Trihydro
CORPORATION

December 16, 2013

Ms. Devin Clary, Project Manager
Department of Environmental Quality
Abandoned Mine Lands Bureau
1100 N. Last Chance Gulch
P.O. Box 200901
Helena, MT 59620-0901

RE: DEQ Contract 407032
Black Pine Mine –Final Repository Investigation Report

Dear Ms. Clary:

Please find enclosed three hard copies of the Final Repository Investigation Report (RIR) for the Black Pine Mine. This Final Report is being submitted by Trihydro and Herrera in fulfillment of Task Order No. 16, under Contract 407032. CDs containing the electronic files associated with the RIR is attached to the back cover of each of the hard copy reports.

We appreciate the opportunity to assist DEQ with the Black Pine Mine project. If you have questions regarding this submittal or encounter issues opening the files, please contact Kevin Houck at (406) 721-4204 or myself at (307) 745-7474.

Sincerely,
Trihydro Corporation

Mark Donner, P.E.
Assistant Project Manager

776-012-005

Enclosures

cc: Kevin Houck, Herrera

REPOSITORY INVESTIGATION REPORT

Black Pine Mine

Prepared for

Montana Department of Environmental Quality

December 2013 Final

REPOSITORY INVESTIGATION REPORT

Black Pine Mine

Prepared for

Montana Department of Environmental Quality
Mine Waste Cleanup Bureau
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December 16, 2013 Final

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Acronyms and Abbreviations

ABA	acid base accounting
AOC	area of concern
ARARs	Applicable or Relevant and Appropriate Requirements
ARD	acid rock drainage
ARM	Administrative Rules of Montana
ASA	American Society of Agronomy
ASARCO	American Smelting and Refining Company
ASTM	American Society for Testing and Materials
bgs	below ground surface
BPB	potential borrow area
BPM	Black Pine Mine
btoc	below top of casing
CAD	Computer Aided Design
CEC	cation exchange capacity
CFR	Code of Federal Regulations
cm/sec	centimeter per second
COC	contaminants of concern
CUX	consolidated-undrained triaxial
cy	cubic yard
DEQ/MWCB	Montana Department of Environmental Quality/Mine Waste Cleanup Bureau
EE/CA	Engineering Evaluation and Cost Analysis
EPA	Environmental Protection Agency
ft	foot or feet
gpm	gallon per minute
GIS	Geographic Information System
HH	human health
HHS	Human Health Standards
HSA	hollow stem auger
J_a	joint alteration number
J_n	joint set number
J_r	joint roughness number
J_w	joint water reduction
LiDAR	Light Detection and Ranging
LL	liquid limit
µg/l	micrograms per liter
meq/100g	milliequivalents per 100 grams
mg/kg	milligrams per kilogram
mg/l	milligrams per liter
mmhos/cm	micromhos per centimeter
MSL	mean sea level
NA	not applicable
O&M	operation and maintenance
pcf	pounds per cubic foot

Acronyms and Abbreviations (continued)

PFT	Paint Filter Test
PL	plastic limit
psf	pounds per square foot
Q	Tunneling Quality Index
QA/QC	quality control/quality assurance
RBCG	Risk Based Cleanup Guidelines
RCRA	Resource Conservation and Recovery Act
RI	Reclamation Investigation
RIR	Repository Investigation Report
RIWP	Repository Investigation Work Plan
RMR	Rock Mass Rating
RPD	relative percent difference
RQD	Rock Quality Designation index
RWP	Reclamation Work Plan
SFLWC	South Fork Lower Willow Creek
SOPs	Standard Operating Procedures
SPT	standard penetration test
SRF	stress reduction factor
s.u.	standard units
TCLP	Toxicity Characteristic Leaching Procedure
t/1000t	tons per 1,000 tons
USCS	Unified Soil Classification System
USDA	U.S. Department of Agriculture
USFS	United States Forest Service
WB	Walkley-Black method
XRF	x-ray fluorescence

Executive Summary

The Black Pine Mine (BPM) is located approximately 10 miles northwest from Philipsburg, Montana in Granite County. The site consists of approximately 1,055 acres of patented mining claims and 157 unpatented lode claims on lands administered by the United States Forest Service (USFS). Mining began at the BPM around 1885 and continued, intermittently, into the 1990s. The mine site encompasses several historic and modern mining areas, including the Combination Mine Area of Concern (AOC), the Tim Smith Mine AOC, the Historic Mine AOC, and the Combination Mill AOC. Physical and environmental hazards resulting from mining operations remain at the site. In addition to remnant structures, adits, and shafts, areas of metals-impacted wastes are located throughout the site. Metals-impacted wastes include mine tailings and waste rock, as well as sediments and soils impacted by metals leaching from mine wastes or from metals-laden seeps. These impacted materials create risks for both site users and ecological receptors.

Site assessments and investigations at the BPM began in 1981 and have continued periodically since then. In 2011, DEQ completed a Reclamation Investigation (RI) to further characterize mine wastes, delineate the extent of wastes, develop estimated quantities of wastes, and preliminarily investigate potential repository areas. Work conducted as part of the RI identified the nature and extent of impacted wastes and physical hazards at the BPM, and estimated the risks these hazards pose to human health and the environment. The primary conclusion of the RI Report was that site users and ecological receptors are at risk due to elevated metals concentrations in impacted surface water, mine wastes, soils, and sediments at the site. Recommendations presented in the RI Report included consolidating the solid-media wastes and separating these wastes from human and ecological receptors. A potential reclamation alternative to address this recommendation is placement of the solid-media wastes in an onsite repository.

A preliminary repository investigation was performed as part of the RI to evaluate whether or not suitable onsite repository locations may exist at the BPM. Four potential repository locations (Repositories 1-4) were investigated during the RI. Based on the preliminary investigations, the Repository 2 Area appeared to be more suitable for long-term waste storage than the other three potential repository areas. The Repository 2 Area covers approximately 15 acres in a topographic bowl north of the access road to the Lewis Shaft and includes the Harrison and Harper Shaft areas within the Historic Mine AOC. While the Repository 2 Area appeared to be suitable, a variety of data gaps were identified. These data gaps, which are discussed in the 2012 Repository Investigation Work Plan (RIWP), ranged from the depth of mine workings in the repository area to the depth of rippable bedrock and permeability of contaminated soils to the engineering properties of borrow materials.

The Montana Department of Environmental Quality, Mine Waste Cleanup Bureau (DEQ/MWCB) performed a Repository Investigation to further investigate conditions at the preferred repository location; to further evaluate engineering properties of waste rock, tailings, and impacted sediments that may be placed in a repository; and to evaluate potential on-site

borrow materials. This Repository Investigation Report (RIR) was prepared to document activities performed and results of the Repository Investigation, and to develop a preliminary repository design configuration and preliminary design parameters. Based on work completed as part of the Repository Investigation, as well as previous repository investigation work at the site, the proposed repository location appears suitable for long-term waste storage.

Field Investigations

Field investigations were completed during August and September 2012 and focused on filling data gaps presented in the RIWP. Investigation activities included:

- Conducting additional site reconnaissance and mapping of springs and seeps.
- Excavating test pits and collecting surface and subsurface samples for geotechnical testing from the Combination Mill tailings impoundments (three test pits), Combination Mill sediments and soils (two sample locations), South Fork Lower Willow Creek sediments (one sample location), reprocessing area tailings on USFS-administered lands (two test pits), and Combination Mine waste rock pile (three test pits).
- Collecting two material samples from the "Old Mill" site and two material samples from the Combination Mill site and submitting these samples for Toxicity Characteristic Leaching Procedure (TCLP) analysis.
- Drilling five boreholes in the repository area and evaluating bedrock cores retrieved from four of the five boreholes.
- Excavating 10 test pits within or adjacent to the proposed repository footprint, and collecting subsurface samples from test pits for laboratory geotechnical testing.
- Excavating 24 test pits in potential borrow areas and collecting surface samples for agronomic testing and subsurface samples for geotechnical testing.
- Monitoring groundwater levels in repository monitoring wells and collecting groundwater samples (from MW-RY-07) for geochemical analyses.

Field Investigation Results and Evaluations

Observations and data collected during the field investigations and from geotechnical and analytical laboratory testing were evaluated to assess the suitability of the proposed repository for long-term waste storage. Evaluations included:

- Evaluating the geotechnical properties of the waste materials for slope stability analyses, determining proper waste handling, and developing conceptual sequencing of waste disposal in the repository.

- Evaluating the geotechnical properties of subsurface materials collected from the repository area and potential borrow areas for use as waste excavation area backfill, liner materials, and cover material.

- Evaluating the agronomic properties of surface materials collected from potential borrow areas for use as cover soil/growth media.

Waste Materials

Approximately 420,000 cubic yards (cy) of metals-impacted wastes are estimated to be present at, and downgradient of the BPM. These impacted wastes, summarized in the table below, include waste rock, tailings, and metals-impacted soils and sediments. The estimated waste volumes are based on review of analytical results, test pit observations, review of boring logs, and interpretation of topographic mapping. The largest volumes of wastes are those that have been consolidated in the Combination Mine waste rock pile and the Combination Mill tailings impoundments.

Impacted Waste Location	Estimated Volume (cy)[(a)]
Combination Mine Waste Rock Pile	231,200
Combination Mine Soils Removal Areas	5,000
Tim Smith Waste Rock Dumps at Tim Smith No. 1 and No. 2 Adits	22,650
Combination Mill Sediments, Soils, and Tailings Impoundments	126,900
South Fork Lower Willow Creek Stream Sediments	21,100
Historic Mine Area Waste Rock Areas	13,350
Total	**420,200**

cy – cubic yards

(a) Quantities are preliminary; estimates will be refined during design.

The waste rock proposed to be placed in the repository contains sulfides that have the potential to generate acid rock drainage (ARD) if exposed to oxygen and water. Heavy metals are present in the waste material from each of the AOCs. Mercury is present in the Combination Mill, reprocessing area, and South Fork Lower Willow Creek-related wastes. These wastes will

require monitoring and management during excavation, transport, and placement. Minimizing contact between waste materials and water is important to reduce generation of ARD, leaching of heavy metals, and transport of the ARD and metals into the groundwater or surface water.

Waste rock samples collected during the Repository Investigation and the RI are characterized as cobbly gravel to silty gravel with cobbles (GP to GM, Combination Mine waste rock pile), well graded gravel with silt and sand (GW-GM, Tim Smith No. 1 Adit waste rock), silty gravel with sand (GM, Harper Shaft waste rock), and clayey gravel with sand (GC, Harrison Shaft waste rock). Samples collected from the Combination Mine waste rock pile were slightly drier than optimum, while samples collected from the Tim Smith, Harrison Shaft, and Harper Shaft waste rock areas were slightly wetter than optimum. Placing the waste materials at moistures contents slightly drier than optimum moisture may be desired to reduce the quantity of leachate material that is generated from pore water being released due to compacting and /or settlement of the wastes in the repository. Therefore, moisture conditioning (drying) may be required for a portion of the waste rock.

The tailings collected from the Combination Mill tailings impoundments are characterized as clayey gravel (GC), silty sand (SM), and clayey silt (CL-ML). Samples collected from the former reprocessing area are characterized as lean clay (CL). The stream sediments along South Fork Lower Willow Creek consist of predominantly non-plastic silts (ML) and silty fine sands (SM). Geotechnical testing performed on Combination Mill tailings, sediment, and reprocessing area samples showed that adequate compaction densities could be achieved for the placement of this material. Based on test pit observations during the RI, some of these materials are highly saturated and will likely require drying or mixing with other materials (e.g., lime products, waste rock, impacted soils, etc.) prior to placement and compaction in a repository.

Long term, stable embankment slope angles for waste materials placed in the repository will vary depending on the type of waste material and the material forming the base of the repository. For sandy gravels (GP), slightly silty gravel with sand (GP-GM), and silty gravels with sand (GM) soils, wastes should be placed at a slope angle of 2 feet horizontal to 1 foot vertical (2H:1V) or flatter. Waste fill slopes comprised of clay, gravelly clay or clayey gravel should be sloped at 3H:1V or flatter. Materials should be moisture conditioned as discussed above and compacted in lifts no greater than 12-inches.

Analytical results for samples of brick and wood collected from the “Old Mill” and the Combination Mill sites did not exceed TCLP characteristic hazardous waste criteria. These materials can be disposed of as non-hazardous materials in RCRA Subtitle D landfill facilities.

Repository Area

The proposed repository is sited in a topographic bowl in the area of the Harrison Shaft. The location and preliminary layout of the repository can accommodate the waste volume of approximately 420,000 cy with room for expansion. Impacts to the surrounding infrastructure caused by the siting and construction of a repository, such as power lines, roads, and historical

shafts, can either be avoided or managed. The proposed layout sits against the southern ridge, which avoids the overhead power lines but requires rerouting USFS Road 678.

Although underground mine workings are known to extend into the area of the repository, they do not appear to substantially affect the suitability of the site due to their depth ranging from 123 feet below ground surface (bgs) (near the Harper Shaft) to 410 feet bgs (near the Lewis Shaft). Mine workings were not observed or encountered during the advancement of boreholes or the installation of test pits associated with this repository investigation.

Bedrock conditions at the site will not significantly affect construction of a repository. Bedrock is approximately 120 feet bgs in the middle of the northern edge of the site. On the perimeter of the proposed repository footprint, where the bedrock is closer to the surface, the bedrock appears rippable. Although the bedrock is fractured, bedrock slippage at the fractures is not expected to occur because bedrock will generally not be disturbed and overburden removal will be minor during construction of the repository.

Although normal faults have been noted in the mine area and near the proposed repository area, either the faults appear to have been inactive for a significant period, allowing soil to develop over them, or the faults do not extend to the surface. In addition, the displacements of these faults are considered to be minimal and no apparent indications of fault activity have been observed during field investigations in the repository area.

The surficial soil in the repository area consists of colluvium derived from the weathering and transport of adjacent outcropping rocks. The colluvium is characterized as slightly silty to silty gravel with fine to coarse sand and cobbles (GP-GM, GM); silty fine to coarse sand with gravel and cobbles (SM); and gravelly silt with fine to coarse sand and cobbles (ML). This material is found as a 3 to 10-foot thick surface layer throughout the proposed repository area. This material was underlain by glacial till deposits. These deposits comprise the bulk of the overburden soils in the northwestern portion of repository area. The glacial till deposits are characterized as moist, clayey or silty gravel with fine to coarse sand and few cobbles (GC, GM); or as gravelly clay (CL) with fine to coarse sand with few to some cobbles.

Based on the field observations and test results, sufficient volumes of material exist within the repository area for construction of the repository, subject to further design and decisions regarding liner systems. The soils within the proposed repository area, including those within the preliminary repository excavation, are suitable for use as soil cover material. These materials should be screened to remove cobbles and larger fractured rock greater than 6 inches as well as large debris. The clayey gravel (GC) and gravelly lean clay (CL) materials encountered within the repository area would be suitable for use as a compacted soil liner for either the repository base or cap, provided the materials could feasibly be processed to remove materials larger than 3 inches.

Topsoil within the repository footprint is suitable for use as cover soil, with the exception of topsoil near RY-SS-03, provided the soils are amended to increase nutrient levels. While the quality of the topsoil is suitable for use as cover soils, there are limited quantities available. An

average of 3 inches of topsoil is assumed salvageable across 11.9 acres of the repository footprint.

Seeps were not identified within the footprint or immediately adjacent to the proposed repository. An area with signs of seeps and defined springs is located approximately 900 to 1,200 feet northwest (downslope) of the proposed repository area. The seeps and springs in this area form the headwaters of Mill Creek. Signs of seeps were also identified approximately 1,000 feet to the northeast, in topographic bowl that is separated from the proposed repository area by a small ridge. These seeps are outside of the repository area and do not affect the suitability of the site for waste storage.

Shallow groundwater/perched water at the site appears to be limited, and the groundwater observed to date does not appear to be extensive or flow significantly. Deeper groundwater has not been observed in MW-RY-09 that is screened between 10 and 30 feet bgs. Deeper groundwater was observed infiltrating at a flow estimated at less than 1 gallon per minute (gpm) into two of the five boreholes advanced during this investigation (RY-RB-01 and RY-RB-02), at depths of approximately 38 feet bgs and between 30 and 43.5 feet bgs, respectively. However, these depths are approximately 20 feet greater than the anticipated excavation depth for the repository.

Borrow Areas

Borrow material may be needed as part of repository construction or as backfill in waste excavation areas. Soils may be required for random fill, structural fill, liner/cover material, drainage material, and/or cover soil. Six potential borrow areas were identified during development of the RIWP. Based on materials observed during test pit excavation two of the potential borrow areas (BPB11 and BPB 12) are discounted from future consideration.

Surface soil samples test pits in potential borrow areas BPB1A, BPB7A, BPB2/3, and BPB13 were collected and submitted for agronomic analysis. Evaluation of the agronomic test results indicates that borrow area surface soils are suitable for the establishment and growth of a lodge pole pine forest and acceptable for grass communities. Levels of potassium, phosphorous, conductivity, and cation exchange capacity (CEC) are within the range to support vegetation, but nitrogen levels are low. Organic matter levels for the soils sampled at the four potential borrow areas are adequate and are typical for mountain soils.

However, while surface soils found in these potential borrow areas may be suitable for use as cover soils, there are only limited quantities available. Topsoil depths across the BPM range from 2 to 5 inches. This makes borrowing topsoil difficult. Sufficient depth of topsoil must exist in borrow areas to provide material for the target area while also maintaining sufficient topsoil at the borrow area to allow for reclamation. Limiting disturbance of borrow areas solely for obtaining cover soils is recommended. Alterations to the conceptual design of the cover system for the repository are also recommended to incorporate a rock erosion protection layer and reduce cover soil needed for a vegetative layer.

Subsurface soils in the potential borrow areas consisted of coarse-grained sands and gravels with varying amounts of silt and lean clay. Sufficient fine-grained materials for possible use in a repository cover or liner were present at BPB1A, BPB7A, and BPB13. The southern portion of BPB7A may serve as a source of materials for random fill and liner/cap construction and likely will be disturbed by other construction-related activities. However, sufficient suitable materials appear to be present in the proposed repository to limit the need to disturb additional borrow areas for the purpose of repository construction. Some materials from these borrow areas may still be needed for backfill of waste excavation areas.

Preliminary Repository Design

A preliminary repository design has been developed based on evaluation of field investigations and laboratory test results. The potential repository area covers approximately 15.5 acres in a topographic bowl north of the access road to the Lewis Shaft and includes the Harrison and Harper Shaft waste rock areas within the Historic Mine AOC. The preliminary design for the proposed repository includes:

- The repository is designed to blend in with the surrounding topography to the extent possible. The area will be excavated to depths of 10 to 14 feet below ground surface (bgs) with cut slopes varying from 2H:1V to 3H:1V. The repository thickness, including waste materials, cap materials, and surface erosion protection features ranges from 25 feet to 35 feet with approximately 13 to 25 feet (including surface cap) above grade. The finished surface slopes for the majority of the repository area will range from 7H:1V to 10H:1V; however, the slopes range from 4H:1V to 3H:1V along the southwest edge of the repository to tie with the existing topography near the Lewis Shaft access road.

- The proposed repository will be capped to reduce precipitation that falls directly on the repository from infiltrating into the waste materials. The surface will also be sloped to promote drainage off the cap. The cap will include a liner system designed to reduce permeability to less than $1x10^{-5}$ centimeters per second (cm/sec). The liner system will include a bedding layer/material, an impervious layer/geosynthetic material, and a drainage layer/material. The composite liner will be protected with a soil cover with a minimum thickness of between 2.5 feet and 3.0 feet.

- An erosion protection layer is required to protect the repository cap. This layer is typically a vegetative layer. However, limited topsoil is available onsite, which would make establishment of a dense vegetation cover difficult, without disturbing larger areas. Additional topsoil is present in potential borrow areas BPB7A, BPB2/3, BPB1A, and BPB13. However, disturbing these areas to provide soil for the repository is not recommended because establishment of vegetation at the borrow areas would be difficult. Instead, a combination rock armoring (approximately 9.5 acres) and vegetation cover (6 acres) is proposed for the repository.

- The repository area soils also have low to moderate compressibility such that settlement of the foundation soils under the waste fill will be minimal. Since the settlement would occur as the loads are applied, differential settlement should not pose a problem. The in-situ native soils appear to be suitable to support construction of a waste repository.

- The preliminary design includes stormwater diversion ditches and interceptor trenches upslope of the repository. The ditches would intercept stormwater runon and snowmelt from upslope areas and divert the water around the repository. These ditches will limit the amount of water contacting the surface of the repository, thereby reducing the potential for erosion of, or infiltration through, the cap. The ditches should be constructed with low permeability materials (available onsite) to limit infiltration through the ditch bottom. Similarly, shallow interceptor trenches along the upslope perimeter would be designed to capture shallow subsurface flows and provide a preferential flow path away from the repository. Drainage material for the interceptor trenches would likely need to be imported from an offsite source or obtained by screening onsite sources.

Future Activities

Limited additional site investigations are recommended to provide additional information for design of a repository. Results from these investigations would be used to support decisions regarding the applicability of a bottom liner and to design liners and groundwater controls. Additional excavation, using location information provided by the USFS is also recommended to evaluate the Harrison Shaft closure.

Other project activities will include development of an Engineering Evaluation and Cost Analysis (EE/CA). If construction of a repository is supported through the EE/CA process, then additional design will be completed.

1.0 Introduction

The Montana Department of Environmental Quality, Mine Waste Cleanup Bureau (DEQ/MWCB) contracted Herrera Environmental Consultants (Herrera), in association with Trihydro Corporation (Trihydro), to conduct a Reclamation Investigation (RI) at the Black Pine Mine (BPM) in 2011. The RI fieldwork was completed between May 2011 and January 2012, and the findings were summarized in the Final Reclamation Investigation Report (RI Report) (Herrera/Trihydro 2012a), dated May 29, 2012.

Work conducted as part of the RI identified the nature and extent of impacted wastes and physical hazards at the BPM, and estimated the risks these hazards pose to human health and the environment. The primary conclusion of the RI Report was that site users and ecological receptors are at risk due to elevated metals concentrations in impacted surface water, mine wastes, soils, and sediments at the site. Recommendations presented in the RI Report included consolidating the solid-media wastes and separating these wastes from human and ecological receptors. A potential reclamation alternative to address this recommendation is placement of the solid-media wastes in an onsite repository.

Four potential repository areas were identified and investigated during the RI. The location, results, and evaluation of these repository areas are included in the RI Report (Herrera/Trihydro 2012a). Based on investigations completed during the RI, one of the potential repository areas, Repository 2, appeared to be more suitable for the siting of a repository than the other sites. However, additional information was necessary to evaluate and confirm the suitability of the Repository 2 Area. Therefore, the RI Report recommended additional geotechnical investigations to: (1) determine whether an onsite repository could be constructed to contain the impacted wastes, and (2) obtain design parameters for the repository.

Pursuant to the findings and recommendations presented in the RI Report, DEQ issued Task Order No. 13 under DEQ Contract 407032 to Herrera for the purpose of preparing a Repository Investigation Work Plan (RIWP) (Herrera/Trihydro 2012b). Following acceptance of the RIWP, DEQ issued Task Order No. 16 for the purpose of investigating the preferred repository area (Repository 2), investigating potential soil borrow areas, and further evaluating geotechnical properties of waste materials. This Repository Investigation Report (RIR) presents the findings of these investigations.

1.1 Site History

The BPM is located approximately 10 miles northwest of Philipsburg, Montana and consists of approximately 1,055 acres of patented mining claims and 157 unpatented lode claims on lands administered by the United States Forest Service (USFS) (Figure 1-1). Mining began at the property in 1882 and continued intermittently up until 1993. The mine primarily produced silver with smaller quantities of gold, copper, and tungsten. The last company to mine the property was the American Smelting and Refining Company (ASARCO). Through the bankruptcy of

ASARCO, the Montana Environmental Custodial Trust was created to address environmental actions at the BPM property and manage the remediation funds. Hazardous features and waste remain at the BPM, including abandoned adits and shafts, two historical mills, mine buildings, and mine wastes (Renewable Technologies, Inc. 2011). Site features are shown on Figure 1-2.

Site assessments and investigations at the BPM began in 1981 and have continued periodically since then. In 2011, DEQ completed an RI to further characterize mine wastes, delineate the extent of wastes, develop estimated quantities of wastes, and preliminarily investigate potential repository areas (Herrera/Trihydro 2012a). Due to the large size of the site, DEQ divided the BPM into four areas of concern (AOCs): the Combination Mine Area; the Tim Smith Mine Area; the Historic Mine Area; and the Combination Mill Area (Figure 1-3). These areas include mine adits, mine facilities, mine shafts, and waste rock or tailings deposits. Background information for the site, including location, history, environmental setting, historical investigations, and results from the 2011 RI is presented in the July 11, 2011 Reclamation Work Plan (RWP) (Herrera/Trihydro 2011) and the RI Report (Herrera/Trihydro 2012a).

1.2 Waste Characteristics and Quantities

The BPM is comprised of a variety of mining-impacted lands, including tailings impoundments, waste rock piles, adits, shafts, and fluvially deposited mine tailings and mill deposits. Elevated levels of antimony, arsenic, cadmium, copper, iron, lead, mercury, and manganese have been detected in tailings and waste rock samples. Elevated levels of antimony, arsenic, cadmium, lead, and mercury have also been detected in sediment samples. Based on the risk assessment conducted as part of the RI, the human health (HH) contaminants of concern (COCs) for soil, sediments, tailings, and waste rock at the BPM are antimony, arsenic, and lead. These three contaminants are also the COCs for terrestrial wildlife. The COCs for terrestrial plant communities include arsenic, cadmium, copper, lead, mercury, and zinc (Herrera/Trihydro 2012a).

Analysis of surface water and groundwater samples have shown elevated levels of antimony, arsenic, cadmium, copper, iron, lead, manganese, mercury, and zinc. The HH COCs for water, excluding seeps, at the BPM are antimony, arsenic, lead, and mercury. COCs for aquatic life (surface water and sediments) include arsenic, cadmium, copper, lead, mercury, silver, and zinc (Herrera/Trihydro 2012a).

DEQ estimated the extent of metals-impacted, solid-media wastes based on the RI and historical investigations. Depths of materials determined through test pitting and previous monitoring well installations were used in conjunction with the aerial extents of impacts and Light Detection and Ranging (LiDAR) topographic mapping to estimate waste volumes. An estimated 420,000 cubic yards (cy) of metals-impacted materials are present at the BPM (Table 1-1). A large portion of the estimated waste volume is associated with the Combination Mine waste rock pile. Other waste materials include impacted soils in the Combination Mine Soils Removal Areas; waste rock in the Tim Smith and Historic Mine AOCs; tailings, impacted soils, and impacted sediments

in the Combination Mill AOC, including the former tailings reprocessing area on USFS lands, and impacted sediments downstream along South Fork Lower Willow Creek.

Table 1-1. Estimated Impacted Waste Volumes at Black Pine Mine

Impacted Waste Location	Estimated Volume (cy)[(a)]
Combination Mine Waste Rock Pile	231,200
Combination Mine Soils Removal Areas	5,000
Tim Smith Waste Rock Dumps at Tim Smith No. 1 and No. 2 Adits	22,650
Combination Mill Sediments, Soils, and Tailings Impoundments	126,900
South Fork Lower Willow Creek Stream Sediments	21,100
Historic Mine Area Waste Rock Areas	13,350
Total	**420,200**

cy – cubic yards

(a) Quantities are preliminary; estimates will be refined during design.

1.3 Preliminary Repository Investigation

A preliminary repository investigation was completed as part of the RI in 2011 to determine if suitable locations existed onsite for the construction of a long-term repository to contain impacted soils, sediments, tailings, and waste rock identified during the RI (Herrera/Trihydro 2012a). Four potential repository locations were identified during the RI; descriptions of the four areas are included in the RI Report and the RIWP. The four potential repository locations are shown on Figure 1-2.

Observations were made of potential repository sites (Repositories 1 – 4) and preliminary subsurface investigations of these sites were conducted, including excavating test pits, drilling boreholes (Repository 2 Area only), and installing monitoring wells (Repository 2 Area only). Surface and subsurface samples were collected and submitted for laboratory analyses to identify geochemical and geotechnical characteristics of soils, agronomic properties of the soils for use as growth media, and potential acid generating properties of the soils. The investigation data is presented in the RI Report.

Of the four repository locations, the Repository 2 Area appeared to be more suitable for long-term waste storage than the other three locations (Herrera/Trihydro 2012a). The Repository

1 Area covered approximately 18 acres along the west side of the ridge above the Combination Mine waste rock pile and west of the Black Pine Road. The proposed Repository 1 Area contains bedrock near the surface, 2 to 3 feet below ground surface (bgs), across this site, limiting the ability to excavate a repository, and increasing construction costs if a below grade repository is required. The Repository 3 Area covered approximately 16 acres along the south face of the ridge separating the Lewis Shaft from the Tim Smith No. 1 Adit, and west of the road from the Lewis Shaft to the Tim Smith No. 1 Adit. Bedrock is shallow (3 feet bgs) in the Repository 3 Area, limiting the ability to excavate a repository, and increasing construction costs if a below grade repository is required. The Repository 3 Area would also result in the most difficult haul of the four identified repository areas. The fourth potential repository, the Combination Mill area identified by the USFS, covered approximately eight acres west of South Fork Lower Willow Creek in the area of the Combination Mill. Shallow groundwater, active springs, limited storage, and distance from the Combination Mine waste rock pile were the primary reasons the Combination Mill area was not considered further as a potential repository site (Figure 1-2).

The Repository 2 Area covers approximately 15 acres in a topographic bowl north of the access road to the Lewis Shaft and includes the Harrison and Harper Shaft areas within the Historic Mine AOC, as shown on Figure 1-4. The Repository 2 Area appears to be the more suitable location for the following reasons:

- The area is centrally located in the mining complex. The area is accessible and minimizes haul distances from individual AOC waste sources.

- The area provides the greatest excavation depths to bedrock, as compared to the other potential repository areas. While weathered bedrock is relatively shallow at 8 to 15 feet bgs in some portions of the proposed repository area, excavation in other portions could extend to estimated depths of over 25 feet.

- Groundwater was not encountered in monitoring wells located within the footprint or immediately adjacent to the proposed site, during or immediately following monitoring well installation.

- A portion (three acres) of the repository footprint has been impacted by waste rock associated with the Harrison and Harper shafts, reducing the net impact and waste rock haul costs associated with constructing a repository in this location.

Additional detail on the preliminary repository investigations can be located in both the RI Report (Herrera/Trihydro 2012a) and the RIWP (Herrera/Trihydro 2012b). The site hydrogeology, geology, and mine geology, as understood at that time, are also described in the RIWP.

1.4 Data Gaps

The results of the RI, combined with the development and evaluation of mine geology and underground mine workings, and the evaluation of Applicable or Relevant and Appropriate Requirements (ARARs) during development of the RIWP were used to identify data gaps for the repository siting and design. The evaluation of ARARs identified in the RIWP (Herrera/Trihydro 2012b) is further discussed in Section 4.3 of this RIR. Additional exploration and testing data needed to meet ARARs and allow development of design elements, as outlined in Section 3 of the RIWP, included:

- Engineering properties of cover material, repository bottom, containment berms and slopes
- Depth and extent of mine workings, engineering properties of bedrock, and status of mine shafts within the Repository 2 Area
- Depth of rippable bedrock, hydraulic conductivity of bedrock, and permeability of containment soils
- Permeability of containment soils from borrow sites
- Agronomic properties of cover soils, if present, from borrow sites
- Engineering properties of Combination Mine waste rock and Combination Mill tailings, sediments, and soils

Evaluating the engineering properties of the waste and borrow materials will determine how these materials should be placed to achieve the desired engineering properties for long-term stability. Repository designers will use the engineering properties in limit equilibrium computer models to evaluate various repository design configurations and to design cover and liner systems that meet ARARs and acceptable levels of safety.

1.5 Objectives of the Repository Investigation

As described in the RIWP, the purpose of the repository investigation was to further evaluate the suitability of the Repository 2 Area for siting a long-term waste storage facility. The specific objectives of the repository investigation were to:

- Evaluate geologic and hydrologic conditions at the proposed repository
- Evaluate engineering properties of tailings, waste rock, impacted sediments, and impacted soils

- Evaluate whether suitable borrow areas for cover soils/growth media and unclassified backfill exist in the vicinity of the BPM

- Develop a preliminary repository configuration and design parameters

1.6 Organization of the Repository Investigation Report

This report is organized into six sections:

- *Executive Summary* – This section is a brief summary of the work and purpose of the report.

- *Section 1.0 Introduction* – This section presents a brief site history, summarizes the site conditions, identifies the existing data gaps necessary to be addressed to site the repository, identifies the objectives of the repository investigation, and outlines the organization of the report.

- *Section 2.0 Field Investigations* – This section summarizes the field investigations that were completed to meet the repository investigation objectives.

- *Section 3.0 Repository Investigation Analyses and Results* – This section presents the results of the repository investigation; including results for waste materials, potential borrow areas, and the proposed repository area.

- *Section 4.0 Repository Evaluation and Preliminary Design* – This section evaluates the results presented in Section 3, summarizes surface and subsurface conditions, and presents the preliminary repository designs.

- *Section 5.0 Conclusions and Recommendations* – This section provides the conclusions and recommendations stemming from the repository investigation.

- *Section 6.0 References* – This section provides technical references used during development of this report.

Additional supporting information is presented in the July 11, 2011 RWP (Herrera/Trihydro 2011), the RI Report (Herrera/Trihydro 2012a), and the RIWP (Herrera/Trihydro 2012b).

2.0 Field Investigations

2.1 Scope of the Investigation

The following activities were completed during the investigation and evaluation of the proposed Repository 2 location to meet the repository investigation objectives (Section 1.5) and to address the associated data gaps:

- Drilled boreholes and retrieved bedrock core(s) in the proposed repository area to evaluate:

  1. The depth to bedrock
  2. The extent of fracturing in the bedrock
  3. The existence of thin stratified layers
  4. Evidence of bedrock faulting
  5. Signs of iron staining, or other signs, as an indication of historic depth to groundwater
  6. The possibility of shallow or unknown mine workings in the proposed repository area

- Excavated test pits in the proposed repository footprint to assess rippability of subsurface soils and fractured bedrock, confirm observations in boreholes, and investigate signs of shallow groundwater. Collected subsurface samples from test pits and submitted these samples for geotechnical testing.

- Excavated test pits and collected surface and subsurface samples for geotechnical testing from the Combination Mill tailings impoundments, Combination Mill sediments and soils, South Fork Lower Willow Creek sediments, reprocessing area tailings on USFS-administered lands, and Combination Mine waste rock pile. Note that in previous reports, including the RI Report and the RIWP, the former reprocessing area tailings on the USFS-administered lands was referred to as the former amalgamation mill. The change in terms from former amalgamation mill to former reprocessing areas was made based on input and site-specific knowledge provided by the USFS.

- Excavated test pits in potential borrow areas to assess potential borrow material types and volumes. Collected and submitted surface samples for agronomic testing and subsurface samples for geotechnical testing.

- Evaluated the geotechnical properties of the waste materials for slope stability analyses, determining proper waste handling, and developing conceptual sequencing of waste disposal in the repository.

- Evaluated the geotechnical properties of subsurface materials collected from the repository area and potential borrow areas for use in embankment construction, as liner materials, and as cover material.

- Evaluated the agronomic properties of surface materials collected from potential borrow areas for use as cover soil/growth media.

- Conducted additional site reconnaissance and mapping of springs and seeps.

- Monitored groundwater levels in repository monitoring wells and collected groundwater samples for geochemical analyses.

- Developed a preliminary repository excavation configuration, and a preliminary repository configuration.

2.2 Sampling Summary

Repository investigation sampling was conducted in accordance with the methods and Standard Operating Procedures (SOPs) detailed in the RIWP (Herrera/Trihydro 2012b), except as outlined in Section 2.3, Deviations from the Repository Investigation Work Plan. The field sampling methods are described in Appendix A.

The project team, consisting of staff from Herrera and Trihydro, conducted investigations at the proposed repository location, potential borrow areas, and waste areas during August and September 2012. A summary of the locations investigated, samples collected, and analyses conducted is provided in Table 2-1. The project team conducted site reconnaissance, excavated eight exploratory test pits at waste areas, and collected three shallow soil/sediment samples at the Combination Mill waste area. At the proposed repository area, the project team excavated 10 exploratory test pits, drilled five boreholes, gauged water levels in four repository wells (MW-RY-06 through MW-RY-09), and collected a groundwater sample from MW-RY-07, the only well with measurable groundwater. DEQ also gauged water levels in the four repository wells and collected a groundwater sample from MW-RY-07 on May 3, 2012, during development of the RIWP. The project team excavated a total of 24 exploratory test pits in six potential borrow areas.

During the field investigation, the team collected the following samples:

- 16 soil/sediment/tailings samples for geochemical analysis of total recoverable mercury

- One groundwater sample for geochemical analysis
- Four debris samples for analysis by the Toxicity Characteristic Leaching Procedure (TCLP)
- 11 waste samples for geotechnical testing
- 216 feet of core samples from 5 boreholes for geologic interpretation
- 17 repository area soil samples for geotechnical testing; 16 of the samples were submitted for geotechnical testing
- 25 borrow area soil samples for geotechnical testing; eight of the samples were submitted for geotechnical testing
- 17 borrow area soil samples for analysis of agronomic parameters; four of these samples were also submitted for acid base accounting (ABA) analysis

The investigations, sample locations, types of samples, analytical parameters, geotechnical tests, and agronomic tests are described in the following sections.

Geochemical samples included impacted wastes from areas known or suspected to contain mercury and surface samples from potential borrow areas. Geochemical samples collected from the Combination Mill tailings, sediments, and soils; reprocessing area tailings; and impacted soils/sediments downstream along South Fork Lower Willow Creek were analyzed for total recoverable mercury prior to submitting the samples to a geotechnical laboratory. The purpose of this analysis was to provide mercury results to the geotechnical laboratory so that the laboratory could manage the geotechnical testing of the waste materials in a manner to protect their personnel and equipment.

Surface samples from select borrow areas were analyzed for agronomic parameters and ABA. The results of these analyses are used in conjunction with the geotechnical parameters to determine the suitability of the materials as cover soil.

2.2.1 Waste Material Investigations

Waste material samples were collected from the Combination Mine AOC and the Combination Mill AOC to characterize the materials engineering properties and assist in designing waste placement and handling procedures. The project team collected waste materials from test pits and from surface sample locations.

