# DRAFT
# BLACKTAIL CREEK RIPARIAN ACTIONS PRE-DESIGN INVESTIGATION WORK PLAN DRAFT SAMPLING AND ANALYSIS PLAN BUTTE PRIORITY SOILS OPERABLE UNIT
OF THE
# SILVER BOW CREEK/BUTTE AREA SUPERFUND SITE SILVER BOW COUNTY, MONTANA

**Prepared for:**

DEQ MONTANA

**Montana Department of Environmental Quality**
**1520 E. 6th Avenue**
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**Task Order: 04 under MDEQ Contract No. 421042**

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**315 N 24th St.**
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**January 2023**

HGL
HydroGeoLogic, Inc

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## TASK ORDER 04

**PROJECT:** Blacktail Creek Riparian Action Remedial Design and Pre-Investigation

**TASK ORDER NUMBER:** 004

**HYDROGEOLOGIC, INC. (HGL)**

**TASK ORDER MANAGER (TOM):** Drew Herrera, P.E.

**Project Engineer**: Don Sutton

**MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY – FEDERAL SUPERFUND**

**TASK ORDER PROJECT OFFICER:** William George

**PREPARATION DATE:** January 11, 2023

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**REVISION:** 0

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## LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ARD | acid rock drainage |
| BPSOU | Butte Priority Soils Operable Unit |
| BRW | Butte Reduction Work |
| BTC | Blacktail Creek |
| CD | Consent Decree |
| cfs | cubic feet per second |
| COC | contaminant of concern |
| CLP | Contract Lab Program |
| CUL | cleanup level |
| DEQ | Department of Environmental Quality |
| DMP | Data Management Plan |
| DPT | direct-push technology |
| DQO | data quality objective |
| EPA | U. S. Environmental Protection Agency |
| EPH | extractable petroleum hydrocarbons |
| ft | feet/foot |
| FTL | Field Team Leader |
| GIS | geographic information system |
| GPM | gallons per minute |
| GPS | global positioning system |
| HASP | Health and Safety Plan |
| HGL | HydroGeoLogic, Inc. |
| ID | identification |
| mg/kg | milligrams per kilogram |
| NAVD | North American Vertical Datum |
| NWE | Northwestern Energy |
| MDEQ | Montana Department of Environmental Quality |
| MBMG | Montana Bureau of Mines and Geology |
| PAH | polycyclic aromatic hydrocarbon |
| PDI | Pre-Design Investigation |
| PID | Photoionization Detector |
| PQL | practical quantitation limit |
| QA | Quality Assurance |
| QAPP | Quality Assurance Project Plan |
| QC | quality control |

## LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| RA | Remedial Action |
| RD | Remedial Design |
| ROD | Record of Decision |
| RPD | Relative Percent Difference |
| | |
| SAP | Sampling and Analysis Plan |
| SBC | Silver Bow Creek |
| SD | Settling Defendant |
| SM | Sample Manager |
| SOP | Standard Operating Procedure |
| SWMP | Surface Water Management Plan |
| | |
| TOM | Task Order Manager |
| | |
| USCS | Unified Soil Classification System |
| | |
| VPH | volatile petroleum hydrocarbons |
| | |
| WET | Water Environment and Technologies, Inc. |
| WP | work plan |
| | |
| XRF | x-ray fluorescence |

# REVISION TRACKING TABLE

| Revision Number | Date | Section Revised | Changes/Comments |
|---|---|---|---|
| 0 | January 11, 2002 | NA | Pre-Draft for DEQ Review |
| 1 | January20, 2002 | 2.4.2 | Draft for DEQ Review |
| | | | |
| | | | |
| | | | |

NA = not applicable

# Blacktail Creek Riparian Actions
# Draft Pre-Design Investigation Work Plan
# Draft Sampling And Analysis Plan

## 1.0 INTRODUCTION

The Consent Decree (CD) for the Butte Priority Soils Operable Unit (BPSOU) Partial Remedial Design/Remedial Action and Operation and Maintenance (the BPSOU CD) describes numerous actions to be completed as a portion of the remedial actions in the BPSOU (EPA 2020a). Appendix A to the BPSOU CD, Record of Decision (ROD) for the Butte Priority Soils Operable Unit of the Silver Bow Creek/Butte Area Superfund Site, Butte-Silver Bow County, MT, includes the 2020 BPSOU ROD Amendment (RODA) (EPA 2020b), which modifies the Remedy for the BPSOU and includes specific provisions requiring more extensive removal of tailings, waste, and contaminated soils materials from the stream channel and floodplain of Blacktail Creek and Silver Bow Creek between Montana Street and Grove Gulch (RODA, Table 3).

Attachment C to Appendix D of the BPSOU CD (EPA 2020), the BPSOU Statement of Work for the Butte Priority Soils Operable Unit of the Silver Bow Creek/Butte Area Superfund Site, Butte-Silver Bow County, MT, defines the actions to be performed by the Settling Defendants (SDs) and Montana DEQ (MDEQ) for the Blacktail Creek (BTC) Riparian Actions and defines the area to be addressed under the BTC Riparian Actions (Figure BTC-1 in Attachment C to Appendix D of the BPSOU CD). Appendix H to the BPSOU CD, the Blacktail Creek Riparian Actions Outline, describes the Remedial Design (RD) and Remedial Actions (RA) process for the BTC Riparian Actions including completion of the Pre-Design Investigation. Figure 1 shows the approximate location of the Blacktail Creek Riparian Actions within the BPSOU.

This site-specific BTC Riparian Actions Pre-Design Investigation (PDI) Work Plan (WP) and Sampling and Analysis Plan (SAP) (PDI WP and SAP) was prepared in accordance with the Blacktail Creek Riparian Actions Outline presented in Appendix H to the BPSOU CD. This PDI WP and SAP provides an evaluation and summary of existing data, a description of currently known data gaps, and a plan to collect the data and information necessary to address the data gaps known at this time in accordance with the applicable provisions of the BPSOU CD. Anticipated investigations are described in this report, and additional quality assurance details are provided in the site-specific BTC Quality Assurance Project Plan (QAPP) (ATTACHMENT A).

The investigation area is located within, or adjacent to, the Figure BTC-1 boundaries shown in Figure 2. The area includes a former tailings pond and has been identified as a potential source of contaminants of concern (COCs) (i.e., arsenic, cadmium, copper, lead, mercury, and zinc) and may contain additional constituents of concern (e.g., manganese, trace elements, hydrocarbons, municipal waste, etc.). Previous studies have been conducted to characterize the Site but did not provide enough data to support RD; consequently, additional design-level data are needed to fill known data gaps and to meet the requirements set forth in the BPSOU CD (CD).

The following additional data and information are needed:

- Define the horizontal and vertical extent of tailings, wastes, contaminated soils, and sediments accessible for removal within the limits shown on Figure BTC-1 to provide an accurate estimate of the volume of contaminated materials to be removed.

- Refine the estimated volume and quality of groundwater associated with dewatering activities related to tailings, waste, and contaminated soils removal, and assess the feasibility of dewatering the excavated materials.
- Gather additional data and information to ensure protection of existing infrastructure and safety during tailings, waste, and contaminated soils removal operations.

## 1.1 SITE LOCATION AND DESCRIPTION

The BTC Riparian Areas Site is located immediately upstream of the Upper Silver Bow Creek (SBC)/BTC confluence between Montana Avenue and Lexington Avenue and between Interstate 90 and Silver Bow Creek with the BPSOU (Figure 1). Upper Silver Bow Creek (the reach above the confluence with BTC) is primarily a stormwater drain immediately upstream of the confluence and receives most of its flow from urban runoff. A discharge point from a water treatment plant located on Montana Resources mine is located at the confluence area of SBC and BTC that contributes a significant source of flow to SBC. BTC receives most of its baseflow contributions from Summit Valley groundwater in Butte, MT, as a portion of the historical Silver Bow Creek Watershed is now captured by the BPSOU sub drain north of the project area.

The BTC Riparian Actions Area will be investigated to address data gaps and satisfy design needs for the remedy for the BTC Riparian Area. The BTC Riparian Actions area is within the boundaries of the BPSOU. Montana DEQ's obligations for the BTC Riparian Actions are outlined in Appendix H of the amended ROD for BPSOU and the finalized BPSOU CD. The BPSOU Statement of Work for BTC is described in Section 5 of Attachment C of Appendix D to the CD.

Montana DEQ is responsible for the removal of tailings, wastes, and contaminated soils and sediment from the 100-year flood plain extending from Lexington Avenue culverts to the George Street Culverts within the boundaries in Figure 2; the removal of tailings, waste, and contaminated soils below the confluence with Blacktail Creek and its 100-year floodplain in the "Confluence Area" north of George Street and east of Montana Street as depicted in Figure 2; removal of contaminated in-stream sediments and banks in BTC 250 east of the Lexington Ave culvert, also shown in Figure 2. Additionally, DEQ is responsible for the reconstruction of BTC and SBC below the confluence with BTC following removal wastes. The SDs are responsible for the control of discharge of contaminated groundwater to surface water in the project area at an initial rate of approximately 100 gpm. AR is responsible for taking DEQ's construction dewatering at the Butte Treatment Lagoons to the extent treatment is needed and at times when the volume and chemistry of such water will not overwhelm the BTL's capacity or prevent it from meeting discharge standards. Construction water that meets a temporary variance will not need to be treated.

This pre-design design investigation will be performed within the approximate boundaries shown on Figure 2 (BTC Riparian Actions Study Area). The BTC Riparian Actions Area, which is the focus of this investigation, extends from BTC 250 feet (ft) east of Lexington Avenue, just past the confluence with Grove Gulch Creek, including its banks; the 100-year floodplain between George Street and Lexington Avenue Culverts; and the 100-year floodplain below the confluence of BTC and SBC north of George Street and east of Montana Street (Figure 2).

## 1.2 PURPOSE AND OBJECTIVES

The purpose of this PDI is to address known data gaps and collect the information needed to proceed with preliminary RD by conducting additional field investigations. Prior investigations demonstrated that tailings, wastes, contaminated soils, and municipal trash are buried at the Site. However, the existing data are not sufficient to estimate the volume to a reasonable accuracy for design purposes. Additionally, groundwater at the BTC Site has not been adequately characterized to fully understand the pumping rate or the volume and quality of water that would need to be removed and managed during remedial construction activities.

The objectives under this PDI Work Plan deal with solid materials and groundwater and have been specified in BTC Riparian Actions Outline in Appendix H of the BPSOU CD and in the BPSOU Statement of work, Section 5 of Attachment C of Appendix D to the CD. The investigation objectives include the following:

- Drill/bore at specific locations identified later in the document to quantify the vertical and lateral extent of tailings, wastes, contaminated soils, and sediments defined by the Waste Identification Criteria Table in Table 1. This list is identical to the table in Appendix 1 in the BPSOU CD.
- Refine the existing groundwater hydraulic models to estimate the volume of water associated with dewatering activities related to a refined waste removal surface. If existing hydraulic models do not provide enough confidence to adequately characterize the volume, then a pump test may be required. If a pump test is required, the BTC PDI QAPP and PDI Work Plan will be modified to include those procedures.
- Generate a report related to geotechnical investigations adequately characterizing subsurface conditions in areas near bridges, culverts, and/or other structural features. The PDI Evaluation Report will include recommendations for any additional sampling or preventative measures that need to occur before remediation begins.

## 1.3 PROJECT SCHEDULE AND DELIVERABLES

The fieldwork for Task Order 04 is tentatively scheduled for late winter or early spring 2023. Fieldwork will be conducted by a field team led by an HGL engineer/geologist. A MDEQ representative may be present for field activities.

A subcontractor will provide drilling/boring services. Fieldwork is expected to be completed over a 3- to 4-week period. The approximate duration of each component of the fieldwork is as follows:

- Soil Boring and Sampling, 15 to 20 working days (3 to 4 workweeks) depending on need for priority 2 drilling and feasibility to complete Vibracore coring in the wetland area;
- Test pit excavation and sampling, 1 to 2 days; and
- Soil/sediment sampling, 1 to 2 days.

The exact start date for fieldwork will depend on the weather and site conditions, availability of subcontractor personnel, and equipment for borings and excavation of test pits. After completion of the fieldwork, HGL will tabulate observations and field data and then incorporate the data into the PDI Evaluation Report. The anticipated contents of the PDI Evaluation Report are described in Section 5.5.

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# 2.0 SITE BACKGROUND

## 2.1 SITE HISTORY

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 (Butte Reduction Works [BRW], Parrot Smelter, and Montana Ore Purchasing Company) 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 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) (Figure 2). 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.

