AS PER C. COOVER
5,420	25	CLAY WITH TRACE SAND, COHESIVE, OLIVE
		HIGHLY OXIDIZED FINE SAND. WATER BEARING AS PER C. COOVER
		WELL GRADED SAND WITH TRACE FINE GRAVEL AND TRACE SILT, ORANGE BROWN. WATER BEARING AS PER C. COOVER
5,415	30	GRAVELY SAND, MEDIUM SUBROUNDED GRAVEL, SP-GP. WATER BEARING AS PER C. COOVER
		FINE TO COARSE SAND AND GRAVEL, LIGHT BROWN TO RUSTY, SUBANGULAR TO SUBROUNDED. ARGON PRESERVED CORE. WATER BEARING AS PER C. COOVER
	35	SILTY CLAY, LIGHT BROWN TO RUSTY. ARGON PRESERVED CORE
5,410		SILTY CLAY WITH FINE SAND AND SOME GRAVEL, LIGHT BROWN TO OLIVE. ARGON PRESERVED CORE
		CLAYEY SILT WITH SOME FINE SAND, LIGHT OLIVE GREEN. ARGON PRESERVED CORE
	40	FINE TO MEDIUM SILTY SAND, SUBANGULAR TO SUBROUNDED WITH FINE TO COARSE SUBANGULAR TO SUBROUNDED GRAVEL, LIGHT BROWN TO RUSTY. ARGON PRESERVED CORE. WATER BEARING AS PER C. COOVER
5,405		SAND MEDIUM GRAINED BROWN ONE COBBLE 3 INCHES WITH IRON STAINING ON COBBLE. ARGON PRESERVED CORE
		SANDY SILTY CLAY BROWN. ARGON PRESERVED CORE
		SILTY CLAY GREENISH BROWN. ARGON PRESERVED CORE
	45	SILTY SAND FINE GRAINED - WATER. ARGON PRESERVED CORE
5,400		SAND MEDIUM TO COARSE GRAINED TRACE GRAVEL. WITH IRON STAINING - WATER. ARGON PRESERVED CORE
		SAND AND GRAVEL BROWN SAND IS MEDIUM GRAINED GRAVEL IS 1/2 TO 2-1/2 INCHES NO FINES - WATER. ARGON PRESERVED CORE
	50	SILTY CLAY BROWN STIFF SAND STRINGERS AT 46.5' AND 47'. ARGON PRESERVED CORE

Flush Mount Cover
Cement Grout
2" PVC Flush Coupled Riser
10-20 Colorado Silica Sand
2" PVC Machine-Slot 0.020" Screen, 10 ft
3/8" Bentonite Chips (Hole Plug)

XRF Data From Collected Core

Cd, Zn, Ni, Ca, Mn, K, Cu, Fe

Concentration (mg/kg) Log Scale: 1, 10, 100, 1000, 10000, 100000

Particle Size Distribution

1"=30%

Gravel, Coarse | Sand, Coarse | Sand, Fine | Clay
Gravel, Fine | Sand, Medium | Silt

Percent (%): 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100

Depth (ft)

Concrete Collar Elevation: 5446.04 ft. (NGVD 29)
5450.4 ft. (NAVD 88)

Well Completion Date: 2/3/2012

Screen Interval: 33-43 ft. | Filter Pack Interval: 32-44 ft.

Driller: J.R. Cantrell | Monitoring Well License: #451

Signature _____

Well Construction Key

Bentonite, Riser, Cement Grout, Slough, Steel Casing, Filter Pack, Screen

Lithology

Ash, Asphalt, Clay, Clayey gravel, Clayey sand, Clayey Sand, some gravel, Clayey silt, Fill, Granite, No Recovery, Organic silt, Residual weathered granite, Sand, Sand, oxidized, Sand and gravel, Sand and gravel, oxidized, Sand, some gravel, Sand, some gravel oxidized, Sandy clay, Sandy silt, Sandy silt, some gravel, Silt, Silt, oxidized, Silty Clay, Silty Clay, oxidized, Silty Clay, some gravel, Silty sand, Silty Sand some gravel, Slag, Tailings, Topsoil, Weathered granite

Latitude (NAD83):45.99361299 (Dec. Degrees)
Longitude (NAD83):-112.52982098 (Dec. Degrees)
Northing (SP-N83):650609.23 ft. (IF)
Easting (SP-N83):1198941.55 ft. (IF)
T3N R8W S24

GWIC ID # 265010

PIONEER TECHNICAL SERVICES, INC.

Well Log

Well Name: BPS11-19A2

Project: 2011 BPSOU MWIP | Location: Butte, Montana

Well Owner: Atlantic Richfield Co. | Depth to Water: 4.53 ft | Date: 2/15/2012 Time: 10:47

Drilled by: Environmental West	Silica Sand Size: 10-20	Casing Type/Dia: PVC/2.0"	Screen Slot Size: 0.020"
Drilling Method: Roto-Sonic	Bentonite Seal: 3/8" chips	Screen Type/Length: PVC Machine Slot/10'	Borehole Dia: 6.0"

Well Construction

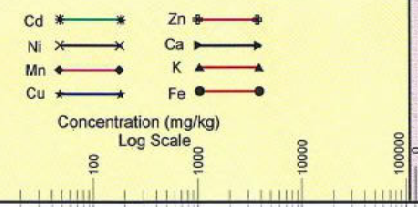
TOC Elevation: 5445.55 ft (NGVD 29)
5449.91 ft (NAVD 88)

Depth (ft)	Elevation (NGVD 29)	Lithology Log	Lithology Description
	5,395		SILTY CLAY BROWN STIFF. ARGON PRESERVED CORE
			SILTY SAND FINE GRAINED BROWN SLIGHT PURPLE STAINING. ARGON PRESERVED CORE
			SAND MEDIUM TO FINE GRAINED TRACE SILT TRACE GRAVEL SLIGHT PURPLE STAINING AT 51.8' ORANGE STAINING AT 51'. ARGON PRESERVED CORE
55			SAND MEDIUM GRAINED BROWN. ARGON PRESERVED CORE
	5,390		SAND WITH SILT FINE GRAINED WITH SOME MEDIUM GRAINED AND TRACE COARSE DENSE. ARGON PRESERVED CORE

3/8" Bentonite Chips (Hole Plug)

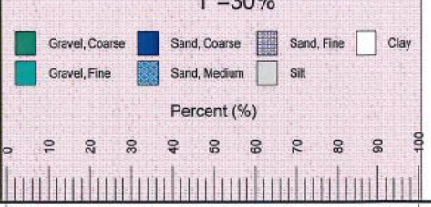
TD: 57'

XRF Data From Collected Core



Particle Size Distribution

1"=30%



Depth (ft) 55

Concrete Collar Elevation: 5446.04 ft. (NGVD 29)
5450.4 ft. (NAVD 88)
Well Completion Date: 2/3/2012
Screen Interval: 33-43 ft. Filter Pack Interval: 32-44 ft.

Driller: J.R. Cantrell Monitoring Well License: #451
Signature _____

Well Construction Key

Bentonite, Riser, Cement Grout, Slough, Steel Casing, Filter Pack, Screen

Lithology

Ash, Asphalt, Clay, Clayey gravel, Clayey sand, Clayey Sand, some gravel, Clayey silt, Fill, Granite, No Recovery, Organic silt, Residual weathered granite, Sand, Sand, oxidized, Sand and gravel, Sand and gravel, oxidized, Sand, some gravel, Sand, some gravel oxidized, Sandy clay, Sandy silt, Sandy silt, some gravel, Silt, Silt, oxidized, Silty Clay, Silty Clay, oxidized, Silty Clay, some gravel, Silty sand, Silty Sand some gravel, Slag, Tailings, Topsoil, Weathered granite

Pg. 2 of 2

Latitude (NAD83):45.99361299 (Dec. Degrees)
Longitude (NAD83):-112.52982096 (Dec. Degrees)
Northing (SP-N83):650609.23 ft. (IF)
Easting (SP-N83):1198941.55 ft. (IF)
T3N R8W S24

GWIC ID # 265010

No Core Recovery
2’ to 7’

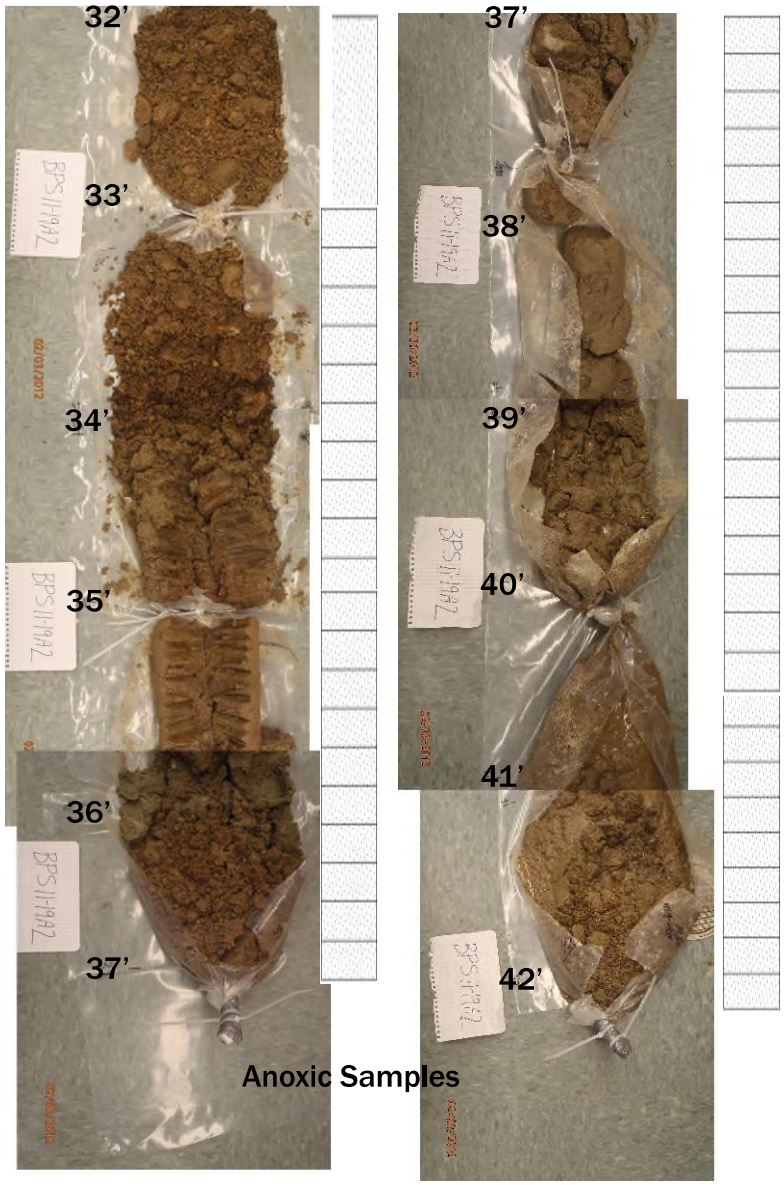
No Core Recovery
16’ to 17’

Anoxic Samples Collected
from 32’ to 42’
See Page 2

LEGEND:
SAND PACK

SCREEN WITH SAND PACK

BPS11-19A2



Anoxic Samples

Anoxic Samples Collected
From 42' to 57'
No Photo Taken

Well Log

PIONEER Technical Services, Inc.

Well Name: BPS11-19B	
Project: 2011 BPSOU MWIP	Location: Butte, Montana
Well Owner: Atlantic Richfield Co.	Depth to Water: 2.87 ft; Date: 2/15/2012; Time: 11:05
Drilled by: Environmental West	Silica Sand Size: 10-20
Casing Type/Dia: PVC/2.0"	Screen Slot Size: 0.020"
Drilling Method: Roto-Sonic	Bentonite Seal: 3/8" chips
Screen Type/Length: PVC Machine Slot/15'	Borehole Dia: 6.0"

Well Construction
TOC Elevation: 5445.56 ft (NGVD 29)
5449.92 ft (NAVD 88)

Logged by: W. Goldberg

Stickup: 0.45 ft

Surface Completion: Flush

Ground Level

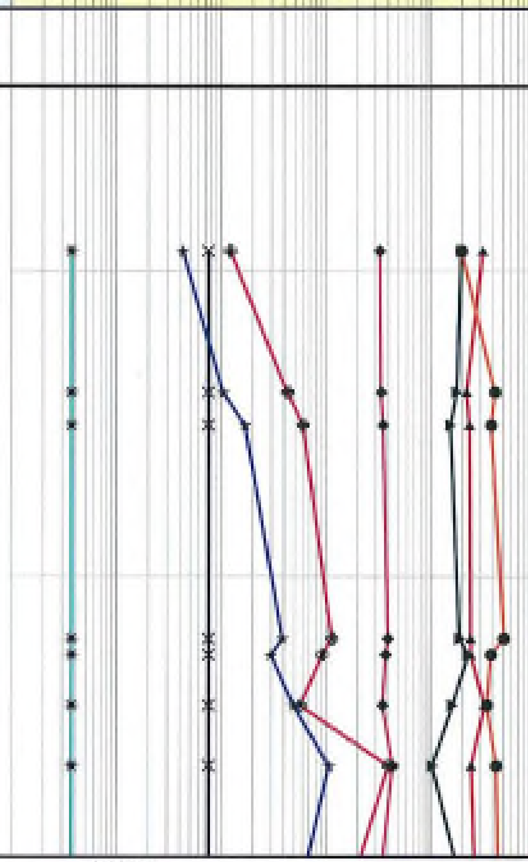
Depth (ft)	Elevation (NGVD 29)	Lithology Description
0	5,445	FILL, SAND, DEBRIS, GLASS, FINE GRAVEL OXIDIZED, ORGANICS, SOIL WITH ROOTS AT 2.5'
		FINE TO MEDIUM SAND, BROWN, SUBANGULAR TO SURROUNDED
5	5,440	
10	5,435	WELL GRADED SUBANGULAR TO SURROUNDED SAND WITH SOME FINE SUBANGULAR GRAVEL. SOME OXIDATION THROUGHOUT WITH STRONG BANDS AT 12', 13', AND 14.5'. 2" SILT BANDS AT 10.5' AND 12.5'.
15	5,430	Gray clay; NO RECOVERY
		WELL GRADED SAND WITH TRACE SUBANGULAR TO SURROUNDED GRAVEL, REDDISH BROWN
20	5,425	SANDY SILT, SOME OXIDATION
		SILT AND CLAY, COHESIVE, GRAY. 2" SILTY SAND BED AT 21.7'-21.9'
25	5,420	SANDY SILT, PINK COLORATION AT BOTTOM. FINE TO MEDIUM SAND WITH SOME MEDIUM SUBROUNDED GRAVEL, OLIVE AT TOP, ORANGE BROWN AT BOTTOM
		SILT, OLIVE WITH SOME OXIDATION ML. SAND, WELL GRADED, SUBANGULAR WITH SOME GRAVEL BECOMING MORE ABUNDANT WITH DEPTH. GRAVEL IS SUBANGULAR TO WELL ROUNDED, ABUNDANT MICA
30	5,415	CLAY WITH TRACE SAND, LIGHT
		SAND AND GRAVEL, SUBANGULAR TO SUBROUNDED, GRAVEL TO 2", MINOR OXIDATION, BROWN
35	5,410	DENSE SANDY SILT, LIGHT BROWN
		SANDY SILT ML
40	5,405	SAND AND GRAVEL, SW-GW, SUBANGULAR TO SURROUNDED, LIGHT OLIVE WITH MINOR
		CLAY AND SILT WITH TRACE SAND, COHESIVE, REDDISH-BROWN
45	5,400	DENSE SANDY SILT, OLIVE
		SANDY SILT, LIGHT OLIVE WITH OXIDATION CLAY AND
50		CLAY, COHESIVE DENSE OLIVE TRACE SAND

Flush Mount Cover

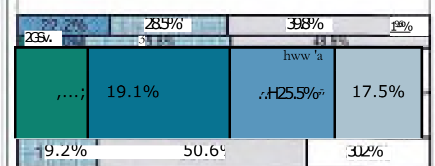
Cement Grout

2" PVC Flush Coupled Riser

XRF Data From Collected Core



Particle Size Distribution



Concrete Collar Elevation: 5446.01 ft. (NGVD 29)
5450.37 ft. (NAVD 88)
Well Completion Date: 1/24/2012
Screen Interval: 52-87 ft. Filter Pack Interval: 51-72 ft

Driller: J.R. Cantrell Monitoring Well License: #451

Signature ______________________

Well Construction Key: Bentonite, Riser, Cement Grout, Slough, Steel Casing, Filter Pack, Screen

Lithology: Ash, Asphalt, Clay, Clayey gravel, Clayey sand, Clayey Sand, some gravel, Clayey silt, Fill, Granite, No Recovery, Organics, Weathered granite, Sand, oxidized, Sand and gravel, Sand and gravel, oxidized, Sand, some gravel, Sandy clay, Sandy gravel, Sandy silt, Sandy silt, some gravel, Silt, Silt, oxidized, Silty Clay, Silty Clay, Brazed, Silty Clay, some gravel, Silty sand, Silty Sand some gravel, Slag, Tailings, Topsoil, Weathered granite

Latitude (NAD83): 45.99359654 (Dec. Degrees)
Longitude (NAD83): -112.52982407 (Dec. Degrees)
Northing (SP-N83): 650803.27 ft. (IF)
Easting (SP-N83): 1198940.53 ft. (IF)
T3N R8W S24

GWIC ID # 265011

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Return to menu
Plot this site in State Library Digital Atlas
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View hydrograph for this site
View field visits for this site
View water quality for this site
View scanned well log (9/20/2011 7:42:02 AM)
View scanned published report (9/20/2011 7:42:29 AM)

Site Name: MBMG MONITOR WELL * BT-98-01
GWIC Id: 171295

Section 1: Well Owner(s)

1) MONTANA BUREAU OF MINES AND GEOLOGY (MAIL)
N/A
N/A N/A N/A [08/11/1999]

Section 2: Location

Township	Range	Section	Quarter Sections
03N	07W	19	SE¼ SW¼ SE¼ SW¼

County: SILVER BOW
Geocode:

Latitude	Longitude	Geomethod	Datum
45.989659995	112.522459755	SUR-GPS	NAD83

Ground Surface Altitude	Method	Datum	Date
5445.99	SUR-GPS	NGVD29	5/3/2010

Measuring Point Altitude	Method	Datum	Date Applies
5457.1			8/11/1999 1:05:00 PM

Addition: **Block:** **Lot:**

Section 3: Proposed Use of Water

MONITORING (1)

Section 4: Type of Work

Drilling Method:
Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Monday, October 19, 1998

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	25	10

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
0	25	4				PVC-SCHED 40

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
15	25	4		20 SLOT	SCREEN-CONTINUOUS-PVC

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
9	14	BENTONITE CHIPS	
14	25	10-20 SILICA SAND	

Section 7: Well Test Data

Total Depth: 25
Static Water Level:
Water Temperature:

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

4" PVC INSIDE 6" STEEL CONDUCTOR WITH LOCKING LID

Section 9: Well Log

Geologic Source

Unassigned

From	To	Description
0	5	FILL MATERIAL DARK BROWN SANDY
5	7	BLACK SILT AND CLAY WITH ORGANIC DEBRIS
7	8	GRAVEL ROUGH DRILLING
8	10	BLACK SILT AND CLAY WITH ORGANIC DEBRIS
10	25	SILT AND CLAY

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:
Company:
License No: -
Date Completed: 10/19/1998

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View hydrograph for this site
View field visits for this site
View water quality for this site

Site Name: ATLANTIC RICHFIELD * BT-98-02B
GWIC Id: 240865

Section 1: Well Owner(s)

1) ATLANTIC RICHFIELD (MAIL)
317 ANACONDA RD
BUTTE MT 59701 [12/13/2007]

Section 2: Location

Township	Range	Section	Quarter Sections
03N	07W	19	NW¼ SW¼

County SILVER BOW **Geocode**

Latitude	Longitude	Geomethod	Datum
45.993388706	112.525103946	SUR-GPS	NAD83

Ground Surface Altitude **Method** **Datum** **Date**

Addition **Block** **Lot**

Section 3: Proposed Use of Water

MONITORING (1)

Section 4: Type of Work

Drilling Method: ROTARY
Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Thursday, December 13, 2007

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	45	7

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
0	29.5	2	0.154		FLUSH THREAD	PVC

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
29.5	39	2		0.020 IN	SCREEN-CONTINUOUS-PVC

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	29.5	BENTOINTE	
29.5	45	SILICA SAND	

Section 7: Well Test Data

Total Depth: 39
Static Water Level: 9.69
Water Temperature:

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source

Unassigned

From	To	Description
0	14	WELL GRADED SAND, DAMP, TAN TO MOIST TO WET
14	18	FINE TO MEDIUM GRAVEL
18	20	COARSE SAND
20	30	CLEAN SAND AND FINE GRAVEL
30	40	SILTY SAND, SOME SILT
40	45	MEDIUM SAND CLEAN

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name: CLAY PARSONS
Company: PARSONS DRILLING
License No: MWC-362
Date Completed: 12/13/2007

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View water quality for this site
View scanned well log (5/25/2007 8:56:22 AM)

Site Name: MBMG MONITOR * WELL BT-98-04
GWIC Id: 169068
DNRC Water Right:

Section 1: Well Owner(s)

Section 2: Location

Township	Range	Section	Quarter Sections
03N	07W	30	NE¼ NW¼ NE¼ NE¼

County SILVER BOW

Geocode

Latitude	Longitude	Geomethod	Datum
45.987726	112.520054	MAP	NAD83

Ground Surface Altitude	Method	Datum	Date
5465			10/27/1998

Addition **Block** **Lot**

Section 3: Proposed Use of Water
MONITORING (1)

Section 4: Type of Work
Drilling Method: HOLLOW STEM AUGER
Status: NEW WELL

Section 5: Well Completion Date
Date well completed: N/A

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	15	10

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-2	15	4				PVC-SCHED40

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
10	15	4		0.020	SCREEN

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	1	CEMENT	
1	8	??	
8	9	BENTONITE	
9	15	10/20 SAND	

Section 7: Well Test Data

Total Depth: 15
Static Water Level:
Water Temperature:

Unknown Test Method *

Yield _ gpm.
Pumping water level _ feet.
Time of recovery _ hours.
Recovery water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source
110ALVM - ALLUVIUM (QUATERNARY)

From	To	Description
0	3	SOIL - BACKFILL
3	5	BLACK ORGANIC SOIL - CREOSOTE SMELL
5	7	BACKFILL
7	8	BLACK CLAY - PEAT
8	11	BROWN CLAY WITH SAND
11	15	TAN CLAY WITH SAND

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:
Company:
License No: -
Date Completed:

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
View hydrograph for this site
View field visits for this site
View water quality for this site
View scanned well log (9/20/2011 7:41:33 AM)
View scanned published report (9/20/2011 7:41:42 AM)

Site Name: MBMG MONITOR WELL * BT-98-05
GWIC Id: 171288

Section 1: Well Owner(s)

1) MONTANA BUREAU OF MINES AND GEOLOGY (MAIL)
N/A
N/A N/A N/A [03/11/1999]

Section 2: Location

Township	Range	Section	Quarter Sections
03N	07W	19	SW¼ SW¼ SE¼ SW¼

County / **Geocode**
SILVER BOW

Latitude	Longitude	Geomethod	Datum
45.98977324	112.522453857	SUR-GPS	NAD83

Ground Surface Altitude	Method	Datum	Date
5446.1	SUR-GPS	NGVD29	5/3/2010

Measuring Point Altitude	Method	Datum	Date Applies
5455.8			8/11/1999 1:00:00 PM

Addition **Block** **Lot**

Section 3: Proposed Use of Water

MONITORING (1)

Section 4: Type of Work

Drilling Method:
Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Friday, November 06, 1998

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	25	10

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
0	15	4				PVC-SCHED 40

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
15	25	4		20 SLOT	SCREEN-CONTINUOUS-PVC

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
6	10	BENTONITE CHIPS	

Section 7: Well Test Data

Total Depth: 19
Static Water Level:
Water Temperature:

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

MONITOR WELL FOR BASEMENT FLOODING. 4" PVC INSIDE 6" STEEL CONDUCTOR WITH LOCKING CAP DRILLED SUMMER 1998

Section 9: Well Log

Geologic Source

110ALVM - ALLUVIUM (QUATERNARY)

From	To	Description
0	5	SANDY FILL
5	20	BLACK SILT AND CLAY WITH ORGANIC MATERIAL
20	25	SILTY MEDIUM TO COARSE SAND; HEAVING

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:
Company:
License No: -
Date Completed: 11/6/1998

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is compiled electronically from the contents of the Ground Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

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View scanned well log (5/25/2007 8:57:28 AM)

Site Name: MBMG MONITOR * WELL BT-99-01
GWIC Id: 171289
DNRC Water Right:

Section 1: Well Owner(s)

1) WILEY, ROBIN (MAIL)
1440 EVANS
BUTTE MT N/A [08/11/1999]

Section 2: Location

Township	Range	Section	Quarter Sections
03N	07W	30	NW¼ NW¼ SW¼ NE¼

County SILVER BOW **Geocode**

Latitude	Longitude	Geomethod	Datum
45.985570215	112.51737791	SUR-GPS	NAD83

Ground Surface Altitude	Method	Datum	Date
5454.64	SUR-GPS	NGVD29	4/21/2010

Measuring Point Altitude	Method	Datum	Date Applies
5458.6			6/10/1999 2:45:00 PM

Addition **Block** **Lot**

Section 3: Proposed Use of Water

MONITORING (1)

Section 4: Type of Work

Drilling Method:
Status: NEW WELL

Section 5: Well Completion Date

Date well completed: Thursday, April 08, 1999

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	12.5	10

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
0	12.5	4				PVC-SCHED40

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
7.5	12.5	4		0.020	SCREEN

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
5.5	6.5	BENTONITE CHIPS	
6.5	12.5	10-20 SILICA SAND	

Section 7: Well Test Data

Total Depth: 12.5
Static Water Level:
Water Temperature:

Unknown Test Method *

Yield _ gpm.
Pumping water level _ feet.
Time of recovery _ hours.
Recovery water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

4" PVC INSIDE 6" STEEL WITH LOCKING CAP. MONITOR WELL FOR BASEMENT FLOODING.