2.2.1.1 Test Pitting

The project team excavated three test pits in the Combination Mine waste rock pile, three in the Combination Mill tailings impoundment, and two in the reprocessing area tailings located downstream of the Combination Mill on USFS-administered lands. Test pit locations are shown

on Figures 2-1, 2-2, and 2-3, respectively, and sample collection information is summarized in Table 2-1. Excavation of the test pits continued to bedrock, refusal, maximum reach of the equipment, or waste/soil interface as appropriate for the location sampled. As the project team encountered different lithology during the excavation, material was segregated into separate piles to facilitate collecting composite samples. Samples were collected for geotechnical testing and geochemical analysis. Composite samples of waste material, comprised of aliquots of material from the different piles, were collected in 5-gallon buckets. Excavation and sampling methodology is described in detail in Appendix A and test pit logs and field notes are included in Appendix B.

Combination Mine Waste Rock

Test pit locations at the Combination Mine waste rock pile are shown on Figure 2-1. Waste materials in the Combination Mine waste rock pile underlie cover material that varies from 2 to 5 feet in thickness. The project team encountered synthetic liner material at 2 feet bgs at CMN-GT-01, but the liner material was not the liner installed at the upper end of the Combination Mine waste rock pile to prevent/minimize surface water run-on to the pile. The observed liner consisted of different material (estimated to be approximately 30 to 40 mil thickness) and is suspected to be a remnant from past actions. There is a clear distinction in cover and waste materials based on the lithology, color, and odor. Waste materials are generally sandy silty gravel with cobbles, damp, with a musty odor. The sidewalls of the test pits caved in during excavation suggesting that the waste material was not compacted when placed. A summary of subsurface conditions encountered in each test pit is presented in Table 2-2.

The project team submitted bulk waste rock samples collected from each test pit at the Combination Mine to the geotechnical laboratory for analysis by one or more of the following tests: moisture content, grain size distribution, and standard Proctor as shown in Table 2-1. Geotechnical results are presented and discussed in Section 3. Combination Mine waste rock samples were not submitted for geochemical analyses during the repository investigation fieldwork. DEQ previously collected and submitted waste rock samples for analyses of total recoverable metals, ABA, and moisture content during the RI. The analytical results for the geochemical samples collected from Combination Mine during the RI are presented in the RI Report (Herrera/Trihydro 2012a).

Table 2-2. Combination Mine Waste Material Test Pit Lithology Summary, Black Pine Mine

Test Pit/Location	Total Depth (feet bgs)	Depth Interval (feet bgs)/ Material Description	
CMN-GT-01 (Combination Mine)	8.0	0 – 2.0	Cover material, sandy silty gravel with cobbles, reddish brown, dry
		2.0	Liner
		2.0 – 8.0	Sandy silty gravel with cobbles, yellowish brown, damp. Caving on sides. Waste does not appear to be compacted.

Test Pit/Location	Total Depth (feet bgs)	Depth Interval (feet bgs)/ Material Description	
CMN-GT-02 (Combination Mine)	7.5	0 – 2.5	Cover material, sandy silty gravel with cobbles, brown to reddish brown, dry
		2.5 – 5.0	Cover material, sandy silty gravel with cobbles, brown to yellowish brown, damp
		5 – 7.5	Gravel with cobbles (4-inch minus), wet, musty odor
		7.5	Stopped excavation due to sidewall caving
CMN-GT-03 (Combination Mine)	8.0	0 – 5	Cover material, sandy/silty gravel, brown, trace cobbles, damp
		5.0 – 8.0	Waste, silty sandy gravel, moist, yellowish-brown, musty odor

bgs – below ground surface

Combination Mill Tailings Impoundment and Reprocessing Area Tailings

Test pit and surface sample locations at the Combination Mill tailings impoundment are shown on Figure 2-2, and test pit locations at the former reprocessing area are shown on Figure 2-3. Waste materials at the Combination Mill tailings impoundment are composed of a mixture of tailings and native material, and range from fines and lean clay to sand and gravel. Refusal or groundwater was encountered at shallow depths ranging from 2.5 feet bgs to 4.5 feet bgs. Waste materials at the reprocessing area are composed of very fine tailings with lenses of sand. The project team did not observe gravel or apparent native materials mixed with the tailings. The project team observed the tailings at the former reprocessing area to extend to a depth of between 5 and 6 feet bgs, at which point cobbles are present. A summary of subsurface conditions encountered in each test pit is presented in Table 2-3.

Due to concerns with mercury levels, samples of tailings collected from the Combination Mill tailing impoundment and the reprocessing area were submitted for analyses of total recoverable mercury prior to submitting the samples to the geotechnical laboratory. In an effort to reduce mercury levels in the samples, project team members placed the waste material from the test pits on tarps and allowed the material to sit exposed to the air for approximately two days prior to collecting bulk samples for geotechnical testing. As described in more detail in Appendix A, an initial waste material sample was collected and submitted for analysis of total recoverable mercury upon excavation of a test pit. A second sample was collected after the material had been exposed to the air and was also submitted for analysis of total recoverable mercury. The second sample was collected in conjunction with the geotechnical sample and was intended to document whether mercury levels attenuated in the material due to dissipation of mercury vapors.

The project team collected and submitted geotechnical samples to the geotechnical laboratories for analysis of one or more of the following tests: moisture content, grain size distribution (with hydrometer), Atterberg Limits, and standard Proctor as shown in Table 2-1. Geotechnical and geochemical results are presented and discussed in Section 3.

Table 2-3. Combination Mill Tailings Impoundment and Reprocessing Area Tailings Test Pit Lithology Summary, Black Pine Mine

Test Pit/Location	Total Depth (feet bgs)	Depth Interval (feet bgs)/ Material Description	
CML-GT-01 (Combination Mill)	3.0	0-1.0	Topsoil - Sandy Gravel, light brown
		1.0-2.0	Tailings - fines, pink/orange
		2.0-3.0	Gravel - Dark brown/black, "native"
		3.0	Hard bottom
CML-GT-02 (Combination Mill)	2.5	0-2.0	Tailings - mixed with "native", gravel, dark brown, not clearly delineated
		2.0-2.5	Dark brown gravel and sand, “native”
		Water at 2.5 feet bgs	
CML-GT-03 (Combination Mill)	5.0	0-4.5	Lean clay, with sand and large gravel, dark brown/black
		4.5-5.0	Gravel, light brown/tan, wet
		Water at 4.5 feet bgs	
CML-GT-07*, (Reprocessing Area)	6.0	0-5.25	Tailings, very fine, sandy, pink/orange
		5.25-6.0	Large rounded cobbles, gravel, gray, "slimy" coating on rocks
CML-GT-08 (Reprocessing Area)	5.0	0-1.75	Tailings, pink/orange, very fine, sandy
		1.75-2.25/2.75	Silty sand, grey, no gravel, moist
		2.25/2.75-5	Dark grey/black, some clay, wet, silty sand with clay and gravel, subrounded, organic matter, odor

* Numbering sequence includes surface soil/sediment samples

bgs – below ground surface

2.2.1.2 Sediment and Soil Sampling

The project team collected two soil/sediment samples adjacent to the Combination Mill tailings impoundment (Figure 2-2), and one sediment sample downstream along South Fork Lower Willow Creek (Figure 2-3). Sample collection information is summarized in Table 2-1. Samples were collected for geotechnical testing and geochemical analysis. Sampling methodology is described in Appendix A and field notes are included in Appendix B.

The two soil/sediment samples (CML-GT/GC-04 and CML-GT/GC-05) collected at the Combination Mill area were both non-plastic silt (ML), whereas the sediment sample (CML-GT/GC-06) collected downstream of the Combination Mill was characterized as silty sand (SM). Each sample was collected between 0 and 1-foot bgs.

Due to concerns with mercury levels, samples of soils and sediments collected from the Combination Mill AOC and downstream along South Fork Lower Willow Creek were submitted for analyses of total recoverable mercury prior to sending the samples to the geotechnical laboratory. The sampling protocol was similar to that described in Section 2.2.1.1 for tailings

samples and is outlined in Appendix A. Geotechnical samples were subjected to one or more of the following tests: moisture content, grain size distribution with hydrometer, and standard Proctor as listed in Table 2-1. Geotechnical and geochemical results are presented and discussed in Section 3.

2.2.1.3 Debris Sampling

The Bevill exclusion, as currently administered, exempts extraction, beneficiation, and certain listed processing solid wastes uniquely associated with mining operations from regulation as hazardous waste. Material such as building debris and roaster brick may not be covered under the Bevill exclusion. Therefore, the project team collected four samples of wood and brick debris at the Combination Mill and "Old Mill" sites, as shown on Figure 2-4, and submitted these samples for TCLP analyses to determine whether the debris could be disposed of as non-hazardous materials in Resource Conservation and Recovery Act (RCRA) Subtitle D landfill facilities. The project team collected one wood and one brick debris sample from each site and submitted each sample for TCLP metal analysis. Sample collection information is summarized in Table 2-1. The TCLP metal analytical results are presented and discussed in Section 3.

2.2.2 Borrow Area Investigations

The project team excavated test pits and collected samples to evaluate the potential to borrow materials suitable for covers soils/growth media, liner material, select backfill, or unclassified backfill.

2.2.2.1 Test Pitting

The project team excavated test pits and collected samples within the six potential borrow areas shown on Figure 2-5. The number and location of test pits include:

- Six test pits in potential Borrow Area (BPB) 2/3 (Figure 2-6)
- Five test pits in BPB 1A (Figure 2-6)
- Three test pits in BPB 7A (Figure 2-6)
- Two test pits in BPB 11 (Figure 2-7)
- Four test pits in BPB 12 (Figure 2-8)
- Four test pits in BPB 13 (Figure 2-8)

Excavation of the test pits continued to refusal or maximum reach of the equipment. Excavation and sampling methodology is described in Appendix A. Field notes and test pit logs are provided in Appendix B.

The project team collected samples from the test pits for geotechnical testing and agronomic analysis. One surface soil sample and one composite subsoil sample were collected from each test pit. However, while the project team excavated 24 test pits, the team only submitted 17 surface soil samples and 8 subsoil samples for laboratory testing. Fewer samples were submitted for testing based on soil conditions encountered in the field. Samples were not submitted from potential borrow areas or test pits where the field team deemed insufficient cover soils or subsoils were present. When similar materials were encountered across test pits, a representative sample was submitted from one test pit, as opposed to each of the test pits. The number and type of tests actually conducted as compared to the tests identified in the RIWP are discussed in Section 2.3, Deviations from the Repository Investigation Work Plan.

The project team submitted the surface soil samples to an analytical laboratory for agronomic testing to determine suitability for use as cover soil. ABA was also performed on one topsoil sample from BPBs 2/3, 1A, 7A, and 13. The project team submitted subsoil samples to a geotechnical laboratory for index property tests including natural moisture content, Atterberg limits, and grain size distribution. The project team selected samples for testing based on the borrow area conditions and test pit lithology. Sample collection and testing information is summarized in Table 2-1.

The observed potential borrow area soils range from silty sand with cobbles and gravel (SM) to cobbles with gravel and sand and trace to some silt (GP-GM, GM) to sandy silt with gravel and cobbles (ML) and sandy clay with gravel (CL).

The borrow area investigation indicated limited potential for borrow due to shallow refusal as a result of cobbles and/or bedrock and relatively few fines suitable for cover materials. Possible exceptions include portions of BPB 1A, surface soils in BPB 2/3, the southern two-thirds of BPB 7A, and BPB 13. The depth to bedrock is at times variable across a single borrow area. In some areas, soils exist at the maximum reach of the excavator, varying from 13.5 to 16.0 feet bgs, depending on the terrain. A detailed description of subsurface conditions encountered in each test pit is presented in Table 2-4. The materials observed in each of the borrow areas are briefly summarized below:

- BPB 1A. A mix of silty sandy gravel with cobbles, weathered bedrock, refusal as shallow as 4.5 feet bgs, and soils extending to the maximum reach of the excavator (approximately 14 feet bgs).

- BPB 2/3. Densely packed cobbles at relatively shallow depths resulting in refusal at depths ranging from 3.5 to 7.0 feet bgs.

- BPB 7A. A mixture of shallow bedrock at 3 feet bgs and soils extending to the maximum reach of the excavator (approximately 14 to 16 feet bgs).

- BPB 11. Shallow bedrock at a depth of 3 feet bgs in the first two test pits at BPB 11 resulted in a decision to eliminate the other two test pits planned for this area.

- BPB 12. Refusal at depths ranging from 4.25 to 11 feet bgs in three test pits across the main part of BPB 12 resulted in a decision to eliminate the other test pit planned for this area despite soils extending to a greater depth in a fourth pit on the periphery of the borrow area.

- BPB 13. Soils extending to the maximum reach of the excavator in four test pits at BPB 13, with refusal in one test pit at a depth of 13.5 feet bgs.

2.2.3 Repository Area Investigations

As identified in the RIWP, the data gaps pertaining to the suitability of the potential repository area for development of a long-term waste repository were the depth, nature, and quality of the bedrock; the depth to groundwater; and the depth, type, and quantity of overburden soils. The preliminary investigation of the Repository 2 Area during the RI provided initial information regarding these data gaps (Herrera/Trihydro 2012a). The data collected during the RI is summarized in this section, and in other applicable sections of this report, along with information from the 2012 repository investigation to provide characterization of the proposed repository area that can serve as the basis for evaluation of the site and preparation of the preliminary design.

During the RI, two test pits, RY-SS-03 (total depth 14 feet bgs) and RY-SS-04 (total depth of 10.5 feet bgs) were excavated in or along the periphery of the Repository 2 Area (Figure 2-9) to assess the potential repository area. The test pits were limited in depth due to a combination of nearing the reach of the excavator and excavation in weathered bedrock. Weathered bedrock was encountered at depths ranging from approximately 0.8 feet to 3 feet bgs. Test pit RY-SS-03 was excavated to a total depth of 14 feet, with hard excavation noted beginning at 11 feet. Test pit RY-SS-04 was excavated to a total depth of 10.5 feet, with hard excavation noted beginning at 8 feet. The field team observed a wet soil zone at 2.75 feet bgs in test pit RY-SS-04 (Herrera/Trihydro 2012a). The test pit logs for these RI test pits are included in Appendix C. Other test pits were excavated within the Repository 2 Area; however, these other test pits were targeted at waste materials and not at determining excavation depth or overburden materials relative to the repository investigation.

In addition, three boreholes (MW-RY-06, MW-RY-07, and MW-RY-08) were drilled within or along the periphery of the Repository 2 Area using a hollow stem auger (HSA) drill rig in August 2011 (Figure 2-9). Each of these boreholes were completed as a shallow monitoring well based on the wet zone observed in test pit RY-SS-04 and observed moist zones in the boreholes. A fourth borehole (MW-RY-09) was installed using an air rotary drill rig in January 2012 and completed as a deep monitoring well to evaluate separation between the base of the proposed repository and groundwater to meet ARAR guidelines (Figure 2-9). Details on the boreholes installed during the RI are presented in the RI Report (Herrera/Trihydro 2012a). Logs for these boreholes are provided in Appendix C for ease of reference; note that MW-RY-06, MW-RY-07, and MW-RY-08 are designated as BP-RY-06, BP-RY-07, and BP-RY-08, respectively in borehole logs. Depth information for the boreholes/monitoring wells is as follows:

- MW-RY-06. Located near the center of the proposed repository area, MW-RY-06 was drilled to a total depth of 28 feet bgs. The monitoring well was completed to a depth of 13 feet bgs and screened from 3 feet to 13 feet bgs. No groundwater was detected in the monitoring well following completion.

- MW-RY-07. Located along the power line road, downslope of the proposed repository area, MW-RY-07 was drilled to a total depth of 26 feet bgs. The monitoring well was completed to a depth of 13 feet bgs and screened from 3 feet to 13 feet bgs. No groundwater was detected in the monitoring well immediately following completion; however, groundwater was detected in subsequent monitoring events.

- MW-RY-08. Located north of the repository area, MW-RY-08 was drilled to a total depth of 10 feet bgs. The monitoring well was completed to a depth of 8 feet bgs and screened from 3 feet to 8 feet bgs. No groundwater was detected in the monitoring well following completion.

- MW-RY-09. Located approximately 40 feet southwest of MW-RY-07, along the power line road, MW-RY-09 was drilled to a total depth of 32 feet bgs. The monitoring well was completed to a depth of 30 feet bgs and screened from 10 feet to 30 feet bgs. No groundwater was detected in the monitoring well following completion.

During the 2011 RI investigation, field logs noted that highly weathered bedrock was encountered at approximately 4.5 feet bgs, weathered bedrock at approximately 19.5 feet, and more competent bedrock at 24 feet bgs. However, based on the boreholes advanced in 2012, the depth to bedrock appears to be deeper than noted during the RI. Likely, the refusal of the HSA during the RI occurred due to the cobbles in glacial till in the Repository 2 Area.

The RI information was used in the planning and implementation of the proposed repository area investigation. The following subsections discuss the repository investigation conducted during 2012.

2.2.3.1 Test Pitting

During the 2012 repository investigation, the project team excavated 10 test pits within or adjacent to the proposed repository area as shown on Figure 2-9. Excavation of the test pits continued to refusal or maximum reach of the excavator. A total of 17 soil samples were collected from the 10 test pits for geotechnical testing. Excavation and sample collection methodology is described in detail in Appendix A. Test pit logs and field notes are provided in Appendix B. The project team collected samples and submitted them to a geotechnical laboratory for analysis by one or more of the following tests: moisture content, grain size distribution (with hydrometer), Atterberg Limits, standard Proctor, consolidated-undrained triaxial (CUX) compression tests, and hydraulic conductivity as shown in Table 2-1.

The observed site soils were interpreted to be composed of residual soils and glacial till. Residual soil is the result of in-situ physical (heat, water, ice, and pressure acting on the rock) and chemical (leaching, dissolving, and oxidizing of the rock) weathering of bedrock. Residual soils, in the form of colluvium, range from gravelly clays to gravel/cobbles with sand/silt. Overall, the observed soils are coarse-grained. The colluvium was deposited over glacial till soil from the weathering of the surrounding bedrock ridges. Glacial till consists of a heterogeneous mixture of clay, silt, sand, gravel and cobbles that were deposited and over-ridden by glaciers. The glacial till soils were observed to generally be overconsolidated, meaning that the soils had more weight (i.e. the glacier) bearing in the past than the current weight of soil overlying the glacial till. The test pits in the repository area encountered soils extending to the maximum reach of the excavator or refusal due to bedrock or cobbles. Only one test pit, RY-SS-06, appeared to have shallow bedrock resulting in refusal at 7.0 feet bgs. The excavator met refusal in test pits RY-SS-08, -09, and -14 due to cobbles at depths ranging from 7.0 to 10.0 feet bgs. Soils were present at the maximum reach of the excavator in test pits RY-SS-07, -10, -11, -12, -13, and -15 at depths of between 11 and 17.5 feet bgs. These test pits, with the exception of RY-SS-13, may be located in a zone of glacial till that was evident in RY-RB-04 to a depth of 120.5 feet bgs (discussed in Section 2.2.3.2). Test pit RY-SS-13, excavated along a road cut in weathered bedrock, was south of and outside of the glacial till zone. Test pits RY-SS-10, -11, -12, and -15 contained clay material varying from clayey gravel (GC) to gravelly clay (CL) with low to moderate plasticity. This clay horizon appears to be the same as the gravelly clay (GC) and clay with gravel (CL) observed in MW-RY-06 installed in 2011 (Herrera/Trihydro 2012a). Detailed lithology for the repository area test pits is summarized in Table 2-5; test pit logs are included in Appendix B.

2.2.3.2 Drilling

Drilling locations were selected to cover the perimeter of the proposed repository configuration with the deeper boreholes located over the approximate location of underground mine workings (as estimated based on review of georeferenced mine maps). The project team drilled and cored five boreholes at the locations shown in Figure 2-9. Samples were not collected for laboratory analysis. Rock cores were collected from RY-RB-01, RY-RB-02, RY-RB-03, and RY-RB-05 for interpretation of rock quality, as listed in Table 2-1. Bedrock was not encountered until 120 feet bgs in RY-RB-04. The boreholes were drilled through the overburden soils with air rotary methods and cored into bedrock as described in Appendix B. The borehole depths varied from 46 to 122 feet bgs (Table 2-6). Borehole logs are included in Appendix D.

Boreholes were advanced to total depths in accordance with the RIWP. The RIWP outlined that two deep boreholes would be cored until 30 feet of competent bedrock was observed, or until a depth of 100 feet was cored, whichever was shallower. Three shallow boreholes were proposed in the RIWP and scheduled to be drilled to the average depth of the top of competent bedrock observed in the two deep boreholes. Borehole RY-RB-01 was planned to be a deep borehole and was advanced to a depth of 86 feet bgs based on encountering competent bedrock at a depth of approximately 55 to 56 feet bgs. Deep borehole RY-RB-02 was advanced to a depth of 77 feet bgs based on encountering competent bedrock at a depth of approximately 46 feet bgs. Shallow borehole RY-RB-03 was advanced to a depth of 52 feet bgs (based on an average depth to

competent bedrock of 51 feet), and RY-RB-05 was advanced to a depth of 46 feet bgs. As discussed in Section 2.3, borehole RY-RB-05 was discontinued slightly shallower than the average depth to bedrock due to borehole stability concerns. Borehole RY-RB-04 was advanced to a depth of 122 feet bgs even though this borehole was identified as a shallow borehole in the RIWP. The borehole was advanced to this depth because bedrock was not encountered until 120.5 feet bgs. The depth at which drilling encountered bedrock, and the lack of additional casing on hand to maintain borehole integrity did not allow coring operations to occur at this location. Borehole data for the repository area is summarized in Table 2-6.

Table 2-6. Summary of Repository Borehole Data, Black Pine Mine

Borehole	Approx. Ground Surface Elevation (MSL)	Top of Bedrock			Groundwater		Bottom of Borehole	
		Depth (feet bgs)	Elevation (MSL)	Description	Depth (feet bgs)	Approx. Elevation (MSL)	Depth (feet bgs)	Approx. Elevation (MSL)
RY-RB-01	6334	11	6323	Fractured quartzite, manganese and iron coated fractures	38	6296	86	6248
RY-RB-02	6388	10	6378	Argillite, with manganese coated fractures	30 - 43.5	6343 - 6358	77	6311
RY-RB-03	6350	4	6346	Highly fractured quartzite	Not observed	NA	52	6298
RY-RB-04	6316	120.5	6195.5	Quartzite, brownish yellow	Not observed	NA	122	6194
RY-RB-05	6300	16	6284	Highly fractured quartzite, brownish yellow	Not observed	NA	46	6254

Approx. – approximate
bgs – below ground surface
MSL – mean sea level
NA – not applicable

The following borehole summaries were prepared from the borehole logs included in Appendix D. The borehole logs include photos of the recovered core.

- Borehole RY-RB-01. The surface soil consisted of 3 inches of duff and topsoil followed by a light brown sandy silt with gravel and cobbles to a depth of 4 feet bgs. From 4 to 11 feet bgs, a light brown silty gravel with sand and cobbles layer was encountered. At 11 feet bgs, quartzite was encountered and extended to the bottom of the borehole. Layers of quartzite were encountered throughout the borehole with the layers alternating in color from brownish yellow, purple, and brownish pink. The fracture faces of the core were generally coated with iron and manganese, which is an indication of groundwater flowing through the fractures in the past. The rock quality ranged from very poor to poor down to a depth of 55 to 56 feet bgs. The rock quality improved with depth from 56 feet bgs to the bottom of the borehole. Of particular note for this borehole, a fault zone was encountered from 34.5 feet to 38 feet bgs. In the fault zone, the quartzite was crushed and the fractures were observed to be smooth, flat, and occasionally undulating. Shearing through the core was observed to be diagonal to the core. Based on these observations, the bedrock was under compression for a period, but is no longer under the same stress, which indicates the fault zone is not active. A small quantity (<1 gallon per minute [gpm]) of groundwater was encountered while drilling at a depth of 38 feet bgs.

- Borehole RY-RB-02. The surface soil consisted of 1 inch of gravel and duff followed by a layer of waste rock fill composed of brown silty sandy gravel with cobbles to a depth of 1.3 feet bgs. At 1.3 feet bgs, a layer of light brown gravel and cobbles with silt and sand was encountered to a depth of 4 feet bgs. From 4 to 9 feet bgs brown silty gravel and cobbles with sand was encountered. At 9 feet bgs, argillite was encountered and extended to a depth of 18 feet bgs. The color of the argillite alternated from purple to brownish yellow. At 18 feet bgs, layers of quartzite were encountered and extended to the bottom of the borehole. The fracture faces of the core were generally coated with iron and manganese, which is an indication of groundwater flowing through the fractures in the past. The rock quality ranged from poor to fair from the start of coring at 10 feet bgs to 35 feet bgs. The rock quality becomes excellent from 35 feet to 43.5 feet bgs then degrades to very poor/fair down to 46 feet bgs where the rock quality improved to good to excellent down to the bottom of the borehole at 73.5 feet bgs. The drop in rock quality from 43.5 to 46 feet bgs is due to a fractured zone with a layer from 45 to 46 feet bgs where recovery (approximately 1 inch) was poor and could only be classified as fractured and stained quartz. A small quantity (<1 gpm) of groundwater was encountered while drilling from 30 feet to 43.5 feet bgs.

- Borehole RY-RB-03. The surface soil consisted of 2 inches of duff and topsoil followed by a light brown sandy gravelly silt with cobbles to a depth of 4 feet bgs. At 4 feet bgs, dark yellowish brown, highly fractured quartzite was encountered to a depth of 7 feet bgs. From 7 to 11.5 feet bgs a highly fractured, oxidized ore zone composed of dark yellowish brown and white highly fractured, vuggy (with small

cavities), massive milky quartz with iron and gossan (an iron bearing weathered sulfide deposit) seams was encountered. This material has the potential to generate acid rock drainage (ARD) if exposed to the elements. This layer also contained a shear zone from 9 to 11 feet bgs. The recovered core fracture faces were observed to be rough. Rough fracture faces indicate that sliding is less likely to occur than smooth fracture faces when a load, like a repository, is applied above the bedrock. Rough fracture faces also indicate that there has been less movement along that fracture than a smooth, slickensided fracture face. Underlying the oxidized ore layer, layers of quartzite were encountered to the bottom of the borehole and varied in color from brownish pink, gray, and dark brownish yellow. The amount of fracturing varied and impacted the rock quality. The rock quality was very poor from 8 to 13 feet bgs, improved to fair from 13 feet to 40 feet bgs, then improved to good down to the bottom of the borehole at 52 feet bgs. Groundwater was not observed during drilling.

Of particular note for this borehole, the coating on the fracture faces was heavier and composed of iron, manganese, chrysocolla (a copper bearing mineral), and other black sulfide minerals along with occasional iron-stained milky quartz veins. The hill on which this borehole is situated is mineralized and oriented northwest – southeast across the site and just south of the Mill Gulch Fault. If excavated and exposed to air, further oxidation may occur and create a release of iron and possibly ARD. A soil cover should remain over the upper oxidized ore zone that appears to exist at the northern end of the proposed repository area.

- Borehole RY-RB-04. The surface soil consisted of 2 inches of duff and topsoil followed by a light brown silt and gravel with sand to a depth of 3 feet bgs. Dark yellowish brown, very dense lean clayey gravel with sand was encountered from 3 to 9 feet bgs. Very stiff, brown, gravelly lean clay with sand was encountered from 9 to 17 feet bgs. Dark yellowish brown lean clayey gravel with sand and cobbles was encountered from 17 to 120.5 feet bgs. This layer contained varying and alternating drier and moist zones. Bedrock composed of brownish yellow quartzite was encountered from 120.5 to 122 feet bgs, the bottom of the borehole. As only 45 feet of casing was available for maintaining the borehole integrity through the soil, the bedrock was not cored. The quartzite description was based on the rock chips that were ejected from the borehole annulus from the air rotary drilling operations.

- Borehole RY-RB-05. The surface soil consisted of 2 inches of duff followed by light brown sandy silt with gravel to a depth of 2.5 feet bgs. From 2.5 feet bgs to 16 feet bgs, a layer of dark yellowish brown lean clayey gravel with sand and cobbles was encountered. At 16 feet bgs, highly fractured quartzite with iron and manganese coated fractures was encountered to the bottom of the borehole at 46 feet bgs. The color of the quartzite varied with depth and included brownish yellow, brownish gray, brown, purplish brown, greenish gray, and brownish pink zones. Groundwater was typically observed to occur in the brownish yellow and brown zones. The rock quality ranged from very poor to poor. The fractures were observed to generally

range from smooth and planar to rough and undulating to irregular. Layers of bedrock will slide easier on smooth and planar surfaces than they will on rough and undulating to irregular surfaces. This situation should be evaluated during repository design. Groundwater was not encountered while drilling.

2.2.3.3 Groundwater Sampling

The project team conducted groundwater gauging and sampling at repository monitoring wells in accordance with the RIWP as described in Appendix A, with the exceptions noted in Section 2.3. The project team gauged water levels in repository monitoring wells MW-RY-06 through MW-RY-09 on September 6, 2013, and collected a water sample on September 7, 2013 from MW-RY-07 (the only well with measurable groundwater).

In accordance with the RIWP, the groundwater sample from MW-RY-07 was analyzed for total suspended solids; total dissolved solids; sulfate; hardness; dissolved calcium, magnesium, potassium, and sodium; and dissolved metals. Dissolved metals included antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver, and zinc. The groundwater analytical results are presented and discussed in Section 3.

2.3 Deviations from the Repository Investigation Work Plan

The project team conducted the repository investigations in accordance with the RIWP. Flexibility in the sampling program was designed into the RIWP and the investigation. The sample locations, number of samples, and sample depths were modified in the field based on observed field conditions and visual inspection. The deviations from the RIWP primarily relate to differences in the samples selected for testing as a result of the type of materials observed during the investigation. The deviations from the RIWP are not indicative of issues with the sampling and testing program, and the investigation as a whole is considered to be in agreement with the purposes and methods of the RIWP. Deviations from the RIWP are described below.

<u>Borrow Area Investigations</u>

- Borrow area samples were not tested for standard Proctors, CUX compression tests, or permeability tests as identified in the RIWP. The lack of a sufficient quantity of fine-grained material in many of the potential borrow areas indicated that the borrow material would be unsuitable for use as a liner. In addition, repository area investigations revealed that there would be sufficient quantities of material in the repository area footprint for reuse in repository construction (with the exception of cover soils). The investigation revealed that fine-grain material existed within the southern part of BPB 7A, which overlapped with the boundaries of the possible layouts for the proposed repository. Additional test pits within the proposed repository area also contained fine-grained material. Therefore, gravelly clay from test pit RY-SS-10 (within the proposed repository area) and a clayey gravel from RY-SS-11 (within BPB7A and just north of the proposed repository area) were tested for standard Proctor, CUX compression tests, and permeability.

- In some cases, the project excavated fewer test pits at the potential borrow areas than planned.

    1. Three test pits were excavated in BPB 7A rather than four due to concerns with the difficulty in accessing one location at the bottom of a steep ravine.

    2. Two test pits were excavated in BPB 11 rather than four because of the shallow depth of refusal in the first two pits.

    3. Four test pits were excavated in BPB 12 rather than five because the observed soils in the excavated test pits is unsuitable for cover material.

- Agronomic testing was conducted on a topsoil sample from each test pit in accordance with the RIWP, with the exception of test pits in BPBs 11 and 12. Topsoil samples from these potential borrow areas were not submitted for testing based on field observations of poor or limited soils.

- ABA analysis was conducted on at least one topsoil sample from each borrow area in accordance with the RIWP, with the exception of BPBs 11 and 12. Topsoil samples from these potential borrow areas were not submitted for testing based on field observations of poor or limited soils.

<u>Repository Investigation</u>

- The RIWP indicated that the shallow boreholes, RY-RB-03, RY-RB-04, and RY-RB-05, would be advanced to the top of competent bedrock as determined by the average depth in the two deep boreholes.

    1. Bedrock was observed at 120.5 feet bgs in RY-RB-04, significantly deeper than expected. This borehole was extended beyond the target depth (51 feet bgs based on the average depth to bedrock encountered in the deep borings) based on a field decision to continue to competent bedrock. The borehole was abandoned shortly (122 feet bgs) after encountering the competent bedrock. The bedrock was not cored due to the substantial depth to the bedrock/amount of overburden and a limited amount of casing. Limited casing was available, as the depth to bedrock had been estimated to be about 50 feet bgs. The drillers would have needed to procure additional casing to allow coring of the bedrock at 120.5 feet bgs.

    2. RY-RB-05 was advanced through bedrock from 16 feet bgs to 46 feet bgs, at which time coring was discontinued because of loss of circulation and caving, and insufficient casing to seal off this zone.

3. The joint water reduction factor of the modified RMR was not recorded on the final rock borehole logs as little to no groundwater was observed while drilling.

- The RIWP indicated that a sixth borehole, downslope of the repository, would be drilled and completed as a monitoring well, MW-RY-10. This monitoring well was not installed due to uncertainty in the final configuration of the repository. Installation of this monitoring well will be reevaluated during final design of the repository, should a repository be selected as part of the preferred reclamation alternative.

- The RIWP indicated six groundwater samples (samples from five wells plus one duplicate) were to be collected and analyzed if groundwater was present. However, only one monitoring well (MW-RY-07) contained measurable water. Therefore, two groundwater samples (original sample plus a duplicate) were collected and analyzed.

Site-Wide

- The sample depths varied from the depths identified in the RIWP. Actual sample collection depths are listed in Table 2-1 and were based on the conditions and depth of materials encountered in the field. The depths of samples identified in the RIWP were reasonable best estimates at the time in the absence of specific knowledge regarding actual material depths. Differences between the actual sample depths and the depths identified in the RIWP were expected and do not reflect issues with the sampling program.

- The number of site-wide solid matrix samples/tests identified in the RIWP compared to the actual number of samples/tests conducted during the repository investigation is shown in Table 2-7. The RIWP allowed for selection of samples for testing based on professional judgment regarding the type and suitability of material for its intended purpose. The numbers of samples identified in the RIWP were reasonable best estimates at the time in the absence of specific knowledge regarding soil types in the areas to be investigated. Differences between the actual number of tests and the number of tests identified in the RIWP were expected and do not reflect issues with the sampling and testing program. Differences of note between the actual number of samples and the number identified in the RIWP are explained below.

  1. Sixteen samples were analyzed for total recoverable metals (mercury) rather than 12 samples identified in the RIWP. Two analyses (before and after drying/dissipation of mercury vapor) were conducted from each of the eight bulk samples collected from the Combination Mill, former reprocessing area, and South Fork Lower Willow Creek areas. The RIWP had not accounted for analysis of mercury from the former reprocessing area samples.

2. Four samples were analyzed for ABA rather than six samples identified in the RIWP. Samples were selected for ABA based on professional judgment regarding the suitability of materials for use as cover soil.

3. Nine hydrometer analyses were conducted as compared to 15 – 17 analyses identified in the RIWP. Fewer samples from the borrow areas were analyzed for particle size because not all of the potential borrow areas appeared to contain suitable soils for use in the repository.

4. Seventeen samples were analyzed for agronomic parameters rather than 26 identified in the RIWP. There was less material suitable for testing than had been estimated during the RIWP.

Table 2-7. Site-Wide Testing and Analyses Work Plan Deviations, Black Pine Mine

Matrix	Analytical Parameters/ Method	Number of Samples in RIWP	Actual Number of Samples/Analyses
Solid	Total recoverable metals[(a)] / SW-846 methods 6020/7471	12	16
Solid	TCLP[(b)]/ EPA Method 1311	4	4
Solid	Acid-base accounting / Modified Sobek	6	4
Solid	Particle size analysis / ASA 15-5	26	17
Solid	Moisture content / USDA Handbook 60, Method 26	26	17
Solid	Natural Moisture Content/ ASTM D2216	35	35
Solid	Atterberg limits/ ASTM D4318	16	14
Solid	Sieve analysis with hydrometer/ ASTM D422	15-17	26(9)
Solid	Standard Proctor/ ASTM D698	9-13	11
Solid	Relative Density/ ASTM D4253 and D4254	1-3	0
Solid	Consolidated-Undrained Triaxial (CUX) Compression/ ASTM D4767[(c)]	6-8	7
Solid	Hydraulic Conductivity/ ASTM D5084 or D2434[(c)]	4	5
Solid	Cation exchange capacity / EPA 6010B/6020	26	17
Solid	pH / ASA 10-3.2	26	17
Solid	Conductivity / ASA 10-3.3	26	17
Solid	Nitrate as nitrogen / EPA 353.2	26	17
Solid	Total phosphorus / EPA 365.1	26	17
Solid	Total potassium / EPA 6010B/6020	26	17
Solid	Organic matter / ASA 29-3.5.2	26	17
Solid	Lime requirement / ASA 12-3.4.4	26	17

Matrix	Analytical Parameters/ Method	Number of Samples in RIWP	Actual Number of Samples/Analyses
Surface water (Equipment Blanks)	Total recoverable metals[(d)]/EPA methods 200.7/ 200.8/7470	3	2

(a) Total recoverable metals for solid matrices include: mercury.

(b) TCLP metals for solid matrices include: arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver.

(c) Two samples were subjected to testing under multiple conditions.

(d) Total recoverable metals for water include: antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver, and zinc.

ASA = American Society of Agronomy

ASTM = American Society of Testing and Materials

EPA = Environmental Protection Agency

TCLP = Toxicity Characteristic Leaching Procedure

USDA = United States Department of Agriculture

- The number of site-wide geotechnical tests by area identified in the RIWP compared to the actual number of samples/tests conducted is shown in Table 2-8. Differences of note between the actual number of samples and the number identified in the RIWP are explained below.

  1. Geotechnical tests, including moister content, Atterberg limits, sieve analysis, standard Proctor, CUX, and hydraulic conductivity, were conducted on the proposed repository samples, which were not anticipated in the RIWP. Fewer geotechnical tests, including moister content, Atterberg limits, standard Proctor, CUX, and hydraulic conductivity, were conducted on borrow area samples. These differences reflect the observed availability of suitable material in the proposed repository area, which encompassed several different potential layouts and overlapped with BPB 7A.

  2. The project team, collected samples from the former reprocessing area and submitted these samples for geotechnical testing based on differences in the tailings observed at the former reprocessing area area as compared to the tailings at the Combination Mill area.

  3. Fewer samples were submitted for CUX testing. Due to the coarseness of the on-site material, only fine-grained samples from the proposed repository area and borrow area BPB7A were submitted for CUX testing.