## 2.2 SELECTED REMEDY

Section 5 of Attachment C and Appendix D of the BPSOU CD define the following selected remedy for the Blacktail Creek Remediation and Contaminated Groundwater Hydraulic Controls Site along with the party responsible for completing each major component of the remedy:

> *The objective of the remedial activities described below for the Blacktail Creek area is to remove tailings, wastes, contaminated soils and sediments from Blacktail Creek and Silver Bow Creek below the confluence with Blacktail Creek, including the Blacktail Creek wetlands, and control discharge of contaminated groundwater to surface water in the area, as depicted in Figure BTC-1. Remedial activities at the Blacktail Creek and confluence area shall include:*
>
> *1. Remove All Tailings, Waste, and Contaminated Soils – The State, through the Montana Department of Environmental Quality (DEQ), shall remove all tailings, wastes, contaminated soils, and sediments that exceed the Waste Identification Criteria in Table 1 of Appendix 1, in and along Blacktail Creek and Silver Bow Creek below the confluence with Blacktail Creek and their 100-year floodplains, as delineated in Figure BTC-1.*
>
> *2. Control Contaminated Groundwater – The SDs shall control discharge of contaminated groundwater to surface water and sediments in the BTC area. The initial contaminated groundwater control is generally depicted in Figure BTC-1. Removal of waste materials contributing to groundwater contamination within the BTC area is anticipated through remedial actions identified in item*

> *1. However, some areas north of Blacktail Creek, outside of the floodplain, are known to contain tailings, waste, and/or contaminated soils. Initially, approximately 100 gallons per minute (gpm) of contaminated groundwater will be collected to control discharge to surface water. The goals for the control of contaminated groundwater in this BTC area are to reduce ongoing and potential future groundwater loading of contaminants of concern to sediments and surface water as outlined in the Surface Water Management Plan (SWMP). Following Remedy implementation, further evaluation by the SDs shall be conducted to allow EPA to determine, in consultation with DEQ, if additional groundwater collection is required in accordance with the SWMP to control contaminated groundwater discharge to surface water and sediments as specifically described below (Control Contaminated Groundwater (SDs Responsibilities)) in the BTC area. Collected contaminated groundwater will be treated at the Butte Treatment Lagoons (BTL) facility, and/or an alternative groundwater treatment facility or approach, as approved by EPA, in consultation with DEQ.*
>
> *3. Reconstruct Blacktail Creek and Silver Bow Creek Below the Confluence with Blacktail Creek –DEQ shall replace removed tailings, wastes, contaminated soils, and in-stream sediments with suitable clean soils. DEQ shall also reconstruct Blacktail Creek and Silver Bow Creek below the confluence with Blacktail Creek and their beds, banks, and 100-year floodplains. DEQ shall also revegetate areas addressed by these restoration and remedial actions in accordance with the Material Suitability Criteria in Appendix 1.*

## 2.3 PREVIOUS INVESTIGATIONS AND INFORMATION

The following previous investigations conducted at or near the BTC Riparian Area Site that provide relevant information for this BTC Riparian Area PDI WP and SAP include the following:

- Stream Characterization of Blacktail and Silver Bow Creeks (MBMG 2014a);
- Tailings/Impacted Sediment Delineation of the Diggins East, Blacktail Creek Berm, and Northside Tailings Areas (MBMG 2014b);
- Data Gap Investigation – Silver Bow Creek and Blacktail Creek Corridors (Tetra Tech, 2016);
- Montana Street Substation Geotechnical Engineering and Environmental Sampling Report Prepared by Pioneer Technical Services for Northwestern Energy, May 2016 (NWE/Pioneer 2016);
- Draft Extent of Impacts Investigation Summary Report/ Butte, Montana, Prepared by Water Environment and Technologies, Inc. (WET) for Northwestern Energy (NWE)/ 11 East Park Street/ Butte, Montana 59701, June 2021(NWE/WET 2021); and
- Publicly available data and information from the Groundwater Information Center (GWIC) maintained by the MBMG (Montana's Groundwater Information Center 2022 (mtech.edu)).

### 2.3.1 Stream Characterization of Blacktail and Silver Bow Creeks

The MBMG 2014a report described the 2011 continuous bromide tracer injection study in the Blacktail Creek/Silver Bow Creek confluence area. The work evaluated streamflow, chemistry, metal loading, and groundwater/surface-water interactions in a reach of stream impacted by more than a century of mining and milling-related activities. The continuous tracer injection test was performed using a sodium bromide solution with a bromide concentration of 22.5 percent weight to obtain creek bromide concentrations of roughly 3 milligrams per liter. Samples from 30 groundwater wells, 17 mainstem locations, 8 tributary locations, 5 drive-point piezometer locations in the Blacktail streambed, and 2 wetland sites were analyzed from bromide, common cations and anions, and 36 minor and trace analytes. The study concluded the following:

- Discharge in BTC increased 2.2 cubic feet per section (cfs) across the BTC study area.
- The majority (61%) of gains observed in BTC were from direct groundwater inputs. The remainder of inputs were from adjacent wetlands under the influence of groundwater.
- All dissolved copper concentrations and most total recoverable concentrations remained below MDEQ-7 acute and chronic aquatic-life hardness-based standards for copper.
- The sources of total recoverable Cu and zinc to BTC are thought to be either bed sediment loads or nearby streambank sediment (BTC Berm) or loading from historic Grove Gulch discharges.

The MBMG 2014a also reported the present-day stream orientation, as well as 1890 and 1895 stream channel overlays. This data has been georeferenced in Figure 1 below.

### 2.3.2 Tailings/Impacted Sediment Delineation

The MBMG 2014b report described the May 2013 trenching, test pit, and borehole investigation in known and suspected mine wastes area of the Blacktail Creek/Silver Bow Creek Confluence. The work was done to quantify the aerial extent and depth of tailings and impacted sediments and was built on a previous study (Tucci, 2010). The study looked at three waste areas; BTC, Diggings East, and the Northside Tailings. The result of the study concludes the following:

- A mixed tailings/oxidized alluvial sand material, often difficult to distinguish from oxidized alluvial sand with naked eye, were encountered in the BTC Berm Areas and were buried.
- The organic silt layer was the underlying lithologic unit observed above the water table in the BTC Berm.
- The majority of soil samples collected just above the water table in the BTC Berm exceeded the COC criteria.
- Waste estimates were approximately 14,000 cubic yards in the BTC area.

### 2.3.3 Data Gap Investigation

The Tetra Tech 2016 report had a similar purpose and objectives as this BTC PDI Work Plan. The purpose and objectives included the following:

- 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 actions.
- Complete groundwater monitoring of selected monitoring wells to gather pre-construction aquifer and groundwater quality data.
- Evaluate contaminant loading to SBC and BTC riparian corridors.

The report presented results of soil, sediment, surface water, groundwater, and pore water sampling pertaining to characterization of mine wastes located at BTC Berm area and within the historical floodplain. The results were utilized to address data gaps and satisfy design needs for the integration of restoration with the remedy of mining and mineral processing wastes in the SBC and BTC corridors and to support restoration design. Tetra Tech 2016 concluded the following:

- 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.
- Metals concentrations were generally above screening criteria in the natural bank and opportunity soil samples.
- X-ray fluorescence (XRF) screening techniques had Relative Percent Difference (RPD) results from 0 to over 300%.
- The estimated waste removal volume was 100,185 cubic yards.
- Surface water with the highest concentration of total metals of arsenic, cadmium, copper, and lead were from wetland pond samples 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.
- A 2.5 gallons per minute aquifer test was conducted within the tailings berm. The test resulted in a mean value transmissivity of 591 $ft^2$/day and hydraulic conductivity of 59 ft/day. However, it should be noted that no aquifer responses were noted in other wells; therefore, the aquifer testing was limited to a single-well observation.

After evaluating the results of the Tetra Tech 2016 report, it was determined that the findings may not provide enough confidence for a detailed remedial design owing to inconsistencies, poor sampling collection, and poor data collection; consequently, further evaluation is needed. For instance, the report states that the RPD between XRF and laboratory total metals ranged from 0 to over 300%. The mean RDP for As, Cd, Cu, Pb, and Zn were 74%, 89%, 74%, 75%, and 82%, respectively. All of the XRF readings have questionable results. This is mainly due to moisture content above 20% that may interfere with sampling 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; therefore, they may have had moisture content above 20%. Additionally, XRF samples were not screened with a 10-mesh sieve prior to analysis.

Three direct push technology (DPT) boreholes were sampled. All contained useful data, but the DPT sampling method had poor core recovery, and not all samples were analyzed in the lab.

Additionally, 17 test pits were excavated below the water table. Many terminated in high metals, which indicate tailings or contaminated soils were present, but the test pits were not deep enough to identify the bottom of the contamination.

Finally, the pump test of AMW-11 provides very limited utility in defining aquifer properties for construction dewatering because only a very small portion of the groundwater bearing zone was stressed due to the low pumping rate (2.5 gpm) and short duration (1 hour). The results indicated that nearby wells saw no aquifer responses, therefor the aquifer test was limited to a single-well observation.

### 2.3.4 Northwestern Energy Investigations

In 2016, as part of the expansion of the substation near George Street, NWE hired Pioneer Technical Services to perform an environmental and geotechnical investigation. The investigation included one borehole that was sampled and left as a monitoring well. Soil samples indicated no tailings and no heavy metals of concern but samples from the boring did show the presence of some hydrocarbons (NWE/Pioneer 2016).

In 2020, NWE retained WET to further investigate the potential presence of hydrocarbons. The investigation included 13 boreholes and showed limited presence of hydrocarbons related to those associated with the NWE George Street Substation (NWE/WET 2021). The available borehole logs from the Pioneer and WET investigations provided some data that helped define the lateral extent of the tailings near the substation and corroborated the estimate extent of the 1890s tailings pool perimeter.

### 2.3.5 Historical Aerial Photographs

An aerial photograph from 1962 (Photograph 1) shows the location of the tailing impoundment in the project area during construction of Interstate 15/90 through Butte. Based on the data from recent investigations and the highway construction records, some of the tailings may have been removed during construction of the highway. However, additional data are needed to verify the remaining extent of tailings in the project area.

*Photograph 1 − 1962 Aerial Image Showing the BTC Riparian Actions Area*

## 2.4 KNOWN DATA GAPS

Based on review of the previous studies, the following data gaps need to be addressed to support the Remedial Design:

- Lateral and vertical extents of tailings, wastes, contaminated soils, and sediments located within the Blacktail Creek Riparian Actions Project boundaries;
- The extent of dewatering and drying that is needed prior to loading and hauling materials to ensure safe and efficient transport of the materials to the repository;
- Dewatering volume and pumping rates and chemistry;
- Potential for dewatering to allow inaccessible tailings (if applicable) to oxidize and their potential to contribute additional COCs to the ground and surface water;
- Potential for groundwater dewatering to causing subsidence or geotechnical concerns beneath Interstate 15/90;
- More precise depth and alignment of existing buried utilities and other critical infrastructure; and
- Potential presence of hydrocarbon contaminated soils, garbage, construction debris, or asbestos-containing materials in the excavation areas.

Previous investigations indicated that hydrocarbon contamination and municipal wastes were detected near the Northwestern Energy sub-station (Pioneer/NWE 2016 and WET/NWE). The sub-station is directly west of BTC project boundary. During field sampling, if any hydrocarbons are suspected or detected during the drilling or trenching processes, a sample will be collected per the QAPP. If construction waste suspected of containing asbestos is encountered, it will be sampled for asbestos. If household garbage or other municipal wastes are noted in the test pit or boring, the location and types of waste will be recorded to aid in estimating the potential volume of landfill debris that may require disposal.

No water sampling is planned during this investigation phase because substantial data have already been collected. During previous investigations, several wells/piezometers were installed, that can be sampled if more pre-excavation water chemistry data are needed.

It is assumed that dewatering of groundwater will need to be conducted to remove the waste. Initial assumptions are either wells or trenches will need to be installed and dewatered to lower the groundwater elevation in the project area prior to excavation. Without dewatering, the waste may be too wet to haul with conventional dump trucks. Previous groundwater investigations have been conducted around/near the BTC project area and are detailed in Section 2.4.2 of this document. HGL will combine all the available data in the previous groundwater models and, after the extent and volume of waste removal is defined, the groundwater dewatering model will be updated using the more recent data from the BTC pumping test conducted by the SDs, and the estimated waste excavation surface area to determine whether additional investigation is warranted.