Section 9: Well Log

Geologic Source

110ALVM - ALLUVIUM (QUATERNARY)

From	To	Description
0	1	SOIL
1	6	SANDY SILT
6	11.5	SILTY SAND
11.5	12.5	SILT

Driller Certification

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:
Company:
License No: -
Date Completed: 4/8/1999

MONTANA WELL LOG REPORT

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Other Options

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View field visits for this site
View water quality for this site

Site Name: FP98-1
GWIC Id: 249081

Section 1: Well Owner(s)
1) FP98-1 (MAIL)
N/A
BUTTE MT 59701 [02/09/2009]

Section 2: Location

Township	Range	Section	Quarter Sections

County **Geocode**
SILVER BOW

Latitude	Longitude	Geomethod	Datum
45.995581741	112.5446298	SUR-GPS	NAD83

Ground Surface Altitude	Method	Datum	Date

Addition	Block	Lot

Section 3: Proposed Use of Water
MONITORING (1)

Section 4: Type of Work
Drilling Method:
Status: NEW WELL

Section 5: Well Completion Date
Date well completed: Monday, February 09, 2009

Section 6: Well Construction Details
There are no borehole dimensions assigned to this well.
There are no casing strings assigned to this well.
There are no completion records assigned to this well.
Annular Space (Seal/Grout/Packer)

There are no annular space records assigned to this well.

Section 7: Well Test Data

Total Depth:
Static Water Level:
Water Temperature:

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log
Geologic Source
Unassigned
Lithology Data

There are no lithologic details assigned to this well.

Driller Certification
All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:
Company:
License No: -
Date Completed: 2/9/2009

PIONEER TECHNICAL SERVICES, INC.

Well Log

Well Name: FP98-01B

Project: 2011 BPSOU MWIP | Location: Butte, Montana

Well Owner: Atlantic Richfield Co. | Depth to Water: 23.78 ft Date: 2/14/2012 Time: 14:01

Drilled by: Environmental West | Silica Sand Size: 10-20 | Casing Type/Dia: PVC/2.0" | Screen Slot Size: 0.020"

Drilling Method: Roto-Sonic | Bentonite Seal: 3/8" chips | Screen Type/Length: PVC Machine Slot/10' | Borehole Dia: 6.0"

Well Construction

TOC Elevation: 5456.98 ft (NGVD 29)
5461.34 ft (NAVD 88)

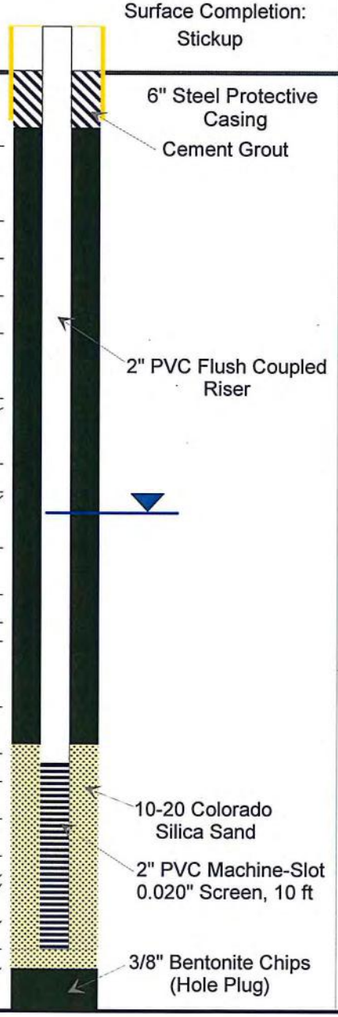
Logged by: W. Goldberg

Stickup: -2.4 ft

Ground Level

Surface Completion: Stickup

Depth (ft)	Elevation (NGVD 29)	Lithology Log	Lithology Description
0	5,455		
			FILL. SAND, SILT, ONE LARGE PIECE OF SLAG AT END OF RUN
5	5,450		NO RECOVERY
			SLAG
10	5,445		NO RECOVERY
			SLAG
15	5,440		TAILINGS, YELLOW, FINE SAND SIZE
			GRANULAR SLAG
20	5,435		TAILINGS, FINE SAND SIZE, YELLOW GREEN
			TAILINGS, INTERBEDDED YELLOW AND GRAY WITH SOME OXIDATION
			COHESIVE CLAY, GRAY
25	5,430		SAND, WELL GRADED, SUBANGULAR, HIGHLY OXIDIZED
			ORGANIC SILT, DARK GRAY TO BLACK, HIGHLY ORGANIC FROM 27.5' - 28'
30	5,425		ORGANIC SILT, BLACK, VISIBLE FIBERS
			SILTY SAND, SM, DARK GRAY, CAPILLARY FRINGE
			SILTY SAND WITH SUBROUNDED MEDIUM TO COARSE GRAVEL, DARK GRAY TO GRAY GREEN. WATER BEARING AS PER C. COOVER
35	5,420		WELL GRADED SAND WITH SUBANGULAR TO SUBROUNDED MEDIUM GRAVEL, OXIDIZED TO ORANGE. WATER BEARING AS PER C. COOVER
			NO RECOVERY
			SILTY SAND WITH TRACE OF MEDIUM SUBROUNDED GRAVEL, BROWN. WATER BEARING AS PER C. COOVER
40	5,415		SANDY SILT, ML, GRAY GREEN
			SAND AND GRAVEL MEDIUM TO COARSE SAND, GRAVEL UP TO 2" SUBANGULAR - WATER
			SANDY SILT DARK BROWN
45	5,410		SAND WITH GRAVEL MEDIUM GRAINED GRAVEL TO 1.5 INCHES SUBANGULAR LOTS OF MICA
			SAND WITH GRAVEL MEDIUM GRAINED GRAVEL TO 1.5 INCHES SUBROUNDED
			WEATHERED BEDROCK, FELDSPARS ALTERED, CRYSTALLINE QUARTZ WITH MICA
50	5,405		

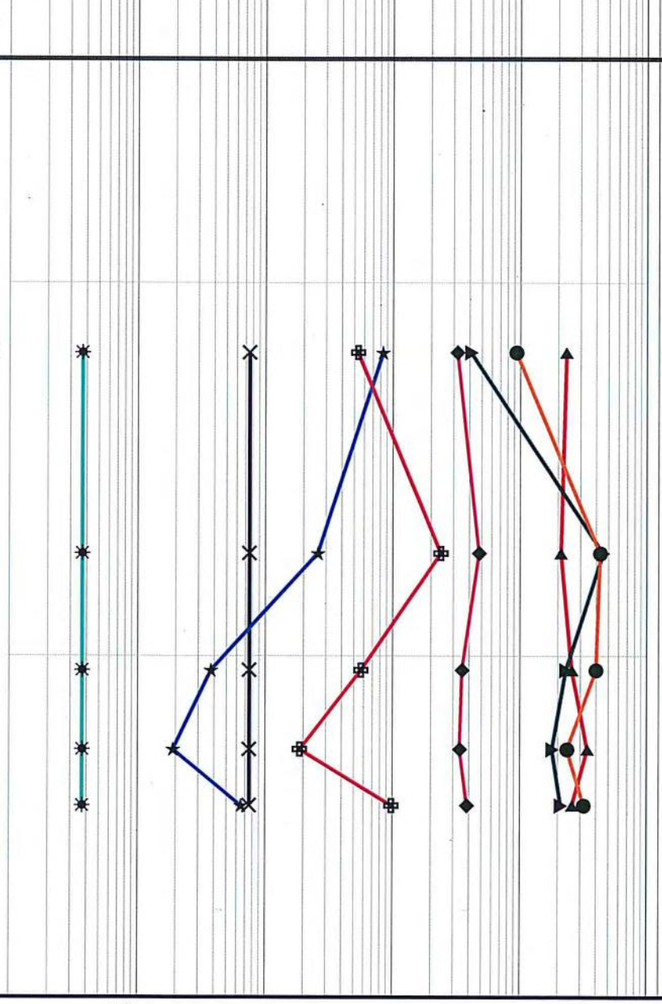


XRF Data From Collected Core

Cd, Ni, Mn, Cu, Zn, Ca, K, Fe

Concentration (mg/kg) Log Scale

1 | 10 | 100 | 1000 | 10000 | 100000



Particle Size Distribution 1"=30%

Gravel, Coarse | Sand, Coarse | Sand, Fine | Clay
Gravel, Fine | Sand, Medium | Silt

Percent (%)

0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100

Depth (ft)

Concrete Collar Elevation: 5454.58 ft. (NGVD 29)
5458.94 ft. (NAVD 88)

Well Completion Date: 11/30/2011

Screen Interval: 37-47 ft. Filter Pack Interval: 36-48 ft.

Driller: J.R. Cantrell Monitoring Well License: #451

Signature _____

Well Construction Key

Bentonite, Riser, Cement Grout, Slough, Steel Casing, Filter Pack, Screen

Lithology

Ash, Asphalt, Clay, Clayey gravel, Clayey sand, Clayey Sand, some gravel, Clayey silt, Fill, Granite, No Recovery, Organic silt, Residual weathered granite, Sand, Sand, oxidized, Sand and gravel, Sand and gravel, oxidized, Sand, some gravel, Sand, some gravel oxidized, Sandy clay, Sandy silt, Sandy silt, some gravel, Silt, Silt, oxidized, Silty Clay, Silty Clay, oxidized, Silty Clay, some gravel, Silty sand, Silty Sand some gravel, Slag, Tailings, Topsoil, Weathered granite

Latitude (NAD83):45.9956952 (Dec. Degrees)
Longitude (NAD83):-112.54437903 (Dec. Degrees)
Northing (SP-N83):651511.01 ft. (IF)
Easting (SP-N83):1195275.21 ft. (IF)
T3N R8W S24

GWIC ID # 264095

PIONEER TECHNICAL SERVICES, INC.

Well Log

Well Name: FP98-01B

Project: 2011 BPSOU MWIP | Location: Butte, Montana

Well Owner: Atlantic Richfield Co. | Depth to Water: 23.78 ft Date: 2/14/2012 Time: 14:01

Drilled by: Environmental West | Silica Sand Size: 10-20 | Casing Type/Dia: PVC/2.0" | Screen Slot Size: 0.020"

Drilling Method: Roto-Sonic | Bentonite Seal: 3/8" chips | Screen Type/Length: PVC Machine Slot/10' | Borehole Dia: 6.0"

Well Construction

TOC Elevation: 5456.98 ft (NGVD 29)
5461.34 ft (NAVD 88)

Depth (ft)	Elevation (NGVD 29)	Lithology Log	Lithology Description
55	5,400		WEATHERED BEDROCK, LIGHT GRAY, CORE SAMPLE SANDY, PREDOMINANTLY QUARTZ WITH TRACE MICA

3/8" Bentonite Chips (Hole Plug)

TD: 57'

XRF Data From Collected Core

Cd, Ni, Mn, Cu, Zn, Ca, K, Fe

Concentration (mg/kg)
Log Scale
1 | 10 | 100 | 1000 | 10000 | 100000

Particle Size Distribution
1"=30%

Gravel, Coarse | Sand, Coarse | Sand, Fine | Clay
Gravel, Fine | Sand, Medium | Silt

Percent (%)
0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100

Depth (ft) 55

Concrete Collar Elevation: 5454.58 ft. (NGVD 29)
5458.94 ft. (NAVD 88)
Well Completion Date: 11/30/2011
Screen Interval: 37-47 ft. Filter Pack Interval: 36-48 ft.

Driller: J.R. Cantrell Monitoring Well License: #451
Signature _____

Well Construction Key

Bentonite, Riser, Cement Grout, Slough, Steel Casing, Filter Pack, Screen

Lithology

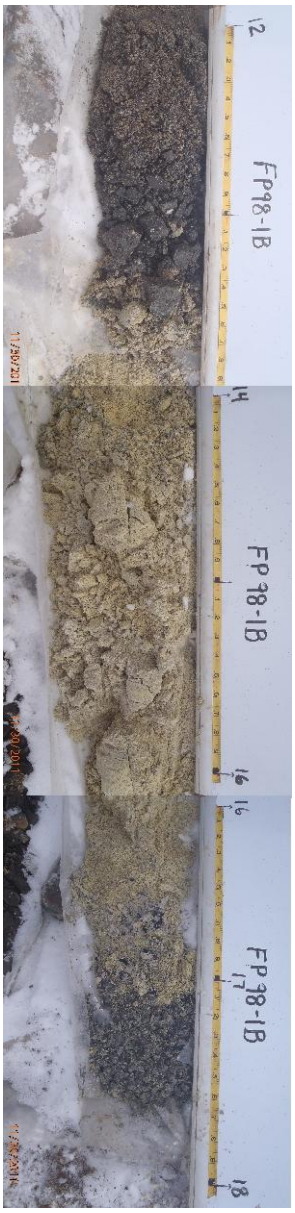
Ash, Asphalt, Clay, Clayey gravel, Clayey sand, Clayey Sand, some gravel, Clayey silt, Fill, Granite, No Recovery, Organic silt, Residual weathered granite, Sand, Sand, oxidized, Sand and gravel, Sand and gravel, oxidized, Sand, some gravel, Sand, some gravel oxidized, Sandy clay, Sandy silt, Sandy silt, some gravel, Silt, Silt, oxidized, Silty Clay, Silty Clay, oxidized, Silty Clay, some gravel, Silty sand, Silty Sand some gravel, Slag, Tailings, Topsoil, Weathered granite

Latitude (NAD83):45.9956952 (Dec. Degrees)
Longitude (NAD83):-112.54437903 (Dec. Degrees)
Northing (SP-N83):651511.01 ft. (IF)
Easting (SP-N83):1195275.21 ft. (IF)
T3N R8W S24

GWIC ID # 264095

No Core Recovery
4’ to 8’

No Core Recovery
10’ to 12’



No Core Recovery
18’ to 19.5’

LEGEND:
SAND PACK

SCREEN WITH SAND PACK

FP98-01B


FP98-1B
48
FP98-1B
50
FP98-1B
52
FP98-1B
54
56
FP98-1B
57
58


38
FP98-1B
40
FP98-1B
42
FP98-1B
44
FP98-1B
46
47
48
FP98-1B


28
FP98-1B
30
FP98-1B
32
FP98-1B
34
FP98-1B
36
37
38
FP98-1B
No Core Recovery
36.5' to 38'

Butte

3N08W24 DBB

Silver Bow

086420

TEST HOLE LOG

State: Montana County: Silver Bow Project: SBC CERCLA Hole Name or Number: AI-GS-GW-29S

Legal Location: T 3N R 8W Sec 24 Tract DBB

Descriptive Location: 70' N of MSD; 100' E of RR bridge over MSD

Recorded By: ME Hole Started: Time: 1530 Date: 07/07/89

Hole Completed: Time: _____ Date: 07/08/89

Driller: Butch Drilling Company: CNI

Drill Method: Auger Drilling Fluids Used: N/A

Pilot Hole Diameter: 9" Reamed Hole Diameter: N/A

Total Depth Drilled: 13.5' Total Depth Reamed: N/A Total Depth Cased Below G.S.: 13'

Diameter and Type of Casing: 2" Flush threaded PVC

Weight or Gage of Casing: Sch. 40 Interval Perforated or Screened Below G.S.: 8.0-13.0' Target Aquifer: Alluvium Packer Type and Depth Below G.S.: N/A

DURING INSTALLATION WAS:	YES	NO
Well Developed?	X	
Well Test Pumped?		X
Water Samples Taken?	X	
Material Samples Taken?		X
E-Logs?		X

Method Perforated or Screened

- _____ No casing in hole
- _____ Open bottom
- _____ Slotted with Mill's Knife
- _____ Slotted with a torch
- _____ Screened by pulling casing
- _____ Field saw cut Hacksaw
- _____ Mechanical slots _____ (size)
- X Other (specify) Factory .02

Static Water Level: 4.80' Date/Time Measured: 8/23/89

Measuring Point Description/Elevation: Top of steel (N side) 5443.26' MP Height Above (+/-) or Below G.S.: + 2.29'

Well Annulus Completion Description: 10-20 Colorado Silica Sand 6.5-13.5'; 1/4" Bentonite pellets 5.5-6.5'; Pure Gold grout 0-5.5'; concrete with locked steel well head protector.

Remarks:

From	To	DRILLING LOG Geological, Drilling, and Water Conditions and Sampling
0	1.75	Sandy, minor pebbles tailings; Yellow orange to light brown.
1.75	7	Minor clay, silty sand, Dark gray. Water at 6'.
7	13.5	Minor clayey, silty, sandy, cobbley fill; Dark gray fines; <200 ~ 30%

PA

MI126154

03N 07W 19 CB

03N 07W 19 CBBA
MF-8 CALIFORNIA & SILVER BOW CREEK 4700

0-3	FILL, SANDY
3-5.5	ORGANIC CLAY
5.5-6.5	SAND, SATURATED
6.5-8	SILTY CLAY, SATURATED
8-13	WATER, CLAY (ORGANIC)
13-18	SAND, GRAVEL (1")

TD-14' 9-14' PERFORATED

03N 07W 19 CABB
MF-9 4692

0-3	SAND, GRAVEL
3-5	SILTY CLAY
5-8	SAND
8-13	SAND, WATER
13-18	DECOMPOSED GRANITE

TD-16' 11-16' PERFORATED

03N 07W 19 CB
MF-10 4695

0-3	FILL, SILT & SAND
3-6	SAND
6-8	SAND
8-13	SAND, SATURATED, 12' HARD DRILLING
13-16	SAND, SATURATED, 16' SOFT
16-18	CLAY
18-23	CLAY, SAND

TD-17' 12-17' PERFORATED

03N 07W 19 BDCD
MF-11 4687

0-3	FILL MATERIAL (BLACK DIRT)
3-8	ORGANIC MATERIAL (PEAT)
8-13	CLAY, SATURATED, 1' OUT OF PEAT
13-18	SAND

TD-15.5' 10.5-15.5' PERFORATED

4695

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Other Options

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View water quality for this site

Site Name: MBMG MONITORING WELL * MT98-05
GWIC Id: 261583

Section 1: Well Owner(s)

Section 2: Location

Township	Range	Section	Quarter Sections
03N	07W	19	

County SILVER BOW

Geocode

Latitude	Longitude	Geomethod	Datum
45.989552	112.52254	NAV-GPS	NAD83

Ground Surface Altitude **Method** **Datum** **Date**

Addition **Block** **Lot**

Section 3: Proposed Use of Water
There are no uses assigned to this well.

Section 4: Type of Work
Drilling Method:
Status: NEW WELL

Section 5: Well Completion Date
Date well completed: N/A

Section 6: Well Construction Details
There are no borehole dimensions assigned to this well.
There are no casing strings assigned to this well.
There are no completion records assigned to this well.
Annular Space (Seal/Grout/Packer)

There are no annular space records assigned to this well.

Section 7: Well Test Data

Total Depth: 13
Static Water Level:
Water Temperature:

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log
Geologic Source
Unassigned

From	To	Description
0	10	BROWN-BLACK CLAY WITH MEDIUM SAND
10	12	BROWN WET CLAY WITH SAND
12	13	BLACK CLAY

Driller Certification
All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:
Company:
License No: -
Date Completed:

MONTANA WELL LOG REPORT

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Return to menu
Plot this site in State Library Digital Atlas
Plot this site in Google Maps
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View field visits for this site
View water quality for this site

Site Name: MT98-06
GWIC Id: 260255

Section 1: Well Owner(s)

Section 2: Location

Township	Range	Section	Quarter Sections
03N	07W	19	

County SILVER BOW

Geocode

Latitude	Longitude	Geomethod	Datum
45.989444	112.522563	NAV-GPS	NAD83

Ground Surface Altitude	Method	Datum	Date

Addition **Block** **Lot**

Section 3: Proposed Use of Water
There are no uses assigned to this well.

Section 4: Type of Work
Drilling Method:
Status: NEW WELL

Section 5: Well Completion Date
Date well completed: N/A

Section 6: Well Construction Details
There are no borehole dimensions assigned to this well.
There are no casing strings assigned to this well.
There are no completion records assigned to this well.

Annular Space (Seal/Grout/Packer)

There are no annular space records assigned to this well.

Section 7: Well Test Data

Total Depth: 13
Static Water Level:
Water Temperature:

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log

Geologic Source
Unassigned

From	To	Description
0	3	DARK BROWN SILTY CLAY
3	11	LIGHT BROWN MEDIUM SAND WITH GRAVEL
11	13	TAN GRAVEL WITH CLAY

Driller Certification
All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:
Company:
License No: -
Date Completed:

APPENDIX C
TABLES

Table 1
Floodplain Soils and Mine Wastes Sampling Analytical Results

Sample ID		Sample Date	Total Metals (mg/kg)								
			Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Zinc
Screening Criteria [a]			200	20	NE	1,000	NE	1,000	NE	10	1,000
BTC-TP-01 (3-4)-OB	N	4/12/2016	94 d	8.3	21	517	36200	1620 d	5080	1	2700
BTC-TP-01 (6.75-8.5)-BC	N	4/12/2016	246 d	8.5	20	1750	32100	347 d	1740	0.59	1940
BTC-TP-01 (8.5-9.5)-BT	N	4/12/2016	148 d	18.7	5	851	14100	478 d	3910	1.5	6570
BTC-TP-01 (10-11.5)-AL	N	4/12/2016	1080 d	70.2	10	20400	32900	3570 d	957	27	6810
BTC-TP-02 (0-1)-OB	N	4/12/2016	90 d	14.2	52	888	41600	1570 d	4480	0.97	6170
BTC-TP-02 (1.5-2)-YT	N	4/12/2016	999 d	6	8	1400	38300	2610 d	297	12	2360
BTC-TP-02 (2-3)-BC	N	4/12/2016	312 d	2.9	21	1270	60300 d	495 d	321	0.84	1240
BTC-TP-02 (3-4)-AL	N	4/12/2016	181 d	60.4	4	1260	14200	949 d	4110	1.8	22000
BTC-TP-03 (0-1)-OB	N	4/13/2016	231 d	14.2	31	933	32300	603 d	3180	3.2	2940
BTC-TP-03 (1.5-2)-BC	N	4/13/2016	264 d	13.9	40	991	40900	312 d	2350	2	6210
BTC-TP-03 (1-1.5)-YT	N	4/13/2016	297 d	11.4	20	1850	36400	761 d	891	5.4	2980
BTC-TP-03 (3-3.5)-AL	N	4/13/2016	276 d	28.3	29	1170	28000	413 d	1260	0.77	6610
BTC-TP-04 (1-2)-OB	N	4/12/2016	38	3.7	35	290	47600	348 d	960	< 0.5	541
BTC-TP-04 (2.5-3)-YT	N	4/12/2016	316 d	6.7	113	1190 d	185000 d	1020 d	1460	5.1	6440 d
BTC-TP-04 (3-3.5)-BC	N	4/12/2016	333 d	11.9	23	1500	35000	475 d	1770	2.2	5040
BTC-TP-05 (3-4)-BC	N	4/12/2016	117 d	3.7	49	652	33500	183 d	753	< 0.5	718
BTC-TP-06 (0-1)-OB	N	4/13/2016	309 d	5.4	24	1290	34500	599 d	1900	6.1	1710
BTC-TP-06 (1-1.8)-YT	N	4/13/2016	531 d	7.4	8	740	26000	1110 d	677	2.3	2330
BTC-TP-06 (1.7-2)-BC	N	4/13/2016	261 d	9	41	1020	36800	255 d	1420	0.78	2950
BTC-TP-06 (2-2.5)-AL	N	4/13/2016	339 d	37.4	11	1940	21500	629 d	2650	0.72	12900
BTC-TP-07 (1-2)-OB	N	4/13/2016	46 d	3.1	25	308	33300	548 d	2200	< 0.5	944
BTC-TP-07 (4-4.5)-AL	N	4/13/2016	430 d	6.3	25	977	43700	365 d	4570	0.72	1340
BTC-TP-07 (4.5-5)-AL	N	4/13/2016	411 d	62.5	5	2840	13500	1430 d	5010	3.7	20800
BTC-TP-07 (4.5-5)-AL	D	4/13/2016	259 d	54.9	3	1820	9780	973 d	6200	1.9	18700
BTC-TP-07 (5-5.5)-AL	N	4/13/2016	371 d	23.9	18	2090	34500	678 d	1410	2.3	6620

Notes:

mg/kg - Milligrams per kilogram

a - Screening Criteria utilized in site investigations from Field Screen Criteria and Procedures Phase 7 and 8 Remedial Action, SST OU Subarea 4, Reaches R and S (Pioneer 2011)

NE - Not established

-- - Sample not collected / analyzed

< - Parameter not detected at or above the laboratory practical quantitation limit

N - Natural sample

D - Duplicate sample

d - Reporting limit increased due to sample matrix.