Table 2-8. Geotechnical Testing Work Plan Deviations, Black Pine Mine

Geotechnical Tests and Method	Area of Concern and Waste Materials to Test[a]	Number of Tests in Work Plan	Actual Number of Tests[e]
Natural Moisture Content[b] (ASTM D2216)	Combination Mill Tailings Impoundment	3	3
	Combination Mill Impacted Sediments & Soils	2	2
	SFLWC Stream Sediments	1	1
	Combination Mine Waste Rock Pile	3	3
	Potential Borrow Areas[c]	up to 26	8
	Reprocessing Area Tailings	0	2
	Repository 2 Area	0	16
Atterberg Limits[b] (ASTM D4318)	Combination Mill Tailings Impoundment	3	2
	Combination Mill Impacted Sediments & Soils	2	1
	SFLWC Stream Sediments	1	1
	Combination Mine Waste Rock Pile	0	0
	Potential Borrow Areas[c]	up to 10	6
	Reprocessing Area Tailings	0	1
	Repository 2 Area	0	5
Sieve Analysis[b] (ASTM D422)	Combination Mill Tailings Impoundment	3	3
	Combination Mill Impacted Sediments & Soils	2	1
	SFLWC Stream Sediments	1	1
	Combination Mine Waste Rock Pile	3	2
	Potential Borrow Areas[c]	6 – 8	8
	Reprocessing Area Tailings	0	1
	Repository 2 Area	0	10
Soil Moisture and Density Relationship (standard Proctor compaction method)	Combination Mill Tailings Impoundment	3	3
	Combination Mill Impacted Sediments & Soils– Held for index property results and comparison to Combination Mill tailings and SFLWC stream sediments	up to 1	1
	SFLWC Stream Sediments– Held for index property results and comparison to Combination Mill tailings and	up to 1	1

Geotechnical Tests and Method	Area of Concern and Waste Materials to Test[a]	Number of Tests in Work Plan	Actual Number of Tests[e]
(ASTMD698 or AASHTO T99)	Combination Mill impacted sediments & soils		
	Combination Mine Waste Rock Pile	0	1
	Potential Borrow Areas[c]	6 – 8	0
	Reprocessing Area Tailings	0	1
	Repository 2 Area	0	4
Relative Density (ASTM D4253 and D4254)	Combination Mine Waste Rock Pile	1 - 3	0
Consolidated-Undrained Triaxial (CUX) Compression (ASTM D4767)	Combination Mill Tailings Impoundment	2	0
	Combination Mill Impacted Sediments & Soils– Held for index property results and comparison to Combination Mill tailings and SFLWC stream sediments	up to 1	0
	SFLWC Stream Sediments– Held for index property results and comparison to Combination Mill tailings and Combination Mill impacted sediments & soils	up to 1	0
	Potential Borrow Areas Repository 2 Area[d](Note that the 7 CUX tests under multiple conditions were performed on soils collected from only 2 of the 10 test pits)	4 0	0 7
Hydraulic Conductivity (ASTM D5084)	Potential Borrow Areas[d] Repository 2 Area[d](Note that the 5 hydraulic conductivity tests under multiple conditions were performed on soils collected from only 2 of the 10 test pits)	4 0	0 5

(a) Geotechnical samples were obtained and transported to Trihydro's Helena office. Tests were assigned after samples were classified.

(b) Geotechnical index property. Atterberg Limits were only performed if soil was fine-grained silt and/or clay.

(c) Testing to determine suitability of borrow sites for constructing a containment berm, liner, and/or cover soil.

(d) Proctor tests were performed first, then the sample at optimum moisture and density was used for CUX Compression testing and hydraulic conductivity testing.

(e) The number of samples collected from each location may have varied from the number of samples submitted for testing. A summary of the samples collected from each area is provided in Table 2-1.

ASTM - American Society of Testing and Materials

SFLWC – South Fork Lower Willow Creek

3.0 Repository Inspection and Analyses Results

The following section presents field observations and laboratory results from the repository investigation. Observations of surface conditions in and near the proposed repository area are presented as they pertain to the suitability of the site for development of a repository. The geochemical, geotechnical, and agronomic results for samples submitted for laboratory testing are presented and discussed by area or material type (e.g., waste materials, borrow areas, and repository area). Test results are provided in tables in this section; the laboratory reports are provided in Appendix E.

The bedrock quality in the proposed repository area is discussed based on evaluation of rock cores collected during borehole drilling. A discussion of the repository area geology, hydrology, and mine workings are presented based on the 2011 RI preliminary repository investigation, research and evaluation completed during development of the RIWP, and results from this repository investigation.

Discussions on how the observations and results affect the proposed repository siting and design are included in Section 4.

3.1 Site Reconnaissance

The field team conducted reconnaissance of the proposed repository area to identify surface features that could limit or enhance the area's suitability for construction of a repository. Personnel noted infrastructure in the repository area, seeps and springs or signs of surface water in or adjacent to the repository area, and vegetative cover in the area.

3.1.1 Infrastructure

The proposed repository location is bounded by the Harper Shaft to the southeast, overhead power lines to the east and north, and overlaps USFS Road 678 to the south (Figure 2-9 and Figure 3-1). The Harper Shaft has been sealed off with a concrete plug and is not within the proposed repository footprint. The Harrison Shaft is located near the center of the proposed repository, based on historical mine maps. However, test pits excavated during the repository investigation to locate the Harrison Shaft collar did not encounter subsurface evidence of the shaft. There are remnant foundations and dilapidated rock and mortar walls associated with surface infrastructure near the Harrison Shaft. Asbestos was detected (60% Chrysotile) in a grout sample collected from the Harrison Shaft rubble during the RI. The remnants of these buildings will need to be removed and disposed of at an appropriate offsite facility if a repository is constructed in this area. Discussions on how the repository would be configured to avoid these features, or how these features would be removed are presented in Section 4.

The Barrett Shaft and Williams No.1, No. 2, and No. 3 shafts are located to the east and northeast of the proposed repository and an overhead power line (Figure 3-1). There are no remaining surface features associated with these shafts. These shafts are outside of the proposed

repository area and should not be disturbed. Likewise, the Lewis Shaft and associated buildings are located to the west of and outside of the proposed footprint. Construction of the proposed repository would not disturb the Lewis Shaft area, with the exception of the access road off USFS Road 678.

3.1.2 Seeps, Springs, and Surface Water

During the 2011 RI fieldwork, test pit RY-SS-03, located along the southern perimeter of the proposed repository (Figure 2-9), was excavated to a depth of 13 feet bgs. The soils were observed to be damp throughout the entire depth of the test pit. A wet soil zone was observed at 2.75 feet bgs in test pit RY-SS-04, located north of the northern perimeter of the proposed repository along the overhead power line road. A confirmation test pit, which was not named, was excavated between test pit RY-SS-04 and monitoring well MW-RY-07 to confirm the wet soil zone observed in RY-SS-04. The field team observed a similar wet soil zone to that observed in RY-SS-04 at approximately the same depth in this confirmation test pit (Herrera/Trihydro 2012a). Moist soils were noted in test pits excavated during the 2012 repository investigation, but seeps were not observed in the test pits.

Field personnel investigated the repository area in May 2012 for signs of seeps or defined springs. This investigation was completed during May to take advantage of seasonally high water tables that would make seeps or springs more apparent. The field team located a series of small seeps and a spring approximately 900 to 1,200 feet to the northwest (downslope) of the repository. These water features form the headwaters of Mill Creek, which flows northwest to South Fork Lower Willow Creek. During the 2011 RI fieldwork, Mill Creek was sampled near its headwaters at the routine surface water monitoring location, MCSP-1. Detected metals concentrations in the water sample from MCSP-1 exceeded the DEQ Risk Based Cleanup Guidelines (RBCG) for arsenic and zinc. Concentrations of cadmium, copper, iron, and lead in sample MCSP-1 also exceeded the "Montana Numeric Water Quality Standards," Circular DEQ-7 (Circular DEQ-7) HH standards (HHS) (Herrera/Trihydro 2012a). A summary of analytical results for this sample location is provided in Appendix F.

During the September 2012 field investigation, the project team observed a surface seep and signs of previous seepage northeast of the Mill Gulch Fault and downslope from the overhead power line, as shown in Figure 2-9. The surface seep and signs of previous seepage are located approximately 1,000 feet northeast of the proposed repository perimeter in a small topographic bowl that parallels the bowl in which the proposed repository would be located. The field team observed standing water in the surface seep and noted the ground was hummocky and dry in the area of previous seepage. The area appears to have a small flow during the spring runoff and drains downhill to the northwest (away from the proposed repository area). The field team did not investigate this area during May 2012 as there is a ridge separating the seep area from the proposed repository area. The seep was encountered during the September 2012 repository investigation while investigating BPB 1A, which encompasses this area (Figure 2-6).

No other signs of seeps, springs, or surface water, other than overland flow during snowmelt or following rainfall events, were observed within the proposed repository area.

3.1.3 Cover Soils and Vegetation

Based on test pits excavated across the BPM, topsoil thickness at the site generally ranges between 2 inches to 5 inches. Similar to other areas at the BPM, the proposed repository area has limited topsoil. In addition, portions of the proposed repository area are covered with waste rock associated with the Harrison and Harper Shafts. These areas (approximately 2.5 acres) have no cover soils. USFS Road 678 and the upper access road to the Lewis Shaft are also located in the proposed repository area, further reducing cover soil areas in the proposed repository footprint by 1.1 acres.

Vegetation in the proposed repository area, and across the BPM, is characterized by native and introduced vegetation species. Dominant trees include lodge pole pine (Pinus contorta), Engelmann spruce (Picea engelmannii), Douglas fir (Pseudotsuga menziesii), and Ponderosa pine (Pinus ponderosa) (MCS 2004). Shrubs and other vegetative species include grouse whortleberry (Vaccinium scoparium), snowberry (Symphoricarpos alba), and blue huckleberry (Vaccinium globurlare) (MNHP 2010). Vegetation is typically limited to undisturbed areas around the site, while areas that have been disturbed previously (tailings areas, waste rock piles, and borrow areas) have little vegetation. For example, BPB 4 was used between 2004 and 2006 to obtain cover soil for regrading/reclamation of the Combination Mine waste rock pile. This borrow area has little to no vegetation nearly seven years after being disturbed.

3.2 Waste Materials

The project team collected samples of waste materials from the Combination Mine waste rock pile, the Combination Mill tailings impoundments, soils and sediments west of the Combination Mill tailings impoundments, sediments downstream of the tailings impoundments, and tailings associated with a former reprocessing area on USFS-administered lands. These samples were submitted for geochemical and geotechnical testing. The project team also collected debris samples from the Combination Mill and the “Old Mill” and submitted these debris samples for TCLP analyses.

3.2.1 TCLP Results

The TCLP metal analytical results for samples of wood and brick collected from structures and debris at the Combination Mill and “Old Mill” sites are shown in Table 3-1. The laboratory analytical reports are provided in Appendix E1. Sample locations are shown on Figure 2-4. None of the metal concentrations in the leachate from the samples exceeded the TCLP characteristic hazardous waste criteria.

Table 3-1. Mill Debris TCLP Results, Black Pine Mine

Location	Date Sampled	TCLP Results							
		Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
Units		(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
TCLP Criteria for Characteristic Hazardous Waste		5.0	100.0	1.0	5.0	5.0	0.2	1.0	5.0
CML-RCRA-05 (wood)	9/7/2012	ND (0.5)	ND (10)	ND (0.1)	ND (0.5)	1.7	0.012	ND (0.1)	ND (0.5)
CML-RCRA-06 (brick)	9/7/2012	ND (0.5)	ND (10)	ND (0.1)	ND (0.5)	1.3	ND (0.002)	ND (0.1)	ND (0.5)
CML-RCRA-07 (wood)	9/7/2012	ND (0.5)	ND (10)	ND (0.1)	ND (0.5)	ND (0.5)	0.018	ND (0.1)	ND (0.5)
CML-RCRA-08 (brick)	9/7/2012	1.0	ND (10)	ND (0.1)	ND (0.5)	1.5	ND (0.002)	ND (0.1)	ND (0.5)

mg/l – milligrams per liter

ND() – Analyte was not detected (reporting limit)

TCLP - Toxicity Characteristic Leaching Procedure

These results indicate that the structural materials and debris associated with the samples can be disposed of as non-hazardous materials in RCRA Subtitle D landfill facilities. These materials will be disposed of offsite in order to avoid mixing Bevill-excluded extraction and beneficiation wastes with non -excluded wastes within the repository. The disposal of structural material and debris will be further discussed in the Engineering Evaluation and Cost Analysis (EE/CA).

3.2.2 Geochemical (Mercury) Results

The project team collected 16 samples of tailings, soils, and sediments in the Combination Mill AOC and submitted these samples to Energy Laboratories for analytical testing to determine total recoverable mercury concentrations. This testing was completed to determine whether or not exposing impacted wastes to the air allowed mercury vapors to dissipate, thus reducing

mercury levels in the wastes. The testing was also completed to provide information on mercury levels to the geotechnical laboratories so that they could conduct geotechnical testing in a safe manner for their personnel and equipment. The analytical results are provided in Table 3-2. The laboratory analytical reports are provided in Appendix E2. Sample locations are shown in Figures 2-2 and 2-3.

The concentrations of mercury decreased in only one sample set (CML-GC-01, CML-GC-01B) as a result of being exposed to air. The mercury concentration decreased 20 milligrams per kilogram (mg/kg) after the waste was exposed to the air. The maximum exposure duration was approximately two days, which the project team had estimated would be a sufficient duration to allow the mercury to partially dissipate. However, the concentrations of mercury in samples after the bulk material was exposed to air were greater than the initially detected concentrations for six of the other sample pairs. The remaining sample pair showed no change in detected mercury concentration (Table 3-2). Because the before and after samples were collected from the bulk material and not from specific samples, this result is thought to be due to the variability in mercury concentrations in the bulk material rather than to physical or chemical changes in the sample. The reported values are on a dry-weight basis; therefore, the differences are not attributed to differences in the moisture content of the samples.

Table 3-2. Waste Material Geochemical (Mercury) Results, Black Pine Mine

Sample Location	Original Sample from Bulk Waste			Sample After Bulk Waste Exposed to Air			Difference in Mercury Concentration (mg/kg)
	Sample	Sample Date / Time	Mercury Concentration (mg/kg)	Sample	Sample Date / Time	Mercury Concentration (mg/kg)	
Combination Mill Tailings	CML-GC-01A	9/5/2012 11:20	190	CML-GC-01B	9/7/2012 15:45	170	-20
Combination Mill Tailings	CML-GC-02A	9/5/2012 11:10	160	CML-GC-02B	9/7/2012 15:50	230	+70
Combination Mill Tailings	CML-GC-03A	9/5/2012 11:00	37	CML-GC-03B	9/7/2012 15:55	59	+22
Combination Mill Impacted Soil/Sediment	CML-GC-04	9/7/2012 10:30	110	CML-GC-04B	9/7/2012 16:00	160	+50
Combination Mill Impacted Soil/Sediment	CML-GC-05	9/7/2012 11:15	110	CML-GC-05B	9/7/2012 16:05	110	0
South Fork Lower Willow Creek Stream	CML-GC-06	9/7/2012 12:10	120	CML-GC-06B	9/7/2012 16:10	170	+50

Sample Location	Original Sample from Bulk Waste			Sample After Bulk Waste Exposed to Air			Difference in Mercury Concentration (mg/kg)
	Sample	Sample Date / Time	Mercury Concentration (mg/kg)	Sample	Sample Date / Time	Mercury Concentration (mg/kg)	
Sediment							
Former Reprocessing Area Tailings	CML-GC-07A	9/5/2012 10:35	7.4	CML-GC-07B	9/7/2012 16:15	78	+70.6
Former Reprocessing Area Tailings	CML-GC-08A	9/5/2012 10:30	0.47	CML-GC-08B	9/7/2012 16:20	0.94	+0.47

mg/kg = milligrams/kilogram

3.2.3 Geotechnical Results

The project team collected 11 waste samples during the 2012 repository investigation; including samples from the Combination Mine waste rock pile, Combination Mill tailings impoundments, Combination Mill soils and sediments, South Fork Lower Willow Creek sediment, and the reprocessing area tailings. The sample locations are shown on Figures 2-2 and 2-3. Waste samples were visually classified (ASTM D2488) in accordance with the Unified Soil Classification System (USCS), which is included in Appendix G for reference. Each of the waste samples were submitted to a geotechnical laboratory for analysis of natural moisture content (ASTM D422). The geotechnical laboratory further classified waste materials by performing laboratory grain size distribution analyses (ASTM D422) on eight representative samples, Atterberg limits (ASTM D4318) on three representative fine-grained samples, and standard Proctor tests (ASTM D698) on seven samples. The classification test results for waste materials are summarized in Table 3-3. Geotechnical laboratory reports are included in Appendix E3.

The particle size distribution percentages presented in Table 3-3 are for the material remaining after cobbles were removed from the respective samples. The standard Proctor results shown in Table 3-3 for gravelly soils are corrected results. The gravelly soils were screened in the laboratory to remove particle sizes larger than ¾-inch; the resulting moisture-density curve was then corrected to include the over-size fraction (ASTM D4718). Both uncorrected and corrected moisture-density plots are included in Appendix E3.

Review of the test results in Table 3-3 indicates that the waste materials varied considerably depending on the specific waste site. Test results by waste area are discussed below:

- The waste rock from the Combination Mine is characterized as cobbly gravel (GP) to silty gravel with cobbles (GM). Natural moisture content of the three Combination Mine samples submitted for geotechnical testing varied from 2 to 5 percent. The

single Combination Mine sample (CMN-GT-01) tested for standard Proctor compaction had a natural moisture content of 5 percent, which is dry of the standard Proctor optimum moisture content of 7 percent. This sample has a standard Proctor maximum compacted dry density of 135 pounds per cubic foot (pcf).

- The samples collected from the Combination Mill tailings impoundments are characterized as clayey gravel (GC), silty sand (SM) and clayey silt (CL-ML). Natural moisture content of the three samples varied from 4 to 7 percent. These moisture contents are dry of their respective optimum moisture content (12 to 20 percent). The maximum compacted dry density for the three samples varies from 103 to 119 pcf. Atterberg limits were performed on two of the samples, CML-GT-01 and CML-GT-03 to determine the moisture contents at which fine grained soils changes states from semi-solid to plastic (plastic limit [PL]) and from plastic to liquid (liquid limit [LL]). The Atterberg limits are 23 percent (LL) to 18 percent (PL) for CML-GT-01 and 45 percent (LL) to 20 percent (PL) for CML-GT-03.

- The soil/sediments collected west of the Combination Mill site are characterized as silt (ML) and the sediment sample collected downstream along South Fork Lower Willow Creek is characterized as silty sand (SM). Natural moisture content of the three samples ranged from 5 to 16 percent. The moisture content for the two samples on which standard Proctors tests were performed, CML-GT-04 and CML-GT-06, are dry of their optimum moisture content (24 and 18 percent, respectively). The maximum compacted dry density is 92 pcf for CML-GT-04 and 100 pcf for CML-GT-06. The materials were determined to be non-plastic when attempting to determine Atterberg limits.

- The two waste samples collected at the reprocessing area are both characterized as lean clay (CL). The natural moisture content was 6 percent for CML-GT-07 and 60 percent for CML-GT-08. Atterberg limits and standard Proctor tests were run on CML-GT-07. The natural moisture content for this sample is dry of the optimum moisture content of 16 percent. The maximum compacted dry density is 107 pcf. The Atterberg limits were 27 percent (LL) and 15 percent (PL).

Natural moisture contents are less than the standard Proctor optimum moisture content except for the reprocessing area sample CML-GT-08, which, with a moisture content of 60 percent, was likely wet of optimum moisture. This natural moisture content for this sample was high due to significant organic content. Maximum compacted dry densities generally range from 92 to 111 pcf for the fine-grained clayey (CL) or silty (ML) soils, and from 119 to 135 pcf for the coarse-grained soils.

Table 3-3. Waste Material Geotechnical Test Results, Black Pine Mine

Waste Area	Sample	Depth (feet)	USCS Symbol [c]	Particle Size Distribution, % [a]					Atterberg Limits, %		Natural moisture (%)	Standard Proctor Compaction	
				Cobble[f]	Gravel	Sand	Fines	Hydro-meter	Liquid Limit	Plastic Limit		Opt. Moisture Content (%)[a]	Max. Dry Density (pcf)
Combination Mine Waste Rock	CMN-GT-01	4-8	GM	0	46	38	16	-	-	-	5	7 [d]	135 [d]
	CMN-GT-02	5-7.5	GP	0	92	5	3	-	-	-	2	-	-
	CMN-GT-03	5-8	GM	-	-	-	-	-	-	-	5	-	-
Combination Mill Tailings Impoundment	CML-GT-01	1-2	CL-ML	0	11	27	62	Yes	23	18	4	15 [d]	111[d]
	CML-GT-02	0.5-2	SM	0	18	52	30	-	-	-	6	20[d]	103[d]
	CML-GT-03	2-3	GC	4	39	20	37	Yes	45	20	7	12 [d]	119[d]
Combination Mill and South Fork Lower Willow Creek Soil/Sediment	CML-GT-04 (at mill)	0-1	ML	0	1	42	57	Yes	NP	NP	5	24	92
	CML-GT-05 (at mill)	0-1	ML	-	-	-	-	-	-	-	16	-	-
	CML-GT-06 (Downstream of mill)	0-1	SM	0	0	80	20	-	NP	NP	6[e]	18	100
Amalga-mation Mill	CML-GT-07	1.5-2	CL	0	0	30	70	Yes	27	15	6	16	107
	CML-GT-08	1-2	CL	-	-	-	-	-	-	-	60	-	-

NP - non-plastic Yes - Test was conducted - Not submitted for test
USCS – Unified Soil Classification System
(a) Percent by weight (b) Weight of water as a percentage of the weight of solids.
(c) USCS Symbols: refer to Appendix G (d) Corrected for over-size fraction
(f) Cobbles were removed from samples prior to performing grain size distributions.
(e) Value reported by laboratory (TerraSense LLC) conducting standard Proctor analysis. Original moisture content of 13.4% was reported by Pioneer Technical Services, Inc.

3.3 Borrow Areas

Test pits were excavated in six potential borrow areas on BPM property and on lands administered by the USFS (Figure 2-5). The project team collected topsoil and subsoil samples from the test pits and submitted select samples for analysis of agronomic or geotechnical parameters to evaluate the suitability of borrow materials for use in repository construction. As described in Section 2, samples were not submitted for testing from BPBs 11 or 12 due to poor soils and/or limited quantities of soil. Sample locations are shown on Figures 2-6 through 2-8.

3.3.1 Agronomic and ABA Results

Seventeen surface soil samples were analyzed for agronomic properties from four potential borrow areas (BPB 1A, BPB2/3, BPB7A, and BPB13). Three of these potential borrow areas were located adjacent to or overlapping with borrow areas identified and sampled during a 2000 Hydrometrics borrow source investigation (Figure 2-6). Samples were analyzed for moisture content (ASTM D2974), pH (American Society of Agronomy [ASA] 10-3.2), conductivity (ASA 10-3.3), nitrogen as nitrate (ASA 33-8), phosphorus (ASA 24-5), potassium (Environmental Protection Agency [EPA] 6010B), organic matter (ASA 29-3), and cation exchange capacity (EPA 9081). Results are shown in Table 3-4 and laboratory reports are provided in Appendix E4.

The following provides a summary of the agronomic analyses and a discussion on how the soil characteristics may affect current and future plant growth:

- pH is the measure of the acidity/alkalinity of soils and influences other soil chemical properties. Neutral pH ranges from 6.6 to 7.3 standard units (s.u.) (Munshower 1993). The pH of samples from each of the soil samples was between 4.8 and 7.5, which is moderately acidic to slightly alkaline. The pH range for the potential borrow area soils is suitable for the establishment and growth of a lodge pole pine forest and acceptable for grass communities.

- Conductivity is a measure of the salinity of soil. High conductivity concentrations may indicate when soil conditions could either limit existing plant growth or impede revegetation. The conductivity of the soils ranged from 0.1 to 0.5 micromhos per centimeter (mmhos/cm), which is within a suitable range for establishing vegetation (Bohn 1979).

- Nitrogen and nitrogen forms such as nitrate and nitrite are essential nutrients for establishing and maintaining vegetative cover. The nitrate levels in the soil samples were non-detect (less than 1.0 mg/kg) with the exception of sample BPB2/3-GC-06, which had a nitrate concentration of 1.1 mg/kg. Applying an organic nitrogen amendment in a slow release form may be appropriate during revegetation due to low levels of available nitrogen.

- Phosphorus is a key nutrient for establishing and maintaining vegetation. Phosphorus as the phosphate ion is especially important during seedling growth (Munshower 1993). Phosphorus/phosphate levels ranged from 1.0 mg/kg to 49 mg/kg in the potential borrow area samples, which is in the low to medium range for phosphorus/phosphate. The existing phosphorous levels should support revegetation.

- Potassium is another essential nutrient that facilitates vegetative growth. The potassium levels in the soil samples ranged from 118 mg/kg to 480 mg/kg. Soils containing potassium at or above 120 mg/kg will typically support vegetation (USDA 2009). The existing potassium levels should support revegetation.

- Organic matter stores anions, buffers the soil against rapid changes due to acidity or alkalinity, and increases the water-storage capacity of the soil. The organic matter in the soil samples ranged from 0.76 to 9.51 percent. Organic matter levels for each of the proposed borrow areas for which samples were submitted are adequate and are typical for mountain soils, which often have only 1 percent organic matter. The existing organic matter would support revegetation.

- Cation exchange capacity (CEC) is the expression of cation adsorption per unit weight of soil. Cation exchange is the relationship between cations attracted to and absorbed on soil colloids at negatively charged sites. Soils can become acidic when the accumulation rate of hydrogen ions is greater than their removal rate. Samples at the site had CECs ranging from 6.68 to 34.9 milliequivalents per 100 grams (meq/100 g), which are within the range to support vegetation.

In summary, the pH of the soils sampled in the four potential borrow areas is suitable for the establishment and growth of a lodge pole pine forest and acceptable for grass communities. Levels of potassium, phosphorous, conductivity, and CEC are within the range to support vegetation, but nitrogen levels are low. Organic matter levels for the soils sampled at the four borrow sites are adequate and are typical for mountain soils.

Table 3-4. Potential Borrow Areas Agronomic Results, Black Pine Mine

Location	Moisture (wt %)	pH, Saturated Paste (s.u.)	Conductivity, Saturated Paste (mmhos/cm)	Nitrate (mg/kg, dry)	Olsen, Phosphorous-Olsen (mg/kg)	Available Potassium (mg/kg)	Organic Matter, WB, %	Cation Exchange Capacity (meq/100g)
BPB1A-GC-01	7.4	5.3	0.2	<1	20	246	9.06	23.4
BPB1A-GC-02	3.6	5.6	0.1	<1	49	262	2.51	15.1
BPB1A-GC-03	6.1	5.4	0.2	<1	13	118	9.51	16.7
BPB1A-GC-04	12.2	5.0	0.1	<1	5	480	3.75	14.7
BPB2/3-GC-01	3.1	5.6	0.5	<1	20	127	2.29	7.16
BPB2/3-GC-02	4.6	5.9	0.5	<1	29	129	1.95	9.90
BPB2/3-GC-03	4.7	6.0	0.4	<1	30	292	9.51	23.1
BPB2/3-GC-04	10.8	5.8	0.1	<1	15	289	9.06	34.9
BPB2/3-GC-05	5.3	5.4	0.3	<1	30	224	4.22	13.1
BPB2/3-GC-06	3.4	5.6	0.2	1.1	16	217	4.65	17.7
BPB7A-GC-02	7.0	5.1	0.1	<1	44	219	4.40	18.7
BPB7A-GC-03	2.5	4.8	0.3	<1	3	206	1.11	6.68
BPB7A-GC-04	4.2	5.4	0.1	<1	7	137	1.91	11.5
BPB13-GC-01	6.8	5.6	0.2	<1	1	217	2.01	14.2
BPB13-GC-02	4.0	5.5	0.1	<1	4	139	0.76	8.60
BPB13-GC-03	7.8	5.0	0.2	<1	30	367	4.47	21.2
BPB13-GC-04	6.3	5.5	0.1	<1	8	269	0.82	14.1

Notes: samples were collected from surface soils

g - gram

meq/100g - milliequivalents per hundred grams

mg/kg – milligrams per kilogram

mmhos/cm - micromhos per centimeter

s.u. – standard units

WB - Walkley-Black method

wt % - percent by weight

Four of the 17 potential borrow area samples, BPB7A-GC-02, BPB2/3-GC-04, BPB1A-GC-02, and BPB13-GC-01, were also analyzed for ABA-related parameters. The results from the ABA analyses are tabulated in Table 3-5. The analytical reports are included in Appendix E4. The results are summarized below:

- Sulfur levels in each of the four samples were <0.01 percent.
- The acid potential was calculated at <0.3 tons per 1,000 tons (t/1000t) in each of the four samples.
- Neutralization potential ranged from 2 t/1000t in BPB7A-GC-02 to 8 t/1000t in BPB2/3-GC-04.
- The lime requirement was calculated at 2 t/1000t in BPB13-GC-01 to 11 t/1000t in BPB7A-GC-02.
- Acid base potential or net neutralization potential ranged from 2 t/1000t in BPB7A-GC-02 to 8 t/1000t in BPB2/3-GC-04.

The acid base potential or net neutralization potential for each of the samples falls within the -20 metric t/1000t to +20 metric t/1000t, which is considered to have uncertainty and the potential to generate acid exists (EPA 1994). The ABA results were similar across the borrow areas. The ABA results in the borrow area samples are within the range to support use of the borrow area soils as cover soils.

3.3.2 Geotechnical Results

The project team collected 25 subsurface, composite soil samples from the six potential borrow areas. Sample locations are shown on Figures 2-6 through 2-8. Two test pits associated with the proposed repository area, RY-SS-11 and RY-SS-12, also fell within the footprint of BPB7A. The sample location nomenclature from the RIWP and field investigation used the RY designation and that designation has been retained for the samples collected from these two test pits. The results for these samples are discussed with other repository samples in Section 3.4 and are not included in the following discussion.

Each of the potential borrow area soil samples were visually classified (ASTM D2488) in accordance with the USCS. Eight, fine-grained soil samples were selected for further classification to evaluate the suitability of these soils as repository cover or bottom liner material (if incorporated into the repository design). These eight samples were submitted to Pioneer Technical Services (Pioneer)for analysis of natural moisture content (ASTM D2216) and grain size distribution (ASTM D422). Pioneer also performed Atterberg limits (ASTM D4318) for six of the samples. Soil classification test results for samples from the potential borrow areas are summarized in Table 3-6. Geotechnical laboratory reports are included in Appendix E3.

Table 3-6. Potential Borrow Areas Geotechnical Test Results, Black Pine Mine

Borrow Pit I.D.	Sample	Depth (feet)	USCS Symbol [c]	Particle Size Distribution, % [a]				Atterberg Limits, %		Natural Moisture Content, % [b]
				Cobble[d]	Gravel	Sand	Fines	Liquid Limit	Plastic Limit	
BPB1A	BPB1A-GT-01	0.5-4.5	GC	-	-	-	-	-	-	-
	BPB1A-GT-02	0.5-13.8	GC	0	42	25	33	21	11	7
	BPB1A-GT-03	0.5-12.5	GC	0	31	39	30	-	-	7
	BPB1A-GT-04	0.5-7	GP-GM	-	-	-	-	-	-	-
	BPB1A-GT-05	3-6	GC	-	-	-	-	-	-	-
BPB2/3	BPB2/3-GT-01	0.5-7.5	SM/ML	-	-	-	-	-	-	-
	BPB2/3-GT-02	0.5-5	GC	0	44	30	26	-	-	3
	BPB2/3-GT-03	0.5-7	ML	-	-	-	-	-	-	-
	BPB2/3-GT-04	0.5-7	SM/ML	-	-	-	-	-	-	-
	BPB2/3-GT-05	0.5-3.5	ML	-	-	-	-	-	-	-
	BPB2/3-GT-06	0.5-4	GP-GM	-	-	-	-	-	-	-
BPB7A	BPB7A-GT-02	0.5-7.5	ML	-	-	-	-	-	-	-
	BPB7A-GT-03	0.5-4	CL	0	26	22	52	25	14	19
	BPB7A-GT-04	0.5-4	GC	0	40	18	42	23	13	13
	BPB7A-GT-04A	4-16	CL	0	28	22	50	23	13	13
	RY-SS-11[e]	See Table 3-9, Repository Area Material Geotechnical Test Results								
	RY-SS-12[e]	See Table 3-9, Repository Area Material Geotechnical Test Results								
BPB11	BPB11-GT-01	0.5-3	GP-GM	-	-	-	-	-	-	-
	BPB11-GT-02	0.5-3.5	SM	-	-	-	-	-	-	-
BPB12	BPB12-GT-01	0.5-4.25	GM	-	-	-	-	-	-	-
	BPB12-GT-02	0.5-7.5	GM	-	-	-	-	-	-	-
	BPB12-GT-03	0.5-11	GM	-	-	-	-	-	-	-
	BPB12-GT-05	0.5-7	ML	-	-	-	-	-	-	-

Borrow Pit I.D.	Sample	Depth (feet)	USCS Symbol [c]	Particle Size Distribution, % [a]				Atterberg Limits, %		Natural Moisture Content, % [b]
				Cobble[d]	Gravel	Sand	Fines	Liquid Limit	Plastic Limit	
BPB13	BPB13-GT-01	0.5-16.5	CL	0	7	34	59	29	16	22
	BPB13-GT-02	0.5-15	GM	-	-	-	-	-	-	-
	BPB13-GT-03	0.5-16	SM	-	-	-	-	-	-	-
	BPB13-GT-04	0.5-13.5	SC	0	18	37	45	36	23	21

- Test not performed

USCS – Unified Soil Classification System

(a) Percent by weight

(b) Weight of water as a percentage of the weight of solids.

(c) USCS Symbols: refer to Appendix G

(d) Cobbles were removed from samples prior to performing grain size distributions.

(e) The boundaries of the Repository 2 Area, Layout 3 and BPB7A overlapped at the sample location. Sample nomenclature honors the sample name identified in the RIWP and the field. Results are included in Table 3-9.

Standard Proctors were not run on the potential borrow area soils due to field observations of beneficial soil types and quantity in the proposed repository area. However, natural moisture contents were estimated to be at or below standard Proctor optimum moisture contents except for soil samples from BPB13, which had natural soil moisture contents estimated to be higher than the optimum moisture content.

In summary, the potential borrow area soil materials consisted of coarse-grained sands and gravels with varying amounts of silt and lean clay. Sufficient fine-grained materials for possible use in a repository cover or liner were present at BPB1A, BPB7A, and BPB13. Soil samples from BPB7A, adjacent to the proposed repository, and BPB13 contained significant quantities of fine-grained material. However, the location of BPB7A is better due to the close proximity to the proposed repository as compared to that of BPB13.

3.4 Repository Area

Investigation activities in the repository area were focused on assessing the depth of overburden and rippable materials relative to excavation of a potential repository; assessing the depth to and character of bedrock underlying the repository; assessing groundwater levels and quality; and checking for shallow underground mine workings. Five boreholes were drilled and 10 test pits were excavated to assess the conditions in the repository area. The borehole and test pit locations are shown on Figure 2-9.

3.4.1 Agronomic Results

Soil samples from the repository area were not submitted for agronomic analysis during the repository investigation. However, three surface soil samples and one subsurface soil sample from or near the proposed repository area were collected during the 2011 RI and submitted for agronomic analyses. Samples were analyzed for moisture content (ASTM D2974), pH (ASA 10-3.2), conductivity (ASA 10-3.3), nitrogen as nitrate (ASA 33-8), available phosphorus (ASA 24-5), total potassium (EPA 6010B), organic matter (ASA 29-3), and cation exchange capacity (EPA 9081). Results from the three surface soil samples and the shallow subsurface soil sample are summarized in Table 3-7. Complete results are included in Appendix B-12 of the RI Report (Herrera/Trihydro 2012a).

The following provides a summary of the agronomic analyses and a discussion on how the soil characteristics may affect current and future plant growth:

- The pH of the four soil samples ranged from 5.8 to 7.5. The soils range from moderately acidic to slightly alkaline. The soil pH is suitable for plant growth (Munshower 1993).

- The conductivity of the soils ranged from 0.067 (estimated) to 0.27 mmhos/cm, which is within a suitable range for establishing vegetation (Bohn 1979).

- The nitrate levels in the soil samples were not detected (less than 5.0 mg/kg). With low levels of nitrogen available, applying an organic nitrogen amendment in a slow release form may be appropriate during revegetation.

- Phosphorus/phosphate levels ranged from 2.8 to 7.1 mg/kg in the samples, which is in the low range for phosphorus/phosphate.

- The potassium levels in the soil ranged from non-detect to 86 (estimated) mg/kg. Soils containing potassium at or above 120 mg/kg will typically support vegetation (USDA 2009).

- The organic matter ranged from 0.15 to 3.1 percent. The existing organic matter likely would support revegetation with the exception of the RY-SS-03 area.

- Samples at the site had a CEC ranging from 11.2 to 14.1 meq/100g, which places the CEC in the medium to high range (Munshower 1993).

Table 3-7. Repository Area Agronomic Results[(a)], Black Pine Mine

Location	Depth (feet)	Collection Date	Moisture (wt %)	pH, Saturated Paste (s.u.)	Conductivity, Saturated Paste (mmhos/cm)	Nitrate (mg/kg, dry)	Olsen, Phosphorous-Olsen (mg/kg)	Total Potassium (mg/kg)	Organic Matter, WB, %	Cation Exchange Capacity (meq/100g)
RY-SS-03	0 - 1	7/12/2011	10.5	7	0.067 J	ND(5)	7.1	ND(174)	0.35	14.1
RY-SS-04	0 - 1	7/12/2011	14.7	7	0.14 J	ND(5)	5.3	ND(180)	3.1	21.1
RY-SS-04	2 -4	7/12/2011	9.5	5.8	0.1 J	ND(5)	3.2	ND(334)	0.15	13.5
MW-RY-08	0 – 0.5	8/17/2011	8	7.5	0.27	ND(5)	2.8	86 J	2.4	11.2

(a) Results are from the Reclamation Investigation Report (Herrera/Trihydro 2012, Appendix B-12)

g - gram

J – Estimated concentration

meq/100g - milliequivalents per hundred grams

mg/kg – milligrams per kilogram

mmhos/cm - micromhos per centimeter

ND() – Analyte was not detected (reporting limit)

s.u. – standard units

WB - Walkley-Black method

wt % - percent by weight

In summary, the pH of the soil samples from the repository area is suitable for plant growth. Conductivity and CEC are within acceptable ranges, but levels of nitrate, phosphorous, and potassium are low. Soils from the repository area would require amendments to increase these levels. The area in the vicinity of RY-SS-03 should be eliminated as a candidate for cover soil due to limited organic matter.