Previous studies did not fully investigate the acid-generating potential of sulfidic tailings and waste rock that may be present in a reduced state below the water table. It is possible that these materials could rapidly oxidize and generate Acid Rock Drainage (ARD) after the water table is lowered and the tailings became exposed to the air during waste excavation. The process of drying the tailings when the water table is lowered and re-wetting the tails when pumping is stopped will be assessed through collection of Acid-Base accounting samples of tailings and waste rock encountered in the borings or test pits. The potential for creating ARD depends on whether the sulfides have already oxidized, and samples will be analyzed to determine the amount of sulfide and sulfate sulfur. If necessary, some of the samples can be archived and tested in humidity cells to evaluate the effects of wetting and drying cycles to determine the potential for ARD. The potential ARD risk for the tailings that will be removed can be managed on site and at the repository but needs to be better understood if there are tailings inaccessible for removal in the cone of depression, especially in the filled area immediately between the pond and George Street.

### 2.4.1 Extent and Volume of Tailings Removal

A major challenge when designing a drilling plan is to determine the drill hole locations and spacing between the drill holes that are needed to collect sufficient data to define the volume and extent of materials to be removed. For this project, the primary task is to collect sufficient data points to determine the base elevation and lateral extent of the tailings, waste, and contaminated soils within the limits of BTC Riparian Actions shown in Figure BTC-1.

For the purposes of this investigation, tailings, waste, and contaminated soils below the estimated 100-year base flood elevation within the boundary shown on Figure BTC-1 would be removed. Sample and log data from previous investigations (MBMG 2014a, Tetra Tech 2016, NWE/WET 2021) and well logs from nearby monitoring wells provide some information to approximate the bottom elevation of the tailings and contaminated soils and were used as a starting point for laying out the proposed sampling sites for this investigation. A map from the 1890s obtained from the MBMG 2014b (original citation: Weed, W.H.; USGS Butte Mining District, Montana Special Folio. USGS Geological Atlas of the United States, Folio 38, Washington, D.C., 1897.) and digitized into CAD (Figure 2) shows the estimated locations of the BTC and SBC stream channels and the back water pool created by the tailings dam downstream from Montana Street and provides additional information on the reasonable lateral extents to be investigated. To optimize the number of sampling sites, this plan uses the 1890s map to place drill holes along the pool boundary to find the outside perimeter, and then places boreholes inside to better map the bottom elevation and to determine if the native organic clay and sand/gravel below the tailings are contaminated. The sample sites shown on Figure 3 were selected to fill in the gaps between the existing sample locations from the previous investigations within the probable boundaries of the 1890s pool.

### 2.4.2 Volume and Quality of Groundwater for Dewatering

Construction dewatering rates for the BTC excavation area may be estimated using a combination of pumping tests and groundwater modeling. A pumping test can be simulated in a groundwater model, with the purpose of updating model hydraulic property values to reproduce observed water level responses from the pumping test. The updated model can then be used to predict possible rates required for full-scale construction dewatering. The remainder of this section briefly discusses available pumping tests and available groundwater models in the area, and the combined use of those to predict possible construction dewatering rates.

Groundwater pumping tests have been completed previously near Grove Gulch, within the BTC berm area, near the Butte Visitors Center, and near the Montana Pole Treating Plant. Of these, the two pumping tests within the BTC berm area and near the Butte Visitors Center are sufficiently close to the BTC excavation area to potentially provide insight on construction dewatering rates. Full results of the 2022 test near the Butte Visitors Center are not yet available, but preliminary data are available for use as appropriate to support analysis for the BTC excavation area. The 2016 pumping test within the BTC Berm area was conducted for a duration and rate (one hour and 2.5 gpm) that resulted in no observed drawdown in nearby monitoring wells. Thus, only a very small portion of the aquifer immediately around the pumping well was stressed, and this pumping test is consequently of little/no value in predicting construction dewatering rates for the BTC excavation area.

Currently available groundwater models that encompass the BTC excavation area include the Montana Pole and Buffalo Gulch models. As a preliminary step, HGL used these models without modification to estimate possible construction dewatering rates in the BTC excavation area. Predicted construction dewatering rates differed greatly between the two models, with the Montana Pole model predicting nearly an order of magnitude higher construction dewatering rate than the Buffalo Gulch model. Although both models are well calibrated to observed heads in the area (at the time of construction of the respective models), neither were calibrated to observed fluxes in the area, according to available model documentation. However, the Montana Pole model better matches observed Blacktail Creek flow rates in MBMG (2014b) than does the Buffalo Gulch model. This indicates that the Montana Pole model better represents the aquifer system in the area near Blacktail Creek under non-construction-dewatering conditions, and so *may* provide a better estimate of construction dewatering rates for the BTC excavation area.

As noted above, pumping tests may be used to update groundwater models to enable more accurate model predictions. The pumping test near the Butte Visitors Center will be simulated within one or both of the above models in order to update those models so that they can be used to produce more reliable estimates of construction dewatering rates for the BTC excavation area. Once this analysis is done, the potential need for a pumping test within the BTC excavation area will be assessed.

The groundwater volume estimates will be refined after determining total volume of tailings, waste, and contaminated soils requiring excavation based on the results of this investigation and the volume below the groundwater surface that will require dewatering for excavation. The refined assessment will also allow better evaluation of the potential impacts to the existing critical infrastructure and interstate. If needed, a new pumping test on a new well located inside the BTC excavation area may be necessary to refine the volume and quality of water to be removed and disposed of to facilitate excavation of tailings, waste, and contaminated soils in the BTC Riparian Actions area. The need for the additional pump testing will be evaluated and discussed in the PDI evaluation report, and plans for a subsequent investigation would be proposed, if needed.

### 2.4.3 Field XRF Screening

XRF screening may be inaccurate when the samples are excessively moist and when the sample is not prepared properly for analysis. The TetraTech 2016 sampling program scanned unprepared samples and found there was a poor RPD between the XRF and the lab samples. Furthermore, differences in sample preparation and the underlying analysis methods (i.e., XRF vs inductively coupled plasma-mass spectrometry [ICP MS]) typically provide concentrations that are not directly comparable with the laboratory concentrations.

Methods of developing field XRF screening criteria based on paired field XRF and laboratory sample results have been developed and successfully applied for local projects (MDEQ/Pioneer 2011, and others). These methods have been successfully used as field screening tools to identify samples for laboratory analysis during design investigations and to determine when excavation is complete during construction. When properly applied, these methods have provided robust design and post-removal verification datasets when combined with a suitable number of laboratory confirmation samples. These methods can be useful even if the XRF screening results have a high RPD compared to the laboratory sample results, and the field XRF results can be a useful to predict if metals are present above applicable laboratory-based cleanup criteria.

Based on the above, HGL recommends the following:

- Use an XRF in the field to scan the extruded cores at 1-foot intervals to preliminarily identify the potential break between soils above and below the applicable cleanup criteria.
- Collect samples from the cores at 1-foot intervals and perform field XRF analysis on prepared samples that bracket (one sample above and two samples below) the estimated bottom of contaminated soils in accordance with EPA Method 6200.
- Submit the prepared samples to the laboratory for analysis to create a dataset of paired field XRF and laboratory sample results.
- If feasible, develop a correlation between the laboratory and field XRF results, and develop field XRF cleanup criteria to predict when a sample would be expected to meet the appropriate Cleanup Levels (CULs) based on laboratory analysis.
- If a suitable field XRF correlation cannot be developed, the full laboratory dataset will be available for design and a suitable construction removal verification process can be developed during design.

### 2.4.4 Direct Push Sampling Limitations

The DPT sample recoveries from the MBMG and Tetra Tech investigations were lower than desired because the wet silty material was frequently lost from the 5-foot core barrel. The metals concentrations increased with depth in some of the DPT and test pit samples collected by MBMG 2014b and Tetra Tech 2016, possibly due to wet and unconsolidated layers contaminating lower layers.

Use of a sonic drill with 10-foot cores should provide higher core recoveries than DPT, with less potential for cross-contamination of the layers. Some testing will be performed on the first few cores to determine if a longer core run (up to 20 feet) down into more consolidated sediments beneath the tailings will further increase the recovery by decreasing the opportunity for the sloppy wet unconsolidated tailings to pour out of the core barrel and contaminate the next core run.

### 2.4.5 Critical Infrastructure and Utility Locations

Numerous buried and overhead utility lines and other critical infrastructure are present within and adjacent to the anticipated investigation and disturbance area. The horizontal alignments of some of these lines have been surveyed, and some are apparent from ground disturbance, including the recently installed high voltage line and the fiber optics line. GIS shape files of the horizontal alignments were provided for some of the buried sewer and water lines. The accuracy of the survey is not known, and additional data are necessary to locate the utilities. All known existing utilities will be located as part of utility location and pre-clearance process for this investigation.

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# 3.0 SAMPLING AND ANALYSIS PLAN

This Sampling and Analysis plan (SAP) is integrated into the PDI Work Plan and details the following activities that will be performed during this investigation:

- Scope,
- Premobilization,
- Mobilization,
- Surveying,
- Standard Operating Procedures,
- Trenching and Boring procedures,
- Sampling Procedures,
- X-ray fluorescence (XRF) screening of soil samples,
- Field Documentation,
- Laboratory Sample Handling,
- Field Quality Control, and
- Data Management and Reporting.

All field activities will be conducted in accordance with the QAPP (Attachment A) and the Health and Safety Plan (HASP) (Attachment B).

## 3.1 SCOPE

The scope of this sampling program is as follows:

- Identify the bottom elevation and the lateral extent of tailings, waste, or contaminated soil within the BTC Riparian Actions Boundary shown on Figure BTC 1 and listed in Table 1: Waste Identification Criteria of Appendix 1 to Attachment C to Appendix D of the BPSOU CD. Samples for this investigation will be collected and analyzed only for the six COCs listed in Table 1.
- Gather sufficient chemistry and geotechnical data and information to complete the design and removal plan for the Preliminary Design Report.
- Gather enough information to evaluate the sufficiency of existing data to calculate and assess construction dewatering risks such as increasing the metals loading to SBC if the water table is lowered.
- Collect data to convert the in situ volume and weight to the weight and volume to be placed in trucks after the saturated tailings have been drained and sufficiently dried.
- Collect samples to determine if drainage from the exposed and drained tailings poses a risk or producing ARD during and after construction.

All the sampling except for eight trenches/auger samples in the streambank upstream from Lexington Avenue will be performed using sonic coring. Up to four trenches and four holes will be hand-dug along the floodplain below the Grove Gulch confluence to determine if runoff from Grove Culch has caused contamination in Blacktail Creek in the study area. Previously collected surface samples in Grove Gulch upstream from I-90 exceeded the BPSOU CD cleanup standards, and 0 to 12-inch surface samples collected by Tetra Tech in 2016 indicated metals concentrations above applicable CULs, especially zinc in the floodplain above and below Lexington Avenue.

The proposed sampling locations are shown on Figure 3 and listed in Table 2. The sampling effort would include collection of approximately 220 laboratory samples from 69 sample sites as follows:

- 12 samples each from 4 hand-dug trenches east of Lexington Avenue near the confluence with Grove Gulch;
- Four hand-dug floodplain surface samples east of Lexington Avenue near the confluence with Grove Gulch;
- 126 samples from 42 Priority 1 sonic boreholes;
- 39 samples from 13 Priority 2 sonic boreholes;
- 18 samples from 6 Vibracore boreholes in the wetland pond area (if feasible); and
- Approximately 20 duplicate samples.

The need for a potential supplemental groundwater investigation and other special focus investigations will be determined in a later phase of the investigation and design process.

HGL will attempt to complete the Vibracore drilling in the wetland areas by using a small pontoon boat or barge as a platform. If the drilling can be completed safely and suitable cores can be recovered, the logging and sampling process will be the same as for the sonic coring methods. If it is not possible to complete Vibracore drilling in the wetland areas, HGL will coordinate with MDEQ to determine if the sample sites can be eliminated from the sampling program or if other means of access, such as constructing a temporary access road, is warranted. In addition, HGL will coordinate with MDEQ if the soil sampling is taking an excessive amount of time or if it becomes apparent that fewer samples will be needed to determine the extent of contamination. Fewer samples may be needed if predicted waste intervals are met.

## 3.2 PRE-MOBILIZATION ACTIVITIES

The premobilization activities for this investigation are described below. Additional tasks may be identified during project planning and mobilization and will be addressed or completed, as needed.

### 3.2.1 Supplies and Equipment

HGL will provide equipment for XRF screening and GPS field mapping. HGL will also obtain sampling supplies and sample containers, coolers, and sample paperwork from the approved analytical laboratory. The drilling subcontractor will provide all equipment, materials, labor, and incidentals necessary for drilling activities.