- Value exceeds screening criteria

BTC - Blacktail Creek

Table 1
Floodplain Soils and Mine Wastes Sampling Analytical Results

Sample ID		Sample Date	Total Metals (mg/kg)								
			Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Zinc
Screening Criteria [a]			200	20	NE	1,000	NE	1,000	NE	10	1,000
BTC-TP-08 (1-2)-OB	N	4/13/2016	167 d	4.6	23	1240	25700	490 d	636	2	972
BTC-TP-08 (2-2.5)-BC	N	4/13/2016	300 d	10.5	22	1410	38400	389 d	459	0.8	3000
BTC-TP-08 (3-5)-AL	N	4/13/2016	205 d	45.6	4	1360	13600	747 d	4220	1.3	15600
BTC-TP-09 (2-2.5)-OB	N	4/12/2016	391 d	15	17	1740	35200	680 d	1050	2.2	5490
BTC-TP-09 (3-3.5)-YT	N	4/13/2016	219 d	60.6	4	1290	19100	820 d	5540	1.4	20600
BTC-TP-09 (4-4.5)-BC	N	4/12/2016	514 d	17.6	18	2490	36500	800 d	1700	7.6	4360
BTC-TP-10 (1-2)-OB	N	4/13/2016	44 d	3.2	43	385	41900	1020 d	825	< 0.5	1500
BTC-TP-10 (4-5)-AL	N	4/13/2016	152 d	6.4	26	762	36600	712 d	573	1.2	2180
BTC-TP-10 (4-5)-AL	D	4/13/2016	271 d	7.2	24	1140	39100	375 d	821	0.77	1690
BTC-TP-11 (1-2)-OB	N	4/13/2016	490 d	8.4	38	941	79100 d	487 d	260	< 0.5	3270
BTC-TP-11 (5-6)-OB	N	4/13/2016	450	40.8	47	7640 d	127000 d	660 d	2770	< 0.5	9410 d
BTC-TP-11 (6.5-7)-BC	N	4/13/2016	163 d	4.2	28	547	36300	164 d	1310	< 0.5	682
BTC-TP-12 (0-1)-OB	N	4/13/2016	57 d	1.7	24	207	33800	99 d	1070	< 0.5	365
BTC-TP-12 (1.3-2)-AL	N	4/13/2016	37 d	1.7	22	184	21100	84 d	525	< 0.5	367
BTC-TP-13 (0-1)-OB	N	4/12/2016	69 d	2.3	24	266	32600	114 d	1400	< 0.5	420
BTC-TP-13 (1.5-2)-YT	N	4/12/2016	69 d	2.7	25	131	35500	110 d	3140	< 0.5	440
BTC-TP-13 (3-3.5)-BC	N	4/12/2016	10	<0.5	33	62	41000	18	393	0.79	89
BTC-TP-13 (4-4.5)-AL	N	4/12/2016	104 d	2.7	15	871	25600	93 d	554	< 0.5	523
BTC-TP-14 (1-2)-OB	N	4/12/2016	70 d	2.3	25	330	23500	139 d	838	< 0.5	364
BTC-TP-14 (2-3)-BC	N	4/12/2016	255 d	4.5	16	1900	30400	330 d	820	0.53	991
BTC-TP-14 (2-3)-BC	D	4/12/2016	65 d	2.1	25	302	21300	127 d	670	< 0.5	351
BTC-TP-15 (1-2)-OB	N	4/12/2016	73 d	3.6	25	376	24200	170 d	1330	< 0.5	882
BTC-TP-15 (2-3)-BC	N	4/12/2016	25	1.9	24	172	21500	71 d	444	< 0.5	393
BTC-TP-15 (3-3.5)-AL	N	4/12/2016	15	1.1	16	93	17500	44 d	237	< 0.5	276
BTC-TP-16 (1-2)-OB	N	4/13/2016	33 d	1.6	25	186	33900	344 d	1000	< 0.5	394

Notes:

mg/kg - Milligrams per kilogram

a - Screening Criteria utilized in site investigations from Field Screen Criteria and Procedures Phase 7 and 8 Remedial Action, SST OU Subarea 4, Reaches R and S (Pioneer 2011)

NE - Not established

-- - Sample not collected / analyzed

< - Parameter not detected at or above the laboratory practical quantitation limit

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d - Reporting limit increased due to sample matrix.

- Value exceeds screening criteria

BTC - Blacktail Creek

Table 1
Floodplain Soils and Mine Wastes Sampling Analytical Results

Sample ID		Sample Date	Total Metals (mg/kg)								
			Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Zinc
Screening Criteria [a]			200	20	NE	1,000	NE	1,000	NE	10	1,000
BTC-TP-16 (6-7)-BC	N	4/13/2016	58 d	1.5	21	386	26100	100 d	489	< 0.5	327
BTC-TP-17 (1-2)-OB	N	4/13/2016	80 d	2.6	15	425	17700	193 d	239	< 0.5	791
BTC-TP-17 (2.5-3.5)-GC	N	4/13/2016	333 d	8.1	17	3000	26800	1540 d	552	23	3510
BTC-TP-17 (3.5-4.5)-BC	N	4/13/2016	182 d	6.6	25	880	36500	562 d	562	0.84	2010
BTC-WS-01 (2.5-4)-OB	N	4/7/2016	189 d	7.4	20	1210	28300	453 d	966	9.9	1730
BTC-WS-01 (6-8)-OB	N	4/7/2016	438 d	23.4	14	2880	30500	649 d	1100	1.6	7930
BTC-WS-01 (12.5-15)-BC	N	4/7/2016	24	1.1 d	18 d	273 d	23000	64 d	471	< 0.5	597 d
BTC-WS-01 (18-20)-AL	N	4/7/2016	21	2 d	26 d	351 d	22600	15	114	< 0.5	273 d
BTC-WS-02 (0-2.5)-OB	N	4/7/2016	82	4.6 d	32 d	444 d	35800	630 d	1990	< 0.5	1060 d
BTC-WS-02 (5-11)-BC	N	4/7/2016	181	6.8 d	20 d	1690 d	29600	279 d	635	1.5	1690 d
BTC-WS-02 (11-17.0)-AL	N	4/7/2016	17	2.7 d	24 d	80 d	14500	9	99	< 0.5	219 d
BTC-WS-02 (11-17.0)-AL	D	4/7/2016	28 d	2.7	30	115	22700	8	114	< 0.5	218
BTC-WS-03 (2-5)-BT	N	4/8/2016	18	<0.5	43	55	58500 d	26	308	< 0.5	89 d
BTC-WS-03 (5-7.5)-BC	N	4/8/2016	10	<0.5	24 d	36 d	28300	16	461	< 0.5	93 d
BTC-WS-03 (12.5-15)-YT	N	4/8/2016	7	0.6	22 d	37 d	27600	12	297	< 0.5	78 d

Notes:

mg/kg - Milligrams per kilogram

a - Screening Criteria utilized in site investigations from Field Screen Criteria and Procedures Phase 7 and 8 Remedial Action, SST OU Subarea 4, Reaches R and S (Pioneer 2011)

NE - Not established

-- - Sample not collected / analyzed

< - Parameter not detected at or above the laboratory practical quantitation limit

N - Natural sample

D - Duplicate sample

d - Reporting limit increased due to sample matrix.

- Value exceeds screening criteria

BTC - Blacktail Creek

Table 2
Bank and Opportunity Soils Metals Analytical Results

Sample ID		Sample Date	Total Metals (mg/kg)								
			Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Zinc
Screening Benchmarks			**9.8**	**0.99**	**43.4**	**31.6**	**20,000**	**35.8**	**460**	**0.18**	**121**
BTC-OSBS-01 (0-12")	N	3/16/2016	237	10.6	32	1400	33900	393	1110	0.94	1840
BTC-OSBS-02 (0-12")	N	3/16/2016	78	1.8	27	449	31300	287	701	< 0.5	415
BTC-OSBS-03 (24-36")	N	4/13/2016	356 d	69.8	6	1520	26100	1170 d	3840	0.69	21700
BTC-SBS-01N (0-12")	N	3/9/2016	111 d	6.7	27	988	28200	1290 d	2060	2.5	2060
BTC-SBS-02S (0-12")	N	3/9/2016	108 d	9.6	21	2390	26300	365 d	2130	0.98	3120
BTC-SBS-03S (0-12")	N	3/9/2016	51 d	3	17	393	19100	117 d	571	< 0.5	903
BTC-SBS-04N (0-12")	N	3/15/2016	70	3.9	25	376	24000	215	883	< 0.5	1140
BTC-SBS-04N (0-12")	D	3/15/2016	14	1.3	14	106	15400	47	291	< 0.5	314
BTC-SBS-05S (0-12")	N	3/15/2016	15	1.1	18	107	18600	38	316	< 0.5	306
BTC-SBS-06N (0-12")	N	3/15/2016	51	1.6	24	238	29000	94	1110	< 0.5	358
BTC-SBS-07S (0-12")	N	3/15/2016	59	1.5	24	215	31100	97	686	< 0.5	389
BTC-SBS-08S (0-12")	N	3/15/2016	66	3.2	22	368	25400	112	658	< 0.5	445
BTC-SBS-09N (0-12")	N	3/15/2016	54	2.7	23	293	25400	126	775	< 0.5	658
BTC-SBS-09N (0-12")	D	3/15/2016	47	2.6	35	258	26000	103 d	734	< 0.5	532
GG-OSBS-01 (0-12")	N	3/16/2016	10	<0.5	32	49	52000 d	20	385	< 0.5	84
SBC-OSBS-01 (0-12")	N	3/16/2016	85	6.8	34	618	28000	348	1970	< 0.5	1740

Notes:

mg/kg - Milligrams per kilogram

EPA Region III BTAG Freshwater Sediment Screening Benchmarks 8/2006

Hierarchy for Selection of Freshwater Sediment Benchmarks

- Preference was given to benchmarks based on chronic direct exposure, non-lethal endpoint studies designed to be protective of sensitive species
- Values derived by statistical- or consensus-based evaluation of multiple studies were given first priority
- Equilibrium partitioning values were selected for contaminants with 2.0< log Kow <6.0 if empirical values based on multiple studies were not available
- Absent consensus or equilibrium partitioning values, single study toxicity values were selected

NE - Not established

-- - Sample not collected / analyzed

< - Parameter not detected at or above the laboratory practical quantitation limit

N - Natural sample

D - Duplicate sample

d - Reporting limit increased due to sample matrix.

- Value exceeds screening criteria

BTC - Blacktail Creek

GG - Grove Gulch

SBS - Silver Bow Creek

Table 3
Floodplain Soils and Mine Wastes
XRF and Laboratory Analytical Results for Selected Parameters

XRF Sample Designation	Lithology Comment	Sample Date	Laboratory Sample Designation	Lab Sample Date	Arsenic (mg/kg)			Cadmium (mg/kg)			Copper (mg/kg)			Lead (mg/kg)			Zinc (mg/kg)		
					XRF	Laboratory	RPD %	XRF	Laboratory	RPD %	XRF	Laboratory	RPD %	XRF	Laboratory	RPD %	XRF	Laboratory	RPD %
TEST PITS																			
BTC-TP-01 (3-4)	OB	4/12/2016	BTC-TP-01 (3-4)-OB	4/12/2016	26.15	94	113	<LOD	8	28	463	517	11	1,239	1,620	27	2,230	2,700	19
BTC-TP-01 (8.5-9.5)	BT	4/12/2016	BTC-TP-01 (8.5-9.5)-BT	4/12/2016	70.06	246	111	<LOD	9	26	460	1,750	117	490	347	34	5,169	1,940	91
BTC-TP-01 (9-11)	BC	4/12/2016			169.09			<LOD			1,085			116			988		
BTC-TP-01 (10-11.5)	AL	4/12/2016	BTC-TP-01 (10-11.5)-AL	4/12/2016	203.44	1,080	137	<LOD	70	146	4,384	20,400	129	1,012	3,570	112	2,587	6,810	90
BTC-TP-02 (1.5-2)	YT	4/12/2016	BTC-TP-02 (1.5-2)-YT	4/12/2016	400.4	999	86	<LOD	6	59	840	1,400	50	1,733	2,610	40	1,523	2,360	43
BTC-TP-02 (2-3)	BC	4/12/2016	BTC-TP-02 (2-3)-BC	4/12/2016	192.38	312	47	<LOD	3	117	717	1,270	56	310	495	46	498	1,240	85
BTC-TP-02 (3-4)	AL	4/12/2016	BTC-TP-02 (3-4)-AL	4/12/2016	78.76	181	79	<LOD	60	138	548	1,260	79	417	949	78	7,903	22,000	94
BTC-TP-03 (0-1)	OB	4/13/2016	BTC-TP-03 (0-1)-OB	4/13/2016	51.24	231	127	<LOD	14	25	316	933	99	152	603	120	783	2,940	116
BTC-TP-03 (1-1.5)	YT	4/13/2016	BTC-TP-03 (1-1.5)-YT	4/13/2016	121.64	297	84	<LOD	11	4	849	1,850	74	251	761	101	955	2,980	103
BTC-TP-03 (1.5-2)	BC	4/13/2016	BTC-TP-03 (1.5-2)-BC	4/13/2016	122.65	264	73	19	14	33	534	991	60	175	312	56	3,690	6,210	51
BTC-TP-03 (3-3.5)	AL	4/13/2016	BTC-TP-03 (3-3.5)-AL	4/13/2016	120.25	276	79	<LOD	28	88	734	1,170	46	350	413	17	2,812	6,610	81
BTC-TP-04 (1-2)	OB	4/12/2016	BTC-TP-04 (1-2)-OB	4/12/2016	33.83	38	12	<LOD	4	99	185	290	44	186	348	61	328	541	49
BTC-TP-04 (2.5-3)	YT	4/12/2016	BTC-TP-04 (2.5-3)-YT	4/12/2016	229.04	316	32	<LOD	7	49	271	1,190	126	165	1,020	144	2,875	6,440	77
BTC-TP-05 (1-1.5)	OB	4/12/2016			60.59			<LOD			448			469			1,267		
BTC-TP-05 (1.5-2)	YT	4/12/2016			67.35			<LOD			580			669			2,913		
BTC-TP-05 (3-4)	BC	4/12/2016	BTC-TP-05 (3-4)-BC	4/12/2016	55.88	117	71	<LOD	4	99	355	652	59	107	183	53	367	718	65
BTC-TP-06 (0-1)	OB	4/13/2016	BTC-TP-06 (0-1)-OB	4/13/2016	202.52	309	42	<LOD	5	68	757	1,290	52	1,105	599	59	976	1,710	55
BTC-TP-06 (1-1.8)	YT	4/13/2016	BTC-TP-06 (1-1.8)-YT	4/13/2016	165.96	531	105	<LOD	7	39	283	740	89	457	1,110	83	750	2,330	103
BTC-TP-06 (1.7-2)	BC	4/13/2016	BTC-TP-06 (1.7-2)-BC	4/13/2016	145.14	261	57	<LOD	9	20	544	1,020	61	127	255	67	805	2,950	114
BTC-TP-06 (2-2.5)	AL	4/13/2016	BTC-TP-06 (2-2.5)-AL	4/13/2016	109.74	339	102	<LOD	37	109	671	1,940	97	250	629	86	2,707	12,900	131
BTC-TP-07 (1-2)	OB	4/13/2016	BTC-TP-07 (1-2)-OB	4/13/2016	23.4	46	65	<LOD	3	112	163	308	62	190	548	97	396	944	82
BTC-TP-07 (4.0-4.5)	BC	4/13/2016	BTC-TP-07 (4.0-4.5)-AL	4/13/2016	242.49	430	56	<LOD	6	54	404	977	83	186	365	65	735	1,340	58
BTC-TP-07 (4.5-5.0)	AL	4/13/2016	BTC-TP-07 (4.5-5.0)-AL	4/13/2016	260.09	411	45	40	63	44	2,095	2,840	30	992	1,430	36	17,289	20,800	18
BTC-TP-07 (5-5.5)	AL	4/13/2016	BTC-TP-07 (5-5.5)-AL	4/13/2016	215.67	371	53	<LOD	24	74	1,323	2,090	45	340	678	66	2,394	6,620	94
BTC-TP-08 (1-2)	OB	4/13/2016	BTC-TP-08 (1-2)-OB	4/13/2016	70.88	167	81	<LOD	5	82	703	1,240	55	219	490	76	419	972	79
BTC-TP-08 (2-2.5)	BC	4/13/2016	BTC-TP-08 (2-2.5)-BC	4/13/2016	235.12	300	24	<LOD	11	5	676	1,410	70	160	389	84	1,470	300	132
BTC-TP-08 (3-5)	AL	4/13/2016	BTC-TP-08 (3-5)-AL	4/13/2016	106.57	205	63	<LOD	46	122	872	1,360	44	396	747	62	7,114	15,600	75
BTC-TP-09 (0-1)	OB	4/12/2016			83.25			<LOD			394			369			1,398		
BTC-TP-09 (2-2.5)	BC	4/12/2016	BTC-TP-09 (2-2.5)-OB	4/12/2016	286.88	391	31	<LOD	15	31	989	1,740	55	424	680	46	2,683	5,490	69
BTC-TP-09 (3-3.5)	YT	4/12/2016	BTC-TP-09 (3-3.5)-YT	4/12/2016	104.31	219	71	<LOD	61	139	493	1,290	89	426	820	63	6,906	20,600	100
BTC-TP-09 (3.5-4)	BC	4/12/2016			254.45			<LOD			1,254			394			1,939		
BTC-TP-09 (4-4.5)	BC	4/12/2016	BTC-TP-09 (4-4.5)-BC	4/12/2016	185.99	514	94	<LOD	18	46	1,077	2,490	79	354	800	77	4,037	4,360	8
BTC-TP-10 (1-2)	OB	4/13/2016	BTC-TP-10 (1-2)-OB	4/13/2016	31.84	44	32	<LOD	3	110	435	385	12	690	1,020	39	1,374	1,500	9
BTC-TP-10 (3.5-4)	OB	4/13/2016			15.59			<LOD			102			174			310		
BTC-TP-10 (3-4)	OB	4/13/2016			<LOD			<LOD			497			273			540		
BTC-TP-10 (4-5)	AL	4/13/2016	BTC-TP-10 (4-5)-AL	4/13/2016	33.39	152	128	<LOD	6	53	175	762	125	139	712	135	434	2,180	134
			BTC-TP-10 (4-5)-AL (DUP.)	4/13/2016		271	156		7	42		1,140	147		375	100		1,690	118
BTC-TP-11 (1-2)	YT	4/13/2016	BTC-TP-11 (1-2)-OB	4/13/2016	294.89	490	50	<LOD	8	27	386	941	84	168	487	98	1,170	3,270	95
BTC-TP-11 (5-6)	YT	4/13/2016	BTC-TP-11 (5-6)-OB	4/13/2016	190.08	450	81	<LOD	41	115	4,279	7,640	56	243	660	92	2,939	9,410	105
BTC-TP-11 (6.5-7)	BC	4/13/2016	BTC-TP-11 (6.5-7)-BC	4/13/2016	134.55	163	19	<LOD	4	89	613	547	11	173	164	6	799	682	16
BTC-TP-12 (0-1)	OB	4/13/2016	BTC-TP-12 (0-1)-OB	4/13/2016	23.9	57	82	<LOD	2	146	125	207	49	41	99	82	238	365	42
BTC-TP-12 (1.5-2)	AL	4/13/2016	BTC-TP-12 (1.5-2)-AL	4/13/2016	31.91	37	15	<LOD	2	146	139	184	28	62	84	31	248	367	39
BTC-TP-13 (0-1)	OB	4/12/2016	BTC-TP-13 (0-1)-OB	4/12/2016	43.26	69	46	<LOD	2	131	196	266	30	69	114	49	247	420	52
BTC-TP-13 (1-1.5)	OB	4/12/2016			27.17			<LOD			122			49			216		
BTC-TP-13 (1.5-2)	YT	4/12/2016	BTC-TP-13 (1.5-2)-YT	4/12/2016	34.41	69	67	<LOD	3	121	132	131	1	65	110	52	287	440	42
BTC-TP-13 (2-3)	BC	4/12/2016			117.32			<LOD			469			144			284		
BTC-TP-13 (3-4)	BC	4/12/2016	BTC-TP-13 (3-3.5)-BC	4/12/2016	103.73	10	165	<LOD	<0.5		993	62	176	139	18	154	706	89	155
BTC-TP-13 (4-5)	AL	4/12/2016	BTC-TP-13 (4-4.5)-AL	4/12/2016	6.12	104	178	<LOD	3	121	57	871	175	15	93	145	37	523	173
BTC-TP-14 (1-2)	OB	4/12/2016	BTC-TP-14 (1-2)-OB	4/12/2016	12.48	70	139	<LOD	2	131	89	330	115	27	139	134	77	364	130
BTC-TP-14 (2-3)	BC	4/12/2016	BTC-TP-14 (2-3)-BC	4/12/2016	116.35	255	75	<LOD	5	84	1,146	1,900	50	221	330	39	443	991	76
			BTC-TP-14 (2-3)-BC (DUP.)	4/12/2016		65	57		2	136		302	117	127	127	54		351	26
BTC-TP-15 (1-2)	OB	4/12/2016	BTC-TP-15 (1-2)-OB	4/12/2016	48.18	73	41	<LOD	4	101	258	376	37	103	170	49	510	882	53
BTC-TP-15 (2.5-3)	BC	4/12/2016	BTC-TP-15 (2.5-3)-BC	4/12/2016	10.24	25	84	<LOD	2	141	97	172	55	43	71	49	203	393	64
BTC-TP-15 (3-3.5)	AL	4/12/2016	BTC-TP-15 (3-3.5)-AL	4/12/2016	<LOD	15	40	<LOD	1	164	39	93	83	10	44	128	42	276	147

Table 3
Floodplain Soils and Mine Wastes
XRF and Laboratory Analytical Results for Selected Parameters

XRF Sample Designation	Lithology Comment	Sample Date	Laboratory Sample Designation	Lab Sample Date	Arsenic (mg/kg)			Cadmium (mg/kg)			Copper (mg/kg)			Lead (mg/kg)			Zinc (mg/kg)		
					XRF	Laboratory	RPD %	XRF	Laboratory	RPD %	XRF	Laboratory	RPD %	XRF	Laboratory	RPD %	XRF	Laboratory	RPD %
BTC-TP-15 (6-7)	AL	4/13/2016			35.03			<LOD			238			65			297		
BTC-TP-16 (1-2)	OB	4/13/2016	BTC-TP-16 (1-2)-OB	4/13/2016	27	33	20	<LOD	2	149	137	186	30	152	344	77	315	394	22
BTC-TP-16 (6-7)	BC	4/13/2016	BTC-TP-16 (6-7)-BC	4/13/2016	35	58	49	<LOD	2	152	238	386	47	65	100	42	297	327	10
BTC-TP-17 (0.5-1)	BT	4/13/2016			93			<LOD			451			323			2,150		
BTC-TP-17 (1-2)	OB	4/13/2016	BTC-TP-17 (1-2)-OB	4/13/2016	23	80	111	<LOD	3	124	294	425	36	52	193	115	282	791	95
BTC-TP-17 (2.5-3.5)	GC	4/13/2016	BTC-TP-17 (2.5-3.5)-GC	4/13/2016	263	333	23	<LOD	8	30	1,361	3,000	75	410	1,540	116	1,397	3,510	86
BTC-17-17 (3.5-4.5)	BC	4/13/2016	BTC-17-17 (3.5-4.5)-BC	4/13/2016	124	182	38	<LOD	7	50	948	880	7	318	562	55	2,774	2,010	32
DPT BOREHOLES																			
BTC-DPT-01 (0-2.5)	OB	4/20/2016			123			<LOD			653			389			947		
BTC-DPT-01 (2.5-4)	OB	4/20/2016	BTC-WS-01 (2.5-4)-OB	4/7/2016	68	189	94	<LOD	7.4	39	534	1,210	78	146	453	103	544	1,730	104
BTC-DPT-01 (4-6)	OB	4/20/2016			245			<LOD			1279			516			1776		
BTC-DPT-01 (6-8)	OB	4/20/2016	BTC-WS-01 (6-8)-OB	4/7/2016	213	438	69	<LOD	23.4	72	1070	2,880	92	359	649	58	3261	7,930	83
BTC-DPT-01 (8-10)	OB	4/20/2016			872			<LOD			4145			537			1771		
BTC-DPT-01 (10-11)	OB	4/20/2016			154			<LOD			3071			280			1059		
BTC-DPT-01 (11-12.5)	OB	4/20/2016			176			<LOD			3338			298			2817		
BTC-DPT-01 (12.5-15)	BC	4/20/2016	BTC-WS-01 (12.5-15)-BC	4/7/2016	119	24	133	<LOD	1.1	164	1772	273	147	1175	64	179	1374	597	79
BTC-DPT-01 (15-18)	GT	4/20/2016			15			<LOD			244			30			175		
BTC-DPT-01 (18-20)	AL	4/20/2016	BTC-WS-01 (18-20)-AL	4/7/2016	<LOD	21	52	<LOD	2	138	53	351	100	15	15	100	52	273	100
BTC-DPT-02 (0-2.5)	OB	4/18/2016	BTC-WS-02 (0-2.5)-OB	4/7/2016	37	82	76	<LOD	4.6	82	263	444	51	251	630	86	650	1,060	48
BTC-DPT-02 (5-11)	BC	4/18/2016	BTC-WS-02 (5-11)-BC	4/7/2016	136	181	28	<LOD	6.8	47	363	1,690	129	166	279	51	634	1,690	91
BTC-DPT-02 (11-17)	AL	4/18/2016	BTC-WS-02 (11-17)-AL	4/7/2016	4	17	124	<LOD	2.7	121	44	80	58	13	9	36	81	219	92
	AL		BTC-WS-02 (11-17)-AL (DUP.)	4/7/2016		28	150		2.7	121		115	89		8	48		218	92
BTC-DPT-03 (0-2.5)	GT	4/18/2016	BTC-WS-03 (2-5)-BT	4/8/2016	<LOD	18	57	<LOD	<0.5	NA	35	55	157	17	26	153	29	89	307
BTC-DPT-03 (5-11)	BC	4/18/2016	BTC-WS-03 (5-7.5)-BC	4/8/2016	15	10	40	<LOD	<0.5	NA	51	36	34	16	16	0	69	93	30
BTC-DPT-03 (11-17)	AL	4/18/2016	BTC-WS-03 (12.5-15)-YT	4/8/2016	<LOD	7	35	<LOD	0.6	179	23	37	161	19	12	63	44	78	177
						Mean RPD (%)	74			89			74			75			82

Notes:
All sample results in mg/kg
OB-overburden, GC- gray clay, BC- black clay, GT- gray tailings, BT- black tailings, YT- yellow tailings, AL - alluvium
RPD% - Relative Percent Difference
Blank cell indicates analysis not conducted

Table 4
Floodplain Soils and Mine Wastes Physical and Chemical Characteristics, Nutrients, Acid Base Accounting and SPLP Analytical Results