Soil samples from the repository area were not submitted for analysis of ABA-related parameters during the repository investigation. However, six soil samples collected from three locations in or near the proposed repository area were collected during the 2011 RI and submitted for ABA analyses. Results from the three surface soil samples and the shallow subsurface soil sample are summarized in Table 3-8. Complete results are included in Appendix B-12 of the RI Report (Herrera/Trihydro 2012a):

- Sulfur levels in the samples were <0.05%.
- The acid potential was calculated at <4.3 t/1000t to 0.2 t/1000t.
- Neutralization potential ranged from 2.4 t/1000t to 7 t/1000t.
- The lime requirement was calculated at <5.4 t/kt to 7 t/kt.
- Acid base potential or net neutralization potential ranged from 2.4 t/kt to 7 t/kt.

The acid base potential or net neutralization potential for these soil samples falls within the -20 t/kt to +20 t/kt, which is considered to have uncertainty and the potential to generate acid exists (EPA 1994). The range of ABA results indicates the surface soils in the proposed repository area could be re-used as cover soils. Lime amendments, if necessary, are low and would require a maximum of 7 tons of lime for every 1,000 tons of soil.

3.4.2 Geotechnical Results

The project team collected 17 soils samples from repository test pits during the field investigation. The sample locations are shown on Figure 2-9. Soil samples were visually classified (ASTM D2488) in accordance with the USCS. Each of the samples, with the exception of the sample collected from RY-SS-08, were submitted to Pioneer for analysis of natural moisture content (ASTM D2216). Soil samples were further classified by performing laboratory grain size distribution analyses (ASTM D422) on 10 representative samples, Atterberg limits (ASTM D4318) on six fine-grained samples, and standard Proctor tests (ASTM D698) on four samples. A senior geotechnical engineer selected the soil samples to be submitted for testing to target those material types, based on visual classification, which would provide the most benefit as borrow materials during construction of a repository. Geotechnical test results for proposed repository area samples are summarized in Table 3-9. Geotechnical laboratory reports are included in Appendix E3.

Table 3-9. Repository Area Geotechnical Test Results, Black Pine Mine

Sample	Depth (ft)	Sample Size	USCS Symbol [c]	Particle Size Distribution, % [a]					Atterberg Limits, %		Natural Moisture Content, % [b]	Standard Proctor Compaction	
				Cobble	Gravel	Sand	Fines	Hydro-meter	Liquid Limit	Plastic Limit		Opt. Moisture Content (%)[c]	Max. Dry Density (pcf)
RY-SS-06	0-4	Bulk	ML	-	-	-	-	-	-	-	8	-	-
RY-SS-06	4-7	Bulk	GM	3.5	39.3	17.2	40	Yes	-	-	7	-	-
RY-SS-07	5-13	Bulk	GM	0	48	20	32	Yes	25	18	8	8 [d]	131 [d]
RY-SS-07	9-13	Bulk	GM	0	47	13	40		NP	NP	13	-	-
RY-SS-08	1.3-7	Bulk	GM	-	-	-	-	-	-	-	-	-	-
RY-SS-09	2	Bag	GM	-	-	-	-	-	-	-	3	-	-
RY-SS-09	4-6	Bulk	GP	0	53	22	25				3	-	-
RY-SS-10	4	Bag	GC	-	-	-	-	-	-	-	14	-	-
RY-SS-10	10	Bag	CL	-	-	-	-	-	-	-	11	-	-
RY-SS-10	14-16	Bulk	GC	10	42.6	14.8	32.6	Yes	35	15	8	8[d]	133[d]
RY-SS-11[e]	2.5-4	Bulk	GC	0	35	16	49				13	9 [d]	127 [d]
RY-SS-11[e]	6 - 8	Bulk	GC	8	46	18	28	Yes	28	17	11	-	-
RY-SS-12[e]	15-17	Bag	GC	3	47	14	36	Yes	28	15	10	-	-
RY-SS-13	2-5	Bulk	GM	8	63	15	14	-	-	-	4	5[d]	141[d]
RY-SS-14	2-3	Bulk	GP	19	79	1	1	-	-	-	3	-	-

Sample	Depth (ft)	Sample Size	USCS Symbol [c]	Particle Size Distribution, % [a]					Atterberg Limits, %		Natural Moisture Content, % [b]	Standard Proctor Compaction	
				Cobble	Gravel	Sand	Fines	Hydro-meter	Liquid Limit	Plastic Limit		Opt. Moisture Content (%)[c]	Max. Dry Density (pcf)
RY-SS-15	2-4	Bulk	ML	-	-	-	-	-	-	-	12	-	-
RY-SS-15	12	Bag	CL	-	-	-	-	-	38	19	14	-	-

NP - non-plastic Yes – hydrometer test was conducted - Test not performed

USCS – Unified Soil Classification System

(a) Percent by weight (b) Weight of water as a percentage of the weight of solids.

(c) USCS Symbols: refer to Appendix G (d) Corrected for over-size fraction

(e) The boundaries of the Repository 2 Area, Layout 3 and BPB7A overlapped at the sample location. Sample nomenclature honors the sample name identified in the RIWP and the field.

The standard Proctor results shown in Table 3-9 for gravelly soils are corrected results. The gravelly soils were screened in the laboratory to remove particle sizes larger than ¾-inch; the resulting moisture-density curve was then corrected to include the over-size fraction (ASTM D4718). Both uncorrected and corrected moisture-density plots are included in Appendix E3.

Review of the test results indicate that the soils generally consist of sandy gravels with varying amounts of silt or lean clay (GP, GM, GC). Natural moisture contents ranged from 3 to 14 percent and were at or slightly wetter than standard Proctor optimum moisture content. Maximum compacted dry densities varied from 127 pcf to 141 pcf.

Based on observations during drilling and test pitting, and on laboratory test results, there are soils containing clay (CL, GC) underlying the northwest portion of the proposed repository area and extending downslope into BPB7A (Figure 3-2). These clayey materials may be appropriate for use in constructing low permeability layers for the repository. The depth to the clayey materials ranges from 2.5 feet (RY-SS-11, RY-RB-05, and MW-RY-06) to more than 7 feet (RY-SS-12). The thickness of these clayey materials, represented by the isopachs on Figure 3-2, ranges from 4 feet (RY-SS-07) to more than 15 feet (MW-RY-06, MW-RY-07 and RY-SS-10). The clayey material extended beyond the reach of the excavator in test pits

Additional testing was performed on clayey gravel samples from RY-SS-10 (14 feet to 16 feet bgs) and RY-SS-11 (6 feet to 8 feet bgs) to better understand the potential for using this material in constructing a repository cap or other low-permeability zones. A total of seven CUX tests with pore water pressure measurements (ASTM D4767) were performed on reconstituted soil samples. The test samples were scalped of ½ inch and larger gravel to create a clayey sand with gravel (SC) sample and a lean clay (CL) sample. Each sample was remolded at near optimum moisture content to 95 percent of standard Proctor maximum dry density (ASTM D698). The samples were saturated and isotropically consolidated to a prescribed stress level before performing a constant head permeability test. Upon completion of the permeability test, the samples were sheared to failure in undrained conditions while measuring axial deformations and sample pore water pressures. The results of the CUX and permeability testing are summarized in Table 3-10. Individual CUX test plots are provided in Appendix E3.

The measured effective Mohr-Coulomb shear strength envelopes and permeabilities of the reconstituted samples are summarized in Table 3-11.

Table 3-10. Repository Isotropically Consolidated Undrained Triaxial and Permeability Test Results, Black Pine Mine

Test Pit	Sample Depth (feet)	USCS	Test No.	Effective Confining Pressure (psf)	Initial Conditions			After Consolidation				At Failure		
					Water Content (%)	Dry Unit Weight (pcf)	Void Ratio	Water Content (%)	Dry Unit Weight (pcf)	Void Ratio	Permeability (cm/sec)	Deviator Stress[(b)] (psf)	q[(c)] (psf)	p'[(d)] (psf)
RY-SS-10	14-16	CL [(a)]	1	1541	11.0	113.4	0.442	15.6	115.1	0.421	2.50E-06	1310	655	1130
			2	2880	11.4	113.4	0.442	14.4	118.2	0.384	-	1944	972	2671
			3	6106	11.4	112.8	0.450	13.6	119.5	0.368	2.00E-08	3701	1850	5248
			4	2491	10.9	113.6	0.440	14.6	118.2	0.383	-	1642	821	1901
RY-SS-11	6-8	SC [(a)]	1	4997	12.7	110.7	0.522	16.5	114.7	0.470	4.60E-07	5275	2638	4912
			2	994	12.7	110.9	0.520	17.1	113.9	0.480	1.00E-06	2515	1258	2006
			3	2420	12.8	110.0	0.533	17.9	114.0	0.479	1.90E-07	2611	1306	2271

- Test not performed

cm/sec – centimeters per second

pcf – pounds per cubic foot

psf – pounds per square foot

USCS – Unified Soil Classification System

(a) Original bulk soil sample was clayey gravel (GC). Test sample was scalped of +1/2 inch gravel to create RY-SS-10 triaxial specimens of sandy clay (CL) and RY-SS-11 triaxial specimens of clayey sand with gravel (SC).

(b) Deviator stress - maximum principal stress difference at maximum principal stress ratio

(c) q - ½ principal stress difference

(d) p' - average effective principal stress

Table 3-11. Summary of Triaxial Test Shear Strength Envelopes and Permeabilities, Black Pine Mine

Test Pit	Depth (feet)	USCS	Effective Mohr-Coulomb Strength Envelope		Total Mohr-Coulomb Strength Envelope		Permeability (cm/sec)
			Cohesion Intercept (psf)	Friction angle (degrees)	Cohesion Intercept (psf)	Friction angle (degrees)	
RY-SS-10	14 - 16	CL	282	17	166	12	2.0×10^{-8} to 2.5×10^{-6}
RY-SS-11	6 - 8	SC	226	30	495	16	1.9×10^{-7} to 1.0×10^{-6}

cm/sec – centimeters per second
psf – pounds per square foot
USCS – Unified Soil Classification System

3.4.3 Rock Core Analysis

Bedrock was cored as part of the investigation of the geologic and hydrogeologic conditions at the proposed repository (Figure 2-9). Bedrock coring was completed in four of the five boreholes. Bedrock was not encountered in RY-RB-04 until a depth of 120 feet bgs and was not cored because the depth of the borehole was greater than originally planned in the RIWP and sufficient casing was not available. The extent of fracturing, existence of thin stratified layers, evidence of bedrock faulting, signs of iron staining, and the possibility of shallow or unknown mine workings were evaluated.. Due to the number of faults observed on the geological mine maps and referenced in geological descriptions of the BPM, the degree of faulting is critical to evaluating the suitability of the proposed repository site.

A senior geological engineer used two methods to evaluate the recovered bedrock cores:

1. **Rock Quality Designation Index (RQD).** The RQD provides a quantitative estimate of in-situ rock mass quality from recovered bedrock core. RQD only represents the degree of fracturing of the rock mass. RQD does not account for the strength of the rock or mechanical and other geometrical properties of the joints. The RQD is calculated as the percentage of the sum of recovered intact core pieces greater than or equal to 4 inches in length divided by the length of the core run. Breaks in the core that result from the drilling process or handling are not included in the RQD calculation. The rock quality description is based on the following calculated percentages:

Amount of Recovered Intact Core	Rock Quality Designation
0 – 25 percent	very poor
25 – 50 percent	poor
50 – 75 percent	fair
75 – 90 percent	good
90 – 100 percent	excellent

2. **Rock Mass Rating (RMR).** The second method used to evaluate rock quality is a RMR method (Hoek 2007). RMR evaluates the rock quality based on the number, roughness, and alteration of joints, as well as additional factors related to the degree of water inflow and zones of weakness. As expressed by Hoek (2007), the number, roughness, and alteration of the joints "appear to play a more important role than [joint] orientation, because the number of joint sets determines the degree of freedom for block movement (if any)…."

   An estimate of a final RMR value would need to be based on more than five boreholes and would need to be correlated to underground mining rock stability (e.g., rock bolting requirements of the roof and walls), which are not available for this site. However, the RMR parameters are useful in identifying potential problem intervals in the bedrock that may require additional investigation and/or engineering consideration. For the cores from the proposed repository site, values were assigned for the number (joint set number [J_n]), roughness (joint roughness number [J_r]), and alteration (joint alteration number, [J_a]) of the joints based on the grading system used in the Tunneling Quality Index, *Q* (Hoek 2007). This grading system is provided in Appendix G. These values (J_n, J_r, and J_a) are included on the core drill logs in Appendix D. The joint water reduction factor (J_w), and the stress reduction factor (SRF), were not evaluated. Insufficient information exists to estimate values for those two factors. In the case of the joint water reduction factor, little to no groundwater was observed while drilling, precluding calculation of this factor.

Overall, the bedrock at the proposed repository can be described as fractured. The layers of bedrock were not observed to repeat within borehole locations. This indicates that the bedrock underlying the site is not thrust faulted (low angled faults that create repetition of beds with depth in a borehole). The bedrock contained a few vugs (small cavities). Occasional thin zones, up to 6 inches in thickness, of finely laminated argillite were identified within the quartzite in boreholes RY-RB-01 and RY-RB-02. Slickensided (polished and striated surface created by sliding of rock surfaces against each other, generally as a result of faulting) fractures generally were not observed. However, one slickensided face was observed in a fracture in RY-RB-02 and slickensided fracture faces were observed in RY-RB-03. Although slickensided features can be an indication of vertical shearing, the observation of isolated sheared areas is not cause for concern for the repository site. An oxidized sulfide ore layer was observed in RY-RB-03 (7 feet to 11.5 feet bgs), which could create ARD if exposed. RY-RB-03 also contained metalliferous veinlets and veins likely associated with the Combination Vein that extends into the proposed repository area (Figure 3-3). The bedrock was also observed to have poorer rock quality within

brownish yellow-colored layers. The brownish yellow color appears to indicate that these layers have been subjected to alteration and stresses that decrease the rock quality of the layers and allow groundwater to flow through preferential flow paths (i.e. the fractures).

Detailed evaluation of the bedrock cores for each borehole are provided in Appendix D. These evaluations include the overall bedrock quality in terms of the RQD and the RMR parameters (number of joints, joint roughness, and degree of alteration) over various depth intervals for each borehole. Some of these intervals extend over tens of feet; however, the RQD and RMR values, as well as photographs of the core, are shown every few feet on the core drill logs (Appendix D). Review of the core drill logs and the Tunneling Quality Index grading system (Appendix G), in parallel with the core evaluations aids in the understanding of the bedrock quality descriptions. An assessment of the suitability of the area for a repository, based on the bedrock quality, is provided in Section 4.1.1.

3.4.4 Groundwater

The presence or absence of groundwater or perched water was noted during the installation/excavation of test pits, boreholes, and monitoring wells in the proposed repository area. A summary of groundwater-related information corresponding to these subsurface investigations is provided in Table 3-12. Groundwater has not been observed during subsurface investigations, with the exception of a small seep in test pit RY-SS-04, minor infiltration (less than 1 gpm) in boreholes RY-RB-01 and RY-RB-02, and static water in monitoring well MW-RY-07. Fluid level measurements have been measured periodically in repository area monitoring wells and transducers were installed in MW-RY-07 and MW-RY-09 to continuously record groundwater levels, if any. Groundwater samples collected from MW-RY-07 in May and September 2012 were submitted for analysis of laboratory parameters and dissolved metals. Field observations of the presence or absence of groundwater, fluid level measurements, and groundwater analytical results are discussed in the following subsections.

3.4.4.1 Test Pits

As noted in Section 3.1.2, groundwater was not observed in test pits excavated during the 2012 repository investigation. Moist soils were noted in the test pits, but defined seeps from the excavation walls were not observed. Damp soils were noted throughout the full depth of test pit RY-SS-03, excavated during the 2011 RI. A wet soil zone was observed at 2.75 feet bgs in test pit RY-SS-04, also excavated during the 2011 RI. This test pit is located north of the northern perimeter of the proposed repository along the overhead power line road. Another, unnamed test pit was excavated during the 2011 RI between test pit RY-SS-04 and monitoring well MW-RY-07. The wet zone encountered in RY-SS-04 was confirmed in this unnamed test pit (Herrera/Trihydro 2012a).

3.4.4.2 Boreholes

Groundwater was only observed while coring boreholes RY-RB-01 and RY-RB-02. While coring RY-RB-01, groundwater slowly infiltrated into the borehole at a depth of approximately 38 feet bgs. During coring of RY-RB-02, groundwater slowly infiltrated the borehole at depths ranging from approximately 30 feet to 43.5 feet bgs. In both boreholes, the groundwater flow into the boreholes was estimated at less than 1 gpm. The boreholes were backfilled immediately after coring and a static water level was not measured.

3.4.4.3 Monitoring Well Fluid Levels

Three shallow monitoring wells (MW-RY-06, MW-RY-07, and MW-RY-08) were installed in August 2011 as part of the RI to investigate shallow groundwater, if any, in the proposed repository area. A fourth, deeper monitoring well (MW-RY-09) was installed during January 2012 to evaluate separation of the base of the proposed repository area from groundwater. Monitoring wells MW-RY-06 and MW-RY-07 are screened from 3 to 13 feet bgs, MW-RY-08 is screened from 3 to 9 feet bgs, and MW-RY-09 is screened from 10 to 30 feet bgs (Herrera/Trihydro 2012a). Groundwater was not detected during drilling, immediately following completion of the wells, or during subsequent monitoring in November 2011. Transducers were installed in MW-RY-07 and MW-RY-09 in January 2012.

Groundwater was not detected in monitoring wells MW-RY-06 or MW-RY-08 during fluid level monitoring events in April and September 2012. Groundwater also has not been detected in MW-RY-09 during fluid level monitoring events or in transducer data collected between January 2012 and April 2013.

While groundwater was not observed in MW-RY-07 immediately following installation in August 2011 or in November 2012, groundwater has been detected in subsequent fluid level measurements. The fluid level in MW-RY-07, based on transducer readings from January 2012 through April 2013, is shown on Figure 3-4. This figure also includes fluid levels noted during field monitoring events in April and September 2012. The transducer reading is approximately 0.2 feet higher than the gauged fluid level, which could be due to inaccuracy in the stated transducer depth or inaccuracies with the field water level meter. The elevations shown on the figure are approximate, as the well has not been surveyed. The top of casing for the well is approximately 3 feet above the ground, so the depth to water below ground is approximately 3 feet less than the depth to water relative to top of casing shown on Figure 3-4 (e.g., on May 2, 2012, the depth to water was approximately 10.04 feet bgs).

Approximately 3 feet of water was detected in MW-RY-07 during fluid level gauging on May 1, 2012. As discussed in the RIWP, the fluid level in MW-RY-07 had increased slowly and linearly, and did not appear to indicate a response to snowmelt or runoff. The increase in fluid level could be a result of groundwater flowing on top of a clay layer that was encountered from 4 to 9 feet bgs (Herrera/Trihydro 2012b).

Groundwater levels in MW-RY-07 have ranged from approximately 12.0 feet bgs to 8.7 feet bgs. Groundwater was measured at 11.86 feet below top of casing (btoc) or approximately 8.86 feet

bgs in MW-RY-07 on September 6, 2012. The groundwater level measured in MW-RY-07 in September 2012 is approximately one foot higher than the level measured in May 2012. Because the well was bailed during sampling in May 2012, this level is indicative of groundwater flowing into the well between May and September 2012. Groundwater may be flowing into the well from a zone above the measured groundwater level. The groundwater level in the well may be a function of the seasonal recharge within this water-producing zone and the lower permeability of the underlying zones. If this is the case, groundwater is able to seep into the well above the measured water level faster than it is able to seep back out of the well in the underlying, lower permeability zone. The groundwater level in MW-RY-07 should not be perceived as a typical static groundwater level in the repository area.

Precipitous decreases in the groundwater levels shown on the plot of transducer data reflect bailing associated with sampling events (Figure 3-4). The reason for the increase in groundwater level of 0.87 feet on October 16, 2012 is unclear at this time. There was no obvious physical damage to the well or the transducer system during the downloading of data in April 2013 that might explain the increase. There was a local precipitation event of approximately 0.3 inches between October 16th and 17th, 2012, but similar precipitation events experienced at the site did not result in similar jumps in water level.

The fluid level in the well slowly decreased from October 2012 through April 2013. The most likely explanation is that seepage out of the well exceeds the inflow into the well over the winter season when the inflows are probably lower than experienced from May through September. Increases in fluid level would be expected with the onset of spring snowmelt and recharge of the water bearing zone above the noted clay layer.

3.4.4.4 Analytical Results

Samples were collected from groundwater in MW-RY-07 in May and September 2012, and submitted for analysis of laboratory parameters and dissolved metals. Analytical results are compared against the Circular DEQ-7 HHS for groundwater in Table 3-13. Laboratory reports are included in Appendix E2.

Metals were not detected in the groundwater samples above the HH standards, except for manganese. The detected manganese concentration exceeded the HH standard (50 micrograms/liter [µg/l]) in both the May (737 µg/l) and September (100 µg/l) samples. The concentration in the sample collected during September was lower than in the sample collected in May, but as these are the first two groundwater samples collected from the well it is not possible to determine if a concentration trend exists. The detected manganese concentrations were substantially higher than the range of manganese concentrations in samples collected from the downslope surface water sample location MCSP-1. Concentrations in surface water samples collected from this location have ranged from non-detect at a reporting limit of 5 µg/l (May 1998) to 15.4 µg/ (June 2011).

Table 3-13. Repository Area Groundwater Analytical Results, Black Pine Mine

Location	Date Sampled	Units	Hardness as CaCO3	Sulfate	Acidity	Alkalinity to pH 4.5, Total	Antimony	Arsenic	Barium	Cadmium	Calcium	Chromium	Copper
Circular DEQ-7 HHS[a]		µg/l	NS	NS	NS	NS	6	10	1,000	5	NS	100	1300
MW-RY-07	5/03/2012	µg/l	68,400[b]	51,000	14	42	**ND (20)**	**ND (20)**	53	ND (2)	NA	ND (10)	ND (10)
MW-RY-07	9/07/2012	µg/l	84,000	71,000	NA	NA	ND (1)	ND (1)	70	ND (0.08)	21,000	ND (5)	ND (5)
MW-RY-07 Duplicate	9/07/2012	µg/l	83,000	74,000	NA	NA	ND (1)	ND (1)	70	ND (0.08)	21,000	ND (5)	ND (5)

Location	Date Sampled	Units	Iron	Lead	Magnesium	Manganese	Mercury (Dissolved)	Mercury (Total)	Nickel	Potassium	Silver	Sodium	Zinc
Circular DEQ-7 HHS[a]		µg/l	300	15	NS	50	2	NS	100	NAP	100	NAP	2,000
MW-RY-07	5/03/2012	µg/l	ND (50)	ND (3)	NA	**737**	ND (0.2)	0.27	ND (20)	NA	ND (10)	NA	1.25
MW-RY-07	9/07/2012	µg/l	70	ND (1)	8,000	**100**	ND (0.1)	NA	ND (5)	3,000	ND (1)	17,000	50
MW-RY-07 Duplicate	9/07/2012	µg/l	ND (30)	ND (1)	8,000	**87**	ND (0.1)	NA	ND (5)	3,000	ND (1)	17,000	40

µg/l – micrograms per liter
NS – A standard has not been adopted
NA – Not Analyzed
ND () – Analyte was not detected (reporting limit)
(a) Human Health Standards (HHS) for Groundwater, Circular DEQ-7, Montana Numeric Water Quality Standards (DEQ 2012)
(b) Total Hardness
Bold, highlighted values exceed HHS values
Laboratory reported values in mg/l have been converted to ug/l for this table

Antimony and arsenic were not detected in samples collected in May and September 2012. However, the reporting limit for both antimony and arsenic (20 µg/l) for the May 2012 sample was higher than the HSS standards (6 µg/l and 10 µg/l, respectively).

Sulfate and acidity levels are relatively low and the field-measured pH of approximately 6.5 is in the neutral range. These results suggest a low likelihood for significant ARD within the current water-bearing zone. However, alkalinity is also low, which suggests that there is relatively low buffer capacity available if conditions were to change.

3.5 Field Quality Assurance/Quality Control Samples

The project team collected the following quality assurance/quality control (QA/QC) samples during the Repository Investigation:

- Two equipment rinsate blank samples for total recoverable metals, one from a spoon and the second from an excavator bucket.
- An aqueous field duplicate sample (Field Duplicate) of sample MW-RY-07.

Duplicate samples of debris for TCLP analysis, or samples of tailings, soils, and sediments for analysis of total recoverable mercury were not specified in the RIWP and were not collected. Duplicate samples, which are not typically collected for geotechnical testing, also were not proposed in the RIWP, and were not collected during the repository investigation.

The project team collected equipment rinsate blank samples from a soil sampling spoon and an excavator bucket as described in Appendix A. The samples were submitted for analysis of total recoverable metals, including Antimony, Arsenic, Barium, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Mercury, Nickel, Silver, and Zinc. The results are included in the groundwater laboratory report in Appendix E2. There were no detections of total recoverable metals, including mercury, in the spoon rinsate blank. There were isolated detections of total recoverable metals in the excavator bucket rinsate blank at or near the reporting limit. However, mercury was not detected in the excavator bucket rinsate blank. These blank detections did not affect the total recoverable mercury results.

Field precision is one criterion for evaluation of data quality. Precision is the measure of variability between sample measurements and is used to evaluate the reproducibility of the analytical data. Relative percent difference (RPD) between field duplicate pairs is used as the measure of precision and is defined as the difference between the primary and duplicate samples divided by the mean and expressed as a percentage. The upper limit for acceptable field duplicate RPDs in water samples is 30 percent (EPA 1996). In cases where both compounds are detected at concentrations less than two times the detection limit, the precision goals are not applicable (EPA 1996). The applicable RPDs of the field duplicate sample for MW-RY-07 are shown in Table 3-14. All field duplicate RPD results were within the data validation QC limits.

Table 3-14. Relative Percent Difference for Groundwater Duplicate Sample Pair, Black Pine Mine

Location	Units	Barium	Calcium	Magnesium	Manganese	Potassium	Sodium	Zinc
MW-RY-07	µg/l	70	21,000	8,000	100	3,000	17,000	50
MW-RY-07 Duplicate	µg/l	70	21,000	8,000	87	3,000	17,000	40
Relative Percent Difference	**percent**	**0**	**0**	**0**	**13.9**	**0**	**0**	**22.2**

µg/l – micrograms per liter

Based on the evaluation, the data are acceptable for use in the repository investigation.

4.0 Repository Evaluation and Preliminary Design

4.1 Geology, Hydrogeology, and Mine Workings

The geology and hydrogeology of the proposed repository area appear suitable to support development of a repository. Similarly, the underground mine workings in the area do not appear to affect the suitability of the site, although they will be considered during design of the repository.

4.1.1 Geology

4.1.1.1 Bedrock

Normal faults have been noted in the mine area and near the proposed repository area (Figure 4-1), but are obscured at the surface. This characteristic suggests that either the faults have been inactive for a significant period, allowing soil to develop over them, or the faults do not extend to the surface. The displacements of these faults are considered to be minimal (Herrera/Trihydro 2012b). No apparent indications of fault activity have been observed during field investigations in the repository area.

There are five noted normal faults in the BPM area (Herrera/Trihydro 2012b). The closest normal fault to the proposed repository location is the Mill Gulch normal fault that bounds the repository area to the north and created Mill Gulch. The Mill Gulch normal fault is oriented northwest to southeast and is located about 240 feet north of the proposed repository area. A series of normal faults are also located to the south of the proposed repository area. The closest of these faults is the Betsy Cook fault that is located 2,000 feet to the south of the proposed repository area.

No rock outcrops are in the proposed repository area, although bedrock is shallow along the southern and southeastern edges. Based on interpretation of test pit and borehole logs, the proposed repository area is situated at the upper end of a glacial bowl filled with glacial till. The nature of the glacial till was discussed in Section 2.2.3.1. The southern and southeastern hillsides of the bowl are relatively steep with thin soil cover overlying highly weathered and weathered bedrock, as observed in test pits RY-SS-13 and RY-SS-14. The depth to bedrock in RY-RB-01, RY-RB-02, RY-RB-03, and RY-RB-05 ranged from 4 feet to 16 feet bgs indicating that these boreholes were situated on the rim of the glacial bowl. These conditions were confirmed by conditions encountered in test pits RY-SS-06, RY-SS-08, and RY-SS-09 where the excavator met refusal at 7 feet bgs. In contrast, the depth to bedrock in RY-RB-04 was 120.5 feet bgs. Bedrock was not encountered in test pits RY-SS-10, RY-SS-12, or RY-SS-15 at the maximum reach of the excavator (17 to 17.5 feet bgs). Observations of the depth to bedrock in the area around RY-RB-04 supports the assertion that the bedrock may have been subjected to glacial processes in the past.

During bedrock coring, the layers of bedrock were not observed to repeat within borehole locations. This is an indication that the bedrock underlying the site is not thrust faulted (low angled faults that create repetition of beds with depth in a borehole). However, some fault or crushed rock zones were observed. The boreholes were also observed to have poorer rock quality within the brownish yellow-colored layers. The brownish yellow color appears to indicate that these layers have been subjected to alteration and stresses that decrease the rock quality of the layers and allow groundwater to flow through preferential flow paths (i.e. the fractures).

Bedrock quality improves with depth. Roughly, half of the fracture faces are planar and the other half is undulating. The fractures are angular and fragments lock together to keep the bedrock in place. As long as extensive lengths of bedrock are not exposed, bedrock sliding is not expected to occur. As the depth to bedrock appears to increase to the northwest and downslope in the glacial bowl, bedrock sliding is not anticipated to be a factor. On the northern end of the proposed repository, near RY-RB-03, the oxidized ore zone should remain covered to avoid ARD and raveling of the rock.

4.1.1.2 Soils

Some areas of the proposed repository are covered by waste rock from the Harrison and Harper shafts. The waste material was characterized as loose to dense, yellowish brown, dry to moist, silty gravel with fine to coarse sand and angular cobbles and some organics. Surface waste material was observed to a depth of up to 7 feet bgs in test pit RY-SS-07, which was in a sunken area near the Harrison shaft. Waste material was also locally observed in RY-SS-08 (0 feet to 1.33 feet bgs) and RY-SS-15 (0 feet to 1 foot bgs). Waste rock was not observed in RY-SS-06. Of the three test pits (HM-RS-01, HM-RS-02, and HM-RS-03) and one monitor well (MW-RY-06) installed in the proposed repository area during the RI, waste rock was only noted in HM-RS-03 to a depth of 1.33 feet bgs.

The surficial soil over the glacial till soils is colluvium derived from the weathering and transport of adjacent outcropping rocks. Colluvium was generally found as a 3 to 10-foot thick surface layer throughout the proposed repository area and characterized by its tan or grayish brown color. Tan to brownish gray, dry to moist, slightly silty to silty gravel with fine to coarse sand and cobbles (GP-GM, GM); silty fine to coarse sand with gravel and cobbles (SM); and gravelly silt with fine to coarse sand and cobbles (ML). The gravels and cobbles were angular to subangular. Standard penetration test (SPT) blow counts for this material in boreholes MW-RY-06, MW-RY-07, and MW-RY-08 varied from 10 to 27 indicating a loose to medium density (Herrera/Trihydro 2012a).

Glacial till deposits comprised the bulk of the overburden soils in the northwestern portion of repository area. Glacial till deposits were generally characterized by their orange brown or reddish brown color. They tended to be moist, clayey or silty gravel with fine to coarse sand and few cobbles (GC, GM); orange brown, gravelly clay (CL) with fine to coarse sand with few to some cobbles. Average SPT blow counts for glacial till in each borehole (MW-RY-06, MW-RY-07, and MW-RY-08) varied from approximately 30 to 50 blows per foot, which

indicated a dense consistency for the GC/GM soils. The SPT blow counts in clayey (CL) materials varied from 15 to 30 indicating stiff to very stiff consistency and soil that was heavily over-consolidated by the weight of prior overburden soils and/or glacial ice.

Suitability of soils in the repository area for construction of a repository are discussed in Section 4.6.

4.1.2 Hydrogeology

Literature research during development of the RIWP did not identify publications related to groundwater at the BPM. However, siting of the repository depends more on the presence and depth to shallow groundwater than on deep or regional groundwater typically described in geologic references.

The monitoring wells present in the proposed repository area and their completion intervals were described in Section 3.4.4.3. As previously mentioned, groundwater was not detected during drilling, immediately following completion of the wells, or during subsequent monitoring in November 2011. No groundwater has been detected in monitoring wells RY-MW-06, RY-MW-08, or RY-MW-09 to date. Up to 4.2 feet of water has been detected in MW-RY-07 (Figure 3-4). Based on transducer measurements, the fluid level appears to increase slowly and linearly following bailing of water from the monitoring well and is not suggestive of a response to snowmelt or runoff. The increase in fluid level could be a result of groundwater flowing on top of a clay layer that was encountered from 4 feet to 9 feet bgs in MR-RY-07 (Herrera/Trihydro 2012b).

During the RI, a shallow seep (2.75 feet bgs) was encountered in test pit RY-SS-04 along the northern perimeter of the proposed repository area. No indications of groundwater were observed along the southern perimeter of the proposed repository, although soils were observed to be damp throughout the entire depth of the single test pit (RY-SS-03) excavated in this area. Seeps were not encountered in waste characterization test pits excavated within the Harper and Harrison Shaft waste rock areas. Approximately 900 to 1,200 feet to the northwest of the repository, groundwater surfaces in the form of a spring forming the headwaters of Mill Creek, which flows into South Fork Lower Willow Creek (Figure 2-9).

As discussed in Section 3.4.4.2, while drilling rock boreholes RY-RB-01 and RY-RB-02, groundwater was observed to be slowly infiltrating into the boreholes at 38 and 30 feet bgs, respectively. In RY-RB-01, the groundwater was observed at the base of a fault zone that was encountered from 34.5 to 38 feet bgs. In addition, the brownish yellow zones of bedrock were observed to generally be more fractured than the brownish pink bedrock layers and appear to be the water bearing zones.

The depth to groundwater in the bedrock observed while drilling, approximately 30 feet bgs, is deeper than anticipated depths (approximately10 feet to 15 feet bgs) of excavation for preparing the repository base. Perched zones of groundwater may be encountered in the glacial till zones

and should be expected. These perched zones may require sumps for dewatering during repository construction, as well as permanent subsurface drains, interceptor trenches, or sumps.

4.1.3 Mine Geology and Underground Mine Workings

One of the data gaps identified in the RIWP to be partially addressed by boring at the proposed repository was whether shallow or unknown mine workings may be present in the proposed repository area. Mine workings or significant voids were not observed in the boreholes advanced during this investigation. However, only five boreholes were advanced and their locations could have missed shallow underground workings. Test pits targeting the Harrison shaft did not encounter subsurface signs of the shaft. There is an approximately 12-foot by 12-foot sunken area in the location of test pit RY-SS-07, but the test pit excavated within this area did not reveal signs of the shaft. This shaft appears to have been filled or caved in; although, as with the boreholes, the test pit excavations could have missed the actual shaft location.

Historical underground mine workings are known to extend underneath the proposed repository. The depth of these workings, based off a review of historic mine maps, appears to vary between 123 feet bgs (near the Harper Shaft) and 410 feet bgs (near the Lewis Shaft), deeper than the target borehole depths. Significant efforts were expended during the RIWP to identify, map, and georeference the mine workings. The following discussion of those findings is from the RIWP (Herrera/Trihydro 2012b).

The host rock in the BPM is Member 2 of the Mount Shields Formation, a pink to red and tan quartzite with shale and argillite zones. Of the four known veins at the BPM, the main ore vein that was developed and mined was the Combination Vein. This vein is also the closest of the four veins to the proposed repository area. The vein orientation strikes north to N 40° W and dips 15º to 22º southwest (Waisman 1985). The Combination Vein is located in a thrust fault that cuts the near horizontal quartzite bedding at an angle of 10º to 15º and cuts through over 320 feet of quartzite within the mine. Mining followed the orientation of the vein. The vein structure is composed of quartz and sulfide minerals that form interconnected vein segments that range in combined thickness between 1 foot and 8 feet (Waisman 1985). There were no indications of recent fault activity observed at the surface, within the mine's main decline drift, or noted in pertinent databases or literature reviewed as part of developing the RIWP.

During preparation of the RIWP, the project team georeferenced selected high-resolution, historical underground mine workings maps in relation to project data using Geographic Information System (GIS) and Computer Aided Design (CAD) software packages. The maps included detailed mapping for the Combination Mine and Tim Smith Mines, as well as less-detailed historical mapping for the Harper Shaft and Harrison Shaft areas. A comprehensive model of the BPM area was constructed to evaluate mine workings relative to surface features and potential repository footprints. Figures illustrating the approximate location of underground mine workings relative to surface features in the proposed repository area are included in Appendix H. Discussion of the individual mine maps and the georeferencing approach is provided in the RIWP (Herrera/Trihydro 2012b).

As described in historical literature and observed through review of historic mine maps, the BPM is comprised of underground mines developed through a room and pillar mining method. The main Combination Mine decline drift extends northwest approximately 3,280 feet along the Combination Vein and extends westward and into the southern and central portions of the proposed repository area (Figure 3-1). The proposed repository area appears to be undermined along the southern edge, following a line running west to east from the Lewis Shaft to the Harper Shaft. These historical workings extend approximately 100 to 300 feet into the southern portion of the proposed repository area. In the vicinity of the Lewis Shaft, the mine workings appear to be approximately 410 feet bgs. The first level of mine workings near the Harper Shaft appears to be 123 feet bgs. A portion of the underground workings extend through the southeast corner of the repository area, under the power line, and to within approximately 200 feet of Mill Creek. Underground mine workings in the repository area are also located along the east side of the power line running to the Combination Mine (Figures 1 through 3 in Appendix H).

4.2 Preliminary Waste Material Evaluation

BPM is comprised of a variety of mining impacted lands including tailings impoundments, waste rock piles, mine adits and shafts, and fluvially deposited mine tailings and mill deposits. Site assessments and preliminary investigations at the BPM began in 1981 and continued periodically prior to the ASARCO bankruptcy. Following the ASARCO bankruptcy in 2009, DEQ compiled assessment and investigation data as well as other site records and conducted a data gap analysis. The RI was completed in 2011 to further characterize mine wastes, delineate extent of wastes, and develop estimated quantities of wastes located at the BPM. During the RI, a total of 283 samples were collected across the four AOCs, including samples of soil, sediments, tailings, waste rock, building materials, surface water, and groundwater. Samples were analyzed for field and laboratory parameters, metals, geotechnical properties, asbestos, agronomic properties, and ABA (Herrera/Trihydro 2012a). The results of these analyses were used in developing human health and ecological risk assessments, identifying areas of contamination, assessing the potential for acid generating material, and assessing revegetation properties.