The general supplies and equipment needed for the project includes, but is not limited to, the items listed below.

- Field logbook and pen
- Measuring tape (calibrated in tenths of a foot, not inches)
- Unified Soil Classification System (USCS) chart (ASTM D-2488)
- Munsell color chart (Munsell, 2009)
- Tarp or polyethylene sheeting to lay on ground to keep samples clean (about 16’ x 10’)

- Field XRF unit.
- No. 10 sieve screen
- Portable heater or oven if the samples need to be dried
- Two PIDs (9.6 eV and 10.6 eV lamps) with humidity filter.
- Lined core boxes (3 x 2-foot configuration)
- Shovel for trench samples
- Sample containers
- Sample bags (quart, gallon, and proctor)
- Sample tags with sealable plastic bags to protect sample tag
- Chain of custody forms
- Coolers for storing and shipping samples
- Decontamination equipment (pressure washer, tap water, dilute nitric acid, Liquinox® soap, decontamination containers, paper towels, scrub brushes, and spray bottles) (refer to SOP-DE-02 in Attachment A)
- GPS-enabled digital camera, smart phone or digital video camera with at least 12-megapixel resolution. Ensure geolocation is on
- White board and marker to identify photograph location
- Resource grade GPS unit
- Marking paint
- Stakes and extra wide marking pens
- Pin flags
- Appropriate safety PPE
- Sunscreen and bug spray
- Foul-weather clothing and gear
- Pontoon Boat for accessing wetland area sample and survey locations
- Personal Flotation devices and water safety equipment

### 3.2.2 Property Owner Access Agreements

Prior to any sampling, consent agreements will be required from Silver Bow County, Northwestern Energy, and Atlantic Richfield Company. HGL and/or DEQ will obtain these consents. No activities are anticipated on the adjacent property (KOA). Maric Properties, LLC of Bozeman must be notified of anticipated work before entering the property.

### 3.2.3 Utility Clearance and Location

Field activities will follow SOP 401.01 (Attachment A) to prevent damage to utilities and ensure safe operations. HGL and any subcontractors that will disturb the ground surface will contact Montana One-Call (811) during the premobilization activities to locate underground utilities in the investigation area. There are buried high voltage, fiber optic, sewer, potable water and process water lines throughout the site, especially near Silver Bow Creek and North of George Street.

If the utilities cannot be located by the owners via the mandatory 811 process, they will be located via careful trenching or hydro vacuum excavation in advance of the drilling. At least three locations will be obtained on each utility to verify the alignment and depth or until the accuracy of the GIS shape files can be verified. The elevation and coordinates of the utilities will be recorded so that this 3-dimensional information can be used for the engineering design and construction phases of the Project. Locations will be surveys as described in Section 3.4.

The boreholes shown on Figure 3 were selected based on the existing information to avoid the known utilities. Locations north of George Street are more likely to have a conflict with utilities, and each location will be hydro vacuum excavated to below the estimated utility depth, if needed. Sample locations will be adjusted, as necessary, to avoid any utilities.

### 3.2.4 Field Personal Assignments and Training

All personnel assigned to perform the field activities will review this PDI WP SAP, the HASP, and the QAPP before performing any work on-Site. Specific tasks will be assigned, and the project manager and field team leaders will provide instructions necessary to ensure all personnel know and understand how to perform their work assignments in accordance with the applicable plans.

## 3.3 MOBILIZATION

HGL will coordinate with all subcontractors and oversight agencies to ensure all equipment, materials and supplies necessary to perform the investigation area are ready prior to starting the work. HGL will notify the agencies, affected landowners, adjacent landowners, and stakeholders prior to mobilizing any equipment or supplies to the site. HGL will coordinate with MDEQ to obtain access and security procedures for the site and at the Montana Pole Plant field laboratory area. Mobilization will be in accordance with applicable provisions of related Site-wide procedures and in accordance with HGL's Standard Operating Procedures (SOPs).

## 3.4 SURVEYING

Prior to performing the field sampling, each proposed soil boring or sample location will be located in the field, checked for suitability, staked, and labeled using a Trimble GEOXT resource grade GPS unit. The field team leader will stake the locations of the boreholes and sample sites to ensure that all the utilities have been identified and will adjust the locations, if needed, to avoid utilities or other obstructions. Some adjustment of boring, surface sample, and trench locations is expected within areas of dense vegetation and where access is limited or not feasible.

The location of the selected sample site will then be surveyed with the resource-grade GPS unit. This task will include any hydro vacuum excavating or trenching to locate the utilities, checking overhead utility clearance, and marking the bore hole locations.

After sampling is complete, the location and elevation of each boring or sample location will be surveyed using a survey grade GPS unit. The sampling crew will place a stake in the center of the backfilled bore hole, surface sample site, or trench site. Survey data collected will include the sample station identifier northing, easting, and elevation. The accuracy of the survey will be to within 0.5 feet horizontally and 0.2 feet vertically. Survey data will be collected and presented in the Montana State Plane (North American Datum 83) coordinate system, and elevation will be based on NAVD 1988.

The sampling team will measure the depth to the bottom of the wetland at several locations during the Vibracore drilling process and will stake the water level on the pond perimeter on the same day the pond bottom measurements are made. The pond elevation stake will be surveyed with the other sample points, and the depth to bottom measurements at several pons will be used to estimate the pond bottom elevation for design purposes.

The proposed sample locations and identifiers for this investigation area are shown on Figure 3 and listed in Table 2.

## 3.5 STANDARD OPERATING PROCEDURES

The investigation will follow the HGL's SOPs. The SOPS for the project are provided in Appendix A to the QAPP (Attachment A) and listed in Table ***3***. If additional SOPS are identified as necessary during the investigation, the applicable HGL SOP will be used.

## 3.6 HAND-DUG TRENCHING AND AUGER/SHOVEL

The previous investigations concluded that fines with potentially high COC concentrations have washed down Grove Gulch and deposited into BTC in the western-most instream sediment removal area, immediately upstream from Lexington Avenue (Figure 3). The purpose of the sampling here is to determine whether the contamination is sufficient to require remedial action between Grove Gulch and the culverts under Lexington Avenue.

Four trenches and four hand auger/shovel pits within the BTC floodplain will be hand excavated and sampled. The procedure will be to shovel away the surface organic matter and litter until the solid mineral ground is exposed. The clean surface will be described and sampled. If the lithology changes, a sample will be obtained from each lithology, or a single sample will be obtained from the trench.

The floodplain bank will be sampled as required in the BPSOU CD. Samples will be hand augered/shoveled as deep as practical in the stream overbank area to determine the extent and depth of the contamination from Grove Gulch. The water table is near the surface (approximately stream water surface elevation), so it may be difficult to sample very deep. The sample locations will be identified in the field where access and digging are practical. Collect samples in 12-inch vertical intervals and place them in a plastic bag with the same labeling procedure as all other samples. The samples will be field screened as described in Section 3.8.3. Samples sent to the lab will be labeled and follow all chain of custody procedures in accordance with the SOPs. The streambank is densely vegetated with willows making access difficult, so the locations of the trenches will be field-modified, as needed.

A stake labeled with the sample station identification will be installed in the center of the backfilled test pit and surveyed to define sample locations. If the willows are too dense for GPS or it is not possible to install a stake, the distance upstream from the Lexington Avenue culvert and offset north or south from the streambank will be measured using a tape measure and recorded. A sketch showing how measurements were made will be recorded in the field logbook.

## 3.7 BOREHOLE DRILLING PROCEDURES

Core samples will be obtained using a sonic drill rig to provide better core recovery than direct push techniques. The following general procedures will be performed at each borehole location at the appropriate depth intervals. However, additional activities may be required per the SOPs or as dictated by Site conditions.

- Perform utility locates prior to drilling boreholes. Do not start drilling any site before prior approval from the project manager and the field team leader.
- Check for overhead utilities. Notify utility owners and isolate or shield lines, as required by the utility owner, if clearance is not adequate.
- Prepare drill rig for operation. Decontaminate drilling tools and sampling equipment, prepare the pad and level the rig, prepare the down-hole tools, set up sample handling areas, install Best Management Practices and water management areas, and perform other tasks as required.
- Prior to use, and between samples, wash all sampling tools and utensils with a detergent solution, followed by a tap water rinse, a diluted acid rinse, and a final rinse with distilled/deionized water.
- Prior to drilling each borehole, observe the area for obvious signs or sources of hydrocarbons on the surface. Record any findings in the field logbook. Any soils that appear to contain hydrocarbons (via sight and/or smell or detection with a PID) will be sampled immediately in the field next to the drill rig. Samples will be collected for laboratory analysis for volatile petroleum hydrocarbons (VPH) and extractable petroleum hydrocarbon (EPH) fractionation with polycyclic aromatic hydrocarbons (PAH).
- Begin advancing the core barrel. Advance the core barrel to collect the core sample, then retrieve the inner core barrel to recover the core sample. Continue adding core barrel segments and collecting core samples until at least 2 feet into undisturbed native ground below an identifiable tailings, waste, and contaminated soils or fill layer or the full 10 foot of core is obtained, whichever is greater.
- Open the core sleeve and lay out the core samples in order on strips of polyethylene sheeting or other appropriate material with pre-labeled boring depths.
- Create a 2-inch slit near the center of each 1-foot interval along the length of the core sleeve. Use the PID immediately to screen for any hydrocarbons. If hydrocarbons are detected, immediately open the core sleeve at the appropriate depth interval and collect samples using the headspace detection method and laboratory hydrocarbon analyses.
- If the presence of hydrocarbons is detected (via sight and/or smell or detection with a PID) and groundwater is present, collect an additional soil sample near the top of the saturated layer (in the capillary fringe).

- Photograph the complete length of the core in 2-foot segments from directly overhead using parallel camera movement and a high-resolution setting (12 megapixel minimum).
- Take additional photographs of subsamples for documentation, as necessary.
- After scanning the core for hydrocarbons and collecting samples if necessary, cut and place the core samples in properly labeled sample core boxes for transport to the field laboratory. Label the core box with the sample site location, depth interval, and core orientation. Ensure that the core sample is marked clearly and is carefully transported horizontally because it will be used for further observation, sample selection, and analysis at the field laboratory.
- If the core is too wet to transfer to a core box, scan the core at 1-foot intervals with the field-portable XRF and collect samples at 1-foot intervals along the entire length of core. Label all samples in accordance with Section 3.8.1.
- If the borehole is to be advanced deeper, and after recovery of the sample, add a drill rod to the drill string to advance core barrel beyond the sonic casing.
- Repeat these steps to advance the drill to the desired depth.
- Backfill the core hole with bentonite chips or cuttings.
- Place a stake in the center of the borehole and label the stake with the sample station identification and the date sampled.
- While all core is anticipated to be archived, specific samples will be selected based field XRF for additional laboratory analyses. Sediment cores from every borehole drilled during this project will be stored in core boxes in their entirety (if possible) at the DEQ Montana Pole facility in Butte, Montana. When it has been determined that enough sampling data has been analyzed for design-related purposes, additional samples will be shared with other parties, transferred off site, or disposed of appropriately.
- Decontaminate the drill rig core barrel(s) between samples by washing with a high-pressure washer and rinsing with tap water.
- Move to the next sampling location.

The depth of each core hole will vary depending on location, but all will be drilled into the native sand/gravel to at least 2 feet below the bottom of the discernable tailings or non-native fill layer. In general, the holes drilled from low-lying areas near the stream elevation will be 10 feet deep, and the ones drilled from filled areas will be up to 20 feet deep. As the first few holes are drilled and the elevation of the base of the tailings becomes evident, the depths can be more accurately predicted, but it will be obvious when the drill enters the sand/gravel below the tailings or native clayey soil horizon. Because the sonic drill typically uses a 10-foot core barrel, a full 10-foot run will be used in the low-lying areas. In the filled areas, the depth of each core run will be adjusted based on experience. The objective will be to drill to the base of the fill in the first run, then run a full 10 feet through the tailings into the native ground in the second run. It may be necessary to drill the first hole to learn the lithology, and then move over a few feet and drill the second hole for sampling. If tailings are present in the boring at greater than 10 feet thick, a third pass will be made to collect cores at least 2 feet below the bottom of tailings into native ground.

### 3.7.1 Logging

The classification and lithology of the core will be logged and photographed. This will include a soil log of the borehole that lists USCS classification; color; depth to top and bottom of each stratigraphic unit; presence or absence of soil staining, odors, nodules, organic matter, and/or groundwater; percent recovery; type of drilling equipment; and bedrock depth (if encountered). All relevant observations will be recorded in a bound field logbook. Field notes will be entered into a form for import into an Excel database that requires each lithology and other characteristic be entered into the appropriate form field. Ensure that all data listed in Table 4 – Sample Excel Entry Log, are recorded and entered into the log.