Sample ID		Sample Date	Physical and Chemical Characteristics				Nutrients	Acid - Base Accounting									Synthetic Precipitation Leaching Procedure								
			SC	Saturated Paste pH	NAG pH	TOC	Nitrate as N	Sulfur, Hot Water Extracable	Sulfur, HCl Extractable	Sulfur, HNO3 Extractable	Sulfur, Residual	Neutral Potential	Acid Base Potential	Acid Base Potential Pyritic	Acid Potential	Acid Potential Pyritic	Arsenic	Cadmium	Chromium	Copper	Iron*	Lead	Manganese*	Mercury	Zinc
			(µmhos/cm)	(s.u.)	(s.u.)	(%)	(mg/L)	(%)	(%)	(%)	(%)	(t/kt)	(t/kt)	(t/kt)	(t/kt)	(t/kt)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
DEQ-7 Surface Water HHS [c]			NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.010	0.005	0.10	1.3	140	0.015	4.3	0.002	2.0
BTC-TP-01 (10-11.5)-AL	N	4/12/2016	1.3	7.4	--	0.7	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-01 (3-4)-OB	N	4/12/2016	3.1	7.5	--	1.1	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-01 (6.75-8.5)-BC	N	4/12/2016	1.4	6.8	--	1.9	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-01 (8.5-9.5)-BT	N	4/12/2016	0.8	6.3	5.3	0.6	1.6	0.01	0.05	0.27	0.11	12	-1	4	14	8.3	0.702	0.0125	0.01	2.57	34.1	1.52	0.7	0.00133	2.33
BTC-TP-02 (0-1)-OB	N	4/12/2016	4.2	7.5	--	1.8	7.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-02 (1.5-2)-YT	N	4/12/2016	2.1	7.5	--	0.6	7.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-02 (2-3)-BC	N	4/12/2016	1.4	5.7	--	2.4	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-02 (3-4)-AL	N	4/12/2016	1.2	7.3	--	0.2	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-03 (0-1)-OB	N	4/13/2016	1.7	7.2	--	6.2	9.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-03 (1.5-2)-BC	N	4/13/2016	2.8	6	--	1.9	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-03 (1-1.5)-YT	N	4/13/2016	1.5	7	--	1	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-03 (3-3.5)-AL	N	4/13/2016	1.1	6.5	--	1.4	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-04 (1-2)-OB	N	4/12/2016	5.1	7.3	--	0.4	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-04 (2.5-3)-YT	N	4/12/2016	1.2	7.6	--	7.4	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-04 (3-3.5)-BC	N	4/12/2016	2	7	--	2.1	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-05 (3-4)-BC	N	4/12/2016	2.4	6.9	--	2.5	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-06 (0-1)-OB	N	4/13/2016	1.7	7.3	--	4.1	2.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-06 (1.7-2)-BC	N	4/13/2016	1.5	6.3	--	2.9	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-06 (1-1.8)-YT	N	4/13/2016	2.5	7.1	--	0.6	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-06 (2-2.5)-AL	N	4/13/2016	0.9	6.3	--	0.3	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-07 (1-2)-OB	N	4/13/2016	3.2	8.1	--	1.1	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-07 (4.5-5)-AL	N	4/13/2016	0.8	5.8	4.9	0.5	< 1	< 0.01	0.02	0.98	0.42	11	-33	-19	45	31	0.062	0.00062	< 0.01	0.255	1.61	0.13	0.03	0.00008	0.185
BTC-TP-07 (4.5-5)-AL	D	4/13/2016	1.2	6.2	4.2	0.2	< 1	0.08	0.22	0.63	0.25	13	-24	-7	37	20	0.089	0.00109	< 0.01	0.475	2.8	0.256	0.06	0.00014	0.312
BTC-TP-07 (4-4.5)-AL	N	4/13/2016	2.8	6.4	--	3.9	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-07 (5-5.5)-AL	N	4/13/2016	1.2	5.7	--	2.6	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-08 (1-2)-OB	N	4/13/2016	4.4	7.3	--	1.1	1.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-08 (2-2.5)-BC	N	4/13/2016	1	5.6	--	2.6	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-08 (3-5)-AL	N	4/13/2016	0.9	6.8	--	1.2	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-09 (2-2.5)-OB	N	4/12/2016	1.5	7.1	--	2.2	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-09 (3-3.5)-YT	N	4/13/2016	1.1	7.5	--	0.2	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-09 (4-4.5)-BC	N	4/12/2016	2.4	7.1	--	1.9	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-10 (1-2)-OB	N	4/13/2016	3.4	7.7	--	7.8	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-10 (4-5)-AL	N	4/13/2016	2.7	7	--	8.4	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-10 (4-5)-AL	D	4/13/2016	1	5.6	--	3	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-11 (1-2)-OB	N	4/13/2016	0.9	3.8	--	0.2	1.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:

SC - Specific Conductance
NAG - Net Acid Generation
TOC - Total Organic Carbon
µmhos/cm - Micromhos per centimeter
S.U. - Standard Units
% - Percent
t/kt - Tons per kiloton
mg/L - Milligrams per liter

NE - Not established
N - Natural sample
D - Duplicate sample
-- - Sample not collected / analyzed
d - RL increased due to sample matrix
L - Lowest available reporting limit for the analytical method
< - Parameter not detected at or above the laboratory practical quantitation limit
- Value exceeds water quality standard

Classification [b]	Criteria for Classification
Potentially Acid Generating	NP:AP [a] <1 and NNP < -20 t/kt
Uncertain Acid Generation Potential	NP:AP between 1 and 3 and/or NNP between -20 and +20 t/kt
Unlikely to Generate Acid	NP:AP > 3 and NNP < +20 t/kt

[a] NP = Neutralization Potential, AP =Acidification Potential, NNP = Net Neutralizaiton Potential
[b] From BLM (1996) and EPA (1994)
[c] Surface Water Human Health standards based on Circular DEQ-7 Montana Numeric Water Quality Standards (October 2012)

*Iron and manganese SPLP Leachate Criterion for soil were calculated based on a DAF 1 and their respective EPA Tap Water standards. The SPLP Leachate Criterion for Soil for the remaining metals were calculated based on a DAF 1 and their respective DEQ-7 water quality standards (see Section 4 of RI report).

BTC - Blacktail Creek

Table 4
Floodplain Soils and Mine Wastes Physical and Chemical Characteristics, Nutrients, Acid Base Accounting and SPLP Analytical Results

Sample ID		Sample Date	Physical and Chemical Characteristics				Nutrients	Acid - Base Accounting									Synthetic Precipitation Leaching Procedure								
			SC	Saturated Paste pH	NAG pH	TOC	Nitrate as N	Sulfur, Hot Water Extracable	Sulfur, HCl Extractable	Sulfur, HNO3 Extractable	Sulfur, Residual	Neutral Potential	Acid Base Potential	Acid Base Potential Pyritic	Acid Potential	Acid Potential Pyritic	Arsenic	Cadmium	Chromium	Copper	Iron*	Lead	Manganese*	Mercury	Zinc
			(µmhos/cm)	(s.u.)	(s.u.)	(%)	(mg/L)	(%)	(%)	(%)	(%)	(t/kt)	(t/kt)	(t/kt)	(t/kt)	(t/kt)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
DEQ-7 Surface Water HHS [c]			NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0.010	0.005	0.10	1.3	140	0.015	4.3	0.002	2.0
BTC-TP-11 (5-6)-OB	N	4/13/2016	1	7.4	--	0.4	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-11 (6.5-7)-BC	N	4/13/2016	1.2	6.6	--	4	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-12 (0-1)-OB	N	4/13/2016	1.9	7.8	--	0.8	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-12 (1.3-2)-AL	N	4/13/2016	1.6	6.7	--	1.4	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-13 (0-1)-OB	N	4/12/2016	0.8	8.1	--	1	1.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-13 (1.5-2)-YT	N	4/12/2016	1.2	7.8	--	0.3	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-13 (3-3.5)-BC	N	4/12/2016	1.6	7	--	2.6	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-13 (4-4.5)-AL	N	4/12/2016	1.4	7.1	--	1.2	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-14 (1-2)-OB	N	4/12/2016	2.9	7.6	--	0.6	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-14 (2-3)-BC	N	4/12/2016	3	6.2	--	1.6	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-14 (2-3)-BC	D	4/12/2016	1.3	7.5	--	0.5	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-15 (1-2)-OB	N	4/12/2016	3	7.6	--	1.7	2.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-15 (2-3)-BC	N	4/12/2016	2.8	5.8	--	1.7	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-15 (3-3.5)-AL	N	4/12/2016	0.8	6.1	--	0.1	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-16 (1-2)-OB	N	4/13/2016	1.5	7.7	--	0.8	1.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-16 (6-7)-BC	N	4/13/2016	1.6	7.7	--	0.5	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-17 (1-2)-OB	N	4/13/2016	4.9	5	--	0.9	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-TP-17 (2.5-3.5)-GC	N	4/13/2016	4.7	6.9	7	0.9	< 1	< 0.01	0.05	0.1	0.07	8	0	5	6.8	3.1	0.02	0.00016	< 0.01	0.148	1.83	0.0908	< 0.02	0.00253	0.156
BTC-TP-17 (3.5-4.5)-BC	N	4/13/2016	2.7	6.9	--	7.4	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-WS-01 (12.5-15)-BC	N	4/7/2016	1.8	6.8	--	1.7	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-WS-01 (18-20)-AL	N	4/7/2016	0.7	6.8	--	0.1	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-WS-01 (2.5-4)-OB	N	4/7/2016	3.2	6.3	--	0.8	17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-WS-01 (6-8)-OB	N	4/7/2016	1.2	6	--	1.4	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-WS-02 (0-2.5)-OB	N	4/7/2016	3.8	7.6	--	2.3	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-WS-02 (11-17.0)-AL	N	4/7/2016	0.3	7.3	--	< 0.1	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-WS-02 (11-17.0)-AL	D	4/7/2016	0.3	7.3	--	< 0.1	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-WS-02 (5-11)-BC	N	4/7/2016	3	6.4	3.9	1.9	< 1	0.02	0.03	0.23	0.22	12	-4	5	16	7	0.086	0.00232	< 0.01	0.415	4.84	0.1	0.06	0.00013	1.43
BTC-WS-03 (12.5-15)-YT	N	4/8/2016	0.3	7.3	--	0.1	1.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-WS-03 (2-5)-BT	N	4/8/2016	0.5	7.8	--	< 0.1	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-WS-03 (5-7.5)-BC	N	4/8/2016	0.4	7.3	--	0.1	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

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[b] From BLM (1996) and EPA (1994)
[c] Surface Water Human Health standards based on Circular DEQ-7 Montana Numeric Water Quality Standards (October 2012)

*Iron and manganese SPLP Leachate Criterion for soil were calculated based on a DAF 1 and their respective EPA Tap Water standards. The SPLP Leachate Criterion for Soil for the remaining metals were calculated based on a DAF 1 and their respective DEQ-7 water quality standards (see Section 4 of RI report).

BTC - Blacktail Creek

Table 5
Bank and Opportunity Soil Physical and Chemical Characteristics, Nutrients, Acid Base Accounting and SPLP Analytical Results

Sample ID	Sample Date	Physical and Chemical Characteristics				Nutrients	Acid - Base Accounting									Synthetic Precipitation Leaching Procedure								
		SC	Saturated Paste pH	NAG pH	TOC	Nitrate as N	Sulfur, Hot Water Extracable	Sulfur, HCl Extractable	Sulfur, HNO3 Extractable	Sulfur, Residual	Neutral Potential	Acid Base Potential	Acid Base Potential Pyritic	Acid Potential	Acid Potential Pyritic	Arsenic	Cadmium	Chromium	Copper	Iron*	Lead	Manganese*	Mercury	Zinc
		(µmhos/cm)	(s.u.)	(s.u.)	(%)	(mg/L)	(%)	(%)	(%)	(%)	(t/kt)	(t/kt)	(t/kt)	(t/kt)	(t/kt)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
DEQ-7 Surface Water HHS [c]		**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.010**	**0.005**	**0.10**	**1.3**	**140**	**0.015**	**4.3**	**0.002**	**2.0**
BTC-OSBS-01 (0-12") N	3/16/2016	0.8	6.2	--	1.3	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-OSBS-02 (0-12") N	3/16/2016	3.1	7.8	--	2.6	6.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-OSBS-03 (24-36") N	4/13/2016	0.8	6.4	--	0.2	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SBS-01N (0-12") N	3/9/2016	1.8	7.7	--	3.8	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SBS-02S (0-12") N	3/9/2016	0.8	7	7.5	2.5	1.4	0.01	< 0.01	0.04	0.04	12	9	11	2.9	1.2	0.082	0.00268 L	0.02	1.26	6.14	0.201	0.18	#######	0.96
BTC-SBS-03S (0-12") N	3/9/2016	0.9	5.9	--	0.7	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SBS-04N (0-12") N	3/15/2016	2.2	7.4	--	2.5	3.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SBS-04N (0-12") D	3/15/2016	1.3	7.2	--	0.4	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SBS-05S (0-12") N	3/15/2016	1.3	7.2	--	0.4	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SBS-06N (0-12") N	3/15/2016	1.5	7.5	--	1.8	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SBS-07S (0-12") N	3/15/2016	1.1	7.2	--	2.3	5.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SBS-08S (0-12") N	3/15/2016	1.5	7.6	--	1.3	1.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SBS-09N (0-12") N	3/15/2016	1.2	7.2	--	1.9	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SBS-09N (0-12") D	3/15/2016	1.2	7.2	--	2	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
GG-OSBS-01 (0-12") N	3/16/2016	0.3	7.6	9.4	0.2	< 1	< 0.01	< 0.01	< 0.01	0.01	64	63	64	0.23	< 0.01	0.013 d	0.00014 L	< 0.01	0.011	2.76	0.0045	0.06	< #######	0.022
SBC-OSBS-01 (0-12") N	3/16/2016	0.8	7.4	--	3.4	3.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:

SC - Specific Conductance
NAG - Net Acid Generation
TOC - Total Organic Carbon
µmhos/cm - Micromhos per centimeter
S.U. - Standard Units
% - Percent
t/kt - Tons per kiloton
mg/L - Milligrams per liter

NE - Not established
N - Natural sample
D - Duplicate sample
-- - Sample not collected / analyzed
d - RL increased due to sample matrix
L - Lowest available reporting limit for the analytical method
< - Parameter not detected at or above the laboratory practical quantitation limit
- Value exceeds water quality standard

Classification [b]	Criteria for Classification
Potentially Acid Generating	NP:AP <1 and NNP < -20 t/kt
Uncertain Acid Generation Potential	NP:AP between 1 and 3 and/or NNP between -20 and +20 t/kt
Unlikely to Generate Acid	NP:AP > 3 and NNP < +20 t/kt

[a] NP = Neutralization Potential, AP =Acidification Potential, NNP = Net Neutralizaiton Potential
[b] From BLM (1996) and EPA (1994)
[c] Surface Water Human Health standards based on Circular DEQ-7 Montana Numeric Water Quality Standards (October 2012)

*Iron and manganese SPLP Leachate Criterion for soil were calculated based on a DAF 1 and their respective EPA Tap Water standards. The SPLP Leachate Criterion for Soil for the remaining metals were calculated based on a DAF 1 and their respective DEQ-7 water quality standards (see Section 4 of RI report).

BTC - Blacktail Creek
GG - Grove Gulch
SBC - Silver Bow Creek

Table 6
In-Stream and Pond Sediment Metals Analytical Results

Sample ID		Sample Date	Total Metals (mg/kg)								
			Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Zinc
Freshwater Sediment Screening Benchmarks [a]			**9.8**	**0.99**	**43.4**	**31.6**	**20,000**	**35.8**	**460**	**0.18**	**121**
BTC-OSS-01 (0-12")	N	3/10/2016	125 d	7	27	978	32600	184 d	500	< 0.5	1370
SBC-SS-01 (0-12")	N	03/07/2016	698 d	11.4	28	10500	42000	1010 d	1770	5.1	3920
SBC-SS-02 (0-12")	N	03/09/2016	4410 d	26	78	3670	69300	1150 d	3820	< 0.5	4490
SBC-SS-03 (0-12")	N	03/08/2016	488 d	10.3	137	7470	90000	1200 d	2490	< 0.5	3010
BTC-PS-01 (0-12")	N	03/16/2016	324	21.8	31	4920	34800	1240 d	729	6	3630
BTC-PS-01 (24-36")	N	03/16/2016	347	23.2	33	2870	35100	1150 d	776	2.5	6510
BTC-PS-02 (0-12")	N	03/15/2016	86	2	42	503	29700	243	632	< 0.5	388 d
BTC-PS-03 (0-12")	N	03/11/2016	227 d	9.2	47	917	46700	703 d	998	< 0.5	2040
BTC-SS-01 (0-12")	N	03/08/2016	666 d	14.1	31	5890	45800	896 d	1350	0.99	3650
BTC-SS-02 (0-12")	N	03/08/2016	125 d	6	39	784	36700	322 d	850	< 0.5	1860
BTC-SS-03 (0-12")	N	03/09/2016	166 d	7.4	63	1420	47100	473 d	2010	< 0.5	2260
BTC-SS-04 (0-12")	N	03/10/2016	103 d	8.3	65	549	43900	263 d	514	< 0.5	1700
BTC-SS-05 (0-12")	N	03/10/2016	28	4.9	54	359	32600	173 d	253	< 0.5	1040
BTC-SS-05 (0-12")	D	03/10/2016	46	6.5	60	425	38000	213 d	247	< 0.5	1180
BTC-SS-06 (0-12")	N	03/10/2016	28	3.3	40	324	29700	125 d	656	< 0.5	630
BTC-SS-07 (0-12")	N	03/11/2016	33	2.4	59	389	37900	268 d	340	< 0.5	563
BTC-SS-07N (0-12")	N	03/11/2016	40	2.8	43	334	27700	177 d	318	< 0.5	503
BTC-SS-08 (0-12")	N	03/11/2016	22	1	50	303	32200	170 d	322	< 0.5	317
BTC-SS-08N (0-12")	N	03/11/2016	55	3.1	47	451	35300	247 d	335	< 0.5	535
BTC-SS-08S (0-12")	N	03/11/2016	66 d	1.8	30	301	25800	144 d	263	< 0.5	482
BTC-SS-09 (0-12")	N	03/14/2016	49	2.2	106	404	43100	579	675	< 0.5	418 d

Notes:

mg/kg - Milligrams per kilogram

a - EPA Region III BTAG Freshwater Sediment Screening Benchmarks 8/2006

Hierarchy for Selection of Freshwater Sediment Benchmarks

- Preference was given to benchmarks based on chronic direct exposure, non-lethal endpoint studies designed to be protective of sensitive species
- Values derived by statistical- or consensus-based evaluation of multiple studies were given first priority
- Equilibrium partitioning values were selected for contaminants with 2.0< log Kow <6.0 if empirical values based on multiple studies were not available
- Absent consensus or equilibrium partitioning values, single study toxicity values were selected

NE - Not established

-- - Sample not collected / analyzed

< - Parameter not detected at or above the laboratory practical quantitation limit

N - Natural sample

D - Duplicate sample

d - Reporting limit increased due to sample matrix.

- Value exceeds screening criteria

BTC - Blacktail Creek

GG - Grove Gulch

SBC - Silver Bow Creek

SC - Sand Creek

Table 6
In-Stream and Pond Sediment Metals Analytical Results

Sample ID		Sample Date	Total Metals (mg/kg)								
			Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Zinc
Freshwater Sediment Screening Benchmarks [a]			**9.8**	**0.99**	**43.4**	**31.6**	**20,000**	**35.8**	**460**	**0.18**	**121**
BTC-SS-10 (0-12")	N	03/14/2016	54	1.4	64	383	48700	216	3330	< 0.5	305 d
BTC-SS-11 (0-12")	N	03/14/2016	64	2	77	389	47500	410	551	< 0.5	582 d
BTC-SS-12 (0-12")	N	03/15/2016	39	1	62	194	51000	196	2730	< 0.5	232 d
BTC-SS-12 (0-12")	D	03/15/2016	56	1.2	86	296	69400	283	4370	< 0.5	291 d
BTC-SS-13 (0-12")	N	03/15/2016	39	2	66	216	47600	140	1690	< 0.5	316 d
GG-SS-01 (0-12")	N	03/10/2016	596 d	12.9	24	1190	53900	1420 d	4410	0.62	3840
SC-SS-01 (0-12")	N	03/10/2016	63	1.1	51	842	49400	283 d	508	< 0.5	334

Notes:

mg/kg - Milligrams per kilogram

a - EPA Region III BTAG Freshwater Sediment Screening Benchmarks 8/2006

Hierarchy for Selection of Freshwater Sediment Benchmarks

- Preference was given to benchmarks based on chronic direct exposure, non-lethal endpoint studies designed to be protective of sensitive species
- Values derived by statistical- or consensus-based evaluation of multiple studies were given first priority
- Equilibrium partitioning values were selected for contaminants with 2.0< log Kow <6.0 if empirical values based on multiple studies were not available
- Absent consensus or equilibrium partitioning values, single study toxicity values were selected

NE - Not established

-- - Sample not collected / analyzed

< - Parameter not detected at or above the laboratory practical quantitation limit

N - Natural sample

D - Duplicate sample

d - Reporting limit increased due to sample matrix.

- Value exceeds screening criteria

BTC - Blacktail Creek

GG - Grove Gulch

SBC - Silver Bow Creek

SC - Sand Creek

Table 7
In-Stream and Pond Sediment Physical and Chemical Characteristics, Nutrients, Acid Base Accounting and SPLP Analytical Results

Sample ID	Sample Date	Physical and Chemical Characteristics				Nutrients	Acid - Base Accounting									Synthetic Precipitation Leaching Procedure								
		SC	Saturated Paste pH	NAG pH	TOC	Nitrate as N	Sulfur, Hot Water Extracable	Sulfur, HCl Extractable	Sulfur, HNO3 Extractable	Sulfur, Residual	Neutral Potential	Acid Base Potential	Acid Base Potential Pyritic	Acid Potential	Acid Potential Pyritic	Arsenic	Cadmium	Chromium	Copper	Iron*	Lead	Manganese*	Mercury	Zinc
		(µmhos/cm)	(s.u.)	(s.u.)	(%)	(mg/L)	(%)	(%)	(%)	(%)	(t/kt)	(t/kt)	(t/kt)	(t/kt)	(t/kt)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
DEQ-7 Surface Water HHS [c]		**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.010**	**0.005**	**0.10**	**1.3**	**140**	**0.015**	**4.3**	**0.002**	**2.0**
BTC-OSS-01 (0-12") N	3/10/2016	1.3	6.2	--	1.2	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SBC-SS-01 (0-12") N	03/07/2016	1.1	7.4	--	0.5	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SBC-SS-02 (0-12") N	03/09/2016	0.9	7.2	5.6	0.8	1.6	0.06	0.05	0.23	0.2	21	4	14	17	7.1	0.242	0.00162 L	< 0.01	0.235	5.35	0.129	0.59	0.00006	0.328
SBC-SS-03 (0-12") N	03/08/2016	0.9	7.5	4.4	0.3	1.1	1.3	0.76	10	0.47	15	-380	-300	390	320	0.031	0.00047 L	< 0.01	0.25	2.87	0.119	0.18	0.00009	0.144
BTC-PS-01 (0-12") N	03/16/2016	0.5	6.3	--	1.6	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-PS-01 (24-36") N	03/16/2016	1	5.8	--	0.7	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-PS-02 (0-12") N	03/15/2016	0.8	7	--	0.9	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-PS-03 (0-12") N	03/11/2016	1.1	7.2	--	0.3	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SS-01 (0-12") N	03/08/2016	0.6	6.5	--	0.5	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SS-02 (0-12") N	03/08/2016	0.8	6.7	--	0.6	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SS-03 (0-12") N	03/09/2016	0.7	6.6	--	0.5	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SS-04 (0-12") N	03/10/2016	0.9	6.9	--	0.4	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SS-05 (0-12") N	03/10/2016	0.5	6.7	--	1.1	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SS-05 (0-12") D	03/10/2016	0.5	6.7	--	1.3	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SS-06 (0-12") N	03/10/2016	0.4	6.9	--	0.4	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SS-07 (0-12") N	03/11/2016	0.3	7.3	--	0.2	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SS-07N (0-12") N	03/11/2016	0.4	6.6	--	4.2	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SS-08 (0-12") N	03/11/2016	0.2	7.2	--	0.2	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SS-08N (0-12") N	03/11/2016	0.7	7	--	1.9	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SS-08S (0-12") N	03/11/2016	0.7	6.4	6.5	1	< 1	0.02	< 0.01	0.04	0.03	8	5	7	3.4	1.3	0.079	0.00136 L	< 0.01	0.179	7.97	0.0487	0.04	0.0001	0.146
BTC-SS-09 (0-12") N	03/14/2016	0.7	6.7	--	0.2	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SS-10 (0-12") N	03/14/2016	0.2	7.3	--	0.2	1.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SS-11 (0-12") N	03/14/2016	0.5	7	5	0.2	< 1	< 0.01	< 0.01	< 0.01	0.01	4	3	3	0.96	0.21	0.009 d	0.00039 L	< 0.01	0.06	3.31	0.0154	0.02	< 0.00005	0.085
BTC-SS-12 (0-12") N	03/15/2016	0.2	7.2	--	0.2	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SS-12 (0-12") D	03/15/2016	0.2	7.3	--	0.1	1.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BTC-SS-13 (0-12") N	03/15/2016	0.6	6.5	5.9	0.4	< 1	0.02	< 0.01	0.01	0.01	4	2	4	1.5	0.37	0.008 d	0.00011 L	< 0.01	0.01	4.33	0.0052	0.09	< 0.00005	0.02
GG-SS-01 (0-12") N	03/10/2016	0.9	6.9	--	2	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SC-SS-01 (0-12") N	03/10/2016	0.3	7.2	--	0.5	< 1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:

SC - Specific Conductance
NAG - Net Acid Generation
TOC - Total Organic Carbon
µmhos/cm - Micromhos per centimeter
S.U. - Standard Units
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t/kt - Tons per kiloton
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Classification[b] — Criteria for Classification[a]
Potentially Acid Generating — NP:AP <1 and NNP < -20 t/kt
Uncertain Acid Generation Potential — NP:AP between 1 and 3 and/or NNP between -20 and +20 t/kt
Unlikely to Generate Acid — NP:AP > 3 and NNP < +20 t/kt

[a] NP = Neutralization Potential, AP =Acidification Potential, NNP = Net Neutralizaiton Potential
[b] From BLM (1996) and EPA (1994)
[c] Surface Water Human Health standards based on Circular DEQ-7 Montana Numeric Water Quality Standards (October 2012)

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BTC - Blacktail Creek
GG - Grove Gulch
SBC - Silver Bow Creek
SC - Sand Creek