Historical sampling results were confirmed by the sample results and observations from the RI. Elevated levels of antimony, arsenic, cadmium, copper, iron, lead, mercury, and manganese have been found in tailings and waste rock samples. Surface water and groundwater samples have shown elevated levels of antimony, arsenic, cadmium, copper, iron, lead, manganese, mercury, and zinc. Sediment samples have shown elevated levels of antimony, arsenic, cadmium, lead, and mercury. A more detailed discussion of the sampling and results are presented in the RI Report (Herrera/Trihydro 2012a).

Additional waste samples from the Combination Mine AOC and the Combination Mill AOC were collected and submitted for geotechnical testing and evaluation as part of the repository investigation. The additional investigation was completed to determine geotechnical properties of the waste materials that are needed to design the repository and the waste handling and placement. As stated in the RIWP, improperly handled wastes can cause slope failures, lead to

settlement, or increase leachate generation. The sample locations and test results are presented in Sections 2.2.1 and 3.2.3, respectively.

4.2.1 Waste Material Quantities

The extents of metals-impacted, solid-media wastes were developed based on analytical results from the RI and historical sampling at the BPM. Depths of materials determined through test pitting and previous monitoring well installations were used in conjunction with the aerial extents of impacts and Light Detection and Ranging (LiDAR) topographic mapping to estimate waste volumes. As much as 420,000 cy of metals-impacted solid-media wastes are estimated to be present at the BPM (Table 4-1). A large portion of the estimated waste volume is associated with the Combination Mine waste rock pile. Other waste materials include impacted soils from the Combination Mine Soils Removal Areas; waste rock from the Tim Smith and Historic Mine AOCs; and tailings, impacted soils, and impacted sediments from the Combination Mill AOC, including the historic reprocessing area on USFS lands and downstream along South Fork Lower Willow Creek.

Table 4-1. Estimated Impacted Waste Volumes, Black Pine Mine

Impacted Waste Location	Estimated Volume (cy)[(a)]
Combination Mine Waste Rock Pile	231,200
Combination Mine Soils Removal Areas	5,000
Tim Smith Waste Rock Dumps at Tim Smith No. 1 and No. 2 Adits	22,650
Combination Mill Sediments, Soils, and Tailings Impoundments	126,900
South Fork Lower Willow Creek Stream Sediments	21,100
Historic Mine Area Waste Rock Areas	13,350
Total	**420,200**

cy – cubic yards

(a) Quantities are preliminary; estimates will continue to be refined during design.

The estimated waste volumes presented in Table 4-1 were updated from the volumes included in the RI (400,000 cy) based on refined calculations completed as part of the repository investigation. The waste volumes will continue to be refined as additional information is collected and during design of the repository.

4.2.2 Waste Material Handling

Segregation of the coarser material will occur when end-dumped into the repository. Waste materials should be mixed at the repository to avoid material segregation and then spread in 12-inch loose lifts and compacted to 95% of standard Proctor maximum dry density. Handling procedures specific to each type of waste are discussed below in the following subsections.

4.2.2.1 Waste Rock

The waste rock collected from the Combination Mine waste rock pile is characterized as cobbly gravel (GP) to silty gravel with cobbles (GM). The natural moisture content of the samples submitted for testing (2 to 5 percent) were slightly drier than the optimum moisture content (7 percent) determined through standard Proctor testing. Placing the waste materials at moistures contents slightly drier than optimum moisture may be desired to reduce the quantity of leachate material that is generated from pore water being released due to compacting and /or settlement of the wastes in the repository. Therefore, moisture conditioning may only be required for a portion of the waste rock.

Geotechnical testing was previously completed for waste rock samples collected from the Harrison, Harper, and Tim Smith No. 1 Adit waste rock areas during the RI. The results are presented in Tables 7-8 and 7-9 in the RI Report. A summary table of the geotechnical results from the RI is provided in Appendix E5. The waste rock samples from these areas were classified as well graded gravel with silt and sand (GW-GM, Tim Smith No. 1 Adit waste rock), silty gravel with sand (GM, Harper Shaft waste rock), and clayey gravel with sand (GC, Harrison Shaft waste rock) (Herrera/Trihydro 2012a). The natural moisture content of the waste rock from the Tim Smith mine was not reported by the laboratory (the laboratory inadvertently overlooked the test for the this sample). However, the natural moisture contents for the sample from the Harper Shaft (10.5 percent) and the Harrison Shaft (16.1 percent) were higher than their respective optimum moisture content (7.8 percent and 12.8 percent, respectively). These materials should be dried or mixed with drier materials prior to or during placement in the repository.

4.2.2.2 Tailings

The tailings collected from the Combination Mill tailings impoundments are characterized as clayey gravel (GC), silty sand (SM), and clayey silt (CL-ML). Samples collected from the former reprocessing area are characterized as lean clay (CL). The natural moisture content of the samples submitted for testing (4 to 7 percent) were drier than the optimum moisture contents (12 to 20 percent). The exception was sample CML-GT-08, collected from the reprocessing area tailings located on USFS administered lands, which had a natural moisture content of 60 percent. A standard Proctor was not run on this sample.

In the condition represented by the samples, the tailings materials could be loaded in a haul truck without drying, physical stabilization, or liners. Most of the samples were drier than optimum, and; therefore, would require moisture conditioning by wetting and mixing to achieve proper compaction. However, the waste materials had been allowed to dry for two days in an attempt to reduce mercury concentrations before samples were collected. The samples were also collected in September during the driest time of the year. Depending on the timing of waste excavation in these areas, materials may be wetter than the samples collected during September and may not require wetting. Other materials in the area, such as the material represented by sample CML-GT-08 and impacted materials in the lower tailings horizons may be wetter or saturated and may degrade to a slurry when excavated and hauled to the repository. These tailings may require dewatering prior to loading and hauling to the repository and/or mixing with drier

materials or lime to reduce the moisture content for proper compaction. Also, as stated for the Combination Mine waste rock pile, placing materials at slightly drier than optimum may be desired to reduce leachate generated by waste placement and compaction.

Soil moisture results from analytical testing performed on samples collected during the RI will be used, in combination with the results discussed above, during development of waste handling procedures as part of the repository design. Soil moisture results for tailings collected during the RI ranged from 8.2 percent (CML-TS-07, collected between 2 and 4 feet bgs) to 40.1 percent (CML-TS-01, collected between 2 and 4 feet bgs). As described above, some materials from the Combination Mill AOC may require the addition of moisture to achieve proper compaction, while other materials may require stabilization or drying.

4.2.2.3 Stream Sediments

The stream sediments along South Fork Lower Willow Creek consist of predominantly non-plastic silts (ML) and silty fine sands (SM). The natural moisture content of the samples submitted for testing (3 to 16 percent) were drier than the optimum moisture contents (18 to 24 percent). In their present condition, these soils can be hauled without lining or stabilization. Similar to the tailings samples, these materials would require moisture conditioning by wetting and mixing to achieve proper compaction. However, these samples were also allowed to sit exposed to the air to allow mercury vapors to dissipate prior to sample collection. The materials are expected to be wetter than represented by the samples. As described for the tailings samples, soil moisture results from analytical testing performed on samples collected during the RI will also be used during development of waste handling procedures as part of the repository design. Soil moisture results for sediment samples collected during the RI ranged from 15.2 percent (CML-SD-01, collected at the surface) to 67.7 percent (CML-SD-04, collected at the surface).

Sediments located closer to or in the South Fork Lower Willow will likely be saturated and will degrade to a slurry when excavated and hauled to the repository. These materials may require dewatering prior to hauling to the repository and would require drying or mixing with lime to reduce the moisture content for proper compaction.

4.2.3 Waste Material Placement

Long term, stable embankment slope angles for waste materials placed in the repository will vary depending on the type of waste material and the material forming the base of the repository. For sandy gravels (GP), slightly silty gravel with sand (GP-GM), and silty gravels with sand (GM) soils, wastes should be placed at a slope angle of 2 feet horizontal to 1 foot vertical (2H:1V) or flatter. Waste fill slopes comprised of clay, gravelly clay or clayey gravel should be sloped at 3H:1V or flatter. All materials should be moisture conditioned as discussed above and compacted in lifts no greater than 12-inches.

Final waste placement slopes will be developed during the repository design based on refinements to the repository configuration and design of the repository bottom.

4.3 Compliance With ARARs

ARARs for the repository are either "applicable," in which case state and federal laws and regulations directly address site standards, or are "relevant and appropriate," in which case statutory or regulatory requirements are determined to address problems sufficiently similar to those encountered at the site. If requirements are determined to be relevant and appropriate, they must be complied with as if applicable. Determinations are guided in part by factors set forth in 40 CFR § 300.400(g). ARARs for the repository are further separated into chemical-specific, location-specific, and action-specific categories.

Chemical-specific ARARs are typically health, technology, or risk-based standards limiting the concentration of relevant chemicals and compounds. They typically set numerical action values based on human or environmental risk-based criteria as applied to site-specific conditions. These guidelines define permissible concentrations of chemicals for soil, surface water or groundwater. Wells and transducers were installed to identify groundwater at the repository, and water samples were analyzed for metals from the wells. These groundwater samples will be used as baseline samples for future monitoring of the repository. Surface water samples collected from seeps and Mill Creek will also be used for baseline conditions.

Location-specific ARARs relate to the geographic or physical position of the site and restrict concentrations of hazardous substances or the conduct of cleanup activities due to their location in the environment. They provide guidelines for proximity of the repository to wetlands, floodplains, and faults and seismic areas. Literature review, field reconnaissance, and subsurface investigations were performed to check compliance of the proposed repository with guidelines identified as location-specific ARARs.

Action-specific ARARs are technology- or activity-based requirements or limitations on hazardous substance handling, and are not typically determinative of the chosen alternative, but instead indicate how the selected alternative should be carried out. Action-specific ARARs provide design criteria for the repository. Action-specific guidelines that are applicable to the repository design include the following criteria:

- Design Requirements (Administrative Rules of Montana [ARM] 17.50.1204) – requires that solid waste facilities do not impact groundwater or exceed groundwater standards at a relevant point of compliance.

- Closure Criteria (ARM 17.50.1403) – requires that solid waste facilities install a final cover system to minimize infiltration and erosion. The final cover system must be designed to have a permeability no greater than the permeability of the bottom liner system or natural subsoils present, or a permeability no greater than $1x10^{-5}$ centimeters per second (cm/sec), whichever is less. This criteria also requires that infiltration is minimized by the use of an infiltration layer that contains at least 18 inches of earthen material, and minimize erosion of the final cover by the use of an

erosion layer that contains at least 6 inches of earthen material that is capable of sustaining native plant growth. DEQ may approve alternative final cover designs.

- Post-Closure Criteria (ARM 17.50.1404) – requires that solid waste facilities maintain the integrity and effectiveness of any final cover system and monitor the groundwater in accordance with the requirements of ARM 17.50.13.

- Variance (MCA 75-10-206) – the Solid Waste Management Board may grant a variance from the rules adopted by the DEQ if it finds that failure to comply with the rules does not result in a danger to public health or safety, and compliance with the rules from which a variance is sought would produce hardship without producing benefits to the health and safety of the public that outweighs the hardship.

A full list of ARARs for the proposed repository is presented in Table 4-2. The repository design will comply with requirements that are applicable or relevant and appropriate. In some instances, a variance may be requested based on consideration of site conditions and controls.

4.4 Surface Conditions

Observations presented in Section 3.1 indicate that the surface conditions in the proposed repository area would not limit development of a repository. There are several features, discussed in the following subsections, which should be considered if development of a repository is selected as the preferred alternative in the EE/CA.

4.4.1 Infrastructure

Infrastructure within or immediately adjacent to the proposed repository area that could be impacted by construction of a repository include the closed Harper Shaft, overhead power lines that run to the Combination Mine and the Lewis Shaft/Tim Smith Mine, debris from the Harrison Shaft, and USFS Road 678 (Figure 2-9). Considerations for these features include:

- Harper Shaft – The Harper Shaft, located along the southeast edge of the proposed repository, has been sealed with a concrete plug. However, the configuration, condition, and bearing capacity of the closure are unknown. The shaft is currently outside of the proposed repository footprint. Alternatives to the proposed footprint should maintain the shaft outside of the footprint. Likewise, activities associated with construction of the repository should avoid the shaft area. No construction equipment, haul trucks, or support vehicles should be allowed to drive over the closure. Rerouting, if undertaken, of USFS Road 678 should also avoid the Harper Shaft.

- Overhead power lines – There are two overhead power lines near the proposed repository area. The power line located along the northwest (downslope) edge of the repository area supplied power to facilities at the Tim Smith Mine and the Lewis Shaft. While these facilities are currently inactive, the power lines are considered an

asset and could be used for future site activities. The second power line, located along the northeast edge of the repository area supplies power to the Combination Mine area. Power is currently used at the Combination Mine to support the pumpback system and provide power to the Combination Mine Northern Building.

- Two of the possible layouts for Repository Area 2 presented in the RIWP (Layout 2 and Layout 3) would have impacted the power lines and required rerouting or reconstruction of a portion of the lines. The repository layout presented in this report (corresponding to Layout 4 in the RIWP) avoids conflicts with the power lines. However, activities associated with development of the proposed repository, including borrow area development and temporary or permanent rerouting of USFS Road 678, may require work under or alongside the power lines. These activities can be completed in a manner to avoid conflicts with the power lines, but will require coordination with the power company.

- Harrison Shaft – The Harrison Shaft is located in the center of the proposed repository and will be disturbed by construction of a repository. Remaining building and foundation debris will need to be removed and disposed of offsite due to the presence of asbestos containing grout. This work will require certified asbestos personnel.

  Three test pits, including test pit RY-SS-07 (Figure 3-2) and two unnamed, exploratory test pits, were excavated during the repository investigation near rubble associated with the Harrison Shaft. A field sketch of these test pits relative to the rubble is provided on the RY-SS-07 test pit log in Appendix B. The test pits did not encounter the shaft collar. However, based on comments received from the USFS on the Draft RIR, the location of test pit RY-SS-07 was in the shaft closure. According to the USFS, the shaft collapsed and then was backfilled by ASARCO in 2002. The USFS believes that the debris encountered in test pit RY-SS-07 is part of the shaft backfill (USFS 2013). The remnants of the shaft are likely to be uncovered with excavation of the proposed repository bottom. Depending on the condition of the material in the shaft, if encountered, an engineered closure may be appropriate. This closure would likely require over-excavation of existing backfill material and construction of a reinforced concrete plug.

- USFS Road 678 – USFS Road 678 runs along the southern edge of the proposed repository area. This road provides the primary access to South Fork Lower Willow Creek and will need to be maintained. The original layout for Repository Area 2 (Layout 1 in the RIWP) avoided disturbing the road by maintaining the proposed footprint between the road and the power lines to the north and east. However, this layout was inefficient and did not take advantage of additional storage that would be provided if the repository were set against the hillslope to the south. This layout resulted in limited storage capacity and would have resulted in construction of a mounded repository that did not tie with the surrounding topography or that required substantial over-excavation.

Development of the a repository matching Layout 4 in the RIWP (the proposed repository layout presented in this report) would provide additional storage capacity and allow the repository to better tie with the surrounding topography. However, this layout would result in constructing the repository over the portion of USFS Road 678 between the intersection with USFS Road 448 and the access road to the Lewis Shaft (Figure 2-9). The USFS was consulted and indicated they may be open to realignment of the road or reconstruction of the road across the repository, if feasible. Three alternatives for rerouting this road are described in Section 4.5.2.7. The road will also require temporary detours during construction of the repository.

Other infrastructure, as presented in Section 3.1.1, is outside of the anticipated repository area and should not be impacted by construction of a repository.

4.4.2 Seeps and Springs

Seeps and springs were identified during field investigations, as described in Section 3.1.2. However, these features are downslope from the proposed repository area, or located on the other side of a small ridge (Figure 2-9), and are not anticipated to affect the repository or to be impacted by the repository.

As discussed in Section 3.1.2 and in other sections of this report, shallow, perched water has been encountered along the northwest (downslope) limits of the proposed repository area. This water is assumed to be the result of water from snowmelt or rainstorms that infiltrates into the shallow subsurface soils and runs slowly along the top of lower permeability clayey materials. A small seep was encountered in test pit RY-SS-04, located north of the proposed repository footprint, and 3 to 4 feet of water has been consistently measured in MW-RY-07, located along the northwest limits of the proposed repository. These areas of perched water may be encountered during excavation of the repository footprint and may require installation of sumps and pumping to dewater.

These areas of perched water will also need to be considered during design of the repository as the water could interact with waste materials resulting in ARD or transport of heavy metals. The proposed repository area is located high in the drainage, near the ridgeline, reducing the amount of area draining to the footprint. A surface cap will also be incorporated into the repository design to reduce the amount of water that can infiltrate into the repository. The repository will also be graded to drain surface water off the repository surface. The repository cap and grading design will reduce the amount of water available to recharge the perched zones below the repository footprint. The repository design should also incorporate stormwater collection ditches and/or interceptor trenches along the upper perimeter of the repository. These controls can intercept and reduce the amount of surface water and shallow subsurface water that reaches the repository, further reducing the volume of water available to recharge perched water zones.

While these design considerations may reduce the amount of water in the perched zones and the likelihood for this water to interact with waste materials or leachate, they will not completely eliminate this possibility. Therefore, a bottom liner (constructed from processed onsite clayey

materials, imported clay, geosynthetic clay liner [GCL], or other geosynthetics) should be evaluated during design of the repository. The decision to include or not include a bottom liner should be made in consultation with state agencies and in consideration of ARARs, long-term maintenance concerns, and the site management approach.

4.4.3 Cover Soils and Vegetation

Construction of the proposed repository will require removal of vegetation and topsoil within the repository footprint, as well as in construction staging, material processing, and adjacent borrow areas. The proposed repository footprint covers 15.5 acres. A portion of this area, approximately 3.6 acres, is already disturbed, which reduces the net impact (11.9 acres) of constructing the proposed repository. Disturbance areas associated with ancillary construction activities in the repository area have not been defined; these will be determined during repository design. Mitigation of the disturbances associated with the repository will require a combination of approaches.

As discussed in Section 3.1.3, existing disturbed areas at the site are largely devoid of vegetation. In certain instances, this is due to metals-impacted soils or waste materials. However, in other disturbed areas the lack of vegetation is largely due to insufficient topsoil. Topsoil depths across the BPM range from 2 to 5 inches bgs. This makes borrowing topsoil difficult. Sufficient depth of topsoil must exist in borrow areas to provide material for the target area while also maintaining sufficient topsoil at the borrow area to allow for reclamation.

Re-establishment of lodge pole pine, the dominant pioneer species in the area and the species covering much of the repository area, is not suitable for the repository. While lodge pole pine can establish in drier areas and require less topsoil, woody plants could compromise the repository cap through root intrusion. Areas disturbed around the repository area could be seeded with upland grasses and planted with lodge pole pine. However, vegetation on the repository should be limited to a dense grass cover that would reduce the natural invasion of woody plants. This dense grass cover would also provide stabilization and reduce erosion. Successful grass establishment would require the placement of at least 6 inches of topsoil.

The required topsoil to establish the dense grass cover does not appear to be available within the proposed repository area. Topsoil was noted in repository test pits RY-SS-03 (24 inches), RY-SS-04 (9 inches), RY-SS-06 (3 inches), and RY-SS-11 (6 inches). The depth of topsoil in RY-SS-03 was listed in the field logs as occurring from 0 feet to 2 feet bgs, but was not distinguished from silty gravel encountered in the same interval. Additionally, the agronomic results (Section 3.4.1) for the sample collected from this location indicated the material would not be suitable for use as cover soil due to low organic content. Areas containing topsoil are also heavily treed. Clearing and grubbing of the lodge pole pine in these undisturbed portions of the repository footprint will also result in some loss of topsoil as root masses will need to be completely removed. Assuming that an average of 3 inches of topsoil can be salvaged across the undisturbed portions of the repository footprint (11.9 acres) equates to approximately 4,800 cy of salvaged topsoil. Re-spreading this topsoil across the 15.5-acre repository would result in a

uniform topsoil thickness of just over 2 inches. This would be insufficient to support the desired dense grass cover.

Additional cover soil is present in potential borrow areas identified during the repository investigation. Borrow areas BPB1A, BPB2/3, and BPB7A are each within the immediate vicinity of the proposed repository area (Figure 2-6). BPB7A abuts the repository area. The southern portion of this borrow area may serve as a source of materials for berm and liner/cap construction and likely will be disturbed by other construction-related activities. Agronomic tests were run on topsoil samples from these potential borrow areas and they were determined to be acceptable for vegetation establishment (refer to Sections 3.3.1 and 3.4.1). Available topsoil in BPB7A should be re-applied to that area if it is disturbed to obtain materials for construction of the repository. The other potential borrow areas may be needed to provide cover soils for waste area removal areas, where no onsite topsoil exists.

In consideration of the difficulty of establishing vegetation on disturbed areas at the site, the limited depth of topsoil across the potential borrow areas, and the need for topsoil from the borrow areas as part of reclaiming waste removal areas, a combination rock armor and grass cover are recommended to protect the repository cap. Use of a rock cover may require DEQ approval of a variation from the Closure Criteria (ARM 17.50.1403) ARAR, which requires an erosion layer that contains at least 6 inches of earthen material that is capable of sustaining native plant growth.

Materials from the excavation of the repository bottom can be screened and the larger material (greater than 3 inches) retained for use in construction of a 6-inch rock armor over a portion of the repository cap. This would reduce the quantity of coversoil required. The topsoil salvaged from the repository area could then be applied 6 inches deep over a smaller (approximately 6 acres) portion of the repository to increase diversity or provide buffer areas.

Due to the difficulty in reclaiming disturbed areas, construction limits should be tightly controlled, and vegetation and topsoil should be protected against disturbance where possible. Avoiding construction disturbance between the northeast and north repository perimeter (from RY-SS-08 north to RY-SS-09 and northwest to RY-SS-04, Figure 2-9) and the power lines would provide a visual buffer for a portion of the repository.

4.5 Preliminary Repository Design

A preliminary repository design was developed to facilitate review of reclamation alternatives that include waste consolidation and disposal in an onsite storage facility. The preliminary design was also completed to further assess the suitability of the site for long-term waste storage.

Preliminary design efforts included evaluating and developing a repository footprint, optimizing repository excavation depths, sizing the repository for the estimated waste quantities, determining appropriate waste material placement slopes, and developing closure grading. Design of the cover system and bottom liner was not included in the preliminary design other

than an evaluation of the suitability of onsite borrow materials. The design of cover systems, as well as refinement of the repository configuration and capacity will be completed during design of the repository should this alternative be selected for advancement during the EE/CA.

4.5.1 Repository Capacity

The estimated volume of solid media wastes to be stored in the repository is 420,200 cy (Table 4-1). The repository was preliminarily sized to store 425,000 cy, while also accounting for volumes of anticipated cap material and possible bottom liner material. The repository capacity can be increased if necessary to accommodate additional wastes or materials (e.g., lime) needed to stabilize saturated tailings or sediments.

4.5.2 Repository Configuration

Beyond compliance with ARARs and the requirement for a repository that provides for long-term waste storage with minimal operation and maintenance (O&M) requirements, one of DEQ's design criteria is that the repository blends with the surroundings. The four pre-conceptual repository layouts presented in Section 2.4 of the RIWP each represented different approaches to accomplishing meeting this criteria. These layouts are shown on Figure 4-2.

The most basic approach to blending a repository with the surrounding terrain is to construct a below grade repository. This option was reviewed during the RI and development of the RIWP, and found to have too many drawbacks. Excavation of a repository to the depths (approximately 20 feet bgs) required to store more than 420,000 cy in a 15-acre footprint (represented by Layout 1 in the RIWP) and account for a final cap system would require excavation into bedrock over portions of the repository footprint. Placing the bottom of the repository 20 feet bgs could also increase the potential for interaction with groundwater. An alternative would be to expand the repository footprint, similar to Layout 3 presented in the RIWP. However, this doubles the disturbance area (approximately 32 acres) and extends the repository closer to known seeps and springs. Both approaches also result in substantial quantities of excavated material (at least 420,000 cy) that would be beyond the volume needed to backfill waste areas (approximately 108,000 cy). The excess 300,000 cy would have to be wasted at the site.

As construction of a subsurface repository does not appear practical, repository configurations that provide partial storage below grade and blend the remaining surface storage with the surrounding terrain were evaluated. The ability of the four layouts presented in the RIWP to meet this criteria are discussed below:

- Layout 1 – This is the layout presented in the RI and is located between USFS Road 678 and the overhead power lines. This area could hold the required waste volume using both below grade and above grade storage. However, the surface storage would not blend well into the surrounding terrain and would result in a noticeable mound on all sides. This layout was not evaluated further during the preliminary design in favor of Layout 4, which can be blended better with the surrounding terrain.

- Layout 2 – This layout fills the topographic bowl at the head of Mill Gulch and could be blended into the surrounding terrain. However, this layout would require rerouting or removal and replacement of the overhead power lines. This layout would also expose the oxidized ore zone near RY-RB-03, which could lead to ARD generation within the repository. This layout was discounted for these reasons.

- Layout 3 – This layout was developed as an alternative to store the majority of the wastes below grade without requiring deep excavations. However, as stated above the surface disturbance for this layout is 32 acres. Considering the difficulty of reclaiming disturbed areas at the site, limiting the disturbance area is critical. This alternative also encroaches on the seeps and springs that form the head of Mill Creek and would require rerouting or removal and replacement of overhead power lines. This layout was discounted for these reasons.

- Layout 4 – This layout sits against the ridge to the south of the Repository 2 Area. This layout avoids the overhead power lines, but requires rerouting USFS Road 678. This area can hold the required waste volume, with room for expansion, using both below grade and above grade storage. A repository sited here can also be blended with the surrounding terrain.

The preliminary repository design is based on Layout 4 due to the capacity of this layout, the ability to blend it with the surrounding terrain, and its location upslope and away from mapped seeps and springs. Specific components are outlined in the following subsections.

4.5.2.1 Repository Footprint

The preliminary repository layout is shown on Figures 2-9, 4-3, and 4-4. The footprint totals 15.5 acres and encompasses the Harrison Shaft waste rock area, the Harper Shaft waste rock area, and portions of USFS Road 678. These areas represented 3.6 acres of the repository footprint, reducing the new disturbance to 11.9 acres. The layout avoids the power lines to the north and east, the Harper Shaft to the east, and the oxidized ore zone noted in RY-RB-03 to the northeast. The repository is also situated upslope of seeps and springs mapped during May 2012 that form the head of Mill Creek. Discussions of infrastructure, seep/spring, and revegetation considerations for the proposed layout are presented in Section 4.4.

4.5.2.2 Excavation and Excavation Slopes

Excavation of the repository base below grade was evaluated as part of the design process. The excavation depth was optimized to reduce the amount of waste storage above ground and balance the cut material generated with fill requirements associated with the repository cover, liner and cap systems, and excavated waste material subsoil backfill. Note that backfill for waste excavation areas was only assumed appropriate for wastes removed from the Combination Mill AOC. The Combination Mine waste rock pile and the Tim Smith waste rock piles were placed on top of native ground. Excavation in these areas will extend to native materials or only slightly deeper. Only cover soil is assumed to be replaced at these sites. Waste materials associated with

the Harrison and Harper Shafts are within the repository footprint and do not extend beyond the anticipated repository excavation depth.

Based on volumetric evaluations, an average excavation depth of 10 feet bgs appears optimal. A preliminary 10-foot excavated repository floor is shown on Figure 4-3. Excavations deeper than an average of 10 feet increase the potential for interaction with groundwater and generate more material than is required to construct the repository and backfill excavated waste areas. Shallow excavations (e.g., 5 feet bgs) do not provide sufficient materials to construct the repository and backfill waste excavation areas. In addition, because more waste is stored above grade, blending the final repository surface with the surrounding native ground is more difficult. A larger mound with steeper slopes results from the shallower excavations.

Cross-sections of the repository based on an average 10-foot excavation depth are shown on Figure 4-5 and 4-6. As shown on the cross-sections, portions of the excavation extend beyond 10 feet-bgs, but are typically less than 14-feet bgs. These areas of deeper excavation typically exist where there is a change in the existing surface terrain. Cut slope heights of up to 10 feet will be required on the uphill side of the repository and up to 13 feet on the downhill side. Cut slopes are shown at 2H:1V on the uphill side of the repository and 3H:1V along the slope and downhill sides.

The temporary cut slope angles could be increased, based on material properties, if deemed appropriate during the repository design. Cuts on the uphill perimeter will primarily be made in dense to very dense sandy gravel with silt (GP-GM) to silty gravel with sand (GM) soils (Figure 4-7). These materials are also found along the eastern perimeter of the repository. Cuts on the downhill perimeter will primarily be made in clayey gravel (GC) and gravelly lean clay (CL). These temporary excavations could be sloped at 1-1/2H:1V to 1H:1V in the absence of groundwater seepage. Flatter slopes on the order of 2H:1V would be required if groundwater seepage were present.

4.5.2.3 Diversion Ditches and Interceptor Trenches

Stormwater diversion ditches and interceptor trenches should be included upslope of the repository. Stormwater ditches should be aligned and constructed to intercept stormwater runoff and snowmelt from upslope areas and divert the water around the repository. These ditches will limit the amount of water contacting the surface of the repository; reducing the potential for erosion of, or infiltration through the cap. The ditches should be constructed with low permeability materials (available onsite) to limit infiltration through the ditch bottom.

Similarly, shallow interceptor trenches should be included along the upslope perimeter to capture shallow subsurface flows and provide a preferential pathway away from the repository. Drainage material for the interceptor trenches would likely need to be imported from an offsite source or possibly screened from onsite sources.

The preliminary alignment of the stormwater ditches and interceptor trenches are shown on Figure 4-4. These will be sized, and the alignment refined, during the repository design.

4.5.2.4 Repository Cap and Bottom Liner

Waste materials targeted for storage in the repository are impacted with heavy metals and some of the wastes have the potential to generate ARD. Tailings, soils, and sediments from the Combination Mill AOC and South Fork Lower Willow Creek include elevated mercury levels. Potential environmental impacts could occur if leachate from these waste materials seeps out of the repository bottom and interacts with groundwater, and/or surfaces as seeps downgradient of the repository. Impacts can also occur if groundwater levels rise, bringing groundwater into contact with the waste materials. Groundwater has not been observed in most of the test pits, boreholes and monitoring wells installed during the RI and repository investigation. However, shallow seeps, believed to be water perched above clayey materials, have been observed along the north perimeter of the repository footprint in test pit RY-SS-04 and monitoring well MW-RY-07.

The preliminary repository design incorporates measures to reduce potential environmental impacts associated with storage of waste materials onsite. These measures include the physical siting and configuration of the repository, construction techniques, and inclusion of a low permeability cap and possibly installation of a bottom liner. The proposed repository is sited high in the topographic bowl above Mill Creek and the repository base excavation depth is limited to approximately 10 feet to provide adequate separation from groundwater. Existing perched water within the repository footprint will be removed during excavation of the repository base. Additionally, upslope stormwater ditches and interceptor trenches are included in the preliminary design to divert up gradient surface and shallow subsurface water from flowing into the repository footprint. Waste materials will also be processed (dewatered, mixed, or stabilized with lime) to reduce leachate generation. The waste materials also are largely inorganic and will not decompose and generate leachate as municipal wastes would.

The proposed repository will be capped to reduce precipitation falling directly on the repository from infiltrating into the waste materials. The surface will also be sloped to promote drainage off of the cap. The cap will include a liner system designed to reduce permeability to less than $1x10^{-5}$ cm/sec. The liner system will include a bedding layer/material, an impervious layer/geosynthetic material, and a drainage layer/material. The composite liner will be protected with a soil cover with a thickness of between 1.5 feet and 2.5 feet. An erosion protection layer (discussed in Section 4.5.2.5) would be installed above the soil cover.

A bottom liner is often not included in repository designs. Inclusion of a bottom liner can increase long-term O&M requirements, primarily associated with leachate collection and management. Moreover, the measures described above would significantly reduce the amount of leachate generated by the wastes, while the siting of the repository would reduce the potential for interaction with groundwater. However, there is the potential for groundwater elevations to rise or for the limited leachate expected to be generated by the wastes to filter through the repository base. Repository subgrade soils are expected to consist of native, undisturbed glacial till comprised of dense sandy gravel with silt (GP-GM), silty to clayey gravel with sand and cobbles (GM, GC), and stiff to very stiff gravelly clay with sand and cobbles (CL) (Figure 4-3). Based on a limited number of laboratory permeability tests and correlations with material gradation

characteristics, the subgrade permeability could vary from $5x10^{-3}$ cm/sec to $1x10^{-7}$ cm/sec. The higher permeability materials (sandy gravel with silt and silty gravel) could allow leachate to migrate from the repository or shallow groundwater to infiltrate into the waste materials. Inclusion of a bottom liner could address these concerns. At a minimum, a liner is appropriate to encapsulate mercury-contaminated materials from the Combination Mill AOC and South Fork Lower Willow Creek.

A bottom liner has not specifically been included in the preliminary repository design, but based on the materials and conditions encountered during the repository investigation, further evaluation of a bottom liner is warranted. An option for further evaluating the need for a bottom liner that could be completed as part of the repository design would be to conduct field infiltration tests.

Design of the configuration, liner material and cap, design of encapsulation for mercury-impacted materials, as well as deciding on the need for a bottom liner will be completed during repository design activities. These tasks will be undertaken at a later date, if onsite waste storage is identified as a preferred reclamation alternative during the EE/CA.

4.5.2.5 Erosion Protection Layer

An erosion protection layer is required to protect the repository cap. This layer is typically a vegetative layer. As discussed in Section 4.4.3, limited cover soils are available onsite, which would make establishment of a dense vegetation cover difficult, without disturbing larger areas. Therefore, the preliminary design includes a combination rock armor and vegetative cover. Available cover soils, estimated at 4,700 cy would be used to cover approximately 6 acres of the repository cap. The vegetative cover could be broken into separate plots to provide vegetative buffers where appropriate. The remaining 9.5 acres would be covered with 6 inches of rock armor processed from material excavated within the repository footprint. This approach may require a variance from the Solid Waste Management Board.

4.5.2.6 Final Surface Slopes

The repository thickness, including waste materials, cap materials, and surface erosion protection ranges from 25 feet to 35 feet, as shown in Figures 4-5 and 4-6. Note that in these figures, the proposed ground is the top of the erosion protection/armoring layer. Approximately 10 to 15 feet of the storage is below grade, while the remaining 13 to 25 feet (including surface cap) is above grade.

The final surface, accounting for waste placement, cap, and erosion protection is shown on Figure 4-4. This surface is based on the preliminary design and waste volume estimates and will be refined during the repository design. The surface ties in with the top of the excavation along the sides and along the downhill edge of the repository. Because the repository is configured to tie in with the top of the excavation, downstream containment berms have not been included in the preliminary design. The surface slopes for the majority of the repository area range from 7H:1V to 10H:1V. The slopes increase along the southwest edge of the repository, ranging from 4H:1V to 3H:1V. The steeper slopes are required along the southwest corner to tie with the

existing topography near the Lewis Shaft. These slopes approximate the slope of the original ground prior to repository construction, and are flatter than the maximum slopes recommended for waste placement in Section 4.2.3.

4.5.2.7 USFS Road 678

The proposed repository would cover USFS Road 678 between the intersection with USFS Road 448 and the access road to the Lewis Shaft (Figure 2-9). This road segment is approximately 0.3 miles (1,570 feet) long. The USFS was consulted prior to the RIWP regarding the feasibility of covering this road with a repository and either rerouting the road or reconstructing the road over the repository. They informally indicated that they would be open to realignment of the road or reconstruction of the road across the repository, if feasible.

There are three primary alternatives for addressing USFS Road 678. These alternatives are shown on Figure 4-8 and include:

1. Reroute the road along USFS Road 448 to the intersection with the power line running southwest to northeast. There is an existing two track that runs along the power line. This two track could be developed into a primary USFS road, although this would requiring moving the road slightly downslope. This alignment would be 1.03 miles (5,450 feet) long, an increase of 0.7 miles over the existing road alignment. Grades along this reroute would be less than the existing route.

2. Reroute the road along USFS Road 448 and then north along the power line that runs along the east side of the repository (power line to the Combination Mine). This new route would then turn back southwest and follow the power line along the northwest edge of the repository. As mentioned for the first alternative, there is an existing two track along this power line that could be developed. However, there is not an existing two track along the eastern power line. The grade is also steeper along this portion of the route, averaging 8.2 percent. This grade is slightly steeper than the grade for the existing route, which varies from 6 percent to just 7.5 percent. This alignment would be 0.5 miles (2,720 feet) long, an increase of 0.2 miles over the existing route.

3. Reconstruct the road across the repository after the repository has been filled and capped. The preliminary grading for this alignment is shown on Figure 4-4. The road could be reconstructed in approximately the same alignment, with modifications to maintain reasonable grades. However, this requires construction of a road over a repository, which typically is not the preferred approach. In addition to vehicle traffic over the repository, possibly including heavy trucks, there is also increased erosion concerns and stormwater issues associated with a road across a repository. Design considerations may include outsloping the road, constructing armored drain dips, and/or lining road ditches with low-permeability materials. This route

would not significantly change the road length. Grades would depend on the final repository grading, but are expected to be in the 4 percent to 8 percent range.

In addition to the permanent rerouting of USFS Road 678, temporary detours will also be necessary during construction. One temporary detour will not be sufficient, due to the likelihood of borrow activities crossing the power line road to the northwest. These temporary detours will depend on the stage of construction and will likely include a combination of the route described in the first permanent alternative discussed above and a temporary detour through the repository footprint.

4.6 Material Suitability

Subsurface soil samples were collected from potential borrow areas and from within the repository area to determine if onsite materials would be suitable for use in constructing the repository. Based on the field observations and test results, sufficient volumes of material exist within the repository area for construction of the repository, subject to further design and decisions regarding liner systems. Topsoil samples were also collected from potential borrow areas to determine suitability for use as cover soil. Topsoil samples were previously collected from the Repository 2 Area and analyzed during the RI.

Test results for these materials are presented and discussed in Section 3. The suitability of these materials for use in constructing the repository are discussed in the following subsections.

4.6.1 Repository Construction Materials

Preliminary engineering soil properties of the repository in-situ native soils and reconstituted soil (compacted fill) are provided in Table 4-3. The properties of the in-situ soils and compacted fill are based on laboratory testing (presented in Section 3), correlation of specific soil properties with soil index tests (i.e., grain size and Atterberg Limits), and SPT blow counts.

Permeability of the in-situ colluvium and glacial till soils were determined using empirical correlations (Carrier 2003) based on laboratory measurements of particle size distribution and assumptions regarding the physical characteristics of individual particle shape.