To correlate the lithology in the 3D geology model, the Primary Description will be used. It can be the broad classification using two letters, or the more detailed classification using a "/" between the primary and secondary characteristics (i.e., GP or GP/CH). The description can be any important observation such an odor, or a comment about the drilling, for example.

To model the elevations and compute the impacted volumes of the various fill and tailings, the Strata Name will be used. The top of the native ground will be used to identify the base of the tailings deposit where it is identifiable. The laboratory sample results will be used to map the bottom of the impacted material to be removed. The following strata layers will be used:

- Fill (where present) – non-native fill materials,
- Tailings – identifiable layers of tailings, and
- Native Ground.

The following labels (if applicable) will be added to the notes for each stratum encountered in the boring:

- If municipal or construction waste (garbage, concrete, asphalt, etc.) is encountered, label the strata "Debris," and note the depths at which it is present in the boring.
- If suspect asbestos-containing material is present, label the strata as "Potential Asbestos," and collect a bulk sample of the layer for laboratory asbestos analysis.
- If hydrocarbons are detected, label the interval "Hydrocarbons," and ensure a sample is collected as soon as feasible, placed in an airtight sample container, and kept on ice in a cooler until delivered to the laboratory.

The borehole header data such as the coordinates, elevation, driller, drill type, date, and weather will be recorded in the field logbook and then later transferred to the Excel database. The survey coordinates will be entered into the database when available. When the laboratory analyses are received, the analytical data will be merged into the lithology data based on the drillhole name the associated strata. The laboratory date will be used to create the bottom of excavation surface. Some manual data interpretation may be necessary to assign the laboratory samples to the correct lithology.

## 3.8 SOIL SAMPLE COLLECTION

### 3.8.1 Sample Identification and Management

A sample number system will be used to uniquely identify the project site, the sampling method, and the specific sample location and depth interval. The sample identification number will be derived from the trench or borehole name followed by the sample interval enclosed in parentheses, as shown below.

- Sample BTC-Sonic-08-1-2 describes a sample from borehole BTC-Sonic-08 taken from a depth of 1 to 2 feet below existing ground.

All measurements will be decimal feet. Do not use blank spaces in the identification. For site numbers below 10, precede the number with a zero (i.e., use “01” rather than “1” to allow the data to be sorted by sample site name).

All samples collected in the field next to the rig will be described in the field logbook. All samples collected in the field will be labeled with the date and time of sample collection, the identification sample number, and the sampler's initials. Use a permanent marker for labeling.

All solid samples will be collected and sealed in plastic bags or glass jars for hydrocarbon samples. The sample identification (ID), date, and depth interval of the sample will be written on the sample container with an indelible marker. If the sample is collected from a soil boring, the core will be sealed in a plastic bag and then that bag and a sample tag with the number will be placed inside a second bag to ensure the sample does not become separated from the tag. Each sample will have the identification written on the outside with an indelible marker and contain a sample tag inside the bag. Place the sample tag inside a sealable “baggie” to keep it clean. If the sample is sent to the lab, the required lab analysis will be listed on the chain of custody form.

### 3.8.2 Borehole Sampling Procedures

Perform all field sampling activities in accordance with the HASP, QAPP, and in accordance with HGL’s SOPs provided in Attachment A. The cores are anticipated to weigh 7 to 8 pounds per foot. Waterproof cardboard core boxes for 4-inch-sized cores designed to hold 6 feet of core in three, 2-foot sections will be used. The full box will weigh 50 to 70 pounds.

A tarp or plastic sheet will be laid out on the ground to maintain cleanliness. The sampling team will observe, and the driller will extrude the core into a plastic sleeve that will contain the full 10-foot core run. The sleeve containing the core will be laid out full length on the tarp to be measured, logged, and scanned with a PID if hydrocarbons are present. The core will then be cut into 2-foot sections and placed in 3- by 2-foot core boxes and transferred to a controlled environment at the Montana Pole Plant for logging and metals sampling. If the core is laid on the ground in the field, and the sleeve is cut for hydrocarbon sampling, it will need to be re-bagged to maintain the moisture, properly labeled, and placed in a core box for storage.

Mark the borehole ID with top and bottom core depths on the box and the outside of the polyethylene sleeve and complete the logs and date entry. The end of each sleeve will be sealed and over-bagged, if necessary. The cores will be moved to the Montana Pole Plant storage location where they will be logged, analyzed with a portable XRF, and samples selected for laboratory analysis.

Before the driller starts the next interval, the notetaker will confer with the driller and note the depths at which the drilling conditions change (such as penetration rate, needing to change sonic frequency, etc.). This info may be useful when logging the core and identifying soft and wet conditions or changes in lithology. Record the depth to the water table.

Write the top and bottom depth on each 2-foot core interval placed in the core box using an indelible marker. Seal the sleeve at both ends to ensure water and air cannot enter or leave. Record the sampled intervals and sample ID for all field collected samples on the outside of the core box. Ensure all cores from all borings are placed in each box in the order in which they were obtained, with the bottoms at the same end of the box.

### 3.8.3 XRF Screening Analysis

HGL will utilize a portable Niton XL3t Series XRF unit (or equivalent), sample analysis stand, sample preparation equipment, and standards necessary for selecting and screening soil samples prior to submitting them to the laboratory. The complete users guide for the XRF will be available on Site. EPA Method 6200 provides procedures for both direct readings (in situ by placing the instrument directly on the surface of the soil to be tested) and readings on a prepared sample (intrusive method). The in situ method will be used to scan cores prior to collecting samples, and a modified intrusive method will be used to select samples for submission to the laboratory.

The portable XRF will first be used to qualitatively differentiate low metals from high metals intervals in the core and to select potential sample intervals for laboratory analysis using the in situ analysis method in accordance with EPA Method 6200. The intent is to identify the lowest sample interval that has COC concentrations above the CULs. This will be accomplished by in situ XRF analysis of the core in the plastic core sleeve to identify depth that COC concentrations begin to decrease below the screening criteria or show a rapid decrease in COC concentrations. After identifying the anticipated COC concentration break zone, one sample from the 1-foot interval above the estimate break in COC concentrations and one sample from each of the two 1-foot sample intervals below the estimate break in COC concentrations will be collected for modified intrusive field XRF field analysis.

After samples have been collected from the cores, the samples will be prepared and analyzed using the portable XRF in accordance with U. S. Environmental Protection Agency (EPA) Method 6200 intrusive method, as modified by SOP 12 . Samples will be sieved, air dried for at least 24 hours, and prepared for the modified intrusive field XRF analysis in accordance with the modified EPA Method 6200 for intrusive analysis and the applicable SOPs, except the samples will not be ground. The prepared samples will be placed in a resealable plastic bag and labeled in accordance with Section 3.8.1. They will then be analyzed using the portable XRF on the prepared and bagged sample or from an aliquot taken from the bag prepared for laboratory analysis, depending on the specific equipment included with the XRF unit.

All cores will be preserved and archived in accordance with the SOPS in case additional intervals need to be sampled and sent to the lab. The XRF unit will be system checked and calibrated using the appropriate standards at the appropriate intervals in accordance with the SOP and manufacturer's instructions. For every twenty samples, or at least once per day, a duplicate sample will be analyzed using the main sampling technique. Once per day, the instrument's precision will be checked by analyzing one of the samples at least seven times in replicate.

### 3.8.4 Selection of Samples for Laboratory Analyses

Upon completion of soil sampling from the borings, samples will be selected and identified for analyses. Three of the 1-foot interval samples thought to bracket (one above and two below) the bottom of the contaminated soils zone will be collected and prepared for the modified intrusive field XRF analysis. Additional samples will be collected and analyzed using the modified intrusive field XRF method, as needed, to identify the samples that bracket the anticipated bottom of the waste and then will be submitted for laboratory analyses.

The screening criteria provided in Table 1 will be applied to assist in determining the base of impacted soils and which samples will be submitted to the laboratory for analyses. All laboratory samples will be analyzed for total metals. All remaining core materials and samples not analyzed at the laboratory will be preserved and archived at the storage facility and will be available for collection of additional samples if the samples originally submitted for laboratory analyses do not adequately define the bottom of excavation necessary to support design.

Up to five tailings samples will be collected for Acid-Base Accounting analysis using the 2015 Nevada Modified Sobek Method. The samples will be collected from core sections identified as tailings present below the groundwater surface elevation. The samples will be selected from cores distributed throughout the areas identified as having discernable tailings deposits.

## 3.9 FIELD DOCUMENTATION

This section describes the field documentation procedures for this investigation.

### 3.9.1 Field Logbook

To provide a permanent record of all field activities, field personnel will document all activities in a bound field logbook per HGL SOP 401.501. This will include a description of Site conditions during sampling activities. Each logbook will have a unique document control number, be bound, and have consecutively numbered pages. All entries will be in waterproof ink, and any mistakes will be lined out with a single line and initialed by the person making the correction. Whenever a sample is collected or a measurement is made, a detailed description of the sample location and any additional observations will be recorded. The GPS coordinates will be recorded when appropriate. Individual field team members may be responsible for required documentation based on specific tasks assigned by the Field Team Leader (FTL) or TOM. GPS coordinates will be recorded as decimal latitude and longitude.

All significant observations, measurements, relevant data, and results will be clearly documented in the data log or the field logbook. At a minimum, the following will be recorded:

- A description of the field task;
- Time and date fieldwork started;
- Location and description of the work area including sketches if possible, map references and references to photographs collected;
- Names and titles of field personnel;

- Name, address, and phone number of any field contacts or site visitors (e.g., Agency representatives, auditors, etc.);
- Meteorological conditions at the beginning of fieldwork and any ensuing changes in the weather conditions;
- Details of the fieldwork performed and the field data sheets used.;
- All field measurements made;
- Any field analysis results;
- Personnel and equipment decontamination procedures; and
- Deviations from the QAPP or applicable field SOPs (Appendix A).

For all drill holes and trenches the following entries will be made:

- Lithologic log of the test pit/test boring indicating material types, from and to depths, rock content, color, presence of water, etc.;
- Depth intervals from the ground surface for each soil horizon and total depth of the test pit/test boring;
- Depth-to-groundwater from the ground surface, identifying the depth at which water is seen initially flowing into the test pit or borehole (if applicable);
- After a piezometer is installed (if applicable), record the height of stickup from the ground surface and the distance from the measuring point (MP) at the top of the piezometer to the water table;
- Photograph or video of each test pit/test boring or trench with a staff gage or tape measure for scale to document existing conditions. Include site name ID in photograph using a white board or note pad; and
- Abnormal occurrences, deviations from the SAP, or other relevant observations.

For any field sampling work the following entries will be made:

- Sample location and ID number;
- Sample type collected;
- Date and time of sample collection;
- Sample location descriptions and designations, soil type and texture (e.g., sand, silt, etc.), grain size, and color (in the field). Further sample information will be included with the laboratory results;
- Split Duplicate samples taken by other parties (note the type of sample, sample location, time/date, name of individual, individual’s company, and any other pertinent information);
- Sampling method, particularly any deviations from the field SOPs;

- Documentation or reference of preparation procedures for reagents or supplies that will become an integral part of the sample (if any used in the field); and
- Sample preservation (if used).

### 3.9.2 Field Photographs

Photographs will be taken of sampling locations and field activities using a GPS-enabled digital camera or cellphone. When practical, photographs will include a measuring tape in the picture as well as a white board with relevant information (e.g., time, date, location, sample number, etc.). Additional photographs documenting site conditions will be taken, as necessary. Documentation of all photographs taken during sampling activities will be recorded in the bound field logbook or appropriate field data sheets (refer to field SOPs in the QAPP provided in Attachment A) and will include the information shown below for each photograph taken.

- Time, date, and location
    - Ensure the camera/phone GPS capability is turned on.
    - Ensure the time on the camera and the time you are recording are synced.
    - Ensure the photo resolution is at least 8 Megapixels.
- Photograph or video number from the camera or video recorder
- Identity of the person taking the photograph/video
- Direction that the photograph was taken and description of the subject photographed

The digital files will be placed with the electronic project files with copies of supporting documentation from the bound field logbooks.

## 3.10 LABORATORY SAMPLE HANDLING

Samples will be either hand-delivered or shipped to the appropriate laboratory in accordance with EPA chain of custody procedures. Samples will be shipped in appropriate containers that will preserve the integrity and prevent detrimental effects to the sample.