Table 8
Surface Water Field and General Chemistry Analytical Results

Sample ID		Sample Date	Field Parameters					Physiochemical							Common Anions				Common Cations				Nutrients
			SC (µmhos/L)	pH [a] (s.u.)	Temp. (ºC)	ORP (mV)	DO (mg/L)	SC (µmhos/L)	pH [a] (s.u.)	Hardness as CaCO3 (mg/L)	Acidity as CaCO3 (mg/L)	Alkalinity as CaCO3 (mg/L)	Total Diss. Solids (mg/L)	Total Susp. Solids (mg/L)	Sulfate (mg/L)	Bicarb as HCO3 (mg/L)	Carbonate as CO3 (mg/L)	Chloride (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Nitrate + Nitrite as N (mg/L)
DEQ-7 Surface Water Standards [1]		**Acute**	**NE**	**NE**	**NE**	**NE**	**4.0 - 8.0**	**NE**	**6.5 - 9.5**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
		Chronic	**NE**	**NE**	**NE**	**NE**	**4.0 - 8.0**	**NE**	**6.5 - 9.5**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
		Human Health	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**6.5 - 9.5**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**10**
BTC-PD-01	N	3/16/2016	431	9.18	0.88	240.2	26.69	310	8.7 H	106	< 4	82	188	< 10	18	97	< 4	35	27	9	5	15	< 0.01
BTC-PD-02	N	3/15/2016	334	--	5.35	334.8	9.88	320	8 H	117	< 4	110	206	40	50	130	< 4	6	34	7	3	17	0.09
BTC-PD-03	N	3/11/2016	828	7.39	7.49	51.4	7.11	425	7.8 H	163	< 4	120	267	13	64	150	< 4	14	48	11	3	19	2.37 d
BTC-SW-01	N	3/8/2016	277	7.03	2.97	131.8	18.65	305	7.8 H	119	< 4	91	217	< 10	33	110	< 4	15	34	8	4	13	0.91 d
BTC-SW-02	N	3/8/2016	280	7.12	3.36	32	17.31	311	7.8 H	122	< 4	92	215	< 10	33	110	< 4	16	34	9	4	14	0.81
BTC-SW-03	N	3/9/2016	560	7.77	5.7	78.8	4.3	309	7.9 H	118	< 4	93	196	< 10	34	110	< 4	15	34	8	4	13	0.8
BTC-SW-04	N	3/10/2016	587	7.28	3.58	135.3	3.52	316	7.6 H	120	< 4	94	198	< 10	35	110	< 4	15	34	9	3	13	0.98
BTC-SW-05	N	3/10/2016	596	8.04	6.41	61.2	5.67	313	7.9 H	118	< 4	94	193	< 10	33	110	< 4	16	33	8	3	13	0.96
BTC-SW-06	N	3/10/2016	555	7.31	6.29	23.3	3.8	306	7.8 H	116	< 4	91	194	< 10	32	110	< 4	16	33	8	3	13	0.95
BTC-SW-07	N	3/11/2016	535	7.23	3.08	111.9	3.79	288	7.6 H	107	< 4	83	183	< 10	32	100	< 4	15	30	8	3	12	0.82
BTC-SW-08	N	3/11/2016	528	7.07	3.45	124.1	4.48	285	7.6 H	107	< 4	82	179	< 10	31	99	< 4	14	30	8	3	11	0.84
BTC-SW-09	N	3/14/2016	550	6.9	2.6	137.4	2.71	306	7.5 H	110	< 4	74	203	12	29	90	< 4	28	28	10	3	12	0.61
BTC-SW-10	N	3/14/2016	675	7.35	3.46	50.2	4.6	350	7.6 H	134	< 4	72	209	19	28	87	< 4	46	27	16	3	13	0.52
BTC-SW-10	D	3/14/2016	675	7.35	3.46	50.2	4.6	352	7.6 H	134	< 4	72	210	15	29	88	< 4	47	27	16	3	13	0.52
BTC-SW-11	N	3/14/2016	521	7.28	3.67	45.6	4.58	277	7.6 H	103	< 4	74	177	< 10	28	89	< 4	21	26	9	3	11	0.51
BTC-SW-12	N	3/15/2016	477	7.17	1.43	119.4	4.35	252	7.5 H	95	< 4	77	169	< 10	30	94	< 4	11	27	7	3	10	0.56
BTC-SW-12	D	3/15/2016	477	7.17	1.43	119.4	4.35	253	7.5 H	95	< 4	77	166	< 10	30	93	< 4	11	27	7	3	10	0.56
BTC-SW-13	N	3/15/2016	235	7.64	2.38	277.3	8.97	246	7.5 H	89	< 4	66	162	11	30	79	< 4	14	25	6	3	11	0.49
GG-SW-01	N	3/10/2016	738	7.37	2.38	79.2	3.68	390	7.7 H	142	< 4	120	246	< 10	56	140	< 4	15	40	10	6	19	0.12
SBC-SW-01	N	3/7/2016	711	7.43	8.05	17.3	0.35	326	7.9 H	126	< 4	94	217	14	35	110	< 4	19	35	9	4	15	0.75
SBC-SW-02	N	3/9/2016	594	7.63	4.96	71.9	4.91	320	7.8 H	121	< 4	92	200	< 10	35	110	< 4	18	34	9	4	14	0.8
SBC-SW-03	N	3/8/2016	283	4.52	2.23	221.3	16.53	310	7.7 H	120	< 4	90	205	< 10	34	110	< 4	16	34	9	4	14	0.88
SC-SW-01	N	3/10/2016	711	7.43	8.05	17.3	0.35	773	7.4 H	277	< 4	210	467	< 10	56	250	< 4	91	73	23	7	41	0.41

Notes:

SC - Specific Conductance
Temp. - Temperature
ORP - Oxygen Reduction Potential
DO - Dissolved Oxygen
µmhos/L - Micromhos per liter
S.U. - Standard Units
ºC - Degrees centigrade
mV - Millivolts
mg/L - Milligrams per liter
NE - Not established

1 - Montana Department of Environmental Quality (MDEQ) Human Health Standard from Circular DEQ-7, Montana Water Quality Standards (October 2012).
a - Per Administrative Rules of Montana (ARM) 17.30.028 for Silver Bow Creek, Stream Class I
N - Natural sample
D - Duplicate sample
-- - Sample not collected / analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
H - Analysis performed past recommended holding time
d - Reporting limit increased due to sample matrix.
- Value exceeds water quality standard

Table 9
Surface Water Total Metals Analytical Results

Sample ID		Sample Date	Total Hard-ness (mg/L)	Total Metals (mg/L)																							
				Arsenic			Cadmium			Chromium			Copper			Iron			Lead			Manganese	Mercury			Zinc		
				Lab Results	Aquatic Life Standard		Lab Results	Aquatic Life Standard		Lab Results	Aquatic Life Standard		Lab Results	Aquatic Life Standard		Lab Results	Aquatic Life Standard		Lab Results	Aquatic Life Standard		Lab Results	Lab Results	Aquatic Life Standard		Lab Results	Aquatic Life Standard	
					Acute[d]	Chronic[d]		Acute[a]	Chronic[b]		Acute[a]	Chronic[b]		Acute[a]	Chronic[b]		Acute[a]	Chronic[b]		Acute[a]	Chronic[b]			Acute[d]	Chronic[d]		Acute[a]	Chronic[b]
DEQ-7 Surface Water HHS [c]				0.01			0.005			0.1			1.3			NE			0.015			NE	0.00005			2.0		
BTC-PD-01	N	3/16/2016	106	0.021	0.34	0.15	0.00008	0.00226	0.00028	< 0.01	1.89118	0.09039	0.018	0.01479	0.00981	0.43	--	1.0	0.0049	0.08793	0.00343	0.31	< 0.00005	1.7	0.91	0.021	0.12588	0.12588
BTC-PD-02	N	3/15/2016	117	0.012	0.34	0.15	0.00067	0.00250	0.00030	< 0.01	2.05046	0.09801	0.021	0.01623	0.01067	1.55	--	1.0	0.0104	0.09971	0.00389	0.31	< 0.00005	1.7	0.91	0.105	0.13686	0.13686
BTC-PD-03	N	3/11/2016	163	0.003	0.34	0.15	0.00004	0.00351	0.00039	< 0.01	2.69023	0.12858	0.003	0.02218	0.01416	0.25	--	1.0	0.0014	0.15207	0.00593	0.05	< 0.00005	1.7	0.91	0.013	0.18126	0.18126
BTC-SW-01	N	3/8/2016	119	0.005	0.34	0.15	0.00004	0.00255	0.00031	< 0.01	2.07912	0.09938	0.005	0.01649	0.01082	0.62	--	1.0	0.0009	0.10188	0.00397	0.10	< 0.00005	1.7	0.91	0.012	0.13884	0.13884
BTC-SW-02	N	3/8/2016	122	0.005	0.34	0.15	0.00005	0.00261	0.00031	< 0.01	2.12196	0.10142	0.005	0.01688	0.01106	0.66	--	1.0	0.001	0.10516	0.00410	0.10	< 0.00005	1.7	0.91	0.012	0.14180	0.14180
BTC-SW-03	N	3/9/2016	118	0.004	0.34	0.15	0.00005	0.00252	0.00031	< 0.01	2.06480	0.09869	0.005	0.01636	0.01075	0.63	--	1.0	0.001	0.10079	0.00393	0.08	< 0.00005	1.7	0.91	0.011	0.13785	0.13785
BTC-SW-04	N	3/10/2016	120	0.004	0.34	0.15	0.00005	0.00257	0.00031	< 0.01	2.09342	0.10006	0.004	0.01662	0.01090	0.55	--	1.0	0.0006	0.10297	0.00401	0.08	< 0.00005	1.7	0.91	0.012	0.13983	0.13983
BTC-SW-05	N	3/10/2016	118	0.004	0.34	0.15	< 0.00003	0.00252	0.00031	< 0.01	2.06480	0.09869	0.004	0.01636	0.01075	0.48	--	1.0	0.0004	0.10079	0.00393	0.06	< 0.00005	1.7	0.91	< 0.008	0.13785	0.13785
BTC-SW-06	N	3/10/2016	116	0.003	0.34	0.15	0.00003	0.00248	0.00030	< 0.01	2.03610	0.09732	0.004	0.01610	0.01059	0.53	--	1.0	0.0004	0.09862	0.00384	0.06	< 0.00005	1.7	0.91	< 0.008	0.13587	0.13587
BTC-SW-07	N	3/11/2016	107	0.004	0.34	0.15	0.00003	0.00229	0.00028	< 0.01	1.90578	0.09109	0.005	0.01492	0.00988	0.74	--	1.0	0.0008	0.08899	0.00347	0.11	< 0.00005	1.7	0.91	< 0.008	0.12689	0.12689
BTC-SW-08	N	3/11/2016	107	0.004	0.34	0.15	0.00004	0.00229	0.00028	< 0.01	1.90578	0.09109	0.005	0.01492	0.00988	0.67	--	1.0	0.0007	0.08899	0.00347	0.10	< 0.00005	1.7	0.91	< 0.008	0.12689	0.12689
BTC-SW-09	N	3/14/2016	110	0.005	0.34	0.15	0.00005	0.00235	0.00029	< 0.01	1.94943	0.09318	0.009	0.01531	0.01012	1.09	--	1.0	0.0018	0.09218	0.00359	0.13	< 0.00005	1.7	0.91	0.012	0.12989	0.12989
BTC-SW-10	N	3/14/2016	134	0.005	0.34	0.15	0.00005	0.00287	0.00034	< 0.01	2.29143	0.10952	0.010	0.01844	0.01198	1.43	--	1.0	0.0022	0.11850	0.00462	0.15	< 0.00005	1.7	0.91	0.014	0.15354	0.15354
BTC-SW-10	D	3/14/2016	134	0.005	0.34	0.15	0.00006	0.00287	0.00034	< 0.01	2.29143	0.10952	0.010	0.01844	0.01198	1.41	--	1.0	0.0022	0.11850	0.00462	0.15	< 0.00005	1.7	0.91	0.015	0.15354	0.15354
BTC-SW-11	N	3/14/2016	103	0.005	0.34	0.15	0.00004	0.00220	0.00028	< 0.01	1.84723	0.08829	0.007	0.01439	0.00957	1.03	--	1.0	0.0011	0.08478	0.00330	0.13	< 0.00005	1.7	0.91	0.009	0.12286	0.12286
BTC-SW-12	N	3/15/2016	95	0.004	0.34	0.15	0.00003	0.00202	0.00026	< 0.01	1.72887	0.08263	0.006	0.01334	0.00893	0.85	--	1.0	0.0008	0.07648	0.00298	0.09	< 0.00005	1.7	0.91	< 0.008	0.11472	0.11472
BTC-SW-12	D	3/15/2016	95	0.004	0.34	0.15	0.00003	0.00202	0.00026	< 0.01	1.72887	0.08263	0.005	0.01334	0.00893	0.85	--	1.0	0.0008	0.07648	0.00298	0.09	< 0.00005	1.7	0.91	< 0.008	0.11472	0.11472
BTC-SW-13	N	3/15/2016	89	0.005	0.34	0.15	0.00005	0.00189	0.00025	< 0.01	1.63892	0.07833	0.008	0.01254	0.00844	1.55	--	1.0	0.0016	0.07039	0.00274	0.16	< 0.00005	1.7	0.91	0.008	0.10855	0.10855
GG-SW-01	N	3/10/2016	142	0.008	0.34	0.15	0.00004	0.00305	0.00035	< 0.01	2.40288	0.11485	0.006	0.01948	0.01259	0.48	--	1.0	0.0016	0.12758	0.00497	0.18	< 0.00005	1.7	0.91	0.024	0.16127	0.16127
SBC-SW-01	N	3/7/2016	126	0.007	0.34	0.15	0.00009	0.00270	0.00032	< 0.01	2.17877	0.10414	0.007	0.01740	0.01137	0.69	--	1.0	0.0016	0.10957	0.00427	0.12	< 0.00005	1.7	0.91	0.020	0.14573	0.14573
SBC-SW-02	N	3/9/2016	121	0.006	0.34	0.15	0.0001	0.00259	0.00031	< 0.01	2.10770	0.10074	0.008	0.01675	0.01098	0.75	--	1.0	0.0019	0.10407	0.00406	0.10	< 0.00005	1.7	0.91	0.019	0.14082	0.14082
SBC-SW-03	N	3/8/2016	120	0.005	0.34	0.15	0.00006	0.00257	0.00031	< 0.01	2.09342	0.10006	0.007	0.01662	0.01090	0.79	--	1.0	0.0016	0.10297	0.00401	0.12	< 0.00005	1.7	0.91	0.021	0.13983	0.13983
SC-SW-01	N	3/10/2016	277	0.008	0.34	0.15	< 0.00003	0.00601	0.00058	< 0.01	4.15335	0.19852	0.003	0.03656	0.02228	1.30	--	1.0	0.0007	0.29868	0.01164	1.28	< 0.00005	1.7	0.91	0.012	0.28407	0.28407

Notes:

mg/L - milligrams per Liter

a,b - Calculated Acute and Chronic aquatic life standards based on total hardness CaCO3 and as per Circular DEQ-7 (October 2012) and compared to total metals sample results

c - Surface Water Human Health standards based on Circular DEQ-7 Montana Numeric Water Quality Standards (October 2012) and compared to total metals sample results

d - Surface Water Acute and Chronic Standard based on Circular DEQ-7 (October, 2012) and compared to total metals sample results

NE - Not established

N - Natural Sample

D - Duplicate Sample

-- - indicates sample not collected/analyzed

< - Not detected above laboratory analytical method reporting limit

- Value exceeds water quality standard

Table 10
Surface Water Dissolved Metals Analytical Results

Sample ID		Sample Date	Dissolved Metals (mg/L)								
			Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Zinc
BTC-PD-01	N	3/16/2016	0.017	<0.00003	< 0.01	0.011	0.03	0.0007	0.27	< 0.00005	< 0.008
BTC-PD-02	N	3/15/2016	0.007	0.00003	< 0.01	0.004	< 0.02	0.0004	0.24	< 0.00005	< 0.008
BTC-PD-03	N	3/11/2016	0.002	<0.00003	< 0.01	0.005	0.02	0.0004	0.04	< 0.00005	0.01
BTC-SW-01	N	3/8/2016	0.003	<0.00003	< 0.01	0.003	0.1	< 0.0003	0.09	< 0.00005	< 0.008
BTC-SW-02	N	3/8/2016	0.003	<0.00003	< 0.01	0.004	0.08	< 0.0003	0.09	< 0.00005	< 0.008
BTC-SW-03	N	3/9/2016	0.003	<0.00003	< 0.01	0.007	0.08	< 0.0003	0.08	< 0.00005	< 0.008
BTC-SW-04	N	3/10/2016	0.002	<0.00003	< 0.01	0.006	0.1	< 0.0003	0.07	< 0.00005	0.009
BTC-SW-05	N	3/10/2016	0.003	<0.00003	< 0.01	0.006	0.07	< 0.0003	0.06	< 0.00005	< 0.008
BTC-SW-06	N	3/10/2016	0.002	<0.00003	< 0.01	0.003	0.06	< 0.0003	0.05	< 0.00005	< 0.008
BTC-SW-07	N	3/11/2016	0.002	<0.00003	< 0.01	0.004	0.11	< 0.0003	0.09	< 0.00005	< 0.008
BTC-SW-08	N	3/11/2016	0.002	<0.00003	< 0.01	0.006	0.12	< 0.0003	0.08	< 0.00005	< 0.008
BTC-SW-09	N	3/14/2016	0.003	<0.00003	< 0.01	0.008	0.11	0.0004	0.1	< 0.00005	< 0.008
BTC-SW-10	N	3/14/2016	0.003	<0.00003	< 0.01	0.003	0.09	< 0.0003	0.11	< 0.00005	< 0.008
BTC-SW-10	D	3/14/2016	0.003	<0.00003	< 0.01	0.007	0.09	0.0004	0.11	< 0.00005	< 0.008
BTC-SW-11	N	3/14/2016	0.002	<0.00003	< 0.01	0.004	0.12	< 0.0003	0.1	< 0.00005	< 0.008
BTC-SW-12	N	3/15/2016	0.002	<0.00003	< 0.01	0.004	0.14	< 0.0003	0.07	< 0.00005	< 0.008
BTC-SW-12	D	3/15/2016	0.002	<0.00003	< 0.01	0.003	0.14	< 0.0003	0.07	< 0.00005	< 0.008
BTC-SW-13	N	3/15/2016	0.002	<0.00003	< 0.01	0.007	0.13	0.0004	0.11	< 0.00005	< 0.008
GG-SW-01	N	3/10/2016	0.006	<0.00003	< 0.01	0.004	0.1	< 0.0003	0.16	< 0.00005	0.016
SBC-SW-01	N	3/7/2016	0.005	0.00003	< 0.01	0.007	0.08	< 0.0003	0.11	< 0.00005	0.011
SBC-SW-02	N	3/9/2016	0.003	<0.00003	< 0.01	0.005	0.1	< 0.0003	0.09	< 0.00005	0.009
SBC-SW-03	N	3/8/2016	0.003	<0.00003	< 0.01	0.002	0.13	< 0.0003	0.11	< 0.00005	0.01
SC-SW-01	N	3/10/2016	0.005	<0.00003	< 0.01	0.005	0.22	< 0.0003	1.2	< 0.00005	0.011

Notes:

mg/L - Milligrams per liter

< - Parameter not detected at or above the laboratory practical quantitation limit

N - Natural sample

D - Duplicate sample

BTC - Blacktail Creek

GG - Grove Gulch

SBC - Silver Bow Creek

Table 11
In-Stream and Pond Sediment Pore Water Field and General Chemistry Analytical Results

Sample ID		Sample Date	Field Parameters					Physiochemical							Common Anions				Common Cations				Nutrients
			SC (µmhos/L)	pH [a] (s.u.)	Temp. (ºC)	ORP (mV)	DO (mg/L)	SC (µmhos/L)	pH [a] (s.u.)	Hardness as CaCO3 (mg/L)	Acidity as CaCO3 (mg/L)	Alkalinity as CaCO3 (mg/L)	Total Diss. Solids (mg/L)	Total Susp. Solids (mg/L)	Sulfate (mg/L)	Bicarb as HCO3 (mg/L)	Carbonate as CO3 (mg/L)	Chloride (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Nitrate + Nitrite as N (mg/L)
DEQ-7		**Acute**	**NE**	**6.5 - 9.5**	**NE**	**NE**	**4.0 - 8.0**	**NE**	**6.5 - 9.5**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Surface Water		**Chronic**	**NE**	**6.5 - 9.5**	**NE**	**NE**	**4.0 - 8.0**	**NE**	**6.5 - 9.5**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Standards [1]		**Human Health**	**NE**	**6.5 - 9.5**	**NE**	**NE**	**NE**	**NE**	**6.5 - 9.5**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**10**
BTC-SPW-01N (12")	N	3/8/2016	400	6.88	3.41	-61.4	5.69	438	7.1 H	149	< 4	180	277	50	7	220	< 4	20	44	10	5	20	0.03
BTC-SPW-02N (12")	N	3/9/2016	1080	7.19	4.2	-72.7	1.84	518	7.2 H	198	< 4	250	280 d	345 d	< 1	310	< 4 d	15	54	15	5	27	0.03
BTC-SPW-02N (36")	N	3/9/2016	859	7.71	8.4	-181.3	0.00	--	--	163	--	--	--	--	--	--	--	--	45	12	6	25	--
BTC-SPW-02S (12")	N	3/8/2016	1038	6.95	2.99	88.7	0.77	372	7.3 H	134	< 4	140	242	92	29	160	< 4	16	38	9	4	23	< 0.01
BTC-SPW-02S (36")	N	3/9/2016	670	6.96	4.37	30.7	0.00	361	7.3 H	127	< 4	110	220	< 10	47	130	< 4	15	36	9	4	22	0.63
BTC-SPW-03N (12")	N	3/9/2016	2455	7.00	4.15	-4.4	0.57	1470	7.2 H	740	< 4	620	1010	55	254	750	< 4	12	188	65	33	42	0.02
BTC-SPW-03S (12")	N	3/9/2016	2383	6.92	4.09	-74.2	0.38	1150	6.8 H	418	< 4	350	650 d	152 d	2	430	< 4 d	154	108	36	12	56	0.03
BTC-SPW-03S (36")	N	3/9/2016	1253	7.77	7.36	-151.1	0.00	--	--	234	--	--	--	--	--	--	--	--	68	15	7	31	--
BTC-SPW-04N (12")	N	3/10/2016	2373	7.24	4.37	-40.1	0.62	1150	7.2 H	480	< 4	600	694	33	21	730	< 4	27	132	36	6	54	0.01
BTC-SPW-04N (12")	D	3/10/2016	2373	7.24	4.37	-40.1	0.62	1120	7.2 H	500	< 4	580	686	34	21	710	< 4	26	137	38	6	56	0.01
BTC-SPW-04S (12")	N	3/10/2016	665	7.94	5.96	-24.9	0.84	--	--	114	--	--	--	--	--	--	--	--	33	8	4	19	--
BTC-SPW-04S (36")	N	3/10/2016	568	7.41	6.95	-107.4	0.00	291	7.3 H	104	< 4	130	184	10	15	150	< 4	6	30	7	3	19	< 0.01
BTC-SPW-05N (12")	N	3/10/2016	579	7.69	8.34	59.6	2.27	302	7.2 H	110	< 4	89	193	< 10	47	110	< 4	6	32	7	3	17	0.88
BTC-SPW-05N (36")	N	3/10/2016	546	7.43	9.53	74.4	1.83	301	7.2 H	110	< 4	90	191	87	47	110	< 4	7	32	7	3	17	0.85
BTC-SPW-05S (12")	N	3/10/2016	1745	6.67	5.5	-16.4	0.50	754	6.7 H	252	< 4	150	448	124	13	190	< 4	139	73	17	4	24	0.19
BTC-SPW-05S (36")	N	3/10/2016	356	7.12	6.06	-96.3	0.32	282	7.0 H	105	< 4	140	166	482	< 1	170	< 4	6	31	7	3	13	< 0.01
BTC-SPW-06N (12")	N	3/10/2016	1945	7.43	5.17	-38.5	2.05	738	7.0 H	332	< 4	320	490	47	75	390	< 4	14	99	21	2	29	0.01
BTC-SPW-06S (12")	N	3/10/2016	850	7.27	5.5	-87.8	0.45	416	7.0 H	164	< 4	160	249	52	27	200	< 4	21	45	13	4	20	0.01
BTC-SPW-06S (36")	N	3/10/2016	840	7.11	6.61	-94.4	0.00	438	7.2 H	176	< 4	160	268	43	38	190	< 4	21	50	13	4	19	0.01
BTC-SPW-07N (12")	N	3/11/2016	611	7.65	5.95	86.3	1.42	328	7.1 H	123	< 4	88	213	< 10	62	110	< 4	6	35	8	3	16	1.6
BTC-SPW-07N (36")	N	3/11/2016	594	7.24	7.23	95.4	0.53	327	7.2 H	121	< 4	86	211	< 10	61	100	< 4	6	35	8	3	16	2.12 d
BTC-SPW-08N (12")	N	3/11/2016	493	7.40	5.95	-45.6	1.27	228	7.1 H	91	< 4	100	135	243	11	120	< 4	4	25	7	3	10	0.01
BTC-SPW-08N (36")	N	3/11/2016	473	7.37	7.27	-104.5	0.79	247	7.3 H	97	< 4	96	146	< 10	20	120	< 4	4	27	7	3	10	0.65
BTC-SPW-08S (12")	N	3/11/2016	528	6.88	5.95	-20.1	2.30	270	7.2 H	108	< 4	110	155	< 10	20	130	< 4	7	30	8	3	11	0.02
BTC-SPW-08S (36")	N	3/11/2016	507	7.18	6.85	-58.1	0.00	276	7.2 H	110	< 4	130	154	< 10	< 1	160	< 4	8	31	8	3	11	< 0.01
BTC-SPW-09N (12")	N	3/14/2016	573	7.38	4.34	108.2	1.08	292	7.2 H	117	< 4	99	189	< 10	31	120	< 4	7	33	9	3	12	1.35
BTC-SPW-09S (12")	N	3/14/2016	--	7.21	6.06	-74	--	979	7.0 H	394	< 4	300	595	56	10	360	< 4	140	110	29	5	44	0.07
BTC-SPW-09S (36")	N	3/14/2016	758	7.21	6.06	-74	0.46	374	7.2 H	158	< 4	120	244	< 10	36	140	< 4	19	45	11	4	13	1.32
BTC-SPW-10N (12")	N	3/14/2016	1198	6.99	4.52	9.8	1.46	641	7.0 H	277	< 4	230	405	31	68	270	< 4	28	79	19	4	27	0.07
BTC-SPW-10N (36")	N	3/14/2016	602	7.02	4.66	-45.6	0.61	466	7.1 H	190	< 4	160	298	< 10	50	190	< 4	18	54	13	3	22	1.06
BTC-SPW-10S (12")	N	3/14/2016	961	7.30	5.56	36.6	1.72	486	7.0 H	200	< 4	130	301	< 10	46	160	< 4	40	58	14	5	16	1.36
BTC-SPW-10S (12")	D	3/14/2016	961	7.30	5.56	36.6	1.72	486	6.9 H	200	< 4	130	299	< 10	46	160	< 4	40	58	14	5	16	1.35
BTC-SPW-10S (36")	N	3/14/2016	898	7.06	6.71	49.9	1.52	459	7.0 H	189	< 4	130	288	19	40	150	< 4	32	55	13	4	14	3.59 d
BTC-SPW-11N (12")	N	3/14/2016	698	7.26	4.06	16.5	2.02	359	7.0 H	152	< 4	110	235	< 10	53	130	< 4	11	45	10	3	10	0.06
BTC-SPW-11N (36")	N	3/14/2016	673	6.72	3.87	30.5	1.03	351	7.1 H	148	< 4	100	229	< 10	50	120	< 4	11	42	11	4	10	1.8