Table 4-3. Preliminary Engineering Properties of Proposed Repository Soils, Black Pine Mine

Geologic Unit	Soil Type	Moist Unit Weight (pcf)	Effective Strength		Undrained Shear Strength (psf)	Vertical Permeability (cm/sec)
			Effective Friction Angle (degrees)	Effective Cohesion Intercept (psf)		
In-Situ Colluvium	GM, GP-GM	125 to 135	35 to 38	0	NA	1.0×10^{-4} to 1.0×10^{-2}
In-Situ Glacial Till	GM	130 to 140	38 to 42	0	NA	5.0×10^{-5} to 5.0 to 10^{-3}
	GC	130 to 140	32 to 36	0	NA	1.0×10^{-6} to 1.0 to 10^{-4}
	CL	125 to 135	24 to 28	0 to 200	2,000 to 4,000	1.0×10^{-7} to 1.0 to 10^{-6}
Compacted Fill [(a)(b)]	GM, GP-GM	130 to 140	36 to 40	0	NA	1.0×10^{-5} to 1.0×10^{-3}
	SC[(b)]	125 to 130	28	300	NA	2.0×10^{-7} to 2.0×10^{-6}
	CL[(b)]	125 to 135	17	300	1,000 to ,2000	1.0×10^{-7} to 1.0×10^{-6}

pcf – pounds per cubic foot

psf – pounds per square foot

NA - Not Applicable

(a) Fill placed and compacted to 95percent standard Proctor.

(b) Based on laboratory permeability and triaxial strength testing

4.6.1.1 Foundation Materials

The subgrade soils are moisture sensitive and can be easily loosened or softened by construction traffic during wet weather. In an undisturbed condition, the subgrade soils have moderate to high strength. These soils also have low to moderate compressibility such that settlement of the foundation soils under the waste fill will be minimal and would occur as the loads are applied. Estimated subgrade settlement due to 26 feet of waste fill will be about 1 to 3 inches. Looser disturbed soils and/or waste material found near the center of the repository (test pit RY-SS-07) at the Harrison shaft could experience up to 50 percent more settlement than the surrounding native soils. However, since the settlement will occur as the loads are applied, differential settlement should not pose a problem. The in-situ native soils appear to be suitable to support construction of a waste repository.

4.6.1.2 Cap and Liner Materials

In-situ, subgrade soils that would form the base of the proposed repository, based on an excavation depth of approximately 10 feet, include dense sandy gravel with silt (GP-GM), silty to clayey gravel with sand and cobbles (GM, GC) and gravelly lean clay with sand and cobbles (CL) (Figure 4-3). As shown in Table 4-3, the range of permeability for these in-situ soils range from $5x10^{-3}$ cm/sec to $1x10^{-7}$cm/sec. The in-situ permeability of the sandy gravel with silt and silty to clayey gravel with sand and cobbles is higher than desired for the repository base. If processed and re-compacted, the permeability of these materials may be lowered, but the permeability of the sandy gravel with silt and silty gravel would likely still be higher than desired for the repository base (Table 4-3).

The clayey gravel (GC) and gravelly lean clay (CL) materials encountered within the repository area would be suitable for use as a compacted soil liner for either the repository base or cap. These clayey materials could provide permeability in the range of $2x10^{-6}$ cm/sec to $1x10^{-7}$ cm/sec if processed and re-compacted. Processing would include removing gravels and cobbles greater than 3 inches from the materials, which could be difficult. If it is feasible to separate the gravels from the finer materials, there does appear to be sufficient clayey material in the repository area to construct a 1.5-foot thick clay liner. A 1.5-foot thick liner would require approximately 59,500 cy of clayey material, assuming the material is comprised of approximately 50 percent gravel and 50 percent clay (i.e., 29,750 cy of clay is needed). Based on materials encountered in the test pits and boreholes, there appears to be approximately 45,000 cy of clayey materials within the proposed repository excavation (based on the 10-foot excavation scenario). The additional 14,000 cy required to construct a clay liner could be borrowed from areas downslope of the repository footprint. While the clay materials encountered within the proposed repository area could be used to construct a clay liner, the cost and time to process the material should be compared to the cost of using a geosynthetic liner system.

The soils within the proposed repository area, including those within the preliminary repository excavation, are suitable for use as soil cover material. These materials should be screened to remove cobbles and larger fractured rock greater than 6 inches as well as large debris. The cobbles and fractured rock screened out of the soil cover could be used as part of the rock armor erosion protection layer. The preliminary repository excavation design results in 192,500 cy of cut, including 4,800 cy of topsoil, 45,000 cy of clayey materials, and 7,700 cy of rock armor material. This leaves approximately 135,000 cy of cut material. Construction of a 1.5-foot thick soil cover would require 37,500 cy and constructing a 2-foot soil cover would require 50,000 cy. Between 85,000 cy and 97,500 cy (assuming clayey materials are used to construct a clay liner) would be left to backfill waste removal areas in the Combination Mill AOC. These values are less than the 108,000 cy of fill estimated for these areas, but again assumes the clayey materials.

4.6.2 Cover Soils

In-situ topsoil within the repository footprint is suitable for use as cover soil, with the exception of topsoil near RY-SS-03. As described in Section 3.4.1, the pH of the topsoil samples collected from the repository is suitable for plant growth. Conductivity and CEC for the topsoil samples

were within acceptable ranges, but levels of nitrate, phosphorous, and potassium are low. The soils would require amendments to increase these nutrient levels.

While the quality of the topsoil is suitable for use as cover soils, there are limited quantities available. A notable portion of the repository footprint (3.6 acres) has been previously disturbed and no longer has topsoil. Topsoil thickness noted in test pits ranged from 3 inches (RY-SS-06) to 9 inches (RY-SS-04). Topsoil was noted in test pit RY-SS-03 to a depth of 24 inches, but was not distinguished from silty gravel encountered in the same interval. Additionally, the agronomic results for the sample collected from this location indicated the material would not be suitable for use as cover soil due to low organic content.

An average of 3 inches of topsoil is assumed salvageable across 11.9 acres of the repository footprint. This equates to approximately 4,700 cy of topsoil available for use as cover soil for the repository. This quantity is less than the amount (12,500 cy) that would be required to establish a 6-inch growth medium across the final repository surface.

Additional topsoil suitable for use as cover soil is present in potential borrow areas BPB7A, BPB2/3, BPB1A, and BPB13. However, disturbing these areas to provide cover soil for the repository is not recommended due to the limited depth of topsoil in these areas and the resulting increase in disturbance area. Instead, a combination rock armoring and vegetation cover is proposed for the repository. This approach will make use of the 4,700 cy of topsoil available within the repository footprint to provide 6 inches of growth media over approximately 6 acres of the repository. The remaining surface will be protected with a 6-inch rock cover.

4.7 Preliminary Construction Flow

The preliminary workflow for the repository construction and support activities has been briefly considered to support the evaluation of the repository location. Repository construction and support activities are anticipated to be conducted in the following general sequence with overlap anticipated between activities. Construction activities should be conducted in parallel when possible and when those activities do not impinge on the quality of the work. Exceptions to the following general sequence will also likely occur during actual construction. Construction will follow best management practices to minimize impacts to the public and the environment. A more complete and thorough presentation of the workflow schedule for the project will be developed during the design.

1. Stormwater Control. Stormwater controls will be installed prior to initiation of clearing and grubbing and road improvements to minimize migration of sediments and contaminants. Stormwater best management practices will be followed throughout the duration of construction. Temporary and permanent stormwater runon and runoff diversions will be constructed at the repository site. Stormwater runoff diversions will be designed to keep water out of the repository site to the extent possible during initial construction, waste loading, and capping. Precipitation that falls within the site footprint will be directed off site to minimize ponding and

infiltration within the repository footprint. Stormwater diversions and controls will also be installed at the waste excavation locations.

2. Clearing and Grubbing. Portions of the repository site are heavily wooded, particularly the northern and eastern sides. Clearing and grubbing with some logging will need to be conducted at the site. If fine-grained soils are ultimately needed from the adjacent downslope borrow area, BPB7A, then clearing and grubbing will need to be conducted in that area.

3. Road Improvements. Preliminary design information suggests that sufficient fine-grained material is available in the proposed repository area and adjacent BPB 7A for use in the construction of the repository. However, during construction of the repository, road improvements may be necessary if additional borrow material is required from other borrow areas.

   In addition, prior to the hauling of waste, existing roads between the waste excavation areas and the proposed repository area may need to be widened to accommodate two-way haul truck traffic or pullouts may be used to provide for two-way traffic. Temporary roads may also be required to access sediments downstream of the Combination Mill in the South Fork Lower Willow Creek drainage and to accommodate waste and borrow material traffic patterns. Existing permanent roads impacted by construction activities may need to be restored after construction is complete. New temporary roads will be kept to a minimum, and following the completion of construction activities, the temporary roads would be reclaimed.

4. Cover Soil Stripping. Cover soil will be stripped, stockpiled, and reused where it exists at the repository area. Additional cover soil may need to be stripped from one of the potential borrow areas, such as BPB7A. Cover soil in borrow areas will not be completely stripped, unless subsurface materials are being mined as well. Approximately 2 to 4 inches of cover soil will be left in place to allow revegetation of these areas.

5. Repository Site Excavation and Preparation. Following removal of vegetation and topsoil, the repository area will be excavated to design grades. The depth of excavation will be dependent on the final design, but 10 feet or more of subsoil may be excavated for the repository. This soil will be staged and screened as appropriate to separate fine-grained material from large gravels, cobbles, and fractured rock. Excavated and screened material will be reused for cover and/or liner material to the extent possible. Cobbles will be used primarily to backfill waste rock excavations.

   The base and sides of the repository will be prepared to allow placement of waste material. Low-permeable soil may be placed on the bottom and sides of the repository to minimize seepage of water into, or leachate out of the repository. Subsurface diversions of water will also be considered at the repository site to prevent migration of water into the repository.

A leachate collection sump will be installed if the repository is lined with a low permeable clay or geosynthetic liner. Active or passive (gravity) methods of removing and disposing of the accumulated leachate will be required during and after waste placement for an undetermined number of years.

6. Borrow Area Activities. Borrow material may be needed for cover soil and/or for fine-grained material for use in the cover and/or liner. Borrow area activities may involve clearing and grubbing, stripping, stockpiling, and hauling of topsoil, and excavation, screening, and use of fine-grained material for a cover or subliner.

7. Waste Excavation, Hauling, and Placement. Excavation, hauling, and placement of waste materials into the repository will commence once the repository basin is complete and necessary ancillary activities, such as road improvements, have been completed. Waste drying and/or mixing with an amendment, such as lime, may occur at the point of excavation so that waste passes the Paint Filter Test (PFT) prior to transport. Waste staging and/or mixing may also occur at or near the repository site prior to or during placement. Lime may need to be mixed with the Combination Mill tailings and/or sediments to help stabilize the finer-grained material and/or slimes. Combination Mill tailings may be placed in an area separate from the waste rock from the other AOCs, or may be mixed with the waste rock for stabilization. Placement means and methods will be determined during the final design.

8. Repository Capping. Following placement of wastes to final design grades, the waste will be capped with a geosynthetic liner, soil cover, and rock armor/growth media.

9. Reclamation. Upon completion of the repository, disturbed areas will be reclaimed by bringing in fill material as necessary and grading the areas to drain. Topsoil will be amended as appropriate and placed on final graded surfaces. The disturbed areas will be revegetated with a native seed mix applicable to the BPM elevation and ecology.

5.0 Conclusions and Recommendations

5.1 General

Site observations and investigations were conducted and the collected data were evaluated to further evaluate the possibility of siting and constructing a long-term waste storage repository at the proposed location. Based on results from the investigations and the evaluations conducted to date, the proposed location appears suitable for long-term waste storage. The critical characteristics of the site contributing to that conclusion include the following:

- The repository site can accommodate the waste volume of approximately 420,000 cy (see Table 4-1) with room for expansion.

- Bedrock conditions at the site will not significantly affect construction of a repository. Bedrock is approximately 120 feet bgs in the middle of the northern edge of the site. On the perimeter of the proposed repository footprint, where the bedrock is closer to the surface, the bedrock appears rippable. Although the bedrock is fractured, bedrock slippage at the fractures is not expected to occur because bedrock will generally not be disturbed and overburden removal will be minor during construction of the repository. The area of bedrock containing ore-bearing rock in the vicinity of RY-RB-03 that, if exposed to the atmosphere and water, may generate ARD is not included within the repository footprint.

- Although normal faults have been noted in the mine area and near the proposed repository area (Figure 4-1), either the faults appear to have been inactive for a significant period, allowing soil to develop over them, or the faults do not extend to the surface. In addition, the displacements of these faults are considered to be minimal (Herrera/Trihydro 2012b) and no apparent indications of fault activity have been observed during field investigations in the repository area. During bedrock coring, layers of bedrock were not observed to repeat within borehole locations, which is an indication that the bedrock underlying the site is not thrust faulted (low angled faults that create repetition of beds with depth in a borehole).

- Although underground mine workings are known to extend into the area of the repository, they do not appear to substantially affect the suitability of the site due to their depth ranging from 123 feet bgs (near the Harper Shaft) to 410 feet bgs (near the Lewis Shaft). Mine workings were not observed or encountered during the advancement of boreholes or the installation of test pits associated with this repository investigation.

- The repository location is upslope and away from mapped seeps and springs.

- Shallow groundwater/perched water at the site appears to be limited, and the groundwater observed to date does not appear to be extensive or flow significantly.

Deeper groundwater has not been observed in MW-RY-09 that is screened between 10 and 30 feet bgs. Deeper groundwater was observed infiltrating at a flow estimated at less than 1 gpm into two of the five boreholes advanced during this investigation (RY-RB-01 and RY-RB-02), at depths of approximately 38 feet bgs and between 30 and 43.5 feet bgs, respectively. However, these depths are greater than the anticipated excavation depth for the repository.

- Impacts to the surrounding infrastructure caused by the siting and construction of a repository, such as power lines, roads, and historical shafts, can either be avoided or managed. The proposed layout sits against the southern ridge, which avoids the overhead power lines but requires rerouting USFS Road 678. Alternatives to rerouting USFS Road 678 were presented in Section 4.

- A repository at this site will be able to comply with requirements that are applicable or relevant and appropriate. In some instances, a variance may be requested based on consideration of site conditions and controls.

5.2 Waste Materials

The waste materials (approximately 420,000 cy) consist of waste rock from the Combination Mine, Tim Smith Mine, and Historic Mine AOCs, fine-grained tailings and sediments from the Combination Mill AOC and reprocessing area, and sediments from the South Fork Lower Willow Creek. The waste rock proposed to be placed in the repository contains sulfides that have the potential to generate ARD if exposed to oxygen and water. Heavy metals are present in the waste material from each of the AOCs and the COCs include antimony, arsenic, cadmium, copper, lead, mercury, silver, and zinc. Mercury is present in the Combination Mill, reprocessing area, and South Fork Lower Willow Creek-related wastes. These wastes will require monitoring and management during excavation, transport, and placement.

Minimizing contact between waste materials and water is important to reduce generation of ARD, leaching of heavy metals, and transport of the ARD and metals into the groundwater or surface water. Repository design features to minimize contact between waste materials and water include a low-permeability cap, surface water and shallow subsurface water diversions, and a bottom liner (if determined to be appropriate).

Geotechnical testing performed on Combination Mill tailings, sediment and reprocessing area samples showed that adequate compaction densities could be achieved for the placement of this material. Based on test pit observations during the RI, some of these materials are highly saturated and will likely require drying or mixing with other materials (e.g., lime products, waste rock, impacted soils, etc.) prior to placement and compaction in a repository. However, the geotechnical results from the samples tested during this investigation indicate that the natural moisture contents were typically dry of optimum indicating that drying and/or mixing will not be required on all tailings and sediment material.

5.3 Repository

The potential repository area covers approximately 15 acres in a topographic bowl north of the access road to the Lewis Shaft and includes the Harrison and Harper Shaft areas within the Historic Mine AOC. Figure 2-9 illustrates the proposed repository layout.

The preliminary design for the proposed repository discussed and presented in Section 4 is summarized below:

- The repository is designed to blend in with the surrounding topography to the extent possible. The area will be excavated to depths of 10 to 14 feet bgs with cut slopes varying from 2H:1V to 3H:1V. The repository thickness, including waste materials, cap materials, and surface erosion protection features ranges from 25 feet to 35 feet with approximately 13 to 25 feet (including surface cap) above grade. The finished surface slopes for the majority of the repository area will range from 7H:1V to 10H:1V; however, the slopes range from 4H:1V to 3H:1V along the southwest edge of the repository to tie with the existing topography near the Lewis Shaft.

- The proposed repository will be capped to reduce precipitation that falls directly on the repository from infiltrating into the waste materials. The surface will also be sloped to promote drainage off the cap. The cap will include a liner system designed to reduce permeability to less than $1x10^{-5}$ cm/sec. The liner system will include a bedding layer/material, an impervious layer/geosynthetic material, and a drainage layer/material. The composite liner will be protected with a soil cover with a thickness of between 1.5 feet and 2.5 feet.

- An erosion protection layer is required to protect the repository cap. This layer is typically a vegetative layer. As discussed in Section 4.4.3, limited topsoil is available onsite, which would make establishment of a dense vegetation cover difficult, without disturbing larger areas. Additional topsoil is present in potential borrow areas BPB7A, BPB2/3, BPB1A, and BPB13. However, disturbing these areas to provide soil for the repository is not recommended because establishment of vegetation on the stripped areas would also be difficult. Instead, a combination rock armoring (approximately 9.5 acres) and vegetation cover (6 acres) is proposed for the repository.

- A bottom liner has not specifically been included in the preliminary repository design, but based on the materials and conditions encountered during the repository investigation, further evaluation of a bottom liner is warranted. An option for further evaluating the need for a bottom liner that could be completed as part of the repository design would be to conduct field infiltration tests.

- Based on the field observations and test results, sufficient volumes of material exist within the repository area for construction of the repository, subject to further design

and decisions regarding liner systems. The clayey gravel (GC) and gravelly lean clay (CL) materials encountered within the repository area would be suitable for use as a compacted soil liner for either the repository base or cap. These clayey materials could provide permeability in the range of $2x10^{-6}$ cm/sec to $1x10^{-7}$ cm/sec if processed and re-compacted. Processing would include removing gravels and cobbles greater than 3 inches from the materials, which could prove difficult. If it is feasible to separate the gravels from the finer materials, there appears to be sufficient clayey material in the repository area to construct a 1.5-foot thick clay liner. The cost and time to process the on-site material as compared to using a geosynthetic liner system should be evaluated during the design.

- These soils also have low to moderate compressibility such that settlement of the foundation soils under the waste fill will be minimal. Since the settlement would occur as the loads are applied, differential settlement should not pose a problem. The in-situ native soils appear to be suitable to support construction of a waste repository.

- The preliminary design includes stormwater diversion ditches and interceptor trenches upslope of the repository. The ditches would intercept stormwater runoff and snowmelt from upslope areas and divert the water around the repository. These ditches will limit the amount of water contacting the surface of the repository, thereby reducing the potential for erosion of, or infiltration through, the cap. The ditches should be constructed with low permeability materials (available onsite) to limit infiltration through the ditch bottom. Similarly, shallow interceptor trenches along the upslope perimeter would be designed to capture shallow subsurface flows and provide a preferential flow path away from the repository. Drainage material for the interceptor trenches would likely need to be imported from an offsite source or obtained by screening onsite sources.

5.4 Borrow Areas

Borrow material may be needed for topsoil and fine-grained material for use in the cover system. The potential borrow area soil materials consisted of coarse-grained sands and gravels with varying amounts of silt and lean clay. Sufficient fine-grained materials for possible use in a repository cover or liner were present at BPB1A, BPB7A, and BPB13. The southern portion of BPB7A may serve as a source of materials for berm and liner/cap construction and likely will be disturbed by other construction-related activities.

Topsoil depths across the BPM range from 2 to 5 inches. This makes borrowing topsoil difficult. Sufficient depth of topsoil must exist in borrow areas to provide material for the target area while also maintaining sufficient topsoil at the borrow area to allow for reclamation. Available topsoil in BPB7A should be re-applied to that area if it is disturbed to obtain materials for construction of the repository. The other potential borrow areas may be needed to provide cover soils for waste removal areas, where no onsite topsoil exists. Agronomic tests were run on topsoil samples from potential borrow areas BPB1A, BPB2/3, BPB7A, and BPB13 and they were

determined to be acceptable (with nitrogen amendment) for vegetation establishment (refer to Sections 3.3.1 and 3.4.1).

5.5 Future Investigations

If the site is acceptable to the DEQ for locating a repository, limited additional site investigations are recommended to provide detailed information for the design. Recommended investigations include:

- Hydraulic conductivity estimates from in-situ large-scale infiltration tests. Large-scale field tests could be conducted to estimate the hydraulic conductivity of the glacial till in the bottom of the excavation. Figure 4-3 shows the soil lithology expected to be present at the bottom of the repository excavation. The soils in the base of the repository are primarily comprised of clay, silt, and clayey gravel in one area and silty gravel with sand and cobbles throughout most of the remaining area. The resulting hydraulic conductivity estimates would be used in evaluating the need for a bottom liner in portions of, or the entire repository.

6.0 References

Carrier, W.D., 2003. "Goodbye, Hazen; Hello, Kozeny-Carman," ASCE Journal of Geotechnical and Geoenvironmental Engineering, Vol 129(11), pp. 1054-1056.

Bohn, H., B. McNeal, and G. O'Conner. *Soil Chemistry*. Wiley. 1979.

DEQ. 2010. Montana Numeric Water Quality Standards. Circular DEQ-7. Montana Department of Environmental Quality. October 2012.

EPA. 1996. Region I, EPA-New England Data Validation Functional Guidelines for Evaluating Environmental Analyses. New England.

EPA. 1994. Acid Mine Drainage Prediction. EPA 530-R-94-036. Washington, DC, USA.

Herrera Environmental Consultants and Trihydro Corporation. 2011. Reclamation Work Plan, Black Pine Mine. Prepared for the Montana Department of Environmental Quality. July 11, 2011. 329 p.

Herrera Environmental Consultants and Trihydro Corporation. 2012a. Reclamation Investigation Report, Black Pine Mine. Prepared for the Montana Department of Environmental Quality. May 29, 2012. 2,621 p.

Herrera Environmental Consultants and Trihydro Corporation. 2012b. Repository Investigation Work Plan, Black Pine Mine. Prepared for the Montana Department of Environmental Quality. August 8, 2012. 219 p.

Hoek, E. 2007. Practical Rock Engineering. http://www.rocscience.com/education/hoeks_corner. 237 p.

MNHP. 2010. Montana Field Guide (<http://fieldguide.mt.gov/>) and TRACKER (http://nhp.nris.mt.gov/Tracker/NHTMap.aspx) web pages. Montana Natural Heritage Program. Accessed from MNHP website: http://nhp.nris.mt.gov/.

Montana Bureau of Mines and Geology 2012. State Geologic Mapping Program, accessed May 2012 from MBMG web site: http://www.mbmg.mtech.edu/gmr/gmr-statemap.asp.

Munshower. 1993. Practical Handbook of Disturbed Land Revegetation. Boca Raton: CRC Press.

Renewable Technologies, Inc., 2011. Abandoned Mines Hazardous Materials Inventory Past and Present Land Ownership/Mine Operators Investigation Phase 1, Black Pine Mine Site Henderson (Black Pine) Mining District Granite County, Montana. Prepared for Montana Department of Environmental Quality. July 2011. 56 p.

USDA. 2009. Natural Resource Conservation Service, Section 9 – Soil Test Reports. U.S. Department of Agriculture. 2009.

USFS. 2013. Technical Comments on June 13, 2013 Draft Repository Reclamation Report, Black Pine Mine. August 20, 2013.

Waisman, D. 1985. Geology and Mineralization of the Black Pine Mine, Granite County, Montana [thesis]. Fort Collins (CO): Colorado State University. 74 p.

TABLES

TABLE 2-1. REPOSITORY INVESTIGATION SUMMARY OF SAMPLING AND TESTING
BLACK PINE MINE

Sample Location	Matrix	Analysis	Sample Identification Number	Sample Type	Sample Date	Sample Depth (feet)[f]	Rationale
Combination Mine AOC							
Combination Mine Waste Rock Pile - Geotechnical Test Pit 1	Waste Rock	Natural Moisture Content Grain Size Distribution Standard Proctor[a]	CMN-GT-01	Composite - Geotechnical	8/30/2012	4-8	Determine geotechnical properties of waste rock to design placement in a repository
Combination Mine Waste Rock Pile - Geotechnical Test Pit 2	Waste Rock	Natural Moisture Content Grain Size Distribution Standard Proctor[a]	CMN-GT-02	Composite - Geotechnical	8/30/2012	5-7.5	Determine geotechnical properties of waste rock to design placement in a repository
Combination Mine Waste Rock Pile - Geotechnical Test Pit 3	Waste Rock	Natural Moisture Content Grain Size Distribution	CMN-GT-03	Composite - Geotechnical	8/30/2012	5-8	Determine geotechnical properties of waste rock to design placement in a repository
Combination Mill AOC							
Combination Mill Tailings Impoundment - Geotechnical Test Pit 1	Tailings	Total Recoverable Mercury	CML-GC-01A	Composite - Geochemical	9/5/2012	1-2	Determine change in mercury level as a result of field handling procedures
		Natural Moisture Content Atterberg Limits Grain Size Distribution Hydrometer Standard Proctor	CML-GT-01	Composite - Geotechnical	9/5/2012	1-2	Determine geotechnical properties of tailings to determine handling procedures and design placement in a repository
		Total Recoverable Mercury	CML-GC-01B	Composite - Geochemical	9/7/2012	1-2	Determine change in mercury level as a result of field handling procedures, determine mercury level for geotechnical tests
Combination Mill Tailings Impoundment - Geotechnical Test Pit 2	Tailings	Total Recoverable Mercury	CML-GC-02A	Composite - Geochemical	9/5/2012	0.5-2	Determine mercury change in mercury level as a result of field handling procedures
		Natural Moisture Content Grain Size Distribution Standard Proctor	CML-GT-02	Composite - Geotechnical	9/5/2012	0.5-2	Determine geotechnical properties of tailings to determine handling procedures and design placement in a repository
		Total Recoverable Mercury	CML-GC-02B	Composite - Geochemical	9/7/2012	0.5-2	Determine change in mercury level as a result of field handling procedures, determine mercury level for geotechnical tests
Combination Mill Tailings Impoundment - Geotechnical Test Pit 3	Tailings	Total Recoverable Mercury	CML-GC-03A	Composite - Geochemical	9/5/2012	2-3	Determine change in mercury level as a result of field handling procedures
		Natural Moisture Content Atterberg Limits Grain Size Distribution Hydrometer Standard Proctor	CML-GT-03	Composite - Geotechnical	9/5/2012	2-3	Determine geotechnical properties of tailings to determine handling procedures and design placement in a repository
		Total Recoverable Mercury	CML-GC-03B	Composite - Geochemical	9/7/2012	2-3	Determine change in mercury level as a result of field handling procedures, determine mercury level for geotechnical tests
Combination Mill Impacted Sediments and Soils - Geotechnical Shallow Soil/Sediment Sample 1	Sediments / Soils	Total Recoverable Mercury	CML-GC-04	Composite - Geochemical	9/7/2012	0-1	Determine change in mercury level as a result of field handling procedures
		Natural Moisture Content Atterberg Limits[b] Grain Size Distribution Hydrometer Standard Proctor[c]	CML-GT-04	Composite - Geotechnical	9/7/2012	0-1	Determine geotechnical properties of impacted soils and/or sediments to determine handling procedures and design placement in a repository
		Total Recoverable Mercury	CML-GC-04B	Composite - Geochemical	9/7/2012	0-1	Determine change in mercury level as a result of field handling procedures, determine mercury level for geotechnical tests

TABLE 2-1. REPOSITORY INVESTIGATION SUMMARY OF SAMPLING AND TESTING
BLACK PINE MINE

Sample Location	Matrix	Analysis	Sample Identification Number	Sample Type	Sample Date	Sample Depth (feet)[f]	Rationale
Combination Mill Impacted Sediments and Soils - Geotechnical Shallow Soil/Sediment Sample 2	Sediments / Soils	Total Recoverable Mercury	CML-GC-05A	Composite - Geochemical	9/7/2012	0-1	Determine change in mercury level as a result of field handling procedures
		Natural Moisture Content	CML-GT-05	Composite - Geotechnical	9/7/2012	0-1	Determine geotechnical properties of impacted soils and/or sediments to determine handling procedures and design placement in a repository
		Total Recoverable Mercury	CML-GC-05B	Composite - Geochemical	9/7/2012	0-1	Determine change in mercury level as a result of field handling procedures, determine mercury level for geotechnical tests
South Fork Lower Willow Creek Stream Sediments - Geotechnical Shallow Sediment Sample 1	Sediments	Total Recoverable Mercury	CML-GC-06A	Composite - Geochemical	9/7/2012	0-1	Determine change in mercury level as a result of field handling procedures
		Natural Moisture Content Atterberg Limits[b] Grain Size Distribution Standard Proctor[c]	CML-GT-06	Composite - Geotechnical	9/7/2012	0-1	Determine geotechnical properties of impacted stream sediments to determine handling procedures and design placement in a repository
		Total Recoverable Mercury	CML-GC-06B	Composite - Geochemical	9/7/2012	0-1	Determine change in mercury level as a result of field handling procedures, determine mercury level for geotechnical tests
Former Amalgamation Mill tailings - Geotechnical Test Pit 1	Tailings	Total Recoverable Mercury	CML-GC-07A	Composite - Geochemical	9/5/2012	1.5-2	Determine change in mercury level as a result of field handling procedures
		Natural Moisture Content Atterberg Limits Grain Size Distribution Hydrometer Standard Proctor	CML-GT-07	Composite - Geotechnical	9/5/2012	1.5-2	Assess geotechnical properties of tailings and evaluate similarities to tailings from the Combination Mill Tailings Impoundment. Determine depth of materials to estimate quantities.
		Total Recoverable Mercury	CML-GC-07B	Composite - Geochemical	9/7/2012	1.5-2	Determine change in mercury level as a result of field handling procedures
Former Amalgamation Mill tailings - Geotechnical Test Pit 2	Tailings	Total Recoverable Mercury	CML-GC-08A	Composite - Geochemical	9/5/2012	1-2	Determine change in mercury level as a result of field handling procedures
		Natural Moisture Content	CML-GT-08	Composite - Geotechnical	9/5/2012	1-2	Assess geotechnical properties of tailings and evaluate similarities to tailings from the Combination Mill Tailings Impoundment. Determine depth of materials to estimate quantities.
		Total Recoverable Mercury	CML-GC-08B	Composite - Geochemical	9/7/2012	1-2	Determine change in mercury level as a result of field handling procedures
"Old Mill" on west side of South Fork Lower Willow Creek - debris samples	Wood	TCLP Metals	CML-RCRA-05	Destructive point sample	9/7/2012	-	Determine toxicity characteristics of material
	Brick / Masonry	TCLP Metals	CML-RCRA-06	Destructive point sample	9/7/2012	-	Determine toxicity characteristics of material
Combination Mill - debris samples	Wood	TCLP Metals	CML-RCRA-07	Destructive point sample	9/7/2012	-	Determine toxicity characteristics of material
	Brick / Masonry	TCLP Metals	CML-RCRA-08	Destructive point sample	9/7/2012	-	Determine toxicity characteristics of material

TABLE 2-1. REPOSITORY INVESTIGATION SUMMARY OF SAMPLING AND TESTING
BLACK PINE MINE

Sample Location	Matrix	Analysis	Sample Identification Number	Sample Type	Sample Date	Sample Depth (feet)[f]	Rationale
Proposed Repository Area							
Proposed Repository area - Borehole No. 1	Soil/Bedrock	Field Observation/Logging Rock Quality Designation Modified Rock Mass Rating	RY-RB-01	Core at 5-ft intervals	8/29/12-8/31/12	0 - 86	Determine soil depth/type, observe signs of groundwater levels, investigate mine voids, and determine bedrock quality
Proposed Repository area - Borehole No. 2	Soil/Bedrock	Field Observation/Logging Rock Quality Designation Modified Rock Mass Rating	RY-RB-02	Core at 5-ft intervals	8/27/12-8/29/12	0 - 76.83	Determine soil depth/type, observe signs of groundwater levels, investigate mine voids, and determine bedrock quality
Proposed Repository area - Borehole No. 3	Soil/Bedrock	Field Observation/Logging Rock Quality Designation Modified Rock Mass Rating	RY-RB-03	Core at 5-ft intervals	9/6/2012	0 - 52	Determine soil depth/type, observe signs of groundwater levels, and determine bedrock quality
Proposed Repository area - Borehole No. 4	Soil/Bedrock	Field Observation/Logging	RY-RB-04	Air rotary drill cuttings. Bedrock was not encountered until 120.5 ft bgs. Bedrock was not cored.	9/5/2012	0 - 122	Determine soil depth/type, observe signs of groundwater levels, and determine bedrock quality
Proposed Repository area - Borehole No. 5	Soil/Bedrock	Field Observation/Logging Rock Quality Designation Modified Rock Mass Rating	RY-RB-05	Core at 5-ft intervals	9/4/2012	0 - 46	Determine soil depth/type, observe signs of groundwater levels, and determine bedrock quality
Proposed Repository area - Monitoring Well 1	Groundwater	Field Parameters[e] Dissolved Metals[e] Laboratory Parameters[e]	MW-RY-06	NA	Not Sampled	Dry	Measure groundwater depth and determine background groundwater quality for future groundwater monitoring
Proposed Repository area - Monitoring Well 2	Groundwater	Field Parameters[e] Dissolved Metals[e] Laboratory Parameters[e]	MW-RY-07	Groundwater	9/7/2012	11.86, depth to GW	Measure groundwater depth and determine background groundwater quality for future groundwater monitoring
Proposed Repository area - Monitoring Well 3	Groundwater	Field Parameters[e] Dissolved Metals[e] Laboratory Parameters[e]	MW-RY-08	NA	Not Sampled	Dry	Measure groundwater depth and determine background groundwater quality for future groundwater monitoring
Proposed Repository area - Monitoring Well 4	Groundwater	Field Parameters[e] Dissolved Metals[e] Laboratory Parameters[e]	MW-RY-09	NA	Not Sampled	Dry	Measure groundwater depth and determine background groundwater quality for future groundwater monitoring
Proposed Repository area - Geotechnical Test Pit 1	Soil / Weathered Bedrock	Field Observation/Logging Rippability	RY-SS-06	Not Applicable	9/5/2012	Not Applicable	Confirm borehole observations, investigate presence of shallow groundwater, and estimate rippability/over excavation depth
		Natural Moisture Content Natural Moisture Content Grain Size Distribution Hydrometer		Geotechnical		0-4'	Assess geotechnical properties
				Composite - Geotechnical		4-7'	Assess geotechnical properties

TABLE 2-1. REPOSITORY INVESTIGATION SUMMARY OF SAMPLING AND TESTING
BLACK PINE MINE

Sample Location	Matrix	Analysis	Sample Identification Number	Sample Type	Sample Date	Sample Depth (feet)[f]	Rationale
Proposed Repository area - Geotechnical Test Pit 2	Soil / Weathered Bedrock	Field Observation/Logging Rippability	RY-SS-07	Not Applicable	9/5/2012	Not Applicable	Confirm borehole observations, investigate presence of shallow groundwater, estimate rippability/over excavation depth, and
		Natural Moisture Content Atterberg Limits Grain Size Distribution Hydrometer Standard Proctor		Composite - Geotechnical		'5-13	Assess geotechnical properties
		Natural Moisture Content Atterberg Limits[b] Grain Size Distribution		Composite - Geotechnical		9-13	Assess geotechnical properties
Proposed Repository area - Geotechnical Test Pit 3	Soil / Weathered	Field Observation/Logging Rippability	RY-SS-08	Composite - Geotechnical	9/4/2012	1.3-7	Confirm borehole observations, investigate presence of shallow groundwater, and estimate rippability/over excavation depth
Proposed Repository area - Geotechnical Test Pit 4	Soil / Weathered Bedrock	Field Observation/Logging Rippability	RY-SS-09	Not Applicable	9/5/2012	Not Applicable	Confirm borehole observations, investigate presence of shallow groundwater, and estimate rippability/over excavation depth
		Natural Moisture Content		Geotechnical		2	Assess geotechnical properties
		Natural Moisture Content Grain Size Distribution		Composite- Geotechnical		4-6'	Assess geotechnical properties
Proposed Repository area - Geotechnical Test Pit 5	Soil / Weathered Bedrock	Field Observation/Logging Rippability	RY-SS-10	Not Applicable	9/6/2012	Not Applicable	Confirm borehole observations, investigate presence of shallow groundwater, and estimate rippability/over excavation depth
		Natural Moisture Content		Geotechnical		4'	Assess geotechnical properties
		Natural Moisture Content		Geotechnical		10'	Assess geotechnical properties
		Natural Moisture Content Atterberg Limits Grain Size Distribution Hydrometer Standard Proctor CU Triaxial Compression[d] Hydraulic Conductivity		Composite - Geotechnical		14-16'	Assess geotechnical properties
Proposed Repository area - Geotechnical Test Pit 6	Soil / Weathered Bedrock	Field Observation/Logging Rippability	RY-SS-11	Not Applicable	9/5/2012	Not Applicable	Confirm borehole observations, investigate presence of shallow groundwater, and estimate rippability/over excavation depth
		Natural Moisture Content Grain Size Distribution Standard Proctor		Composite - Geotechnical		2.5 - 4	Assess geotechnical properties
		Natural Moisture Content Atterberg Limits Grain Size Distribution Hydrometer CU Triaxial Compression[d] Hydraulic Conductivity		Composite - Geotechnical		6-8'	Assess geotechnical properties
Proposed Repository area - Geotechnical Test Pit 7	Soil / Weathered Bedrock	Field Observation/Logging Rippability Natural Moisture Content Atterberg Limits Grain Size Distribution Hydrometer	RY-SS-12	Composite - Geotechnical	9/6/2012	15-17	Confirm borehole observations, investigate presence of shallow groundwater, and estimate rippability/over excavation depth