All samples not submitted to the laboratory will be archived. When it is determined that the samples are no longer needed, they will be disposed of at the Mine Waste Repository, if applicable.

### 3.10.1 Chain of Custody

The components of the field chain of custody (chain of custody form, labels, and custody seals) and laboratory chain of custody (chain of custody form, custody seals, and laboratory custody) are described in this section.

The SOP for chain of custody is provided in Attachment A. Maintaining the integrity of the sample from collection through data reporting is critical to the sampling and analytical program. This process includes the ability to trace the possession and handling of samples from the time of collection through analysis and final disposal. This documentation of the sample's history is referred to as chain of custody. A sample is considered to be in an individual's custody if it is in that individual's physical possession, in view of the individual after taking possession, or secured by that individual so that no one can tamper with the sample.

### 3.10.2 Chain of Custody Form

A chain of custody form will be completed and will accompany every sample. A standard form will be provided by the laboratory and will be pre-filled with potentially applicable analyses for this investigation. The form will include the information listed below.

- Project code
- Project name
- Sampler's signature
- Sample identification
- Date sampled
- Time sampled
- Analyses requested
- Remarks
- Relinquishing signature, data, and time
- Receiving signature, date, and time

A copy of the chain of custody record will accompany the samples during shipment and will serve as the laboratory request form. The chain of custody form will specify the type of analysis requested for each individual sample. The original form will be maintained with the field notes and in the project records.

### 3.10.3 Custody Seals

Custody seals are used to detect unauthorized tampering with samples following sample collection up to the time of analysis. Custody seals will be applied to the shipping containers when the samples are not in the sampler's custody. Custody seals will be applied across the lids of hydrocarbon sample jars.

### 3.10.4 Laboratory Custody

Laboratory custody procedures will conform to procedures established for the EPA Contract Laboratory Program (CLP) (EPA, 2016). These procedures include the following:

- Designation of sample custodian;
- Correct completion of the chain of custody form, recording of sample identification numbers, and documentation of sample condition upon receipt;
- Laboratory sample tracking and documentation procedures; and
- Secure sample storage.

The samples will be delivered to the laboratory for analysis in a timely manner to ensure the requested analyses can be performed within the specified allowable holding times. The sample will be hand-delivered or addressed to a person in the laboratory who is authorized to receive samples (laboratory sample custodian).

### 3.10.5 Sample Disposal and Archiving

Upon the completion of the laboratory analysis, the unused portion of the tested sample will be returned to the originator with their original chain of custody records from the laboratory. All samples and applicable forms will be archived in an appropriate storage facility until additional testing is required, if any. When it is determined that the samples are no longer required, they will be disposed of at the Butte Mine Waste Repository, if applicable.

## 3.11 FIELD QUALITY CONTROL

Field quality control (QC) samples are used to identify any biases from transportation, storage, and field handling processes during sample collection and to determine sampling precision. All field QC samples will be shipped with field samples to the laboratory. Brief descriptions of the field QC samples are below, along with when and how many are to be collected.

### 3.11.1 Field Duplicates

Field duplicates will be collected. A field duplicate is an identical, second sample collected from the same location, in immediate succession of the primary sample, using identical techniques. The duplicate sample will have its own unique sample number that prevents the laboratory from determining which sample is the corresponding primary sample. Duplicate samples will be sealed, handled, stored, shipped, and analyzed in the same manner as the primary sample. Both the primary sample and duplicate sample will be analyzed for identical chemical parameters in the field and in by the laboratory. The analytical results of the primary and duplicate sample will be compared to determine sampling precision. One field duplicate will be collected each day of sampling or 1 for every 20 samples collected, whichever is greater.

### 3.11.2 Field Activities Oversight

Oversight personnel will have the ability to inspect each sample collected to determine the appropriateness of the recorded data and ensure that the appropriate samples are collected. Copies of field logbook pages will be included in the PDI Evaluation Report.

Any deviations from the QAPP will be recorded in the field logbook along with any necessary corrective actions to be implemented. If oversight personnel request a deviation from the QAPP, the deviation and the reasons for the deviation will be noted and then signed by the agency personnel.

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# 4.0 QUALITY ASSURANCE/QUALITY CONTROL

## 4.1 DATA QUALITY OBJECTIVES

The data quality objectives for this phase of the PDI investigation are as follows:

1. Collect sufficient data to determine the base, lateral extent, and volume of contaminated soils, tailings, and waste in accordance with the requirements of the BPSOU CD. To meet the removal criteria (Table 1), the necessary practical quantitation limits (PQLs) for the data are not generally rigorous. For example, the general guidance for copper, lead, and zinc is that their concentrations will not exceed 1,000 milligrams per kilogram (mg/kg). However, mercury concentrations should not exceed 10 mg/kg, and cadmium concentrations should not exceed 20 mg/kg; therefore, the analysis method(s) used should have respectively lower PQLs. The reporting limits listed in Table 1 of the Laboratory Quality Assurance Project Plan (Attachment A) should meet this objective. To meet this objective, samples should be recovered from enough borings to identify the bottom of the waste at a horizontal spacing of approximately 250 feet.
2. Collect paired XRF and laboratory sample data to develop a correlation with laboratory analysis to support field decision making during remedial construction. To meet this objective at least 60 paired sample results need to be obtained from a variety of materials near the base of contamination.
3. Collect at least 5 samples of submerged tailings material in a reducing environment for ABA analysis to evaluate the potential risk for acid generation during construction dewatering activities.
4. Obtain sufficient recovery of core samples along the Interstate, George Street, and the BNSF railroad embankment to assess subsurface strata and geotechnical conditions and to collect bulk samples from archived cores as necessary to support geotechnical assessments of the excavation and dewatering activities. To meet this objective at least 2 cores should be obtained along the BNSF embankment, at least one core on each side of George Street, and at least 4 cores along the interstate embankment within the CD boundary.

## 4.2 FIELD QUALITY ASSURANCE/QUALITY CONTROL

The field Quality Assurance/Quality Control (QA/QC) protocols for sampling the base of T/IS are described in Section 3.1 of this report. Field protocols consist of sampling SOPs, decontamination procedures, sample documentation, and collection and analysis of QA samples.

## 4.3 LABORATORY QUALITY ASSURANCE/QUALITY CONTROL

The laboratory used, Energy Laboratories, will be responsible for completing laboratory QA/QC according to the procedures established in the EPA CLP program. The Energy Laboratories Quality Assurance Project Plan is provided as Appendix B in Attachment A.

# 5.0 DATA MANAGEMENT AND REPORTING

The sample collection activities to be conducted at this site will generate fixed laboratory data from the chemical analysis of soil, survey data, field measurements; and other site-derived information. The resulting data will be entered into a single data management system for consistency in tracking samples; storing and retrieving data; evaluating analytical results; and generating data tables, figures, and reports. The Data Management Plan (DMP) presented in this section was prepared to assist in implementing a successful data management strategy. The DMP is augmented by the requirements and procedures for field sample collection detailed in the Field Sampling Plan, and the sampling and analytical methodologies detailed in the QAPP and HGL SOPs.

## 5.1 OBJECTIVES OF DATA MANAGEMENT PLAN

Successful data management results from coordinating data collection, control, storage, access, reduction, evaluation, and reporting. This DMP documents the methodology that will be employed during project execution to link the various data management tools, including software packages, to assure that the various data and information types to be collected are systematically collected and managed.

The specific objectives of this DMP are as follows:

- Standardize and facilitate the collection, formatting, and transfer of project data into the data management system and components.
- Provide a structured data system that will support the end uses of the data, including planning, decision making, and design.
- Minimize the uncertainties associated with the data, data-derived products, and interpretation of results through defined QC measures and documented processes, assumptions, and practices.
- Provide data that are adequately documented with descriptive information for technical defensibility and legal admissibility of the data.

## 5.2 DATA MANAGEMENT TEAM ORGANIZATION

A data management team has been established for the BTC Project. The team will work together to properly execute the DMP and ensure that the project objectives and scope are realized. The team comprises of specialists in each related discipline and technical resource. The Project Manager is an integral part of the data management team and has overall responsibility for assuring the data are collected in accordance with the approved SAP. The members of the data management team are as follows:

- Project Manager – Drew Herrera, P.E.;
- FTL/Project Geologist – As assigned;
- Project Chemist – As assigned;

- Sample Manager (SM) – As assigned; and
- GIS Developer – As Assigned.

The functional responsibilities of the data management team are described in the QAPP (Attachment A). One or more team members may perform multiple roles on this project, depending on availability and the amount of data to be managed and analyzed.

## 5.3 ROLES AND RESPONSIBILITIES OF DATA MANAGEMENT TEAM

The responsibilities of the members of the data management team are summarized below. Should the scope of the data require a division of labor, the PM in consultation with the Data Manager will determine assignments, as appropriate, to assure the best work flow.

| Team Member | Roles and Responsibilities |
|---|---|
| **PM** | • Responsible for preparing the planning documents, schedule and milestones.<br>• Coordinates efforts with the MDEQ Task Order Project Manager.<br>• Determines the needs and objectives for tasks.<br>• Assigns appropriate personnel to review data deliverables and complete the project.<br>• Ultimately responsible for the completion of the project. |
| **FTL** | • Responsible for the collection and documentation of field generated data.<br>• Reports collection efforts and information to the SM.<br>• Assigns tasks and provides direction and oversight of all field team members and activities.<br>• Leads and documents daily toolbox meetings |

## 5.4 GEOGRAPHIC INFORMATION SYSTEM

The existing project data has been integrated into a GIS database to facilitate visualizing environmental data, mapping, generating figures for reports, and project tracking. Data collected from this investigation gathered, entered, and integrated into the existing GIS database to provide a single integrated data source to visualize, analyze, and view the project data.

The following types of data are included in the project GIS:

- Sampling locations;
- Northing/easting coordinates;
- Buildings, roads, site features, and utilities;
- Topography and land features; and
- Sample Analysis Results.

The base map data includes layers from previous Site-specific investigations. The analytical data point layers will be created from database queries based on the sampling results from project. The GIS Developer will be responsible for standardizing all the spatial data sources into the project coordinate system. The GIS Developer also will be responsible for maintaining the GIS database, including the following:

- Assigning colors, titles, symbols, line types, fonts, and text sizes to each theme to ensure consistency of views and themes within the GIS database; and
- Organizing files stored within the GIS database to ensure that they are saved in the correct folders.

The GIS Developer will generate figures for deliverables as directed by the TOM to meet data reporting needs.

## 5.5 PRE-DESIGN INVESTIGATION EVALUATION REPORT

The results of the field data collection activities will be tabulated and presented in the Pre-Design Investigation Evaluation Report that will be distributed to the project team and used for design purposes. The PDI Evaluation Report will be included as an appendix in the Design Report. The PDI Evaluation Report will include the following information.

- Summary of investigation results,
- Narrative interpretation of data and results,
- Summary of validated data (i.e., tables and graphics,
- Tailings, waste, and contaminated soils volume estimate broken down by project area,
- Assessment of dewatering and material drying issues,
- Updated hydraulic calculations and a recommendation regarding the sufficiency of the existing data or recommendation for additional data gathering as appropriate,
- Tabulation of the sample site locations and elevations,
- Locations of utilities and other relevant site features,
- Test pit logs and relevant field observations,
- Data validation reports and laboratory data reports,
- XRF sample results,
- Laboratory/XRF paired sample correlation analysis,
- Results of statistical and modeling analysis,
- Photographs documenting the actions conducted,
- Description of SAP deviations and assessment of impacts on the DQOs,
- Maps and figures showing the sample locations and estimate depth and extent of contamination,
- Conclusions and recommendations for RD, including design parameters and criteria
- Additional items as identified during the investigation, and
- Recommendations for further investigations (if applicable).

EPA may require DEQ to supplement the PDI Evaluation Report and/or to perform additional pre-design studies. It is unknown at this time whether EPA may require DEQ to supplement the PDI Evaluation Report or to perform additional investigations; therefore, these items are not addressed in this PDI Work Plan.

# 6.0 REFERENCES

Montana Bureau of Mines and Geology (MBMG) 2014a. Final Draft Version Tailings/Impacted Sediment Delineation of the Diggings East, Blacktail Creek Berm, and Northside Tailings Areas. Prepared by the Montana Bureau of Mines and Geology for the Montana Natural Resource Damage Program, February 2014

MBMG 2014b. Stream Characterization of Blacktail and Silver Bow Creeks, A Continuous Tracer Injection Investigation Conducted during Baseflow Conditions in an Urban Area Impacted by Mining: Butte, Montana. Montana Bureau of Mines and Geology, 2014)

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Meinzer, O.E., 1914. The water resources of Butte, Montana: U.S. Geological Survey Water Supply Paper 345-G, p. 79–125.