Notes:

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Temp. - Temperature
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DO - Dissolved Oxygen
µmhos/L - Micromhos per liter
S.U. - Standard Units
ºC - Degrees centigrade
mV - Millivolts
mg/L - Milligrams per liter
NE - Not established

1 - Montana Department of Environmental Quality (MDEQ) Human Health Standard from Circular DEQ-7, Montana Water Quality Standards (October 2012).
a - Per Administrative Rules of Montana (ARM) 17.30.028 for Silver Bow Creek, Stream Class I
N - Natural sample
D - Duplicate sample
-- - Sample not collected / analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
H - Analysis performed past recommended holding time
d - Reporting limit increased due to sample matrix.
 - Value meets or exceeds surface water standard

Table 11
In-Stream and Pond Sediment Pore Water Field and General Chemistry Analytical Results

Sample ID		Sample Date	Field Parameters					Physiochemical							Common Anions				Common Cations				Nutrients
			SC	pH [a]	Temp.	ORP	DO	SC	pH [a]	Hardness as CaCO3	Acidity as CaCO3	Alkalinity as CaCO3	Total Diss. Solids	Total Susp. Solids	Sulfate	Bicarb as HCO3	Carbonate as CO3	Chloride	Calcium	Magnesium	Potassium	Sodium	Nitrate + Nitrite as N
			(µmhos/L)	(s.u.)	(ºC)	(mV)	(mg/L)	(µmhos/L)	(s.u.)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
DEQ-7		**Acute**	**NE**	**6.5 - 9.5**	**NE**	**NE**	**4.0 - 8.0**	**NE**	**6.5 - 9.5**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Surface Water		**Chronic**	**NE**	**6.5 - 9.5**	**NE**	**NE**	**4.0 - 8.0**	**NE**	**6.5 - 9.5**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Standards [1]		**Human Health**	**NE**	**6.5 - 9.5**	**NE**	**NE**	**NE**	**NE**	**6.5 - 9.5**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**10**
BTC-SPW-11S (12")	N	3/14/2016	1333	7.21	4.58	18.1	1.96	679	7.0 H	261	< 4	210	416	14	27	250	< 4	77	73	19	6	32	0.17
BTC-SPW-11S (36")	N	3/14/2016	975	7.18	5.41	14.4	2.18	498	7.1 H	192	< 4	140	312	< 10	29	180	< 4	48	54	14	5	21	1.03 d
BTC-SPW-12N (12")	N	3/15/2016	1032	7.39	3.78	99.9	1.83	527	7.2 H	241	< 4	200	333	< 10	44	240	< 4	18	71	15	3	18	2.05 d
BTC-SPW-12N (12")	D	3/15/2016	1032	7.39	3.78	99.9	1.83	528	7.2 H	236	< 4	200	336	< 10	44	240	< 4	18	70	15	3	19	2.17 d
BTC-SPW-12S (12")	N	3/15/2016	1204	7.10	3.45	-60.6	0.17	643	7.0 H	267	< 4	200	403	14	18	250	< 4	71	75	19	5	19	0.04
BTC-SPW-12S (36")	N	3/15/2016	521	7.26	3.43	105.4	0.16	524	7.0 H	215	< 4	160	330	20	25	200	< 4	50	61	16	4	17	0.04
BTC-SPW-13N (12")	N	3/15/2016	446	6.15	5.45	262.7	5.25	448	7.3 H	190	< 4	150	297	< 10	55	180	< 4	11	55	13	2	18	0.76
BTC-SPW-13N (36")	N	3/15/2016	416	7.38	5.45	253.6	1.61	422	7.4 H	172	< 4	140	280	< 10	55	160	< 4	9	50	11	2	18	3.95 d
BTC-SPW-13S (12")	N	3/15/2016	--	7.06	2.56	129.4	0.94	435	7.0 H	159	< 4	140	262	< 10	25	170	< 4	38	44	12	4	22	0.01
BTC-SPW-13S (36")	N	3/15/2016	268	7.05	4	194.9	0.95	312	7.0 H	124	< 4	110	195	< 10	33	130	< 4	10	35	9	3	12	0.27
BTC-WPPW-01 (12")	N	3/16/2016	252	6.80	1.6	273.2	1.14	276	6.8 H	82	< 4	48	189	26	20	58	< 4	35	19	8	9	12	< 0.01
BTC-WPPW-01 (36")	N	3/16/2016	1346	7.02	0.97	-26.2	1.19	1310	6.9 H	508	< 4	490	788	62	< 1	600	< 4	121	141	38	10	48	0.06
BTC-WPPW-02 (12")	N	3/15/2016	383	7.42	2.64	120	2.75	377	7.2 H	140	< 4	140	234 d	442 d	15	160	< 4 d	28	40	10	3	19	0.02
BTC-WPPW-02 (36")	N	3/15/2016	995	7.05	1.98	117.6	0.99	967	7.0 H	477	< 4	540	589	49	< 1	660	< 4	9	134	35	6	29	0.02
GG-SPW-01E (12")	N	3/10/2016	583	6.90	4.5	-75.4	0.86	305	7.2 H	121	< 4	110	182	< 10	26	140	< 4	10	34	9	3	14	0.18
GG-SPW-01E (36")	N	3/10/2016	560	6.88	4.98	-97.9	0.14	299	7.7 H	118	< 4	120	177	< 10	20	140	< 4	10	33	9	3	14	< 0.01
SBC-SPW-01N (12")	N	3/9/2016	1270	7.45	3.95	-84.7	1.66	686	7.2 H	326	< 4	310	420	33	39	380	< 4	20	93	23	4	16	< 0.01
SBC-SPW-01S (12")	N	3/9/2016	3885	7.14	4.92	-76.2	0.64	1850	7.2 H	685	< 4	300	1070	108	183	370	< 4	343	174	61	11	99	0.01
SBC-SPW-02N (12")	N	3/9/2016	5961	5.03	4.99	119.2	0.31	2980	4.2 H	702	1400	< 4	3560	198	2220	< 4	< 4	19	246	22	30	20	< 0.01
SBC-SPW-02N (36")	N	3/9/2016	4655	5.52	5.67	89.5	0.82	2440	4.6 H	740	840	< 4	2590	57	1630	< 4	< 4	47	251	28	23	35	0.02
SBC-SPW-02S (12")	N	3/9/2016	5267	7.04	4.75	5.1	0.97	2580	7.4 H	469	< 4	200	1430	28	56	240	< 4	685	138	30	11	313	0.01
SBC-SPW-02S (36")	N	3/9/2016	5362	7.16	5.26	8.6	0.86	2630	7.1 H	469	< 4	180	1470	34	44	220	< 4	736	137	31	10	323	0.02
SBC-SPW-03N (12")	N	3/8/2016	1062	6.61	5.57	143.7	2.80	1180	7.2 H	456	< 4	220	814	75	353	270	< 4	39	129	33	10	77	0.44
SC-SPW-01E (12")	N	3/10/2016	711	7.43	8.05	17.3	0.35	374	7.3 H	151	< 4	130	216	< 10	34	150	< 4	16	43	11	4	15	1.75
SC-SPW-01E (36")	N	3/10/2016	698	7.30	5.23	27.8	1.36	363	7.3 H	147	< 4	120	212	< 10	33	150	< 4	15	42	10	4	14	1.76

Notes:

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TABLE 12

In-Stream and Pond Sediment Pore Water Dissolved Metals Analytical Results

Sample ID		Sample Date	Total Hardness (mg/L)	Dissolved Metals (mg/L)																							
				Arsenic			Cadmium			Chromium			Copper			Iron			Lead			Manganese	Mercury			Zinc		
				Lab Results	Aquatic Life Standard		Lab Results	Aquatic Life Standard		Lab Results	Aquatic Life Standard		Lab Results	Aquatic Life Standard		Lab Results	Aquatic Life Standard		Lab Results	Aquatic Life Standard		Lab Results	Lab Results	Aquatic Life Standard		Lab Results	Aquatic Life Standard	
					Acute[e]	Chronic[e]		Acute[a]	Chronic[b]		Acute[a]	Chronic[b]		Acute[a]	Chronic[b]		Acute[a]	Chronic[b]		Acute[a]	Chronic[b]			Acute[e]	Chronic[e]		Acute[a]	Chronic[b]
DEQ-7 Surface Water HHS [c]				0.01			0.005			0.1			1.3			NE			0.015			NE	0.00005			2.0		
BTC-SPW-01N (12")	N	3/8/2016	149	0.028	0.34	0.15	< 0.00003	0.00255	0.00031	< 0.01	2.07912	0.09938	< 0.002	0.01649	0.01082	12.1	--	1.0	< 0.0003	0.10188	0.00397	1.59	< 0.00005	1.7	0.91	< 0.008	0.13884	0.13884
BTC-SPW-02N (12")	N	3/9/2016	198	0.033	0.34	0.15	< 0.00003	0.00261	0.00031	< 0.01	2.12196	0.10142	< 0.002	0.01688	0.01106	18.2	--	1.0	< 0.0003	0.10516	0.00410	2.36	< 0.00005	1.7	0.91	< 0.008	0.14180	0.14180
BTC-SPW-02N (36")	N	3/9/2016	163	0.044	0.34	0.15	< 0.00003	0.00261	0.00031	< 0.01	2.12196	0.10142	0.004	0.01688	0.01106	1.12	--	1.0	0.0003	0.10516	0.00410	1.50	< 0.00005	1.7	0.91	< 0.008	0.14180	0.14180
BTC-SPW-02S (12")	N	3/8/2016	134	0.003	0.34	0.15	< 0.00003	0.00261	0.00031	< 0.01	2.12196	0.10142	< 0.002	0.01688	0.01106	2.56	--	1.0	< 0.0003	0.10516	0.00410	0.63	< 0.00005	1.7	0.91	< 0.008	0.14180	0.14180
BTC-SPW-02S (36")	N	3/9/2016	127	0.013	0.34	0.15	0.00398	0.00261	0.00031	< 0.01	2.12196	0.10142	0.604	0.01688	0.01106	< 0.02	--	1.0	0.0017	0.10516	0.00410	0.11	< 0.00005	1.7	0.91	0.506	0.14180	0.14180
BTC-SPW-03N (12")	N	3/9/2016	740	0.070	0.34	0.15	< 0.00003	0.00252	0.00031	< 0.01	2.06480	0.09869	< 0.002	0.01636	0.01075	17.6	--	1.0	< 0.0003	0.10079	0.00393	2.71	< 0.00005	1.7	0.91	< 0.008	0.13785	0.13785
BTC-SPW-03S (12")	N	3/9/2016	418	0.198	0.34	0.15	< 0.00003	0.00252	0.00031	< 0.01	2.06480	0.09869	< 0.002	0.01636	0.01075	71.5	--	1.0	< 0.0003	0.10079	0.00393	6.06	< 0.00005	1.7	0.91	< 0.008	0.13785	0.13785
BTC-SPW-03S (36")	N	3/9/2016	234	0.028	0.34	0.15	< 0.00003	0.00252	0.00031	< 0.01	2.06480	0.09869	0.005	0.01636	0.01075	5.36	--	1.0	0.0009	0.10079	0.00393	2.48	< 0.00005	1.7	0.91	< 0.008	0.13785	0.13785
BTC-SPW-04N (12")	N	3/10/2016	480	0.002	0.34	0.15	< 0.00003	0.00257	0.00031	< 0.01	2.09342	0.10006	< 0.002	0.01662	0.01090	11	--	1.0	< 0.0003	0.10297	0.00401	4.30	< 0.00005	1.7	0.91	< 0.008	0.13983	0.13983
BTC-SPW-04N (12")	D	3/10/2016	500	0.001	0.34	0.15	< 0.00003	0.00257	0.00031	< 0.01	2.09342	0.10006	< 0.002	0.01662	0.01090	11.5	--	1.0	< 0.0003	0.10297	0.00401	4.47	< 0.00005	1.7	0.91	< 0.008	0.13983	0.13983
BTC-SPW-04S (12")	N	3/10/2016	114	0.018	0.34	0.15	< 0.00003	0.00257	0.00031	< 0.01	2.09342	0.10006	0.003	0.01662	0.01090	0.72	--	1.0	0.0007	0.10297	0.00401	0.40	< 0.00005	1.7	0.91	< 0.008	0.13983	0.13983
BTC-SPW-04S (36")	N	3/10/2016	104	0.004	0.34	0.15	< 0.00003	0.00257	0.00031	< 0.01	2.09342	0.10006	< 0.002	0.01662	0.01090	3.72	--	1.0	< 0.0003	0.10297	0.00401	0.41	< 0.00005	1.7	0.91	< 0.008	0.13983	0.13983
BTC-SPW-05N (12")	N	3/10/2016	110	0.002	0.34	0.15	0.00047	0.00252	0.00031	< 0.01	2.06480	0.09869	< 0.002	0.01636	0.01075	< 0.02	--	1.0	< 0.0003	0.10079	0.00393	< 0.02	< 0.00005	1.7	0.91	0.095	0.13785	0.13785
BTC-SPW-05N (36")	N	3/10/2016	110	0.002	0.34	0.15	0.0004	0.00252	0.00031	< 0.01	2.06480	0.09869	0.004	0.01636	0.01075	< 0.02	--	1.0	< 0.0003	0.10079	0.00393	< 0.02	< 0.00005	1.7	0.91	0.091	0.13785	0.13785
BTC-SPW-05S (12")	N	3/10/2016	252	0.026	0.34	0.15	< 0.00003	0.00252	0.00031	< 0.01	2.06480	0.09869	< 0.002	0.01636	0.01075	25.9	--	1.0	< 0.0003	0.10079	0.00393	5.07	< 0.00005	1.7	0.91	< 0.008	0.13785	0.13785
BTC-SPW-05S (36")	N	3/10/2016	105	0.009	0.34	0.15	< 0.00003	0.00252	0.00031	< 0.01	2.06480	0.09869	< 0.002	0.01636	0.01075	11.5	--	1.0	< 0.0003	0.10079	0.00393	1.08	< 0.00005	1.7	0.91	< 0.008	0.13785	0.13785
BTC-SPW-06N (12")	N	3/10/2016	332	0.056	0.34	0.15	< 0.00003	0.00248	0.00030	< 0.01	2.03610	0.09732	0.004	0.01610	0.01059	10	--	1.0	< 0.0003	0.09862	0.00384	4.94	< 0.00005	1.7	0.91	< 0.008	0.13587	0.13587
BTC-SPW-06S (12")	N	3/10/2016	164	0.005	0.34	0.15	< 0.00003	0.00248	0.00030	< 0.01	2.03610	0.09732	< 0.002	0.01610	0.01059	7.84	--	1.0	< 0.0003	0.09862	0.00384	0.83	< 0.00005	1.7	0.91	< 0.008	0.13587	0.13587
BTC-SPW-06S (36")	N	3/10/2016	176	0.007	0.34	0.15	< 0.00003	0.00248	0.00030	< 0.01	2.03610	0.09732	0.002	0.01610	0.01059	2.57	--	1.0	< 0.0003	0.09862	0.00384	0.20	< 0.00005	1.7	0.91	< 0.008	0.13587	0.13587
BTC-SPW-07N (12")	N	3/11/2016	123	0.002	0.34	0.15	0.00033	0.00229	0.00028	< 0.01	1.90578	0.09109	< 0.002	0.01492	0.00988	< 0.02	--	1.0	< 0.0003	0.08899	0.00347	< 0.02	< 0.00005	1.7	0.91	0.121	0.12689	0.12689
BTC-SPW-07N (36")	N	3/11/2016	121	< 0.001	0.34	0.15	0.00025	0.00229	0.00028	< 0.01	1.90578	0.09109	0.003	0.01492	0.00988	< 0.02	--	1.0	< 0.0003	0.08899	0.00347	< 0.02	< 0.00005	1.7	0.91	0.097	0.12689	0.12689
BTC-SPW-08N (12")	N	3/11/2016	91	0.008	0.34	0.15	< 0.00003	0.00229	0.00028	< 0.01	1.90578	0.09109	< 0.002	0.01492	0.00988	9.13	--	1.0	< 0.0003	0.08899	0.00347	0.06	< 0.00005	1.7	0.91	< 0.008	0.12689	0.12689
BTC-SPW-08N (36")	N	3/11/2016	97	< 0.001	0.34	0.15	< 0.00003	0.00229	0.00028	< 0.01	1.90578	0.09109	0.003	0.01492	0.00988	< 0.02	--	1.0	< 0.0003	0.08899	0.00347	< 0.02	< 0.00005	1.7	0.91	< 0.008	0.12689	0.12689
BTC-SPW-08S (12")	N	3/11/2016	108	0.001	0.34	0.15	< 0.00003	0.00229	0.00028	< 0.01	1.90578	0.09109	< 0.002	0.01492	0.00988	1.17	--	1.0	< 0.0003	0.08899	0.00347	0.03	< 0.00005	1.7	0.91	< 0.008	0.12689	0.12689
BTC-SPW-08S (36")	N	3/11/2016	110	< 0.001	0.34	0.15	< 0.00003	0.00229	0.00028	< 0.01	1.90578	0.09109	< 0.002	0.01492	0.00988	1.81	--	1.0	< 0.0003	0.08899	0.00347	0.04	< 0.00005	1.7	0.91	< 0.008	0.12689	0.12689
BTC-SPW-09N (12")	N	3/14/2016	117	0.002	0.34	0.15	< 0.00003	0.00235	0.00029	< 0.01	1.94943	0.09318	0.004	0.01531	0.01012	< 0.02	--	1.0	< 0.0003	0.09218	0.00359	< 0.02	< 0.00005	1.7	0.91	< 0.008	0.12989	0.12989
BTC-SPW-09S (12")	N	3/14/2016	394	0.029	0.34	0.15	< 0.00003	0.00235	0.00029	< 0.01	1.94943	0.09318	< 0.002	0.01531	0.01012	14.3	--	1.0	< 0.0003	0.09218	0.00359	1.32	< 0.00005	1.7	0.91	< 0.008	0.12989	0.12989
BTC-SPW-09S (36")	N	3/14/2016	158	< 0.001	0.34	0.15	< 0.00003	0.00235	0.00029	< 0.01	1.94943	0.09318	0.003	0.01531	0.01012	< 0.02	--	1.0	< 0.0003	0.09218	0.00359	< 0.02	< 0.00005	1.7	0.91	< 0.008	0.12989	0.12989
BTC-SPW-10N (12")	N	3/14/2016	277	0.014	0.34	0.15	< 0.00003	0.00287	0.00034	< 0.01	2.29143	0.10952	0.002	0.01844	0.01198	18.5	--	1.0	< 0.0003	0.11850	0.00462	0.54	< 0.00005	1.7	0.91	< 0.008	0.15354	0.15354
BTC-SPW-10N (36")	N	3/14/2016	190	0.001	0.34	0.15	< 0.00003	0.00287	0.00034	< 0.01	2.29143	0.10952	0.006	0.01844	0.01198	< 0.02	--	1.0	0.0003	0.11850	0.00462	0.03	< 0.00005	1.7	0.91	< 0.008	0.15354	0.15354
BTC-SPW-10S (12")	N	3/14/2016	200	< 0.001	0.34	0.15	< 0.00003	0.00287	0.00034	< 0.01	2.29143	0.10952	0.003	0.01844	0.01198	< 0.02	--	1.0	< 0.0003	0.11850	0.00462	< 0.02	< 0.00005	1.7	0.91	< 0.008	0.15354	0.15354
BTC-SPW-10S (12")	D	3/14/2016	200	< 0.001	0.34	0.15	< 0.00003	0.00287	0.00034	< 0.01	2.29143	0.10952	0.002	0.01844	0.01198	< 0.02	--	1.0	< 0.0003	0.11850	0.00462	< 0.02	< 0.00005	1.7	0.91	< 0.008	0.15354	0.15354
BTC-SPW-10S (36")	N	3/14/2016	189	0.002	0.34	0.15	< 0.00003	0.00287	0.00034	< 0.01	2.29143	0.10952	0.006	0.01844	0.01198	< 0.02	--	1.0	0.0003	0.11850	0.00462	< 0.02	< 0.00005	1.7	0.91	< 0.008	0.15354	0.15354
BTC-SPW-11N (12")	N	3/14/2016	152	0.002	0.34	0.15	< 0.00003	0.00220	0.00028	< 0.01	1.84723	0.08829	< 0.002	0.01439	0.00957	2.98	--	1.0	< 0.0003	0.08478	0.00330	0.44	< 0.00005	1.7	0.91	0.015	0.12286	0.12286
BTC-SPW-11N (36")	N	3/14/2016	148	0.003	0.34	0.15	0.00007	0.00220	0.00028	< 0.01	1.84723	0.08829	0.014	0.01439	0.00957	< 0.02	--	1.0	< 0.0003	0.08478	0.00330	< 0.02	< 0.00005	1.7	0.91	0.018	0.12286	0.12286
BTC-SPW-11S (12")	N	3/14/2016	261	0.003	0.34	0.15	< 0.00003	0.00220	0.00028	< 0.01	1.84723	0.08829	0.005	0.01439	0.00957	1.31	--	1.0	< 0.0003	0.08478	0.00330	1.21	< 0.00005	1.7	0.91	< 0.008	0.12286	0.12286

Notes:

mg/L - milligrams per Liter

a,b - Calculated Acute and Chronic aquatic life standards based on total hardness CaCO3 from the nearest corresponding surface water sample location and results and as per Circular DEQ-7 (October 2012)

c - Surface Water Human Health standards based on Circular DEQ-7 Montana Numeric Water Quality Standards (October 2012)

e - Surface Water Acute and Chronic Standard based on Circular DEQ-7 (October, 2012)

NE - Not established

N - Natural Sample

D - Duplicate Sample

-- - indicates no sample not collected/analyzed

< - Not detected above laboratory analytical method reporting limit

d Reporting limit increased due to sample matrix.