TABLE 2-1. REPOSITORY INVESTIGATION SUMMARY OF SAMPLING AND TESTING
BLACK PINE MINE

Sample Location	Matrix	Analysis	Sample Identification Number	Sample Type	Sample Date	Sample Depth (feet)[f]	Rationale
Proposed Repository area - Geotechnical Test Pit 8	Soil / Weathered Bedrock	Field Observation/Logging Rippability Natural Moisture Content Grain Size Distribution Hydrometer Standard Proctor	RY-SS-13 (VP-1)	Composite - Geotechnical	9/5/2012	2-5	Confirm borehole observations, investigate presence of shallow groundwater, and estimate rippability/over excavation depth
Proposed Repository area - Geotechnical Test Pit 9	Soil / Weathered Bedrock	Field Observation/Logging Rippability Natural Moisture Content Grain Size Distribution	RY-SS-14 (VP-2)	Composite - Geotechnical	9/5/2012	2-4	Confirm borehole observations, investigate presence of shallow groundwater, and estimate rippability/over excavation depth
Proposed Repository area - Geotechnical Test Pit 10	Soil / Weathered Bedrock	Field Observation/Logging Rippability	RY-SS-15 (VP-3)	Not Applicable	9/6/2012	Not Applicable	Confirm borehole observations, investigate presence of shallow groundwater, and estimate rippability/over excavation depth
		Natural Moisture Content		Geotechnical		2-4'	
		Natural Moisture Content Atterberg Limits		Composite - Geotechnical		12'	
Potential Borrow Areas							
Potential Borrow Area BPB-1A - Geotechnical Test Pit 1	Topsoil / Cover Soil	Agricultural	BPB1A-GC-01	Soil Sample - Geochemical	8/31/2012	0 - 0.5	Determine suitability for use as cover soil
	Soil	Soil Classification Only	BPB1A-GT-01	Composite - Geotechnical	8/31/2012	0.5-4.5	Determine index and strength properties of soils to assess suitability as liner material, bedding material, embankment/berm material, or as unclassified fill
Potential Borrow Area BPB-1A - Geotechnical Test Pit 2	Topsoil / Cover Soil	Agricultural ABA	BPB1A-GC-02	Soil Sample - Geochemical	8/28/2012	0 - 0.5	Determine suitability for use as cover soil
	Soil	Natural Moisture Content Atterberg Limits Grain Size Distribution	BPB1A-GT-02	Composite - Geotechnical	8/28/2012	0.5-13.8	Determine index and strength properties of soils to assess suitability as liner material, bedding material, embankment/berm material, or as unclassified fill
Potential Borrow Area BPB-1A - Geotechnical Test Pit 3	Topsoil / Cover Soil	Agricultural	BPB1A-GC-03	Soil Sample - Geochemical	8/28/2012	0 - 0.5	Determine suitability for use as cover soil
	Soil	Natural Moisture Content Grain Size Distribution	BPB1A-GT-03	Composite - Geotechnical	8/28/2012	0.5-12.5	Determine index and strength properties of soils to assess suitability as liner material, bedding material, embankment/berm
Potential Borrow Area BPB-1A - Geotechnical Test Pit 4	Topsoil / Cover Soil	Agricultural	BPB1A-GC-04	Soil Sample - Geochemical	8/28/2012	0 - 0.5	Determine suitability for use as cover soil
	Soil	Soil Classification Only	BPB1A-GT-04	Composite - Geotechnical	8/28/2012	0.5-7	Determine index and strength properties of soils to assess suitability as liner material, bedding material, embankment/berm material, or as unclassified fill
Proposed Repository area - Geotechnical Test Pit 11	Soil / Weathered Bedrock	Soil Classification Only	BPB1A-GT-05 (RY-SS-16, VP-4)	Composite - Geotechnical	9/6/2012	3-6'	Confirm borehole observations, investigate presence of shallow groundwater, and estimate rippability/over excavation depth
Potential Borrow Area BPB-2/3 - Geotechnical Test Pit 1	Topsoil / Cover Soil	Agricultural	BPB2/3-GC-01	Soil Sample - Geochemical	8/29/2012	0 - 0.5	Determine suitability for use as cover soil
	Soil / Weathered Bedrock	Soil Classification Only	BPB2/3-GT-01	Composite - Geotechnical	8/29/2012	0.5 - 7.5'	Confirm borehole observations, investigate presence of shallow groundwater, and estimate rippability/over excavation depth
Potential Borrow Area BPB-2/3 - Geotechnical Test Pit 2	Topsoil / Cover Soil	Agricultural	BPB2/3-GC-02	Soil Sample - Geochemical	8/29/2012	0 - 0.5	Determine suitability for use as cover soil
	Soil	Natural Moisture Content Grain Size Distribution	BPB2/3-GT-02	Composite - Geotechnical	8/29/2012	0.5 -5	Determine index and strength properties of soils to assess suitability as liner material, bedding material, embankment/berm

TABLE 2-1. REPOSITORY INVESTIGATION SUMMARY OF SAMPLING AND TESTING
BLACK PINE MINE

Sample Location	Matrix	Analysis	Sample Identification Number	Sample Type	Sample Date	Sample Depth (feet)[f]	Rationale
Potential Borrow Area BPB-2/3 - Geotechnical Test Pit 3	Topsoil / Cover Soil	Agricultural	BPB2/3-GC-03	Soil Sample - Geochemical	8/29/2012	0 - 0.5	Determine suitability for use as cover soil
	Soil	Soil Classification Only	BPB2/3-GT-03	Composite - Geotechnical	8/29/2012	0.5-7	Determine index and strength properties of soils to assess suitability as liner material, bedding material, embankment/berm material, or as unclassified fill
Potential Borrow Area BPB-2/3 - Geotechnical Test Pit 4	Topsoil / Cover Soil	Agricultural ABA	BPB2/3-GC-04	Soil Sample - Geochemical	8/29/2012	0 - 0.5	Determine suitability for use as cover soil
	Soil	Soil Classification Only	BPB2/3-GT-04	Composite - Geotechnical	8/29/2012	0.5-7	Determine index and strength properties of soils to assess suitability as liner material, bedding material, embankment/berm material, or as unclassified fill
Potential Borrow Area BPB-2/3 - Geotechnical Test Pit 5	Topsoil / Cover Soil	Agricultural	BPB2/3-GC-05	Soil Sample - Geochemical	8/29/2012	0 - 0.5	Determine suitability for use as cover soil
	Soil	Soil Classification Only	BPB2/3-GT-05	Composite - Geotechnical	8/29/2012	0.5-3.5	Determine index and strength properties of soils to assess suitability as liner material, bedding material, embankment/berm material, or as unclassified fill
Potential Borrow Area BPB-2/3 - Geotechnical Test Pit 6	Topsoil / Cover Soil	Agricultural	BPB2/3-GC-06	Soil Sample - Geochemical	8/29/2012	0 - 0.5	Determine suitability for use as cover soil
	Soil	Soil Classification Only	BPB2/3-GT-06	Composite - Geotechnical	8/29/2012	0.5-4	Determine index and strength properties of soils to assess suitability as liner material, bedding material, embankment/berm material, or as unclassified fill
Potential Borrow Area BPB-7A - Geotechnical Test Pit 2	Topsoil / Cover Soil	Agricultural ABA	BPB7A-GC-02	Soil Sample - Geochemical	8/31/2012	0 - 0.5	Determine suitability for use as cover soil
	Soil	Soil Classification Only	BPB7A-GT-02	Composite - Geotechnical	8/31/2012	0.5 - 7.5	Determine index and strength properties of soils to assess suitability as liner material, bedding material, embankment/berm material, or as unclassified fill
Potential Borrow Area BPB-7A - Geotechnical Test Pit 3	Topsoil / Cover Soil	Agricultural	BPB7A-GC-03	Soil Sample - Geochemical	8/31/2012	0 - 0.5	Determine suitability for use as cover soil
	Soil	Natural Moisture Content Atterberg Limits Grain Size Distribution	BPB7A-GT-03	Composite - Geotechnical	8/31/2012	0.5 - 14.0	Determine index and strength properties of soils to assess suitability as liner material, bedding material, embankment/berm material, or as unclassified fill
Potential Borrow Area BPB-7A - Geotechnical Test Pit 4	Topsoil / Cover Soil	Agricultural	BPB7A-GC-04	Soil Sample - Geochemical	8/31/2012	0 - 0.25	Determine suitability for use as cover soil
	Soil	Natural Moisture Content Atterberg Limits Grain Size Distribution	BPB7A-GT-04	Composite - Geotechnical	8/31/2012	0.5 - 4.0	Determine index and strength properties of soils to assess suitability as liner material, bedding material, embankment/berm material, or as unclassified fill
		Natural Moisture Content Atterberg Limits Grain Size Distribution	BPB7A-GT-04A	Composite - Geotechnical	8/31/2012	4.0 - 16.0	Determine index and strength properties of soils to assess suitability as liner material, bedding material, embankment/berm material, or as unclassified fill
Potential Borrow Area BPB-11 - Geotechnical Test Pit 1	Soil	Soil Classification Only	BPB11-GT-01	Composite - Geotechnical	8/29/2012	0.5-3.0	Determine index and strength properties of soils to assess suitability as liner material, bedding material, embankment/berm material, or as unclassified fill
Potential Borrow Area BPB-11 - Geotechnical Test Pit 2	Soil	Soil Classification Only	BPB11-GT-02	Composite - Geotechnical	8/29/2012	0.5-3.5	Determine index and strength properties of soils to assess suitability as liner material, bedding material, embankment/berm material, or as unclassified fill

TABLE 2-1. REPOSITORY INVESTIGATION SUMMARY OF SAMPLING AND TESTING
BLACK PINE MINE

Sample Location	Matrix	Analysis	Sample Identification Number	Sample Type	Sample Date	Sample Depth (feet)[f]	Rationale
Potential Borrow Area BPB-12 - Geotechnical Test Pit 1	Soil	Soil Classification Only	BPB12-GT-01	Composite - Geotechnical	8/30/2012	0.5-4.25	Determine index and strength properties of soils to assess suitability as liner material, bedding material, embankment/berm material, or as unclassified fill
Potential Borrow Area BPB-12 - Geotechnical Test Pit 2	Soil	Soil Classification Only	BPB12-GT-02	Composite - Geotechnical	8/30/2012	0.5-7.5	Determine index and strength properties of soils to assess suitability as liner material, bedding material, embankment/berm material, or as unclassified fill
Potential Borrow Area BPB-12 - Geotechnical Test Pit 3	Soil	Soil Classification Only	BPB12-GT-03	Composite - Geotechnical	8/30/2012	0.5-11	Determine index and strength properties of soils to assess suitability as liner material, bedding material, embankment/berm material, or as unclassified fill
Potential Borrow Area BPB-12 - Geotechnical Test Pit 5	Soil	Soil Classification Only	BPB12-GT-05	Composite - Geotechnical	8/30/2012	0.5 - 17.5	Determine index and strength properties of soils to assess suitability as liner material, bedding material, embankment/berm material, or as unclassified fill
Potential Borrow Area BPB-13 - Geotechnical Test Pit 1	Topsoil / Cover Soil	Agricultural ABA	BPB13-GC-01	Soil Sample - Geochemical	8/30/2012	0 - 0.5	Determine suitability for use as cover soil
	Soil	Natural Moisture Content Atterberg Limits Grain Size Distribution	BPB13-GT-01	Composite - Geotechnical	8/30/2012	0.5 - 16.5	Determine index and strength properties of soils to assess suitability as liner material, bedding material, embankment/berm material, or as unclassified fill
Potential Borrow Area BPB-13 - Geotechnical Test Pit 2	Topsoil / Cover Soil	Agricultural	BPB13-GC-02	Soil Sample - Geochemical	8/30/2012	0 - 0.5	Determine suitability for use as cover soil
	Soil	Soil Classification Only	BPB13-GT-02	Composite - Geotechnical	8/30/2012	0.5 - 15	Determine index and strength properties of soils to assess suitability as liner material, bedding material, embankment/berm material, or as unclassified fill
Potential Borrow Area BPB-13 - Geotechnical Test Pit 3	Topsoil / Cover Soil	Agricultural	BPB13-GC-03	Soil Sample - Geochemical	8/30/2012	0 - 0.5	Determine suitability for use as cover soil
	Soil	Soil Classification Only	BPB13-GT-03	Composite - Geotechnical	8/30/2012	0.5 - 16	Determine index and strength properties of soils to assess suitability as liner material, bedding material, embankment/berm material, or as unclassified fill
Potential Borrow Area BPB-13 - Geotechnical Test Pit 4	Topsoil / Cover Soil	Agricultural	BPB13-GC-04	Soil Sample - Geochemical	8/30/2012	0 - 0.5	Determine suitability for use as cover soil
	Soil	Natural Moisture Content Atterberg Limits Grain Size Distribution	BPB13-GT-04	Composite - Geotechnical	8/30/2012	0.5 - 13.5	Determine index and strength properties of soils to assess suitability as liner material, bedding material, embankment/berm material, or as unclassified fill

TABLE 2-1. REPOSITORY INVESTIGATION SUMMARY OF SAMPLING AND TESTING
BLACK PINE MINE

Sample Location	Matrix	Analysis	Sample Identification Number	Sample Type	Sample Date	Sample Depth (feet)[f]	Rationale
Quality Assurance/Quality Control							
Proposed Repository Area - Monitoring Well	Groundwater	***Field Parameters*** [e] ***Dissolved Metals*** [e] ***Laboratory Parameters*** [e]	MW-RY-07-DUP	Field Duplicate	9/7/2012	-	Measure field variability
Equipment Rinsate	Surface Water	Total Recoverable Metals	Equipment Rinsate	Equipment Blank	9/7/2012	-	Measure field variability
Equipment Rinsate 2	Surface Water	Total Recoverable Metals	Equipment Rinsate 2	Equipment Blank	9/7/2012	-	Measure field variability

[a] Two waste rock samples were submitted for Standard Proctor testing in place of relative density testing due to the nature of the waste samples.

b Sample was submitted for Atterberg Limits testing, but sample was non-plastic so laboratory did not conduct the test.

[c] Samples collected from the Combination Mill Impacted Sediments and Soils and the South Fork Lower Willow Creek Stream Sediments were submitted for Standard Proctor testing because there was a notable difference between their index properties and those of the materials from the Combination Mill Tailings Impoundment.

[d] Proctor tests were performed first, then the sample at optimum moisture and density was used for CU Triaxial Compression testing and/or permeability testing, as appropriate.

[e] Groundwater samples were only collected if sufficient groundwater was present.

[f] Depth of test pits, borings, and samples were based on field conditions.

ABA - acid base accounting
AOC - area of concern
BPB - Black Pine borrow
CML - Combination Mill AOC
CMN - Combination Mine AOC
CU - consolidated, undrained
ft - feet
GC - geochemical
GT - geotechnical
MW - monitoring well
RB - boring
RY - repository
SS - soil sample
TCLP - Toxicity Characteristic Leaching Procedure

TABLE 2-4. POTENTIAL BORROW AREAS TEST PIT LITHOLOGY SUMMARY
BLACK PINE MINE

Test Pit	Total Depth (feet bgs)	Depth Interval (feet bgs)/ Material Description	
BPB1A-01	4.5	0 – 0.25	Duff and Topsoil with gravel, dark brown, dry
		0.25 – 4.5	Highly weathered, silty sandy gravel with cobbles, trace organics, dry, brown
		4.5	Refusal
BPB1A-02	13.8	0 – 0.5	Duff silty sand with gravel, trace organics, brown, dry
		0.25 – 3.0	Silty sand with gravel, trace cobbles and roots, dry, brown
		3.0 – 13.8	Lean clayey sand and gravel, with cobbles, shale, argillite, dark yellowish brown, damp
		13.8	Maximum reach of excavator
BPB1A-03	12.5	0 – 0.25	Duff, black to dark brown
		0.25 – 3.0	Gravelly silt, with sand, trace organics, dry, brown, non-plastic
		3.0 – 12.5	Highly weathered bedrock, silty sand, with gravel, trace cobbles, dark yellowish brown, dry
		12.5	Refusal
BPB1A-04	7.0	0 – 0.25	Duff dark brown
		0.25 – 3.0	Silt, with sand, trace gravel and organics, dry, brown, nonplastic
		3.0 – 7.0	Sand and gravel with silt, dark yellowish brown, dry
		7.0	Refusal
BPB1A-05 (VP-4)	9.5	0 – 0.5	Topsoil, duff
		0.5 – 2.5	GM, Silty gravel with sand and cobbles, tan, dense, dry, fine to coarse sand, angular to subangular gravels and cobbles,
		2.5 – 9.5	GL, Clayey gravel with sand and cobbles, very dense, orange-brown, moist, angular to subangular gravels and cobbles
		9.5	Refusal
BPB2/3-01	7.0	0 – 0.25	Topsoil, with gravel and cobbles, brown, dry
		0.25 – 5.0	Sandy silt with cobbles and gravels, light brown, dry
		5.0 – 7.0	Fine sand with gravels and lean clayey-coated cobbles, dark yellowish brown, damp
		7.0	Refusal
BPB2/3-02	5.0	0 – 0.3	Topsoil, with gravel and organics, dark brown, dry
		0.3 – 5.0	Silty sand with gravel and cobbles, trace organics, light brown, dry
		5.0	Refusal
BPB2/3-03	7.0	0 – 0.25	Topsoil, sandy silt with organics and cobbles, dark brown, dry
		0.25 – 7.0	Sandy silt with gravels and cobbles, light brown, dry
		7.0	Refusal
BPB2/3-04	7.0	0 – 0.5	Topsoil, gravelly silt with organics, dry
		0.25 – 4.0	Silt and sand with gravels and cobbles, light brown, dry, trace organics
		4.0 – 7.0	Sandy gravel with silt and cobbles, reddish brown, damp
		7.0	Refusal
BPB2/3-05	3.5	0 – 0.25	Topsoil, organics with gravel, dark brown
		0.25 – 3.5	Sandy silt with gravels and cobbles, trace organics, light brown, dry
		3.5	Refusal
BPB2/3-06	4.0	0 – 0.25	Topsoil, silt and sand with gravel, trace organics, brown, dry
		0.25 – 4.0	Cobbles and gravel with silt and sand, brown, dry
		4.0	Refusal

TABLE 2-4. POTENTIAL BORROW AREAS TEST PIT LITHOLOGY SUMMARY
BLACK PINE MINE

Test Pit	Total Depth (feet bgs)	Depth Interval (feet bgs)/ Material Description	
BPB7A-01	Test BPB7A-01 was not completed due to concerns with the difficulty in accessing the location at the bottom of a steep ravine, and possible slope and vegetation damage that might occur during access. In addition, excavation tended to become more difficult in test pits further downhill.		
BPB7A-02	7.5	0 – 0.5	Topsoil, sand with silt and gravel, dark brown, dry
		0.5 – 3.0	Highly weathered bedrock, shale, silty sand with cobbles and gravel, reddish brown, dry
		3.0	Refusal
BPB7A-03	14.0	0 – 0.25	Duff Topsoil with trace gravel, dry
		0.25 – 1.5	Sandy silt with gravel, trace organics, light brown, dry
		1.5 – 4.0	Sandy silt with gravel and cobbles, light brown, dry
		4.0 – 8.0	Silty sandy gravel with cobbles, reddish brown, damp
		8.0 – 14.0	Glacial till, sandy lean clay, with gravel and cobbles. Reddish brown damp to moist.
		14.0	Total depth, maximum reach of excavator
BPB7A-04	16.0	0 – 0.25	Duff Topsoil with trace gravel, dark brown, dry
		0.25 – 2.5	Sandy silt with gravel and cobbles, trace organics, light brown, dry
		2.5 – 4.0	Sandy silt with gravel and cobbles, reddish brown, damp, slightly plastic
		4.0 – 16.0	Glacial till, sandy lean clay with cobbles, trace gravel. Reddish brown, moist, overconsolidated
		16.0	Total depth, maximum reach of excavator
BPB11-01	3.0	0 – 0.5	Topsoil, sand with silt and gravel, organics, dark brown, dry
		0.5 – 3.0	Highly weathered bedrock, shale, silty sand with cobbles and gravel, reddish brown, dry
		3.0	Refusal
BPB11-02	3.0	0 – 0.5	Topsoil, sandy silty gravel, organics, dark brown, dry
		0.5 – 3.0	Highly weathered bedrock, shale, gravels and cobbles with sand and silt, brown, dry
		3.0	Refusal
BPB-11 - 03	Not excavated because the shallow refusal observed in BPB11-01 and -02 indicated that this potential borrow area was unsuitable to provide sufficient topsoil or cover soil for the repository.		
BPB-11 - 04	Not excavated because the shallow refusal observed in BPB11-01 and -02 indicated that this potential borrow area was unsuitable to provide sufficient topsoil or cover soil for the repository.		
BPB12-01	4.25	0 – 0.25	Duff topsoil with gravel, dark brown, dry
		0.25 – 3.0	Sand, silty gravel, shale with trace organics, dry, reddish brown, consolidated
		3.0 – 4.25	Sandy, silty gravel with cobbles, dark reddish brown, damp
		4.25	Refusal
BPB12-02	3.0	0 – 0.3	Topsoil, sandy silt with gravel, organics, dark brown, dry
		0.3 – 7.5	Highly weathered bedrock, silty sandy gravel with cobbles, shale, trace organics, reddish brown, dry
		3.0	Refusal

TABLE 2-4. POTENTIAL BORROW AREAS TEST PIT LITHOLOGY SUMMARY
BLACK PINE MINE

Test Pit	Total Depth (feet bgs)	Depth Interval (feet bgs)/ Material Description	
BPB12-03	11	0 – 0.5	Topsoil – duff, dark brown
		0.25 – 2.0	Sandy silt with trace gravel, light reddish brown, dry, trace organics
		2 - 5.0	Sandy silty gravel, trace cobbles, reddish brown, damp
		5.0 - 11	Sandy silty gravel with cobbles, reddish brown, moist, slightly plastic
		11	Refusal
BPB12 – 04	Not excavated because the shallow refusal observed in BPB12-01 and -02 indicated that this area was unsuitable to provide sufficient topsoil or cover soil for the repository.		
BPB12-05	17.5	0 – 1.0	Topsoil – silty sand with trace gravel, brown, dry
		1.0 – 7.0	Sandy silt with gravel, trace cobbles, reddish brown, damp
		7.0 – 15	Fine sandy silt, with cobbles and gravel, yellowish brown, reddish brown, moist
		15 – 17.5	Same, wet
		17.5	Maximum reach of excavator
BPB13-01	16.5	0 – 0.25	Duff and Topsoil – sandy silt with organics, very dark brown, dry
		0.25 – 1.75	Silty sand and gravel, trace organics, light gray, dray
		1.75 – 6.26	Glacial till, sandy lean to fat clay, with gravel and cobbles, reddish brown, overconsolidated, damp
		6.25 – 9	Silt, trace fine sand, lean clay, brownish gray overconsolidated, damp
		9	with fine sand
		11	Consolidation increasing, difficult to break by hand
		16.5	Total depth, maximum reach of excavator
BPB13-02	15.0	0 – 0.25	Duff and Topsoil – sandy silt with organics, very dark brown, dry
		0.25 – 2.5	Silty sand and gravel with cobbles, light brown, dry
		2.5 – 4.25	Silty gravel with cobbles Glacial till, with sand, reddish brown, overconsolidated, moist
		4.25 – 15.0	Fine sandy silt, trace gravels and cobbles, brownish gray, overconsolidated, moist
		15.0	Total depth, maximum reach of excavator
BPB13-03	16.0	0 – 0.25	Topsoil – sandy silt with organics, dark brown, dry
		0.25 – 1.0	Sandy silt with trace gravel, light brown, dry, trace organics
		1-16.0	Silty sand with gravel, dark brown, overconsolidated, moist, harder excavating
		16	Total depth, maximum reach of excavator
BPB13-04	13.5	0 – 0.25	Duff and Topsoil
		0.25 – 1.0	Sandy silt with trace gravel, light brown, dry
		1.00 – 2.5	Lean clayey sand with gravel, damp, dark brownish yellow, slightly plastic sand and gravel with cobbles, light brown, dry
		2.5 – 5.0	Sandy silt with gravel, light grayish brown, damp
		5.0 – 13.5	Clayey sandy silt with gravel, damp, brown, hard digging
		13.5	Refusal

BPB – potential borrow area
bgs – below ground surface

TABLE 2-5. REPOSITORY TEST PITS LITHOLOGY SUMMARY

BLACK PINE MINE

Test Pit	Total Depth (feet bgs)	Depth Interval (feet)/ Material Description	
RY-SS-06	7.0	0 – 0.25	Topsoil, vegetated
		0.25 – 4.0	Tan gravelly soil, sandy with 2-3” minus gravel,
		4.0 – 7.0	Coarse rock, red brown soil, Bottom of excavation into 6” plus fracture
		7.0	Refusal (rock)
RY-SS-07	13.0	0 – 5.0	Cobbles, gravel and silt with sand, dry
		@2.0	Orange bricks, not arranged
		@5.0	Color becomes dark yellowish brown, decreasing cobbles
		@7.0	Cobbly, gravelly silt with sand, trace lean clay, moist, dark yellowish brown
		@9.0	Cobbly, gravelly silt with sand, very moist, dark brown
		13.0	Maximum reach of excavator, still easy digging
RY-SS-08	7.0	0 – 0.1	Gravel and duff, light brown, dry
		0.1 – 1.3	Silty sandy gravel with cobbles, trace roots, and waste rock fill, iron staining
		1.3 – 4.0	Gravel and cobbles with silt and sand, light brown, dry
		4.0 – 7.0	Silty gravel and cobbles with sand, brown, slightly moist,
		7.0	Refusal (cobbles)
RY-SS-09	7.0	0 – 3.0	GM, Silty gravel with sand, trace cobbles, angular to subangular gravels and cobbles, fine to coarse sand, tan, dry, dense
		3.0 – 7.0	GP-GM, Gravel and cobbles with silt and fine to coarse sand, angular gravel cobbles, orangish brown, very dense, moist
		7.0	Refusal (cobbles)
RY-SS-10	17.0	0 – 3.0	SM, Silty gravel with sand, few cobbles, angular to subangular gravels and cobbles, fine to coarse sand, tan, dense
		3.0 – 9.0	GC, Clayey gravel with sand and few cobbles, fine to coarse sand, angular to subangular gravel and cobbles, orangish brown, dense, moist, low to moderately plastic clay
		9.0-17.0	CL, Gravelly clay with sand, very stiff, moist, orangish brown, low to moderately plastic clay, fine to coarse sand, angular to subangular gravel and cobbles,
		17.0	Maximum reach of excavator
RY-SS-11	14.5	0 – 0.5	Topsoil, duff, brown
		0.5 – 2.5	ML, Sandy silt, tan, dense, moist, fine to med sand, trace coarse sand
		2.5 – 8.0	GC, Clayey gravel with sand and cobbles, very dense, orange-brown, moist, fine to coarse sand, angular to subangular gravels and cobbles, increasing gravels and cobbles below 7.5 feet
		8.0 – 14.5	SM, Silty sand with gravels and cobbles, very dense, orange-brown, moist, angular to subangular gravel and cobbles,
		14.5	Maximum reach of excavator

TABLE 2-5. REPOSITORY TEST PITS LITHOLOGY SUMMARY

BLACK PINE MINE

Test Pit	Total Depth (feet	Depth Interval (feet)/ Material Description	
RY-SS-12	17.0	0.0 – 4.0	GM, Silty gravel with sand, dense, tan, dry, fine to coarse sand, angular to subangular gravel, trace organics
		4.0 – 7.0	GM, grades orange-brown, moist, very dense
		7.0 – 8.0	GC, Clayey gravel with sand, very dense, orange-brown, moist, fine to coarse sand, angular to subangular gravels, lean clay
		8.0 – 17.0	CL, Gravelly clay with sand, very stiff, moist, orangish brown, low to moderate plasticity, fine to coarse sand, angular to subangular gravel
		17.0	Maximum reach of excavator
RY-SS-13 (VP-1)	11.0	0.0 – 1.0	GM, Silty gravel with sand, loose to medium dense, tan, dry, fine to coarse sand, angular gravel, several roots
		1.0 – 8.5	GM, Silty gravel with sand, very dense, brownish gray, dry to moist (below 3 feet), few cobbles, fine to coarse sand, angular gravel and cobbles,
		8.5 – 11.0	GM, Silty gravel with cobbles, fine to coarse sand, brownish gray, moist, angular gravel and cobbles,
		11.0	Maximum reach of excavator
RY-SS-14 (VP-2)	10.0	0.0 – 3.0	GP - GM, Sandy gravel with silt, loose, tan, dry, angular gravel,
		3.0 – 4.0	GP, Sandy gravel with few cobbles, dense, brownish gray, moist, fine to coarse sand, angular gravel and cobbles,
		4.0 – 10.0	Cobbles with gravels, trace sand and silt, brownish gray, moist, very dense
		10.0	Refusal (cobbles)
RY-SS-15 (VP-3)	17.5	0.0 – 1.0	SM, Silty sand with gravel loose, brown, dry to moist, angular gravel, fine to coarse sand, some organics
		1.0 – 4.0	ML, Gravelly silt with sand, dense, tan, moist, fine to coarse sand, angular to subangular gravel
		4.0 – 8.0	GC, Clayey gravel with cobbles and fine to coarse sand, orange brown, moist, dense, angular to subangular gravel
		8.0 – 17.5	CL, Gravelly clay with fine to coarse sand and cobbles, very stiff, orange brown, moist, low to moderate plasticity
		17.5	Maximum reach of excavator

bgs – below ground surface
RY – repository
SS – soil sample

TABLE 3-5 POTENTIAL BORROW AREAS ACID BASE ACCOUNTING RESULTS
BLACK PINE MINE

Location	Date Sampled	Sample Depth (feet)	Acid Base Potential** (t/1000t)	Acid Potential (t/1000t)	Neutralization Potential (t/1000t)	pH, SMP Buffer (s.u.)	SMP Lime Requirement (t/1000t)	Sulfur (HCL Extraction) (%)	Sulfur (HNO3 Extraction) (%)	Sulfur (Hot Water Extraction) (%)	Sulfur, Residual (%)	Sulfur, Total (%)
BPB1A-GC-02	8/29/2012	0	5	<0.3	5	6.2	5	<0.01	<0.01	<0.01	<0.01	<0.01
BPB2/3-GC-04	8/29/2012	0	8	<0.3	8	5.7	9	<0.01	<0.01	<0.01	<0.01	<0.01
BPB7A-GC-02	8/31/2012	0	2	<0.3	2	5.4	11	<0.01	<0.01	<0.01	<0.01	<0.01
BPB13-GC-01	8/30/2012	0	6	<0.3	6	6.7	2	<0.01	<0.01	<0.01	<0.01	<0.01

t/1000t - tons per 1,000 tons waste
NP - Neutralization Potential
AP - Acid Potential
NNP - Net Neutralizing Potential = Neutralizing Potential - Acid Potential
s.u. - standard units

** Acid/Base Potential = NP - AP
Potentially Acid Generating: NP:AP < 1 and NNP < -20 metric tons/kton
Uncertain Acid Generation Potential: NP:AP between 1 and 3 and/or NNP between -20 and +20 metric tons/kton
Unlikely to Generate Acid: NNP > +20 metric tons/kton

TABLE 3-8 REPOSITORY AREA ACID BASE ACCOUNTING RESULTS
BLACK PINE MINE

Location	Date Sampled	Sample Start Depth (feet)	Sample End Depth (feet)	Acid Base Potential** (t/1000t)	Acid Potential (t/1000t)	Neutralization Potential (t/1000t)	pH, SMP Buffer (Standard Units)	Recommended Lime (t/1000t)	SMP Lime Requirement (t/1000t)	Sulfur (HCL Extraction) (%)	Sulfur (HNO3 Extraction) (%)	Sulfur (Hot Water Extraction) (%)	Sulfur, Residual (%)	Sulfur, Total (%)
RY-SS-03	7/12/2011	0	1	6.5	ND(4.3)	6.5	6.8	ND(5.4)	0.3	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)
RY-SS-03	7/12/2011	12	14	3.7	ND(4.3)	3.7	7	ND(5.4)	0	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)
RY-SS-04	7/12/2011	0	1	7	ND(4.3)	7	6.2	7	5.3	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)
RY-SS-04	7/12/2011	2	4	4	ND(4.3)	4	6.8	ND(5.4)	1	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)
RY-SS-04	7/12/2011	9	11	3	ND(4.3)	3	7	ND(5.4)	0	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)
MW-RY-08	8/17/2011	0	0.5	2.4	ND(4.3)	2.4	7	ND(5.4)	0	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)

t/1000t - tons per 1,000 tons waste
NP - Neutralization Potential
AP - Acid Potential
NNP - Net Neutralizing Potential = Neutralizing Potential - Acid Potential
s.u. - standard units

** Acid/Base Potential = NP - AP
Potentially Acid Generating: NP:AP < 1 and NNP < -20 metric tons/kton
Uncertain Acid Generation Potential: NP:AP between 1 and 3 and/or NNP between -20 and +20 metric tons/kton
Unlikely to Generate Acid: NNP > +20 metric tons/kton

TABLE 3-12. OBSERVED GROUNDWATER OR PERCHED WATER IN PROPOSED REPOSITORY AREA
BLACK PINE MINE

LOCATION	TYPE OF LOCATION	DATE INSTALLED	COMPLETION INFORMATION			DEPTH TO GROUNDWATER (feet bgs)	GROUNDWATER NOTES
			TOTAL DEPTH OF TEST PIT OR BOREHOLE (feet bgs)	TOTAL DEPTH OF WELL (feet bgs)	SCREENED INTERVAL (feet bgs)		
RY-SS-03	Test Pit	July 2011	14.0	NA	NA	NO	Groundwater was not observed.
RY-SS-04	Test Pit	July 2011	10.5	NA	NA	2.75	Small seep above clay layer
RY-SS-06	Test Pit	September 2012	7.0	NA	NA	NO	Groundwater was not observed.
RY-SS-07	Test Pit	September 2012	13.0	NA	NA	NO	Groundwater was not observed.
RY-SS-08	Test Pit	September 2012	7.0	NA	NA	NO	Groundwater was not observed.
RY-SS-09	Test Pit	September 2012	7.0	NA	NA	NO	Groundwater was not observed.
RY-SS-10	Test Pit	September 2012	17.0	NA	NA	NO	Groundwater was not observed.
RY-SS-11	Test Pit	September 2012	14.5	NA	NA	NO	Groundwater was not observed.
RY-SS-12	Test Pit	September 2012	17.0	NA	NA	NO	Groundwater was not observed.
RY-SS-13	Test Pit	September 2012	11.0	NA	NA	NO	Groundwater was not observed.
RY-SS-14	Test Pit	September 2012	10.0	NA	NA	NO	Groundwater was not observed.
RY-SS-15	Test Pit	September 2012	17.5	NA	NA	NO	Groundwater was not observed.
MW-RY-06	Monitor Well	August 2011	28.0	13	3 to 13	NO	No groundwater measured during completion in August 2011, or subsequent gauging events in November 2011, April 2012, and September 2012
MW-RY-07	Monitor Well	August 2011	26.0	13	3 to 13	8.86 to 12.0	No groundwater measured during completion in August 2011. Groundwater observed during subsequent gauging events in November 2011, April 2012, and September 2012. No groundwater observed from the transducer data between January 2012 (installed) and April 18, 2013, Refer to Figure 3-3
MW-RY-08	Monitor Well	August 2011	9.0	8	3 to 8	NO	No groundwater measured during completion in August 2011, or subsequent gauging events in November 2011, April 2012, and September 2012
MW-RY-09	Monitor Well	January 2012	32.0	30	10 to 30	NO	No groundwater measured during completion in August 2011, or subsequent gauging events in November 2011, April 2012, and September 2012. No groundwater observed from the transducer data between January 2012 (installed) and April 18, 2013.
RY-RB-01	Borehole	August 2012	86.0	NA	NA	38	Groundwater was observed slowly infiltrating into the borehole at a depth of approximately 38 feet bgs
RY-RB-02	Borehole	August 2012	77.0	NA	NA	30 - 43.5	Groundwater was observed slowly infiltrating into the borehole at depths ranging from approximately 30 feet to 43.5 feet bgs
RY-RB-03	Borehole	September 2012	52.0	NA	NA	NO	Groundwater was not observed at time of drilling.
RY-RB-04	Borehole	September 2012	122.0	NA	NA	NO	Groundwater was not observed at time of drilling.
RY-RB-05	Borehole	September 2012	46.0	NA	NA	NO	Groundwater was not observed at time of drilling.

bgs - below ground surface
NO - Not Observed
NA - Not applicable

TABLE 4-2. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)
BLACK PINE MINE

ARARs	Description	Applicable or Relevant and Appropriate
State Location-Specific ARARs		
Montana Solid Waste Management Act and Regulations		
Montana Solid Waste Management Act and Regulations, Section 75-10-201, et seq., MCA, ARM 17.50.1001, et seq.	Provides that the management system of any solid waste facility must protect the public health and safety and conserve natural resources.	Relevant and Appropriate. These standards provide sound guidance for any solid waste facility for the treatment, storage, or disposal of mine wastes.
Floodplains, ARM 17.50.1004	Provides that a solid waste facility located within the 100-year floodplain may not restrict the flow of the 100-year flood, reduce the temporary water storage capacity of the floodplain, or result in washout of solid waste that poses a hazard to human health or the environment.	Applicable. If a new solid waste repository is constructed or existing solid waste facility is expanded in the 100-year floodplain, it will not restrict the flow of 100-year flood. In any event, disposal of mine wastes within a floodplain is to be avoided per other ARAR requirements.
Wetlands, ARM 17.50.1005	Prohibits the location of a solid waste facility in a wetland, unless there is no practicable alternative.	Applicable. New solid waste facilities will not be located in a wetland.
Fault Areas, ARM 17.50.1006	Prohibits the location of a solid waste facility within 200 feet (60 meters) of a fault that has had displacement in Holocene time unless an alternative setback will prevent damage to the solid waste facility and will protect human health and the environment.	Applicable. New solid waste facilities will not be located within 200 feet of a fault.
Seismic Areas, ARM 17.50.1007	Prohibits the location of a solid waste facility in a seismic impact zone unless the solid waste structure is designed to resist the maximum horizontal acceleration in lithified earth material for the site.	Applicable. New solid waste facility will not be located in a seismic impact zone.
Unstable Areas, ARM 17.50.1008	Prohibits the location of a solid waste facility in an unstable area (determined by local soil conditions, local geographic or geomorphologic features, and local artificial features or events) unless the solid waste facility is designed to protect its structural components.	Applicable. New solid waste facilities will not be located in an unstable geologic area or will be designed to protect the structural components of the facility.
Location Restrictions, ARM 17.50.1009	Requires that a solid waste facility must have sufficient acreage and adequate separation of wastes from underlying groundwater or adjacent surface water, be located so as to prevent pollution of water systems, be accessible, and allow for reclamation of the land.	Applicable. The listed requirements apply to management and disposal of mine wastes at the site.
Section 75-10-212, MCA	Prohibits dumping or abandoning any debris or refuse upon or within 200 yards of any State road, other public property, or private property where hunting, fishing or other recreation is permitted.	Applicable. The listed requirements apply to management and disposal of mine wastes at the site.