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NWE/ Water and Environment and Technologies, Inc. (WET) 2021. Draft Extent of Impacts Investigation Summary Report, Butte, Montana, Prepared by WET for Northwestern Energy 11 East Park Street/ Butte, Montana 59701, June 2021

TetraTech 2016. Data Gap Investigation – Silver Bow Creek and Blacktail Creek Corridors technical Memorandum Prepared for Montana Natural Resource Damage Program. July 21, 2016.

U.S. Environmental Protection Agency (EPA) 2020a. Consent Decree for the Butte Priority Soils Operable Unit, Partial Remedial Design / Remedial Action and Operation and Maintenance. United States of America vs Atlantic Richfield Company and the City and County of Butte - Silver Bow, Civil Action No. CV 80-039-Bu-SHE In the United Stated District Court for the District of Montana, Butte Division, 2020.

EPA/MDEQ 2020b. Record of Decision Amendment (RODA) for the Butte Priority Soils Operable Unit of the Silver Bow Creek/Butte Area Superfund Site, Butte-Silver Bow County, Montana. Appendix A to the Consent Decree, 2020.

# TABLES

## Table 1
## BPSOU Consent Decree Metals Cleanup Criteria for BTC Riparian Area

| Contaminant of Concern | Laboratory Action Level (mg/Kg) (1) | Laboratory Ceiling Criteria | XRF Screening Level (mg/kg) (2) | XRF Ceiling Level (mg/kg) (2) |
|---|---|---|---|---|
| Arsenic | 200 | 5000 | <150 | > 2500 |
| Cadmium | 20 | 100 | <20 | >50 |
| Copper | 1,000 | 5000 | <600 | > 2500 |
| Lead | 1,000 | 5000 | <750 | > 2500 |
| Mercury | 10 | 50 | <10 | >25 |
| Zinc | 1,000 | 5000 | <500 | > 2500 |
| (1) | | | | |

**Notes:**

1) Any single analyte above 5,000 mg/Kg.
2) Adapted from SSTOU Screening Criteria and methodology for typical XRF pass fail criteria for the SSTOU. Screening Criteria will be updated after completion of the investigation if a suitable XRF to laboratory correlation can be developed.

# Table 2
# Planned Sample Locations

| TempName | E | N | TempName | E | N | TempName | E | N |
|---|---|---|---|---|---|---|---|---|
| BTC-Sonic-34 | 1196707 | 651152 | BTC-Sonic-26 | 1197694 | 650916 | BTC-SVC-02 | 1197636 | 650483 |
| BTC-Sonic-38 | 1196760 | 651249 | BTC-Sonic-21 | 1197699 | 650747 | BTC-SVC-01 | 1197790 | 650552 |
| BTC-Sonic-42 | 1196835 | 651337 | BTC-Sonic-24 | 1197773 | 650855 | BTC-Surface-03 | 1199211 | 649901 |
| BTC-Sonic-32 | 1196905 | 651141 | BTC-Sonic-18 | 1197778 | 650687 | BTC-Surface-02 | 1199254 | 649880 |
| BTC-Sonic-41 | 1196909 | 651316 | BTC-Sonic-23 | 1197820 | 650815 | BTC-Surface-04 | 1199282 | 649842 |
| BTC-Sonic-37 | 1196959 | 651238 | BTC-Sonic-06 | 1197838 | 650361 | BTC-Surface-01 | 1199337 | 649839 |
| BTC-Sonic-40 | 1197091 | 651296 | BTC-Sonic-22 | 1197853 | 650794 | BTC-Trench-04 | 1199215 | 649941 |
| BTC-Sonic-31 | 1197105 | 651132 | BTC-Sonic-19 | 1197934 | 650737 | BTC-Trench-03 | 1199254 | 649922 |
| BTC-Sonic-36 | 1197160 | 651226 | BTC-Sonic-04 | 1197980 | 650340 | BTC-Trench-02 | 1199307 | 649872 |
| BTC-Sonic-14 | 1197228 | 650593 | BTC-Sonic-12 | 1198035 | 650527 | BTC-Trench-01 | 1199379 | 649821 |
| BTC-Sonic-16 | 1197287 | 650619 | BTC-Sonic-15 | 1198094 | 650616 | BTC-Sonic-49 P2 | 1196809 | 651147 |
| BTC-Sonic-11 | 1197297 | 650502 | BTC-Sonic-10 | 1198107 | 650491 | BTC-Sonic-52 P2 | 1196860 | 651244 |
| BTC-Sonic-30 | 1197309 | 651020 | BTC-Sonic-13 | 1198189 | 650576 | BTC-Sonic-55 P2 | 1196861 | 651293 |
| BTC-Sonic-39 | 1197312 | 651264 | BTC-Sonic-02 | 1198236 | 650294 | BTC-Sonic-54 P2 | 1196963 | 651289 |
| BTC-Sonic-33 | 1197330 | 651145 | BTC-Sonic-09 | 1198267 | 650488 | BTC-Sonic-48 P2 | 1197006 | 651137 |
| BTC-Sonic-35 | 1197364 | 651216 | BTC-Sonic-03 | 1198414 | 650315 | BTC-Sonic-51 P2 | 1197030 | 651234 |
| BTC-Sonic-17 | 1197367 | 650668 | BTC-Sonic-01 | 1198425 | 650256 | BTC-Sonic-53 P2 | 1197163 | 651282 |
| BTC-Sonic-28 | 1197367 | 650973 | BTC-Sonic-07 | 1198438 | 650409 | BTC-Sonic-47 P2 | 1197222 | 651124 |
| BTC-Sonic-25 | 1197430 | 650878 | BTC-Sonic-05 | 1198535 | 650341 | BTC-Sonic-50 P2 | 1197259 | 651221 |
| BTC-Sonic-20 | 1197451 | 650740 | BTC-SVC-06 | 1197378 | 650535 | BTC-Sonic-45 P2 | 1197461 | 650796 |
| BTC-Sonic-08 | 1197468 | 650417 | BTC-SVC-05 | 1197511 | 650506 | BTC-Sonic-46 P2 | 1197473 | 650848 |
| BTC-Sonic-29 | 1197524 | 651019 | BTC-SVC-04 | 1197557 | 650733 | BTC-Sonic-44 P2 | 1197579 | 650399 |
| BTC-Sonic-27 | 1197611 | 650969 | BTC-SVC-03 | 1197568 | 650626 | BTC-Sonic-43 P2 | 1197687 | 650385 |

**Notes:**
The coordinates above are in MT State Plane NAD 83 International Feet.
E = Easting
N = Northing

**Table 3**
**HydroGeoLogic Applicable Standard Operating Procedures (Found in Attachment A)**

| Reference Number | Title, Revision Date, and/or Number | Originating Organization | Equipment Type | Modified? | Comments |
|---|---|---|---|---|---|
| S-1 | SOP 300.07 Environmental Data Base Quality Control | HGL | Excel, GIS | No | General Data Management Procedures |
| S-2 | SOP 401.501 Field Logbook Use and Maintenance | HGL | Field logbooks, permanent markers | No | Record all fieldwork in logbook |
| S-3 | SOP 403.01 Soil Sample Collection | HGL | Disposal gloves, scoops, sample jars | No | Use if Hydrocarbons suspected |
| S-4 | SOP 403.02 Hand-Operated Auger Sampling | HGL | Hand auger | No | Surface soil and bank sampling |
| S-5 | SOP 403.03 Soil or Sediment Sample Compositing | HGL | Mixing bowls and utensils | No | For collection of duplicate samples |
| S-6 | SOP 403.04 Direct Push Technology Soil Sampling | HGL | DPT or Sonic rig | No | Subsurface soil sampling and logging, |
| S-7 | SOP 403.06 Surface and Shallow Depth Soil Sampling | HGL | Trowel/hand auger | No | Surface soil and bank sampling |
| S-8 | SOP 403.07 Borehole Logging | HGL | DPT rig | No | Subsurface soil logging |
| S-9 | SOP 403.08 Sediment Sampling | HGL | Sediment sampler | No | In conjunction with surface and subsurface soil sampling, as needed |
| S-10 | SOP 411.02: Sampling Equipment Cleaning and Decontamination | HGL | All non-disposal sampling equipment | No | Decontamination procedure |
| S-11 | SOP 411.03 Subsurface Utility Avoidance | HGL | Location Marker (paint, flag, stake) | No | Prior to any subsurface auguring |
| S-12 | SOP 408.511 XRF Screening Procedures | HGL | XRF Unit | Yes | Addresses Modified EPA 6200 |
| S-13 | HGL SOP 408.511.F01 XRF Usage Log | HGL | XRF Unit | No | Scan cores, Screening Samples |
| S-14 | HGL SOP 408.511.F02 XRF Calibration Form | HGL | XRF Unit | No | Scan cores, Screening Samples |
| S-15 | HGL SOP 408.511.F03 XRF Daily Log | HGL | XRF unit | No | Scan cores, Screening Samples |
| S-16 | HGL SOP 412.501 Data Validation | HGL | Forms, Database | No | General Data Validation Procedures |
| S-17 | ELI SOP, Field Sampling | Energy Laboratories | Forms | No | Sample chain of custody procedures |
| S-18 | ELI SOP, Sample Receipt, Login, and Labeling. | Energy Laboratories | Forms | No | Sample tracking procedures |

**Table 4**
**Sample Excel Database Entry Log**

| **Sample Location** | | **Easting** | **Northing** | **Ground Elevation** | **Depth to Water** | **Matrix** | **Sample IDs** (list all samples collected from this strata) | |
|---|---|---|---|---|---|---|---|---|
| BTC-Sonic-50-P2 | | #### | ###### | ##### | #.# | Soil | BTC-Sonic-50-P2-1-2, BTC-Sonic-50-P2-2-3, BTC-Sonic-50-P2-3-4, BTC-Sonic-50-P2-4-5, BTC-Sonic-50-P2-5-6, | |
| From | To | % Recovery | USCS Primary Description | Secondary Description | Tertiary Description | Color | Strata Name | Other Characteristics |
| 2.5 | 6.5 | 80 | i.e., GP or<br>GP/CH | Clayey | Poorly graded | Orange | Tailings<br>Fill<br>Native | Poorly graded gravel/ clay of high plasticity, fat clay. Sloppy and wet orange with organic odor.<br>Note presence and depth of “Debris” suspected, “Asbestos,” and “Hydrocarbons.” Record asbestos or hydrocarbon samples collected. |

**Notes:**

## Table 5

## XRF Sample Selection Process

| Lithology/Layer | Analysis Types | Sample Selection Process and Criteria |
|---|---|---|
| General Fill | XRF Scan | Don’t sample Fill unless screening or observations indicate material may contain hydrocarbons or asbestos or the XRF scan indicates the bottom of contamination is in the fill layer. |
| Tailings Lithology 1 | XRF Scan | Send to lab only if XRF screening sample is elevated and lower layer sample XRF values are low. |
| Tailings Lithology 2 | XRF Scan/Screen | Send to lab (lowest interval), XRF first; if high don’t XRF samples above. |
| Native Organic Soil | XRF Scan/Screen | Send to lab only if XRF is high. |
| Native Sand/Gravel | XRF Scan/Screen | Send to lab only if XRF is high or there is visible mineral staining. No XRF if there is coarse gravel. Screen to -2mm. |

Notes:
Gray shading indicates general fill material
Tan shading indicates tailings material
Black indicates paleo soil horizon
White is native Sand/Gravel