Meets or exceeds Circular DEQ-7, Montana Numeric Water Quality Standards (October 2012)

TABLE 12

In-Stream and Pond Sediment Pore Water Dissolved Metals Analytical Results

Sample ID		Sample Date	Total Hardness (mg/L)	Dissolved Metals (mg/L)																								
				Arsenic			Cadmium			Chromium			Copper			Iron			Lead			Manganese	Mercury			Zinc		
				Lab Results	Aquatic Life Standard		Lab Results	Aquatic Life Standard		Lab Results	Aquatic Life Standard		Lab Results	Aquatic Life Standard		Lab Results	Aquatic Life Standard		Lab Results	Aquatic Life Standard		Lab Results	Lab Results	Aquatic Life Standard		Lab Results	Aquatic Life Standard	
					Acute[e]	Chronic[e]		Acute[a]	Chronic[b]		Acute[a]	Chronic[b]		Acute[a]	Chronic[b]		Acute[a]	Chronic[b]		Acute[a]	Chronic[b]			Acute[e]	Chronic[e]		Acute[a]	Chronic[b]
DEQ-7 Surface Water HHS [c]				**0.01**			**0.005**			**0.1**			**1.3**			**NE**			**0.015**			**NE**	**0.00005**			**2.0**		
BTC-SPW-11S (36")	N	3/14/2016	192	< 0.001	0.34	0.15	< 0.00003	0.00220	0.00028	< 0.01	1.84723	0.08829	0.005	0.01439	0.00957	< 0.02	--	1.0	< 0.0003	0.08478	0.00330	< 0.02	< 0.00005	1.7	0.91	< 0.008	0.12286	0.12286
BTC-SPW-12N (12")	N	3/15/2016	241	< 0.001	0.34	0.15	< 0.00003	0.00202	0.00026	< 0.01	1.72887	0.08263	0.005	0.01334	0.00893	< 0.02	--	1.0	< 0.0003	0.07648	0.00298	< 0.02	< 0.00005	1.7	0.91	< 0.008	0.11472	0.11472
BTC-SPW-12N (12")	D	3/15/2016	236	0.001	0.34	0.15	< 0.00003	0.00202	0.00026	< 0.01	1.72887	0.08263	< 0.002	0.01334	0.00893	< 0.02	--	1.0	< 0.0003	0.07648	0.00298	< 0.02	< 0.00005	1.7	0.91	< 0.008	0.11472	0.11472
BTC-SPW-12S (12")	N	3/15/2016	267	0.002	0.34	0.15	< 0.00003	0.00202	0.00026	< 0.01	1.72887	0.08263	0.002	0.01334	0.00893	10.7	--	1.0	< 0.0003	0.07648	0.00298	0.52	< 0.00005	1.7	0.91	< 0.008	0.11472	0.11472
BTC-SPW-12S (36")	N	3/15/2016	215	0.004	0.34	0.15	< 0.00003	0.00202	0.00026	< 0.01	1.72887	0.08263	0.004	0.01334	0.00893	8.45	--	1.0	< 0.0003	0.07648	0.00298	0.34	< 0.00005	1.7	0.91	< 0.008	0.11472	0.11472
BTC-SPW-13N (12")	N	3/15/2016	190	< 0.001	0.34	0.15	< 0.00003	0.00189	0.00025	< 0.01	1.63892	0.07833	0.004	0.01254	0.00844	< 0.02	--	1.0	< 0.0003	0.07039	0.00274	< 0.02	< 0.00005	1.7	0.91	< 0.008	0.10855	0.10855
BTC-SPW-13N (36")	N	3/15/2016	172	< 0.001	0.34	0.15	< 0.00003	0.00189	0.00025	< 0.01	1.63892	0.07833	0.003	0.01254	0.00844	< 0.02	--	1.0	< 0.0003	0.07039	0.00274	< 0.02	< 0.00005	1.7	0.91	< 0.008	0.10855	0.10855
BTC-SPW-13S (12")	N	3/15/2016	159	< 0.001	0.34	0.15	< 0.00003	0.00189	0.00025	< 0.01	1.63892	0.07833	0.004	0.01254	0.00844	0.88	--	1.0	0.0003	0.07039	0.00274	0.20	< 0.00005	1.7	0.91	< 0.008	0.10855	0.10855
BTC-SPW-13S (36")	N	3/15/2016	124	< 0.001	0.34	0.15	< 0.00003	0.00189	0.00025	< 0.01	1.63892	0.07833	0.005	0.01254	0.00844	< 0.02	--	1.0	< 0.0003	0.07039	0.00274	0.07	< 0.00005	1.7	0.91	< 0.008	0.10855	0.10855
BTC-WPPW-01 (12")	N	3/16/2016	82	0.016	0.34	0.15	0.00913	0.00226	0.00028	< 0.01	1.89118	0.09039	0.915	0.01479	0.00981	0.04	--	1.0	0.0044	0.08793	0.00343	0.92	0.00037	1.7	0.91	1.210	0.12588	0.12588
BTC-WPPW-01 (36")	N	3/16/2016	508	0.215	0.34	0.15	< 0.00003	0.00226	0.00028	< 0.01	1.89118	0.09039	0.002	0.01479	0.00981	66.2	--	1.0	< 0.0003	0.08793	0.00343	5.79	< 0.00005	1.7	0.91	< 0.008	0.12588	0.12588
BTC-WPPW-02 (12")	N	3/15/2016	140	0.009	0.34	0.15	< 0.00003	0.00250	0.00030	< 0.01	2.05046	0.09801	< 0.002	0.01623	0.01067	2.9	--	1.0	< 0.0003	0.09971	0.00389	0.62	< 0.00005	1.7	0.91	< 0.008	0.13686	0.13686
BTC-WPPW-02 (36")	N	3/15/2016	477	< 0.001	0.34	0.15	< 0.00003	0.00250	0.00030	< 0.01	2.05046	0.09801	< 0.002	0.01623	0.01067	3.67	--	1.0	< 0.0003	0.09971	0.00389	3.56	< 0.00005	1.7	0.91	< 0.008	0.13686	0.13686
GG-SPW-01E (12")	N	3/10/2016	121	0.006	0.34	0.15	< 0.00003	0.00305	0.00035	< 0.01	2.40288	0.11485	< 0.002	0.01948	0.01259	0.64	--	1.0	< 0.0003	0.12758	0.00497	0.05	< 0.00005	1.7	0.91	< 0.008	0.16127	0.16127
GG-SPW-01E (36")	N	3/10/2016	118	0.001	0.34	0.15	< 0.00003	0.00305	0.00035	< 0.01	2.40288	0.11485	< 0.002	0.01948	0.01259	0.51	--	1.0	< 0.0003	0.12758	0.00497	0.03	< 0.00005	1.7	0.91	< 0.008	0.16127	0.16127
SBC-SPW-01N (12")	N	3/9/2016	326	0.055	0.34	0.15	< 0.00003	0.00270	0.00032	< 0.01	2.17877	0.10414	< 0.002	0.01740	0.01137	4.95	--	1.0	< 0.0003	0.10957	0.00427	7.06	< 0.00005	1.7	0.91	< 0.008	0.14573	0.14573
SBC-SPW-01S (12")	N	3/9/2016	685	0.937	0.34	0.15	< 0.00003	0.00270	0.00032	< 0.01	2.17877	0.10414	< 0.002	0.01740	0.01137	7.87	--	1.0	< 0.0003	0.10957	0.00427	8.34	< 0.00005	1.7	0.91	< 0.008	0.14573	0.14573
SBC-SPW-02N (12")	N	3/9/2016	702	d 5.100	0.34	0.15	0.155	0.00259	0.00031	< 0.01	2.10770	0.10074	d 39.7	0.01675	0.01098	d 633	--	1.0	0.001	0.10407	0.00406	14.50	< 0.00005	1.7	0.91	95.000	0.14082	0.14082
SBC-SPW-02N (36")	N	3/9/2016	740	d 3.300	0.34	0.15	0.109	0.00259	0.00031	< 0.01	2.10770	0.10074	d 29.9	0.01675	0.01098	d 361	--	1.0	0.0096	0.10407	0.00406	17.60	< 0.00005	1.7	0.91	54.800	0.14082	0.14082
SBC-SPW-02S (12")	N	3/9/2016	469	d 0.324	0.34	0.15	< 0.00003	0.00259	0.00031	< 0.01	2.10770	0.10074	0.003	0.01675	0.01098	10.5	--	1.0	0.0005	0.10407	0.00406	8.08	< 0.00005	1.7	0.91	0.023	0.14082	0.14082
SBC-SPW-02S (36")	N	3/9/2016	469	0.328	0.34	0.15	< 0.00003	0.00259	0.00031	< 0.01	2.10770	0.10074	< 0.002	0.01675	0.01098	13.2	--	1.0	< 0.0003	0.10407	0.00406	11.60	< 0.00005	1.7	0.91	0.015	0.14082	0.14082
SBC-SPW-03N (12")	N	3/8/2016	456	0.005	0.34	0.15	0.00179	0.00257	0.00031	< 0.01	2.09342	0.10006	0.064	0.01662	0.01090	0.02	--	1.0	0.0013	0.10297	0.00401	0.71	< 0.00005	1.7	0.91	0.148	0.13983	0.13983
SC-SPW-01E (12")	N	3/10/2016	151	0.002	0.34	0.15	0.00006	0.00601	0.00058	< 0.01	4.15335	0.19852	0.007	0.03656	0.02228	< 0.02	--	1.0	0.0003	0.29868	0.01164	< 0.02	< 0.00005	1.7	0.91	0.011	0.28407	0.28407
SC-SPW-01E (36")	N	3/10/2016	147	< 0.001	0.34	0.15	< 0.00003	0.00601	0.00058	< 0.01	4.15335	0.19852	0.003	0.03656	0.02228	< 0.02	--	1.0	< 0.0003	0.29868	0.01164	< 0.02	< 0.00005	1.7	0.91	< 0.008	0.28407	0.28407

Notes:

mg/L - milligrams per Liter

a,b - Calculated Acute and Chronic aquatic life standards based on total hardness CaCO3 from the nearest corresponding surface water sample location and results and as per Circular DEQ-7 (October 2012)

c - Surface Water Human Health standards based on Circular DEQ-7 Montana Numeric Water Quality Standards (October 2012)

e - Surface Water Acute and Chronic Standard based on Circular DEQ-7 (October, 2012)

NE - Not established

N - Natural Sample

D - Duplicate Sample

-- - indicates no sample not collected/analyzed

< - Not detected above laboratory analytical method reporting limit

d Reporting limit increased due to sample matrix.

Meets or exceeds Circular DEQ-7, Montana Numeric Water Quality Standards (October 2012)

Table 13
Groundwater Field and General Chemistry Analytical Results

Sample ID		Sample Date	Survey Data			Field Parameters					Physiochemical								Common Anions				Common Cations			
			MPE (ft AMSL)	DTW (ft)	GWE (ft AMSL)	SC (µmhos/L)	pH (s.u.)	Temp. (ºC)	ORP (mV)	DO (mg/L)	SC (µmhos/L)	pH (s.u.)	Turbidity (NTU)	Hardness as CaCO3 (mg/L)	Acidity as CaCO3 (mg/L)	Alkalinity (mg/L)	Total Diss. Solids (mg/L)	Total Susp. Solids (mg/L)	Sulfate (mg/L)	Bicarb as HCO3 (mg/L)	Carbonate as CO3 (mg/L)	Chloride (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)
Groundwater Standards MDEQ 2012	**a**					NE	NE	NE	NE	NE	NE	6.5 - 8.5	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
AMC-23	N	3/11/2016	5452.52	8.15	5444.37	1498	6.9	9.2	-21.8	7.1	1480	7.1 H	144 H	609	< 4	210	1060	45	476	260	< 4	79	175	42	11	77
AMC-24	N	3/8/2016	5456.29	10.65	5445.64	515	6.5	9.9	15.3	2.2	500	6.6 H	9.2 H	194	< 4	77	366	< 10	123	94	< 4	21	54	15	5	22
AMC-24B	N	3/8/2016	5455.94	10.31	5445.63	1330	6.4	9.0	-20.25	0.3	1310	6.4 H	0.7 H	548	< 4	55	1100	< 10	641	67	< 4	21	159	37	13	85
AMC-24C	N	3/8/2016	5454.63	8.91	5445.72	1166	6.3	9.6	76	0.3	1120	6.6 H	0.3 H	416	< 4	72	898	< 10	509	87	< 4	20	126	25	13	86
AMW-11	N	3/11/2016	5445.24	6.14	5439.1	412	7.2	5.2	-58.3	1.2	405	7.4 H	27.1 H	153	< 4	150	246	11	29	190	< 4	17	45	10	4	22
AMW-11	D	3/11/2016	5445.24	6.14	5439.1	412	7.2	5.2	-58.3	1.2	405	7.4 H	24.2 H	153	< 4	150	253	10	28	190	< 4	17	45	10	4	22
AMW-13A	N	3/7/2016	5454.99	11.3	5443.69	1004	6.6	8.0	-7.6	3.0	1140	6.7 H	92.6 H	560	< 4	320	852	23	320	390	< 4	10	182	25	18	23
AMW-13A*	N	3/7/2016	--	11.3	--	--	6.6	8.0	-7.6	3.0	--	--	--	522.01	--	--	--	--	--	--	--	--	166.83	25.89	17.33	20.85
AMW-13B	N	3/8/2016	5454.97	10.43	5444.54	315	7.1	9.5	25.6	58.4	309	7.4 H	14.4 H	92	< 4	90	228	30	52	110	< 4	5	26	6	3	28
AMW-13B*	N	3/8/2016	--		--	--	7.1	9.5	25.6	584.0	--	--	--	94.6	--	--	--	--	--	--	--	--	25.82	7.32	3.65	30.03
AMW-13B2	N	3/8/2016	5451.76	11.55	5440.21	329	7.0	9.7	31	2.8	328	7.4 H	0.3 H	95	< 4	89	229	< 10	59	110	< 4	5	27	6	3	29
AMW-13B2*	N	3/8/2016	--		--	--	7.0	9.7	31	2.8	--	--	--	95.13	--	--	--	--	--	--	--	--	26.79	6.86	3.42	27.34
AMW-13C	N	3/8/2016	5449.81	9.63	5440.18	769	6.6	9.9	26.8	1.2	747	6.8 H	1.5 H	274	< 4	57	570	< 10	312	69	< 4	6	79	18	9	49
AMW-13C*	N	3/8/2016	--		--	--	6.6	9.9	26.8	1.2	--	--	--	276.61	--	--	--	--	--	--	--	--	77.76	20.03	8.78	47.45
BPS07-08A	N	3/9/2016	--	10.13	--	2693	6.6	10.0	116.9	0.3	2690	7.1 H	1.4 H	1110	< 4	470	1690	< 10	405	570	< 4	372	292	93	52	90
BPS07-08A	D	3/9/2016	--	19.61	--	21.33	6.6	10.0	63.7	2.9	2680	7.1 H	1 H	1140	< 4	480	1700	< 10	405	580	< 4	372	299	95	52	89
BPS07-14A	N	3/9/2016	--	20.85	--	1217	6.8	9.1	-41.1	21.1	1190	6.9 H	130 H	385	< 4	150	712	24	190	180	< 4	158	116	23	10	78
BPS07-15A	N	3/9/2016	--	19.61	--	21.33	6.6	10.0	63.7	2.9	2130	7.1 H	7.2 H	288	< 4	140	1150	12	96	170	< 4	513	86	18	7	292
BPS07-16A	N	3/10/2016	--	7.52	--	462	6.1	6.6	96.2	1.9	450	6.5 H	2.3 H	165	< 4	77	287	< 10	80	93	< 4	28	46	12	4	25
BPS07-16B	N	3/10/2016	5452.17	7.41	5444.76	279	7.0	10.4	45.3	5.4	278	7.4 H	16.5 H	100	< 4	86	192	15	43	100	< 4	4	30	6	2	16
BPS07-21B	N	3/11/2016	--	13.45	--	457	6.7	9.8	47.8	3.1	444	7.1 H	1 H	130	< 4	77	292	< 10	128	93	< 4	7	38	9	6	33
BPS07-21C	N	3/11/2016	--	12.66	--	813	6.6	10.1	51	1.2	804	6.9 H	0.2 H	271	< 4	63	575	< 10	328	77	< 4	7	80	18	9	57
BPS07-24	N	3/8/2016	--	7.81	--	2332	6.1	9.4	91.6	0.3	2230	6.5 H	0.4 H	1180	< 4	140	2050	< 10	1220	170	< 4	30	355	71	20	100
BPS07-25	N	3/9/2016	--	10.77	--	1237	6.9	9.9	91.2	0.6	1230	7.4 H	3.3 H	519	< 4	290	789	< 10	208	350	< 4	99	145	38	9	59
BPS11-19A2	N	3/10/2016	5445.62	4.11	5441.51	464	6.6	10.4	71.6	5.9	465	6.9 H	0.2 H	161	< 4	57	316	< 10	149	69	< 4	8	46	11	6	25
BPS11-19B	N	3/10/2016	5445.62	2.64	5442.98	953	6.4	10.2	103.7	0.4	938	6.8 H	0.6 H	379	< 4	55	708	< 10	407	67	< 4	12	111	25	9	47
BT98-01	N	3/10/2016	--	6.92	--	236	3.0	10.1	71.9	3.0	232	7.3 H	0.4 H	87	< 4	92	148	< 10	15	110	< 4	4	25	6	2	13
BT98-01*	N	3/10/2016	--	8.9	--	--	6.9	10.1	71.9	3.0	--	--	--	87.75	--	--	--	--	--	--	--	--	23.8	6.88	2.63	13.48
BT98-02B	N	3/10/2016	5456.65	9.8	5446.85	668	6.4	10.5	79.2	0.4	665	6.7 H	0.4 H	277	< 4	54	462	< 10	237	65	< 4	12	80	19	4	22
BT98-05	N	3/10/2016	--	8.9	--	322	6.8	10.3	71	4.4	332	7.2 H	0.2 H	125	< 4	96	215	< 10	45	120	< 4	7	36	8	3	16
BT98-05*	N	3/10/2016	--	8.9	--	--	6.8	10.3	71	4.4	--	--	--	118.11	--	--	--	--	--	--	--	--	35.73	7.02	2.12	12.06
BT99-01	N	3/10/2016	--	5.54	--	513	6.8	7.5	63.5	3.0	511	7.2 H	0.3 H	218	< 4	150	317	< 10	47	180	< 4	27	67	12	6	13
BT-99-01*	N	3/10/2016	--	5.54	--	--	6.8	7.5	63.5	3.0	--	--	--	207.93	--	--	--	--	--	--	--	--	66.41	10.23	4.68	9.67
BT99-04	N	3/10/2016	--	11.32	--	577	7.2	7.3	55.9	6.8	575	7.4 H	6.8 H	242	< 4	170	364	< 10	47	210	< 4	28	73	15	3	19
BT-99-04*	N	3/10/2016	--	11.32	--	--	7.2	7.3	55.9	6.8	--	--	--	231.52	--	--	--	--	--	--	--	--	72.38	12.34	2.58	14.04

Notes:

MPE - Measuring Point Elevation, feet above mean sea level
DTW - Depth to Water
GWE - Groundwater Elevation, feet above mean sea level
SC - Specific Conductance
Temp. - Temperature
ORP - Oxygen Reduction Potential
DO - Dissolved Oxygen
µmhos/L - Micromhos per liter
S.U. - Standard Units
ºC - Degrees centigrade
mV - Millivolts

mg/L - Milligrams per liter
NE - Not established
a - Montana Department of Environmental Quality (MDEQ) Human Health Standard from Circular DEQ-7, Montana Water Quality Standards (October 2012).
-- - Sample not collected / analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
N - Natural sample
D - Duplicate sample
* - Samples collected/analyzed by Montana Bureau of Mines and Geology
d - Reporting limit increased due to sample matrix.
H - Analysis performed past recommended holding time
- Value exceeds water quality standard

Table 13
Groundwater Field and General Chemistry Analytical Results

Sample ID		Sample Date	Survey Data			Field Parameters					Physiochemical								Common Anions				Common Cations			
			MPE (ft AMSL)	DTW (ft)	GWE (ft AMSL)	SC (µmhos/L)	pH (s.u.)	Temp. (ºC)	ORP (mV)	DO (mg/L)	SC (µmhos/L)	pH (s.u.)	Turbidity (NTU)	Hardness as CaCO3 (mg/L)	Acidity as CaCO3 (mg/L)	Alkalinity (mg/L)	Total Diss. Solids (mg/L)	Total Susp. Solids (mg/L)	Sulfate (mg/L)	Bicarb as HCO3 (mg/L)	Carbonate as CO3 (mg/L)	Chloride (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)
Groundwater Standards MDEQ 2012	**a**					**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**6.5 - 8.5**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
BTC-DPT-01	N	4/8/2016	--	5.4	--	5	8.1	12.6	26.2	5.3	1000	7 H	365 H	278	< 4	160	712 D	470 D	234	200	< 4 D	86	85	16	7	34
BTC-DPT-02	N	4/8/2016	--	1.03	--	325	7.8	9.4	-16.6	1.7	329	7.2 H	7 H	114	< 4	120	217	27	27	140	< 4	12	32	8	4	20
BTC-DPT-02	D	4/8/2016	--	1.03	--	325	7.8	9.4	-16.6	1.7	327	7.2 H	7 H	116	< 4	120	215	22	28	140	< 4	12	33	8	4	21
BTC-DPT-03	N	4/8/2016	--	1.7	--	--	6.8	430.0	631	0.0	609	7.3 H	45.5 H	251	< 4	230	378	151	33	280	< 4	33	72	18	5	27
FP98-1	N	3/9/2016	5438.15	6.26	5431.89	4131	6.0	3.4	142.3	0.6	4050	6.7 H	359 H	2260	< 4	250	3700 d	366 d	2090 d	300	< 4 d	262	666	145	14	99
FP98-1B	N	3/9/2016	5456.96	24.07	5432.89	675	6.7	10.5	59.8	2.1	681	7.1 H	0.3 H	254	< 4	150	415	< 10	90	180	< 4	56	76	16	5	32
GS-29D	N	3/9/2016	5443.64	5.8	5437.84	1490	7.5	10.6	23.5	2.1	1490	7.9 H	0.5 H	334	< 4	150	1030	< 10	605	180	< 4	12	73	37	11	195
GS-29D*	N	3/9/2016	--	5.8	--	--	7.5	10.6	23.5	2.1	--	--	--	350.09	--	--	--	--	--	--	--	--	68.88	43.27	11.94	207.79
GS-29SR	N	3/9/2016	--	6.65	--	435	6.3	7.8	131.8	0.4	434	7 H	1.1 H	145	< 4	100	269	< 10	62	130	< 4	24	45	8	6	26
GS-29SR*	N	3/9/2016	--	6.65	--	--	6.3	7.8	131.8	0.4	--	--	--	143.9	--	--	--	--	--	--	--	--	42.76	9.02	7.24	27.77
MF-10	N	3/8/2016	5452.12	9.23	5442.89	648	6.4	8.7	33.2	1.4	594	6.6 H	206 H	211	< 4	89	421	89	169	110	< 4	28	59	16	6	25
MT98-05	N	3/10/2016	--	4.18	--	401	6.8	7.7	96.8	3.8	402	7.1 H	0.6 H	156	< 4	120	250	< 10	55	140	< 4	12	46	10	3	20
MT98-05*	N	3/10/2016	--	4.18	--	--	6.8	7.7	96.8	3.8	--	--	--	158.51	--	--	--	--	--	--	--	--	43.42	12.17	3.27	23.12
MT98-06	N	3/10/2016	--	3.39	--	240	6.8	8.6	116.2	2.3	242	7.2 H	2.5 H	98	< 4	96	150	< 10	18	120	< 4	4	28	7	3	11
MT98-06*	N	3/10/2016	--	3.39	--	--	6.8	8.6	116.2	2.3		--	--	98.59	--	--	--	--	--	--	--	--	26.23	8.04	2.98	12.13

Notes:

MPE - Measuring Point Elevation, feet above mean sea level
DTW - Depth to Water
GWE - Groundwater Elevation, feet above mean sea level
SC - Specific Conductance
Temp. - Temperature
ORP - Oxygen Reduction Potential
DO - Dissolved Oxygen
µmhos/L - Micromhos per liter
S.U. - Standard Units
ºC - Degrees centigrade
mV - Millivolts
mg/L - Milligrams per liter
NE - Not established
a - Montana Department of Environmental Quality (MDEQ) Human Health Standard from Circular DEQ-7, Montana Water Quality Standards (October 2012).
-- - Sample not collected / analyzed
< - Parameter not detected at or above the laboratory practical quantitation limit
N - Natural sample
D - Duplicate sample
* - Samples collected/analyzed by Montana Bureau of Mines and Geology
d - Reporting limit increased due to sample matrix.
H - Analysis performed past recommended holding time
- Value exceeds water quality standard

Table 14
Groundwater Metals Analytical Results

Sample ID		Sample Date	Dissolved Metals								
			Arsenic (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Zinc (mg/L)
Groundwater Standards DEQ-7 [a]			**0.01**	**0.005**	**0.1**	**1.3**	**NE**	**0.015**	**NE**	**0.002**	**2**
AMC-23	N	3/11/2016	< 0.001	0.00514	< 0.01	0.004	3.89	< 0.0003	0.3	< 0.00005	0.493
AMC-24	N	3/8/2016	< 0.001	0.00083	< 0.01	< 0.002	0.78	< 0.0003	0.07	< 0.00005	0.549
AMC-24B	N	3/8/2016	0.005	0.00646	< 0.01	0.12	< 0.02	< 0.0003	< 0.02	< 0.00005	1.28
AMC-24C	N	3/8/2016	0.008	0.00406	< 0.01	0.056	< 0.02	< 0.0003	< 0.02	< 0.00005	0.433
AMW-11	N	3/11/2016	0.013	0.00045	< 0.01	< 0.002	1.11	< 0.0003	1.47	< 0.00005	0.163
AMW-11	D	3/11/2016	0.014	0.00046	< 0.01	0.002	1.11	< 0.0003	1.47	< 0.00005	0.162
AMW-13A	N	3/7/2016	0.001	0.00174	< 0.01	0.01	17.5	< 0.0003	0.32	< 0.00005	0.388
AMW-13A*	N	3/7/2016	0.0011	0.0017	0.00059 J	0.01465	15.778	< 0.00015	0.276	--	0.36732
AMW-13B	N	3/8/2016	0.004	0.00032	< 0.01	< 0.002	< 0.02	< 0.0003	< 0.02	< 0.00005	0.026
AMW-13B*	N	3/8/2016	0.00327	0.00023 J	0.00084	0.00117 J	< 0.015	< 0.00006	< 0.002	--	0.02321
AMW-13B2	N	3/8/2016	0.005	0.00048	< 0.01	0.002	< 0.02	< 0.0003	< 0.02	< 0.00005	0.052
AMW-13B2*	N	3/8/2016	0.0046	0.00045	0.0005	0.00181 J	< 0.015	< 0.00006	< 0.002	--	0.04586
AMW-13C	N	3/8/2016	0.006	0.00219	< 0.01	< 0.002	< 0.02	< 0.0003	< 0.02	< 0.00005	0.197
AMW-13C*	N	3/8/2016	0.00478	0.00199	0.00029 J	0.0007 J	< 0.015	< 0.00006	< 0.002	--	0.17727
BPS07-08A	N	3/9/2016	0.092	0.00247	< 0.01	0.129	< 0.02	< 0.0003	13.1	< 0.00005	0.306
BPS07-08A	D	3/9/2016	0.089	0.0025	< 0.01	0.128	< 0.02	< 0.0003	13.3	< 0.00005	0.313
BPS07-14A	N	3/9/2016	0.123	0.00042	< 0.01	0.017	11	0.0013	2.2	< 0.00005	4.07
BPS07-15A	N	3/9/2016	0.302	0.00273	< 0.01	0.008	< 0.02	< 0.0003	0.03	< 0.00005	0.284
BPS07-16A	N	3/10/2016	< 0.001	0.00207	< 0.01	0.003	< 0.02	< 0.0003	< 0.02	< 0.00005	0.828
BPS07-16B	N	3/10/2016	0.001	0.00035	< 0.01	< 0.002	< 0.02	< 0.0003	< 0.02	< 0.00005	0.011
BPS07-21B	N	3/11/2016	0.007	0.002	< 0.01	< 0.002	< 0.02	< 0.0003	< 0.02	< 0.00005	0.221
BPS07-21C	N	3/11/2016	0.006	0.00251	< 0.01	< 0.002	< 0.02	< 0.0003	< 0.02	< 0.00005	0.208
BPS07-24	N	3/8/2016	0.01	0.0175	< 0.01	0.667	< 0.02	< 0.0003	< 0.02	< 0.00005	4.05
BPS07-25	N	3/9/2016	0.032	0.00203	< 0.01	0.086	< 0.02	< 0.0003	2.03	< 0.00005	0.34
BPS11-19A2	N	3/10/2016	0.001	0.00063	< 0.01	< 0.002	< 0.02	< 0.0003	< 0.02	< 0.00005	0.072
BPS11-19B	N	3/10/2016	0.005	0.00294	< 0.01	0.041	< 0.02	< 0.0003	< 0.02	< 0.00005	0.349

Notes:

Concentrations are presented as dissolved fraction. Samples were field filtered using a disposable 0.45 micro in-line filter

mg/L - Milligrams per liter

NE - Not established

a - Montana Department of Environmental Quality (MDEQ) Human Health Standard from Circular DEQ-7, Montana Water Quality Standards (October 2012).