# Table 6
# Sample Analysis Methods

| Analyte | Analytical Method | CRQL | Holding Time | Container Size | Preservation[1] | Justification |
|---|---|---|---|---|---|---|
| Soil Laboratory Samples | | | | | | |
| Arsenic (As) | SW-846 6010D Or EPA 6020B and 7471B | 1.0 mg/kg[5] | 6 months | Large plastic bag | None | Per the BPSOU CD the contaminants of concern are limited to:<br>Arsenic 200 mg/kg<br>Cadmium 20 mg/kg<br>Copper 1,000 mg/kg<br>Lead 1,000 mg/kg<br>Mercury 10 mg/kg<br>Zinc 1,000 mg/kg |
| Cadmium (Cd) | | 0.15 mg/kg[5] | | | | |
| Copper (Cu) | | 0.50 mg/kg[5] | | | | |
| Iron (Fe) | | 2.5 mg/kg[5] | | | | |
| Lead (Pb) | | 0.50 mg/kg[5] | | | | |
| Zinc (Zn) | | 1.0 mg/kg[5] | | | | |
| Mercury | | 0.1 mg/kg | | | | |
| Acid-Base Accounting | Nevada Mod. Sobek | See Method | 7 Days | Gallon-sized plastic bag | Ice | Use the 2015 Nevada Modified Sobek Method. Includes Saturated Paste pH. |
| Asbestos | EPA 600 | NA | None | Double-quart size plastic bags | None | Licensed inspector must sample if suspected asbestos containing materials are noted in core. |
| Polychlorinated Biphenyl (PCB) | EPA 8082A | 0.8-0.160 mg/kg | 14 Days | 4 oz. amber glass container | None | Only collect and analyze sample if PCB is suspected. |
| Volatile Petroleum Hydrocarbons (VPH) | MAVPH (Rev 1.1) | Various depending on analyte detected.[3] | 7 Days | 4 oz. amber glass container | None | Only collect and analyze sample if hydrocarbons are suspected to be present. |
| EPH Fractionation with Polycyclic Aromatic Hydrocarbons (PAHs) | Montana Method EPH (PAHs: 8270C or 8270D) | Various depending on analyte detected.[3] | 14 Days | | | |

**Notes:**

# FIGURES


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1/11/2023 DH
Source: HGL. DEQ, ArcGIS Online Imagery

Notes:
BPSOU - Butte Priority Soils Operable Unit

HGL HydroGeoLogic, Inc

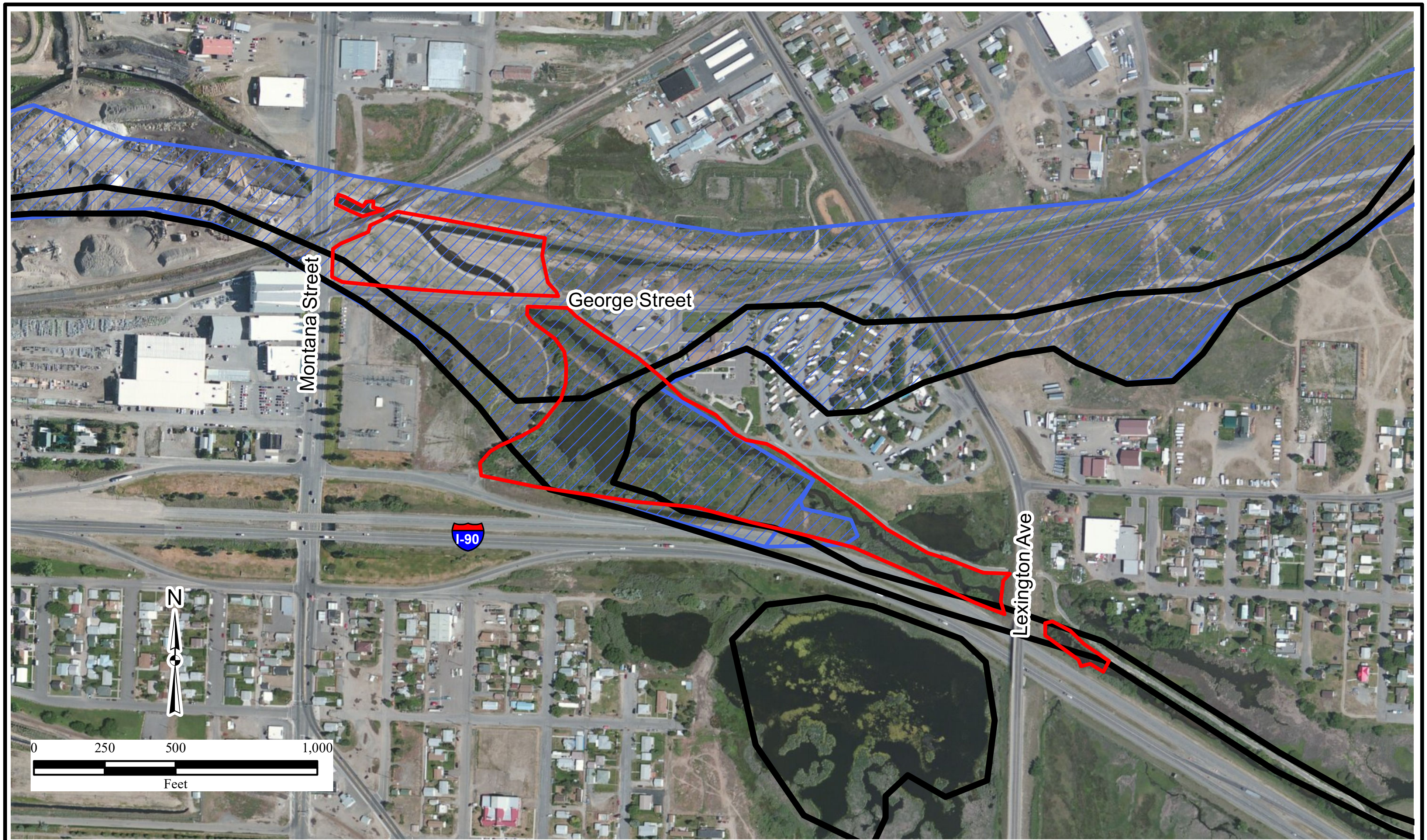
Legend

BPSOU Boundary

Blacktail Creek Riparian Actions Study Area

**Figure 1 - Project Location**

**Blacktail Creek PDI SAP**

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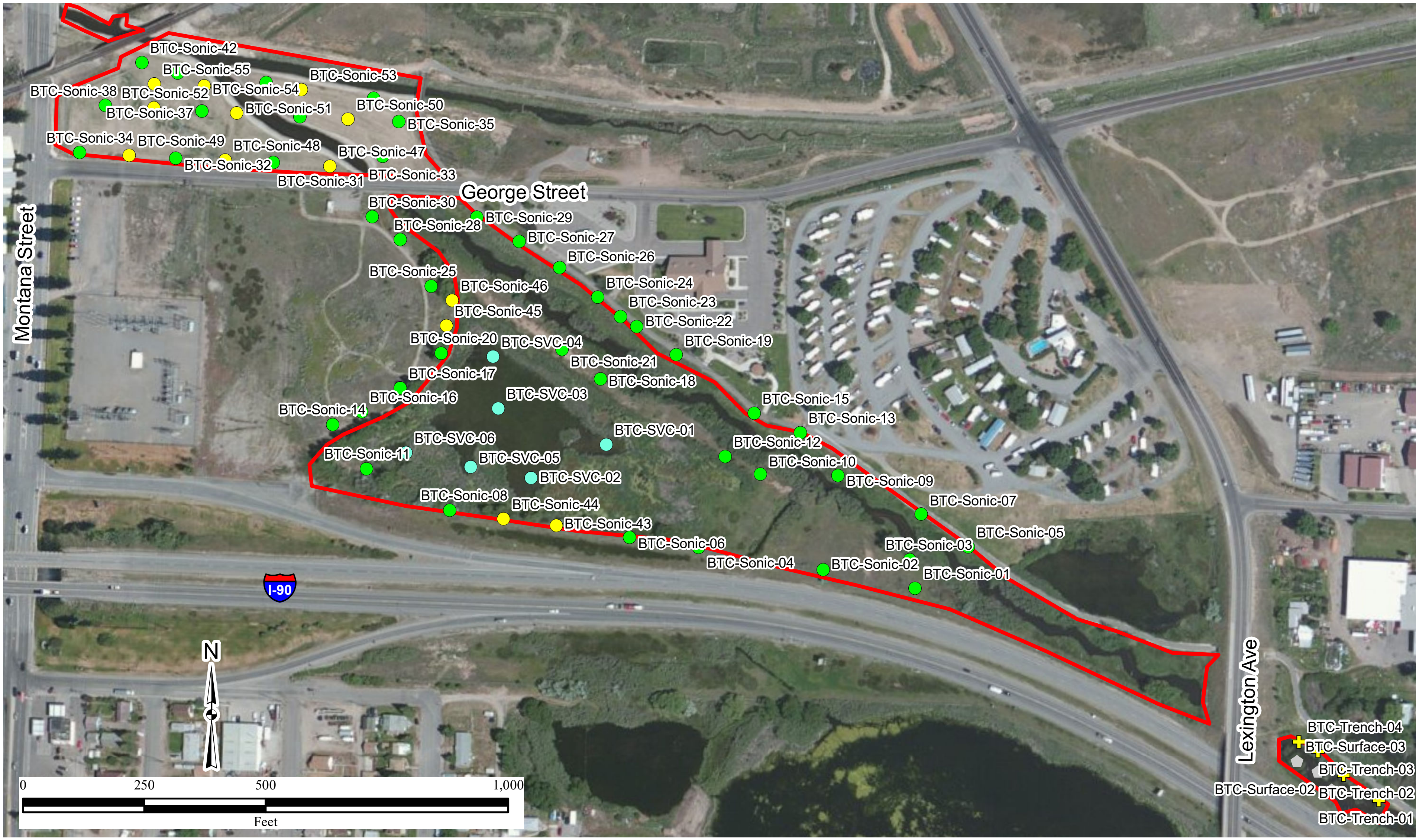
1/18/2023 DH
Source: HGL, DEQ, ArcGIS Online Imagery

HGL HydroGeoLogic, Inc

Legend

- Approximate 1890's Stream Channel
- Blacktail Creek Riparian Actions Study Area
- Estimated 1890's Pool

**Figure 2 - BTC Riparian Area & Historical Channels Blacktail Creek PDI SAP**

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*PDI_SAP_Figure_3.mxd*
*1/11/2023 DH*
*Source: HGL, DEQ, ArcGIS Online Imagery*

HGL HydroGeoLogic, Inc

Legend

Blacktail Creek Riparian Actions Study Area

Sonic Priority 1

Sonic Priority 2

Sonic Vibracore

Hand Dug Pit

Hand Dug Trench

**Figure 3 - Proposed Sampling Sites**

**Blacktail Creek PDI SAP**

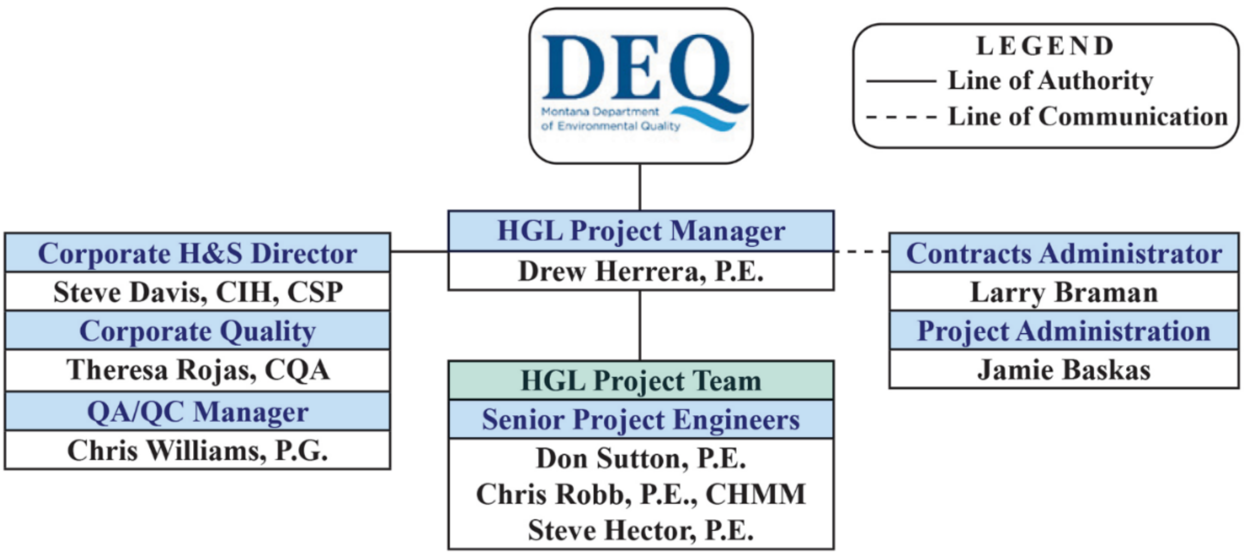


**Figure 4**
**Blacktail Creek PDI Work Plan Project Management Structure**

# ATTACHMENT A

# QUALITY ASSURANCE PROJECT PLAN

## UNIFORM FEDERAL POLICY-QUALITY ASSURANCE PROJECT PLAN FOR BLACKTAIL CREEK RIPARIAN ACTIONS REMEDIAL DESIGN WORKPLAN AND PRE-DESIGN INVESTIGATION

# ATTACHMENT B

# HEALTH AND SAFETY PLAN