* - Samples collected/analyzed by Montana Beurea of Mines and Geology

-- - Sample not collected / analyzed

< - Parameter not detected at or above the laboratory practical quantitation limit

N - Natural sample

D - Duplicate sample

J - Estimated quantity above detection limit but below reporting limit

- Value meets or exceeds groundwater standard

Table 14
Groundwater Metals Analytical Results

Sample ID		Sample Date	Dissolved Metals								
			Arsenic (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)	Mercury (mg/L)	Zinc (mg/L)
Groundwater Standards DEQ-7 [a]			**0.01**	**0.005**	**0.1**	**1.3**	**NE**	**0.015**	**NE**	**0.002**	**2**
BT98-01	N	3/10/2016	0.001	< 0.00003	< 0.01	< 0.002	< 0.02	< 0.0003	< 0.02	< 0.00005	< 0.008
BT98-01*	N	3/10/2016	0.00101	< 0.0001	0.00052	< 0.0005	< 0.015	< 0.00006	< 0.002	--	< 0.0005
BT98-02B	N	3/10/2016	< 0.001	0.00143	< 0.01	< 0.002	< 0.02	< 0.0003	< 0.02	< 0.00005	0.062
BT98-05	N	3/10/2016	0.001	< 0.00003	< 0.01	< 0.002	< 0.02	< 0.0003	< 0.02	< 0.00005	< 0.008
BT98-05*	N	3/10/2016	0.00088	< 0.0001	0.00047 J	< 0.0005	< 0.015	< 0.00006	< 0.002	--	< 0.0005
BT99-01	N	3/10/2016	0.003	< 0.00003	< 0.01	0.002	< 0.02	< 0.0003	< 0.02	< 0.00005	< 0.008
BT-99-01*	N	3/10/2016	0.00228	< 0.0001	0.00061	0.00178 J	< 0.015	< 0.00006	< 0.002	--	< 0.0005
BT99-04	N	3/10/2016	0.004	< 0.00003	< 0.01	0.002	< 0.02	< 0.0003	< 0.02	< 0.00005	< 0.008
BT-99-04*	N	3/10/2016	0.0036	< 0.0001	0.00111	0.00176	< 0.015	< 0.00006	< 0.002	--	< 0.0005
BTC-DPT-01	N	4/8/2016	0.062	0.00046	< 0.01	< 0.002	10.3	0.0005	2.7	< 0.00005	0.442
BTC-DPT-02	N	4/8/2016	0.004	0.00017	< 0.01	< 0.002	0.31	< 0.0003	0.53	< 0.00005	0.051
BTC-DPT-02	D	4/8/2016	0.003	0.00018	< 0.01	< 0.002	0.33	< 0.0003	0.54	< 0.00005	0.049
BTC-DPT-03	N	4/8/2016	0.005	0.00051	< 0.01	0.003	0.16	< 0.0003	1.34	< 0.00005	< 0.008
FP98-1	N	3/9/2016	0.087	0.037	< 0.01	0.531	16.4	< 0.0003	56.9	< 0.00005	24.1
FP98-1B	N	3/9/2016	0.001	0.00482	< 0.01	0.003	< 0.02	< 0.0003	1.11	< 0.00005	0.488
GS-29D	N	3/9/2016	0.025	0.00011	< 0.01	< 0.002	< 0.02	< 0.0003	< 0.02	< 0.00005	0.028
GS-29D*	N	3/9/2016	0.02063	< 0.00025	< 0.00025	0.00128	< 0.038	< 0.00015	< 0.005	--	0.02365
GS-29SR	N	3/9/2016	0.005	0.00861	< 0.01	0.505	< 0.02	< 0.0003	0.16	< 0.00005	1.83
GS-29SR*	N	3/9/2016	0.00415	0.00814	0.00042 J	0.54845	< 0.015	< 0.00006	0.152	--	1.67742
MF-10	N	3/8/2016	0.019	0.00487	< 0.01	0.042	2.06	< 0.0003	0.67	< 0.00005	16
MT98-05	N	3/10/2016	0.001	< 0.00003	< 0.01	< 0.002	< 0.02	< 0.0003	< 0.02	< 0.00005	< 0.008
MT98-05*	N	3/10/2016	0.00111	< 0.0001	0.00052	0.00113 J	< 0.015	< 0.00006	< 0.002	--	0.00641
MT98-06	N	3/10/2016	0.001	< 0.00003	< 0.01	0.003	< 0.02	< 0.0003	< 0.02	< 0.00005	< 0.008
MT98-06*	N	3/10/2016	0.00089	< 0.0001	0.0004 J	0.00186 J	< 0.015	< 0.00006	< 0.002	--	0.00228

Notes:

Concentrations are presented as dissolved fraction. Samples were field filtered using a disposable 0.45 micro in-line filter

mg/L - Milligrams per liter

NE - Not established

a - Montana Department of Environmental Quality (MDEQ) Human Health Standard from Circular DEQ-7, Montana Water Quality Standards (October 2012).

* - Samples collected/analyzed by Montana Beurea of Mines and Geology

-- - Sample not collected / analyzed

< - Parameter not detected at or above the laboratory practical quantitation limit

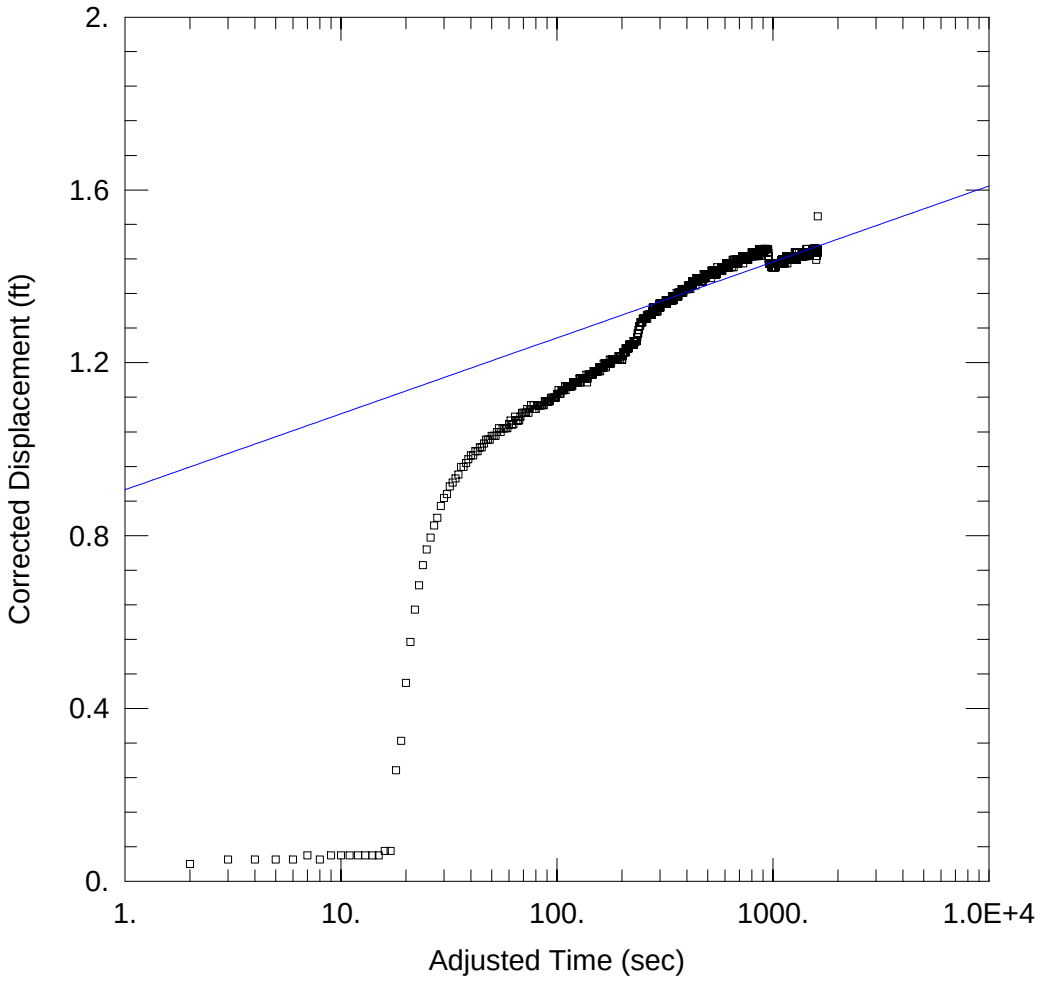
N - Natural sample

D - Duplicate sample

J - Estimated quantity above detection limit but below reporting limit

- Value meets or exceeds groundwater standard

APPENDIX D
AQUIFER TEST ANALYSIS OUTPUT FORMS



WELL TEST ANALYSIS

Data Set: P:\...\AMW-11Pumping-CJ_1.aqt
Date: 05/02/16 Time: 14:30:26

PROJECT INFORMATION

Company: DOJ NRDP
Project: 114-571057
Location: Butte, Montana
Test Well: AMW-11
Test Date: 4-28-16

AQUIFER DATA

Saturated Thickness: 10. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
AMW-11	0	0

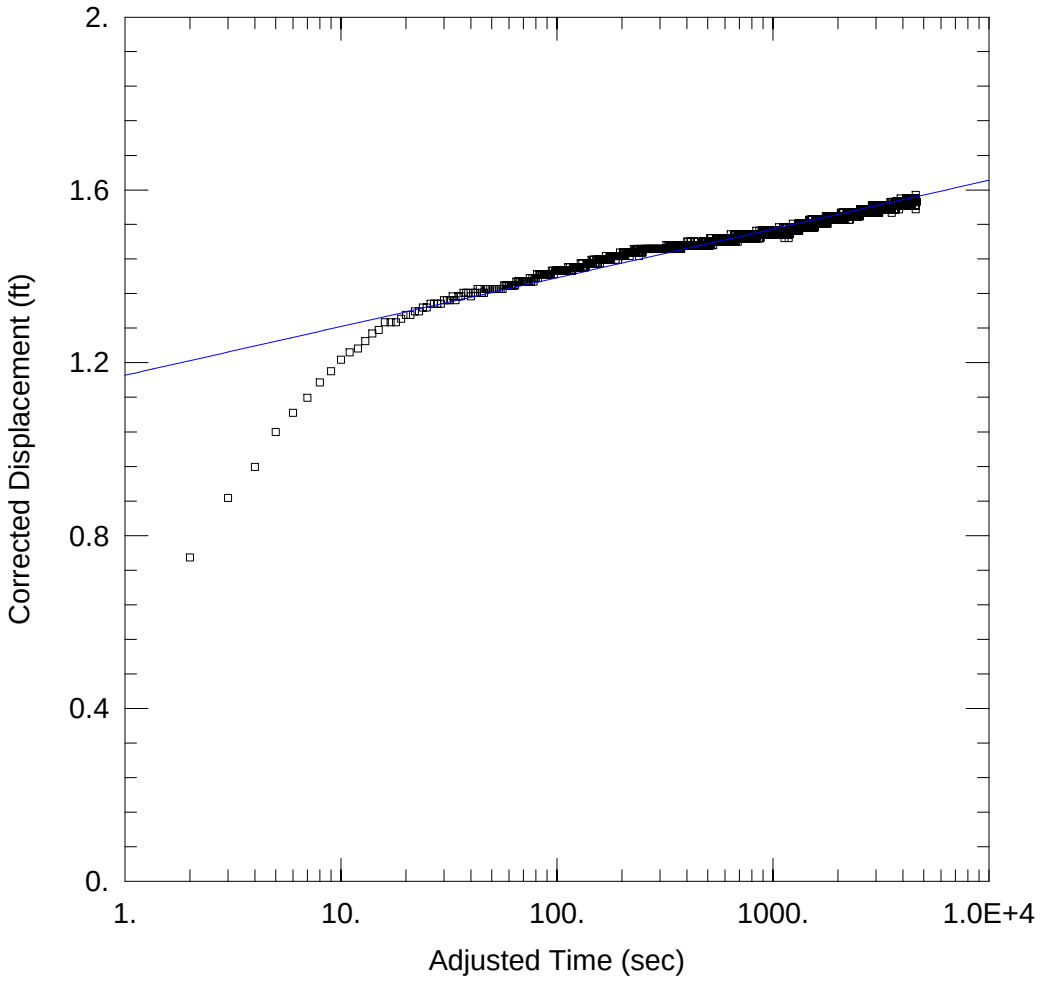
Observation Wells

Well Name	X (ft)	Y (ft)
AMW-11	0	0

SOLUTION

Aquifer Model: Unconfined Solution Method: Cooper-Jacob

T = 501.7 ft^2/day S = 1.315E-5



WELL TEST ANALYSIS

Data Set: P:\...\AMW-11Pumping-CJ_2.aqt
Date: 05/02/16 Time: 14:29:43

PROJECT INFORMATION

Company: DOJ NRDP
Project: 114-571057
Location: Butte, Montana
Test Well: AMW-11
Test Date: 4-28-16

AQUIFER DATA

Saturated Thickness: 10. ft Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
AMW-11	0	0

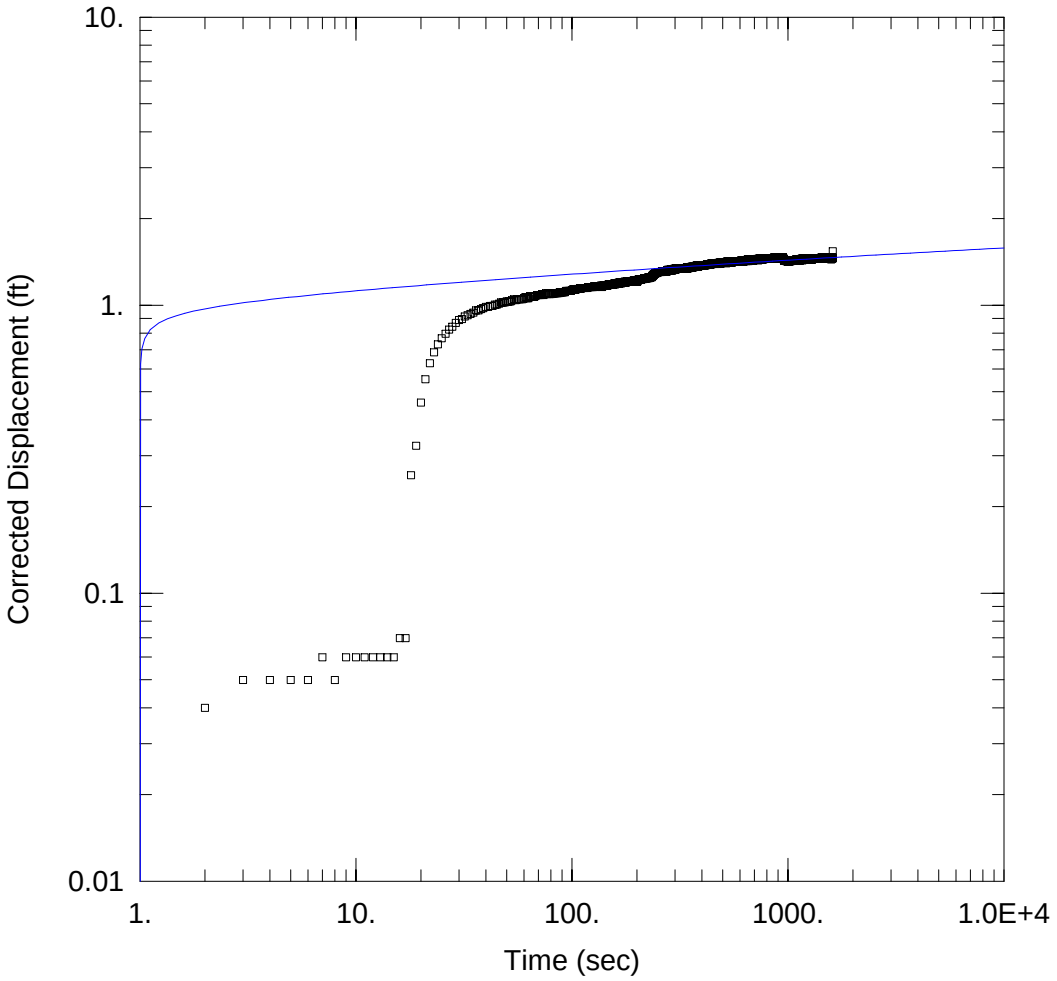
Observation Wells

Well Name	X (ft)	Y (ft)
▫ AMW-11	0	0

SOLUTION

Aquifer Model: Unconfined Solution Method: Cooper-Jacob

T = 781.2 ft^2/day S = 1.24E-10



WELL TEST ANALYSIS

Data Set: P:\...\AMW-11Pumping-Theis_1.aqt
Date: 05/02/16 Time: 14:30:52

PROJECT INFORMATION

Company: DOJ NRDP
Project: 114-571057
Location: Butte, Montana
Test Well: AMW-11
Test Date: 4-28-16

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
AMW-11	0	0

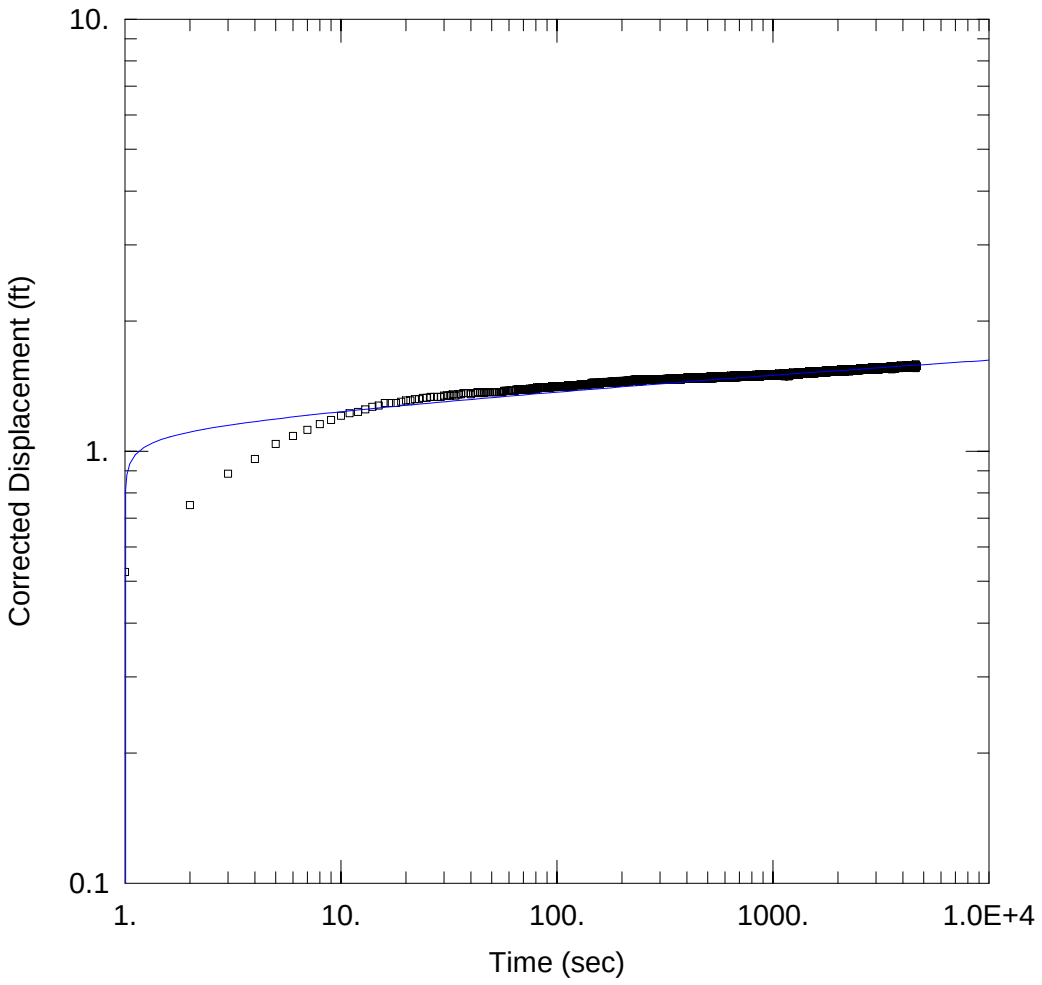
Observation Wells

Well Name	X (ft)	Y (ft)
▫ AMW-11	0	0

SOLUTION

Aquifer Model: Unconfined
Solution Method: Theis

T = 499.6 ft^2/day
S = 2.978E-6
Kz/Kr = 0.1
b = 10. ft



WELL TEST ANALYSIS

Data Set: P:\...\AMW-11Pumping-Theis_2.aqt
Date: 05/02/16 Time: 14:31:42

PROJECT INFORMATION

Company: DOJ NRDP
Project: 114-571057
Location: Butte, Montana
Test Well: AMW-11
Test Date: 4-28-16

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
AMW-11	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
▫ AMW-11	0	0

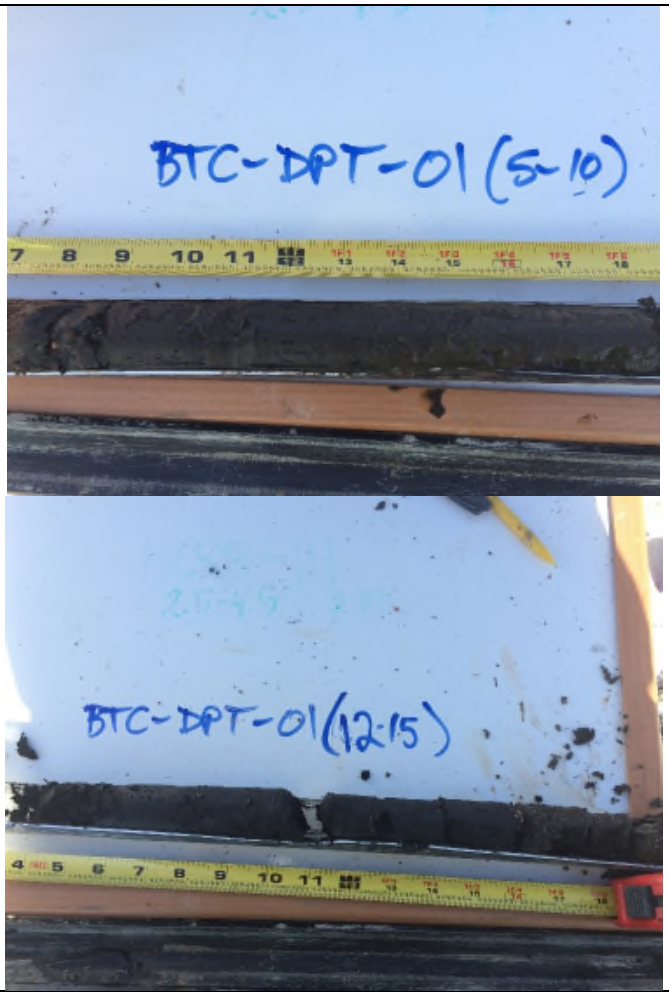
SOLUTION

Aquifer Model: Unconfined
Solution Method: Theis

T = 582. ft^2/day
S = 3.755E-8
Kz/Kr = 0.1
b = 10. ft

APPENDIX E
SITE PHOTOGRAPHS

BUTTE AREA ONE DATA GAP INVESTIGATION
SILVER BOW AND BLACKTAIL CREEK CORRIDORS
TETRA TECH PROJECT 114-571057



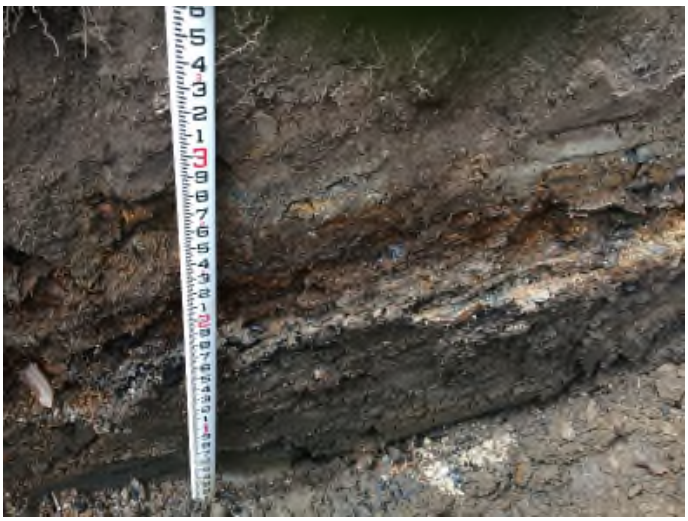
PHOTOGRAPH 1 Direct push boring BTC-DPT-01, with overburden to 12.5 ft bgs, black clay to 14 ft bgs, and alluvial sediments below.

PHOTOGRAPH 2 Installing piezometer BTC-PZ-02 at boring BTC-DPT-02 south of Blacktail Creek, east of berm.

PHOTOGRAPH 3 Digging test pit BTC-TP-01, SW of Blacktail Creek.

PHOTOGRAPH 4 Overburden debris from BTC-TP-05 along north bank of Blacktail Creek, between walking trail and creek.

BUTTE AREA ONE DATA GAP INVESTIGATION
SILVER BOW AND BLACKTAIL CREEK CORRIDORS
TETRA TECH PROJECT 114-571057



PHOTOGRAPH 5 View of wall of test pit BTC-TP-05 showing interbedded tailings and debris.

PHOTOGRAPH 6 Test pit BTC-TP-11, with orange sand and debris to 4 ft bgs, with groundwater at 4 ft bgs.

PHOTOGRAPH 7 Collecting a streambed sediment sample at BTC-01 using the AMS™ slide hammer sediment sampling apparatus.

PHOTOGRAPH 8 Collecting streambank sediment sample BTC-SBS-02S.

BUTTE AREA ONE DATA GAP INVESTIGATION
SILVER BOW AND BLACKTAIL CREEK CORRIDORS
TETRA TECH PROJECT 114-571057

PHOTOGRAPH 9 Collecting a pore water sample near confluence of Sand Creek and Blacktail Creek, at sample point SC-01.

PHOTOGRAPH 10 Collecting surface water and pore water samples at sample point BTC-05N.

PHOTOGRAPH 11 Collecting surface water and pore water data from sample point BTC-11

PHOTOGRAPH 12 Collecting a pore water sample from the wetland pond area (WSW of BTC-03), south of Blacktail Creek and berm road north of freeway.

APPENDIX F
DATABASE FILES