TABLE 4-2. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)
BLACK PINE MINE

ARARs	Description	Applicable or Relevant and Appropriate
Action-Specific ARARs		
Federal and State RCRA Subtitle C Requirements		
Federal and State RCRA Subtitle C Requirements, 42 USC Section 6921, et seq. (relevant and appropriate for solid wastes, applicable for hazardous wastes)	Sets criteria for identifying the characteristics of hazardous waste, and for listing hazardous waste, taking into account toxicity, persistence, and degradability in nature, potential for accumulation in tissue, and other related factors such as flammability, corrosiveness, and other hazardous characteristics.	Relevant and appropriate. However, there may be some roaster brick or other RCRA wastes for which these requirements are applicable.
40 CFR Part 264 Subpart F,	Sets regulations that apply to facilities that treat, store or dispose of hazardous waste.	Relevant and appropriate. However, the State of Montana has promulgated solid waste and mine reclamation regulations: ARM 17.50. 1111, 1116, 1403,1404.
General Facility Standards:		
40 CFR 264.92, .93, and .94	Prescribes groundwater protection standards. Ensures that hazardous constituents detected in groundwater do not exceed the concentration limits established in 40 CFR 264.94 in the uppermost aquifer underlying the waste management area.	Relevant and appropriate. Reclamation activities will protect the groundwater quality by placing waste in an engineered facility that would not degrade water quality.
40 CFR 264.97	Prescribes general groundwater monitoring requirements.	Relevant and appropriate. Future monitoring will need to meet these requirements, including but not limited to well structures, sample frequency, sample handling, analytical procedures, and chain of custody control if material is hauled to a Subtitle D facility.
40 CFR 264.98	Prescribes requirements for monitoring and detecting indicator parameters.	Relevant and appropriate. Future monitoring will also include detection monitoring for indicator parameters, waste constituents, or reaction products, which would indicate the presence of hazardous constituents in groundwater.
Closure Requirements:		
40 CFR 264.111	Requires an owner or operator of a hazardous waste management facility to close the facility in a way that minimizes the need for further maintenance, and controls or eliminates the escape of hazardous waste or its constituents, leachate, or runoff.	Relevant and appropriate. However, the State of Montana has promulgated solid waste closure regulations: ARM 17.50. 1403.

TABLE 4-2. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)
BLACK PINE MINE

ARARs	Description	Applicable or Relevant and Appropriate
40 CFR 264.117	Provides requirements for post-closure care and use of hazardous waste management units, including length of care period, length of security period, and prohibition of using the property in a way that would disturb the integrity of the management facility.	Relevant and appropriate. However, the State of Montana has promulgated solid waste closure regulations: ARM 17.50. 1404.
40 CFR 264.310	Specifies requirements for caps, maintenance, and monitoring after closure.	Relevant and appropriate. However, the State of Montana has promulgated solid waste closure regulations: ARM 17.50. 1404.
40 CFR 264.301	Prescribes design and operating requirements for landfills.	Relevant and appropriate. However, the State of Montana has promulgated solid waste design and operating requirements: ARM 17.50. 1101 through 17.50.1118 and ARM 17.50.1201 through 17.50.1205.
40 CFR 264.301(a)	Provides for a single liner and leachate collection and removal system.	Relevant and appropriate. However, the State of Montana has promulgated solid waste design requirements: ARM 17.50. 1204.
40 CFR 264.301(f)	Requires a run-on control system.	Relevant and appropriate. However, the State of Montana has promulgated solid waste operating requirements: ARM 17.50.1109.
40 CFR 264.301(g)	Requires a run-off management system.	Relevant and appropriate. However, the State of Montana has promulgated solid waste operating requirements: ARM 17.50.1109.
40 CFR 264.301(h)	Requires prudent management of facilities for collection and holding of run-on and run-off.	Relevant and appropriate. However, the State of Montana has promulgated solid waste operating requirements: ARM 17.50.1109.
40 CFR 264.301(j)	Requires that wind dispersal of particulate matter be controlled.	Relevant and appropriate. However, the State of Montana has promulgated solid waste operating requirements: ARM 17.24.761 and ARM 17.50.1107.

TABLE 4-2. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)
BLACK PINE MINE

ARARs	Description	Applicable or Relevant and Appropriate
Federal and State RCRA Subtitle D and Solid Waste Management Requirements		
Federal Requirements:		
40 CFR 257	Establishes Criteria for Classification of Solid Waste Disposal Facilities and Practices.	Applicable.
40 CFR 257.3-1	Prohibits washout of solid waste in solid waste facilities in a floodplain posing a hazard to human life, wildlife, or land or water resources.	Applicable. However, Montana has promulgated state standards regulating landfill siting: ARM 17.50.1004.
40 CFR 257.3-2	Prohibits solid waste facilities from contributing to the taking of endangered species or the endangering of their critical habitat.	Applicable. However, Montana has promulgated state standards regulating landfill siting: ARM 17.50.1009.
40 CFR 257.3-3	Prohibits solid waste facilities from discharging pollutants, dredged or fill material, into waters of the states. And prohibits causing non-point source pollution in violation of applicable legal requirements.	Applicable. However, Montana has promulgated state solid waste requirements: ARM 17.50.1110, ARM 17.50.1204, ARM 17.50.1109.
40 CFR 257.3-4	Prohibits solid waste facilities from contaminating an underground source of drinking water beyond the solid waste boundary or beyond an alternative boundary.	Applicable. However, Montana has promulgated state solid waste requirements: ARM 17.50.1109 and ARM 17.50.1204.
40 CFR 257.3-8(d)	Regulates access to a solid waste facility so as to prevent public exposure to potential health and safety hazards at the site.	Applicable. However, Montana has promulgated state requirements: ARM 17.50.1108.
State of Montana Solid Waste Requirements:		
The Montana Solid Waste Management Act, Section 75-10-201 et seq., MCA, and regulations	Controls the management and disposal of all solid wastes, including mine wastes at sites that are not subject to the mining and reclamation laws.	Relevant and appropriate.
Transportation, ARM 17.50.523	Requires that solid waste be transported in such a manner as to prevent its discharge, dumping, spilling or leaking from the transport vehicle.	Relevant and appropriate. Will comply with requirement when transporting waste.
Location Restrictions, ARM 17.50.1009(1)(c)	Prohibits solid waste facilities from discharging pollutants in excess of state standards. A solid waste facility must contain a leachate collection system unless there is no potential for migration of a constituent in Appendix I or II to 40 CFR 258.	Relevant and appropriate. The listed requirements provide sound guidance for management and disposal of mine wastes at the site.
Design Requirements, ARM 17.50.1204	Requires solid waste facilities to either be designed to ensure that MCLs are not exceeded or contain a composite liner and leachate collection system that complies with specified criteria.	Relevant and appropriate. The listed requirements provide sound guidance for management and disposal of mine wastes at the site.

TABLE 4-2. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)
BLACK PINE MINE

ARARs	Description	Applicable or Relevant and Appropriate
Access Requirements, ARM 17.50.1108	Requires the owner or operator of a solid waste facility to use barriers to control public access.	Relevant and appropriate. The listed requirements provide sound guidance for management and disposal of mine wastes at the site.
Run-On and Run-Off Control Systems, ARM 17.50.1109	Requires owners or operators of solid waste facilities to design, construct and maintain a run-on control system to prevent flow onto the active portion of the solid waste facility, and a run-off control system to collect and convey stormwater from the active portion of the solid waste facility.	Relevant and appropriate. The listed requirements provide sound guidance for management and disposal of mine wastes at the site.
Surface Water Requirements, ARM 17.50.1110	Prohibits any discharge of a pollutant from a solid waste facility to state waters that violates any requirement of the Montana Water Quality Act, and any discharge from a solid waste facility of a nonpoint source of pollution to waters of the United States that violates any appropriate requirements.	Relevant and appropriate. The listed requirements provide sound guidance for management and disposal of mine wastes at the site.
Liquid Restrictions, ARM 17.50.1111	Prohibits placement of bulk or non-characterized waste into a solid waste facility.	Relevant and appropriate. The listed requirements provide sound guidance for management and disposal of mine wastes at the site.
Operating Criteria, ARM 17.50.1116	Stipulates requirements for operations of a solid waste facility, including maintenance, fencing, signage, and control of litter, insects, rodents, odor, residues, waste water and air pollutants.	Relevant and appropriate. The listed requirements provide sound guidance for management and disposal of mine wastes at the site.
Closure Criteria, ARM 17.50.1403	Sets forth closure requirements for solid waste facilities. Solid waste facilities must meet the following criteria: 1) install a final cover that is designed to minimize infiltration and erosion; 2) design and construct the final cover system to minimize infiltration through the closed unit by the use of an infiltration layer that contains a minimum 18 inches of earthen material and has a permeability less than or equal to the permeability of any bottom liner, barrier layer, or natural subsoils or a permeability no greater than 1×10^{-5} cm/sec, whichever is less; and 3) minimize erosion of the final cover by the use of a seed bed layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.	Relevant and appropriate. The listed requirements provide sound guidance for management and disposal of mine wastes at the site.
Post-Closure Criteria, ARM 17.50.1404	Provides post- closure care requirements for solid waste facilities that must be conducted for a period sufficient to protect human health and the environment.	Relevant and appropriate. The listed requirements provide sound guidance for management and disposal of mine wastes at the site.

TABLE 4-2. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)
BLACK PINE MINE

ARARs	Description	Applicable or Relevant and Appropriate
Section 75-10-206, MCA	Allows variances from solid waste regulations if failure to comply with the rules does not result in a danger to public health or safety or compliance with specific rules would produce hardship without producing benefits to the health and safety of the public that outweigh the hardship.	Relevant and appropriate. The listed requirements provide sound guidance for management and disposal of mine wastes at the site.

FIGURES

1 PROJECT LOCATION
SCALE: NONE

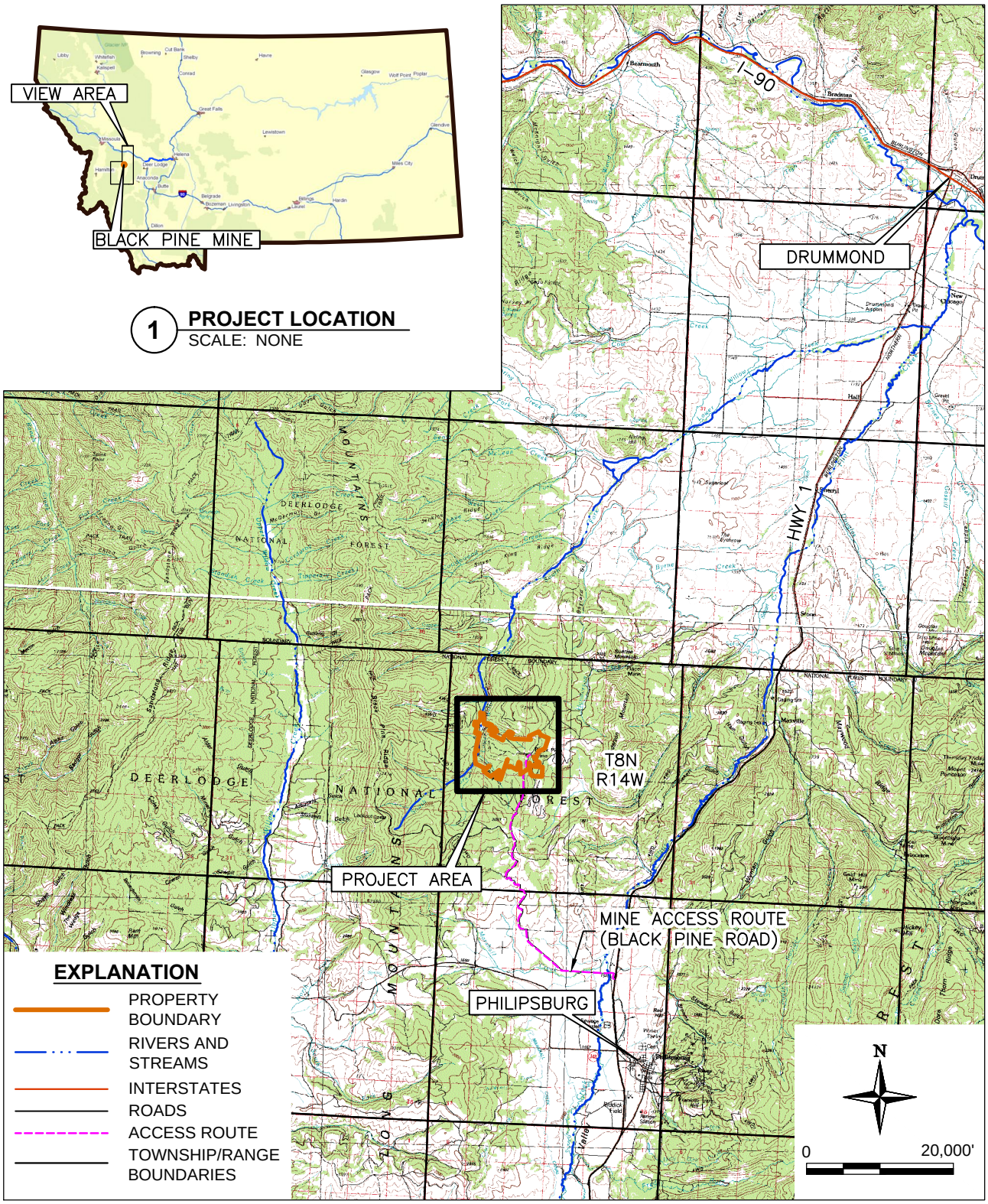

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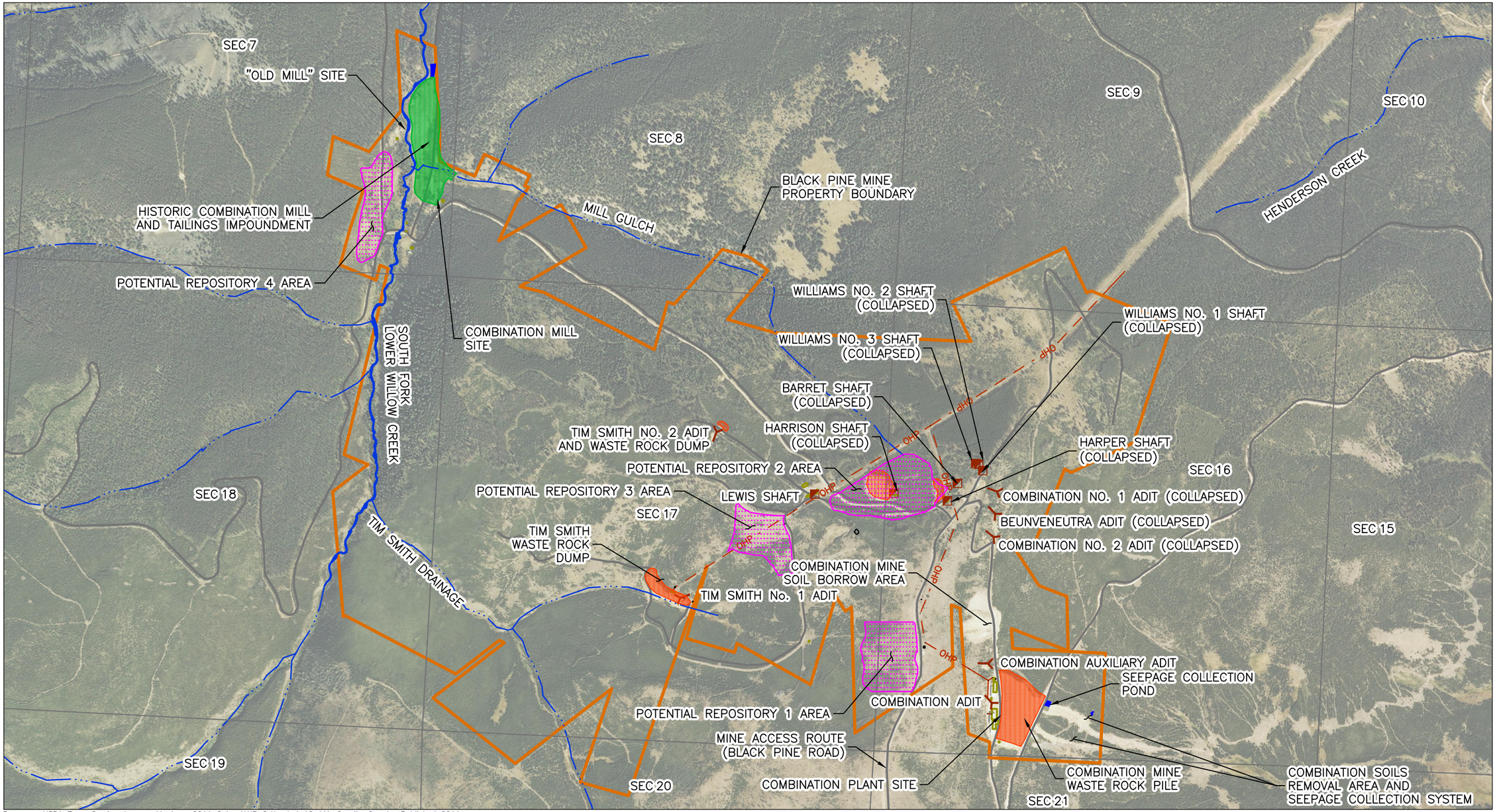
FIGURE 1-1

VICINITY MAP

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
MINE WASTE CLEANUP BUREAU

Drawn By: CJN	Checked By: MD	Scale: 1" = 20,000	Date: 8/14/13	File: 776_RIR2012-SITELOC



Basemap: USDA Farm Service Agency, Montana 2011 Color NAIP Orthophoto12-kM, Granite County. Published 2011.

EXPLANATION

N

0 1,200'

- PROPERTY BOUNDARY
- ROAD CENTERLINE
- SECTION BOUNDARIES
- OHP — OVERHEAD POWER
- STREAMS
- EXISTING STRUCTURE
- WASTE ROCK AREAS
- TAILINGS AREA
- POTENTIAL REPOSITORY LOCATION
- ADIT
- SHAFT

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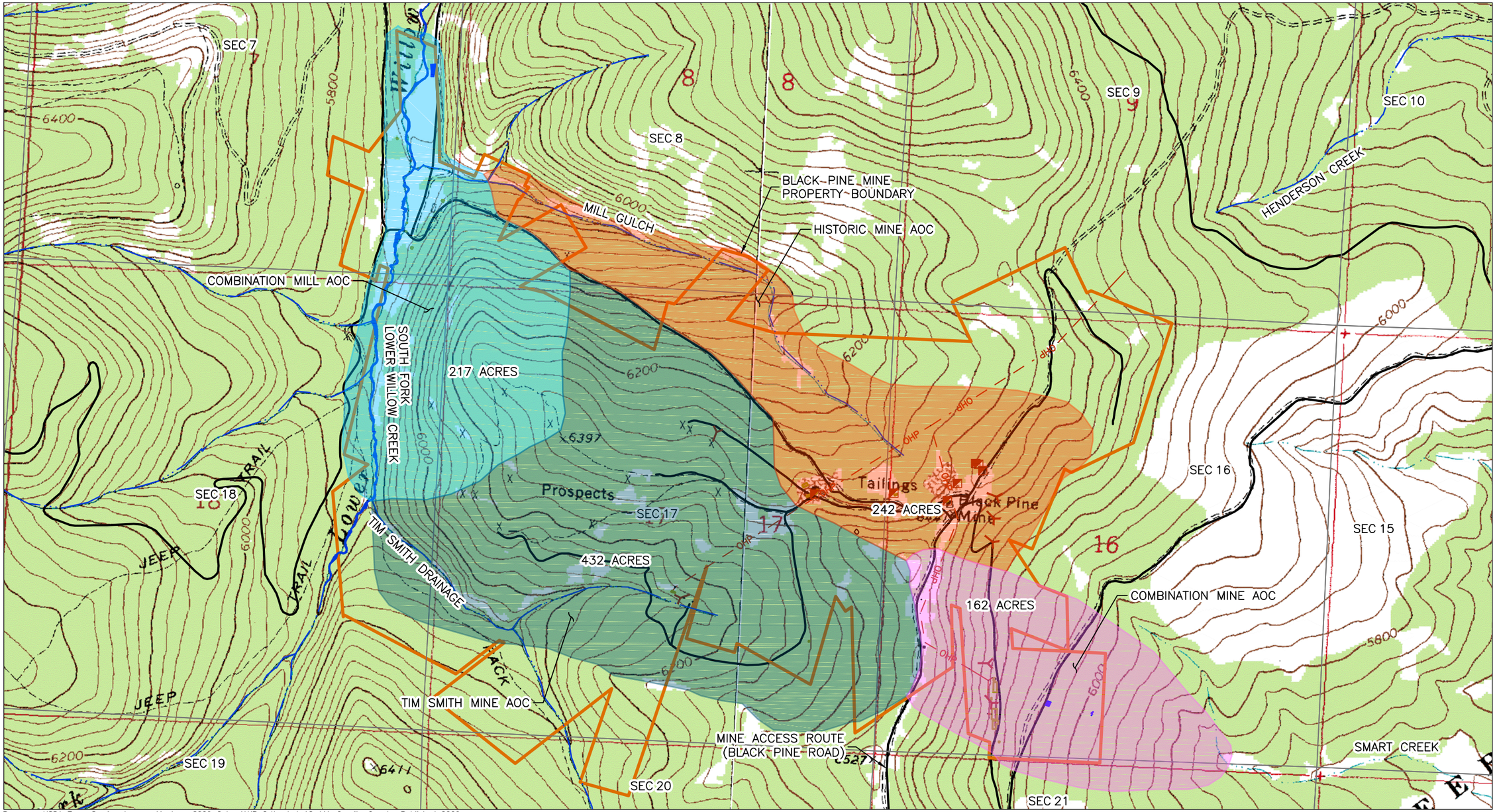
FIGURE 1-2

SITE FEATURES

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
MINE WASTE CLEANUP BUREAU

Drawn By: BH	Checked By: MD	Scale: 1" = 1,200'	Date: 6/13/13	File: 776_RIP2012-SITEFEAT



Basemap: USDA Farm Service Agency, Montana 2009 Color NAIP Orthophoto12-kM, Granite County. Published 2009.

EXPLANATION

N

0 1,200'

- PROPERTY BOUNDARY
- ROAD CENTERLINE
- SECTION BOUNDARIES
- OHP — OVERHEAD POWER
- STREAMS
- EXISTING STRUCTURE
- APPROXIMATE COMBINATION MILL AREA OF CONCERN
- APPROXIMATE HISTORIC MINE AREA OF CONCERN
- APPROXIMATE COMBINATION MINE AREA OF CONCERN
- APPROXIMATE TIM SMITH AREA OF CONCERN
- ADIT
- SHAFT
- AOC — AREA OF CONCERN

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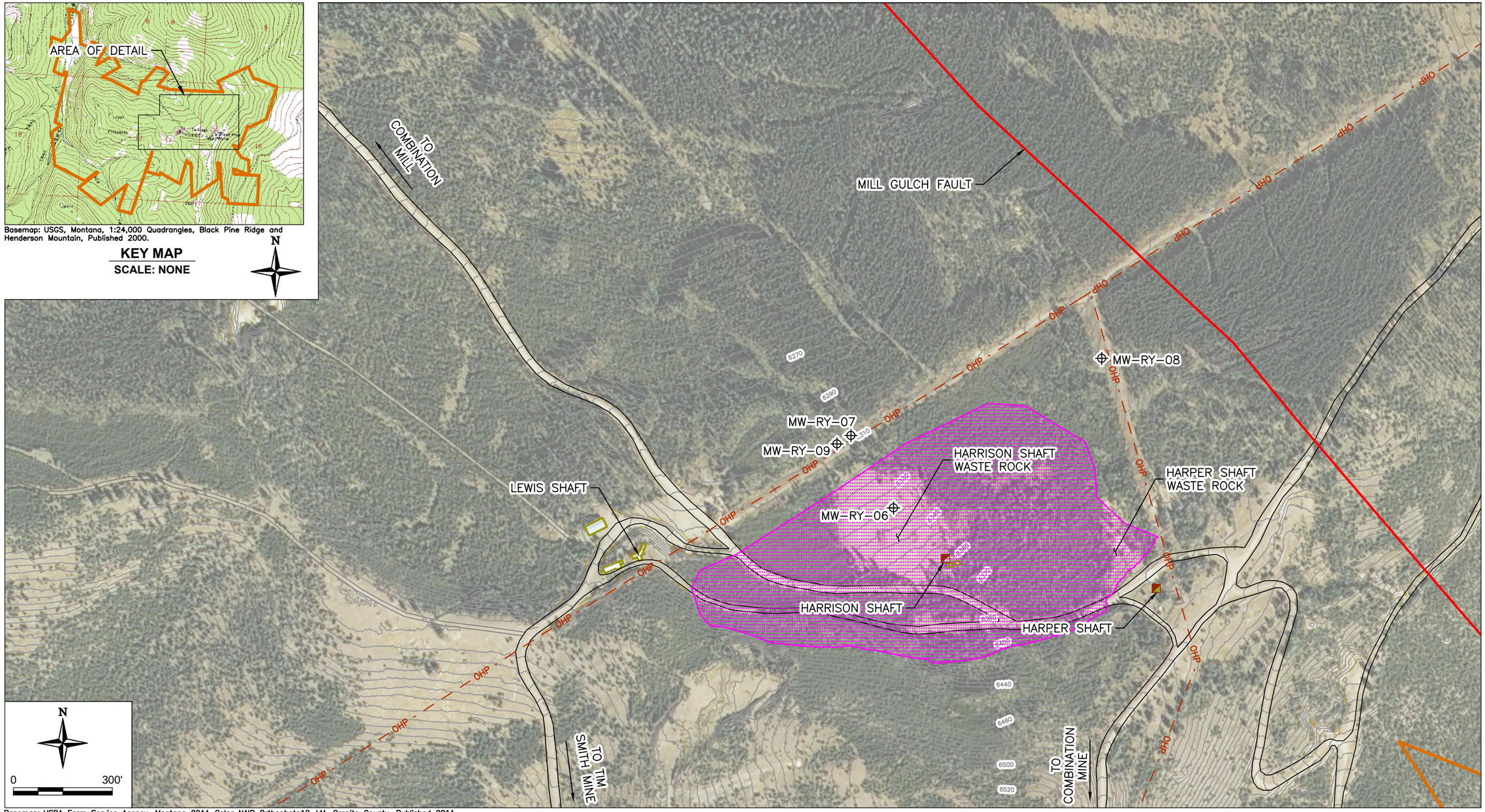
FIGURE 1-3

AREAS OF CONCERN

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
MINE WASTE CLEANUP BUREAU

Drawn By: BH	Checked By: MD	Scale: 1" = 1,200'	Date: 6/13/13	File: 776_RIR2012-AOC



Basemap: USDA Farm Service Agency, Montana 2011 Color NAIP Orthophoto12-kM, Granite County. Published 2011.

EXPLANATION

6260	EXISTING GROUND SURFACE CONTOURS (5' INTERVAL)
OHP	OVERHEAD POWER
	PROPERTY BOUNDARY
	APPROXIMATE FAULT LOCATION
	EDGE OF ROAD
	EXISTING STRUCTURE
	PROPOSED REPOSITORY AREA
MW-RY-07	EXISTING MONITORING WELL LOCATION AND DESIGNATION
MW	MONITORING WELL
RY	REPOSITORY

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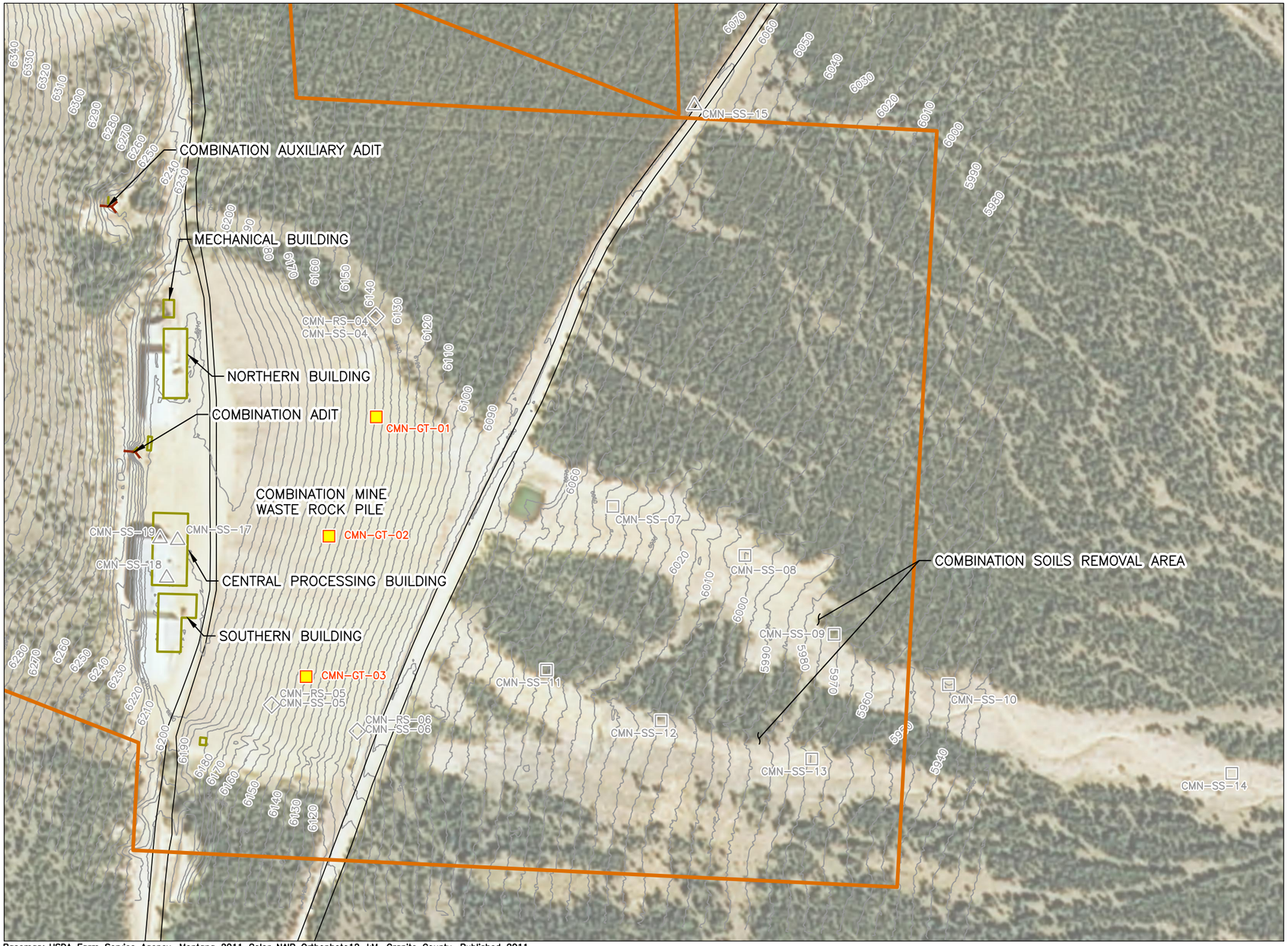
FIGURE 1-4

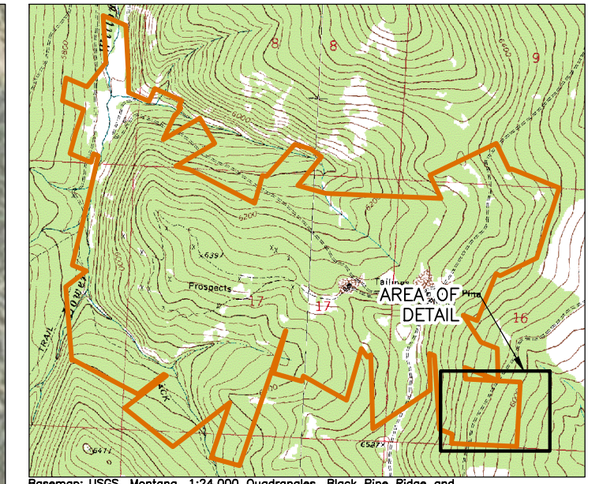
REPOSITORY 2 AREA

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
MINE WASTE CLEANUP BUREAU

Drawn By: BH	Checked By: MD	Scale: AS SHOWN	Date: 6/13/13	File: 776_RIR2012-BPM-REPOS



Basemap: USDA Farm Service Agency, Montana 2011 Color NAIP Orthophoto12-kM, Granite County. Published 2011.



Basemap: USGS, Montana, 1:24,000 Quadrangles, Black Pine Ridge and Henderson Mountain, Published 2000.

KEY MAP

SCALE: NONE

N

EXPLANATION

	PROPERTY BOUNDARY
	EXISTING STRUCTURE
5980	EXISTING GROUND SURFACE CONTOURS (INTERVAL = 5')
	ADIT (APPROXIMATE LOCATION)
CMN-GT-01	TEST PIT LOCATION AND DESIGNATION
CMN-SS-08	RI SAMPLE LOCATION AND DESIGNATION
CMN-SS-09	RI TEST PIT SAMPLE LOCATION AND DESIGNATION (SOIL)
CMN-RS-06 CMN-SS-06	RI TEST PIT SAMPLE LOCATION AND DESIGNATION (WASTE ROCK)
SS	SOIL
RS	WASTE ROCK
RI	RECLAMATION INVESTIGATION
GT	GEOTECHNICAL
CMN	COMBINATION MINE

N

0 200'

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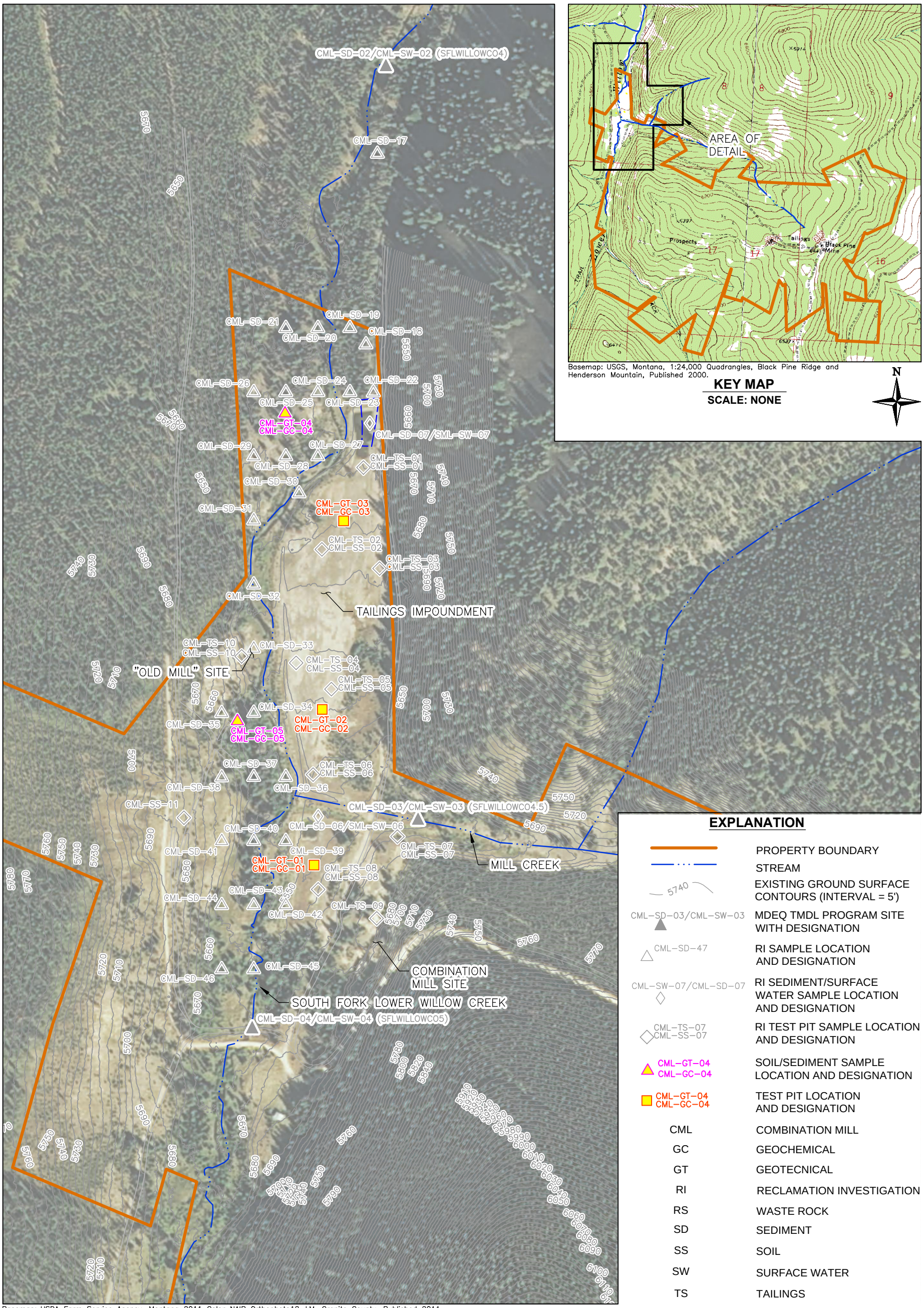
FIGURE 2-1

SAMPLE LOCATION MAP
COMBINATION MINE AREA OF CONCERN

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
MINE WASTE CLEANUP BUREAU

Drawn By: CJN	Checked By: AV	Scale: 1" = 200'	Date: 11/30/12	File: 776_RIR2012_SLM-CMA



Basemap: USGS, Montana, 1:24,000 Quadrangles, Black Pine Ridge and Henderson Mountain, Published 2000.

KEY MAP

SCALE: NONE

Basemap: USDA Farm Service Agency, Montana 2011 Color NAIP Orthophoto12-kM, Granite County. Published 2011.

EXPLANATION

	PROPERTY BOUNDARY
	STREAM
5740	EXISTING GROUND SURFACE CONTOURS (INTERVAL = 5')
CML-SD-03/CML-SW-03	MDEQ TMDL PROGRAM SITE WITH DESIGNATION
CML-SD-47	RI SAMPLE LOCATION AND DESIGNATION
CML-SW-07/CML-SD-07	RI SEDIMENT/SURFACE WATER SAMPLE LOCATION AND DESIGNATION
CML-TS-07 CML-SS-07	RI TEST PIT SAMPLE LOCATION AND DESIGNATION
CML-GT-04 CML-GC-04	SOIL/SEDIMENT SAMPLE LOCATION AND DESIGNATION
CML-GT-04 CML-GC-04	TEST PIT LOCATION AND DESIGNATION
CML	COMBINATION MILL
GC	GEOCHEMICAL
GT	GEOTECNICAL
RI	RECLAMATION INVESTIGATION
RS	WASTE ROCK
SD	SEDIMENT
SS	SOIL
SW	SURFACE WATER
TS	TAILINGS

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FIGURE 2-2

SAMPLE LOCATION MAP
COMBINATION MILL AREA OF CONCERN

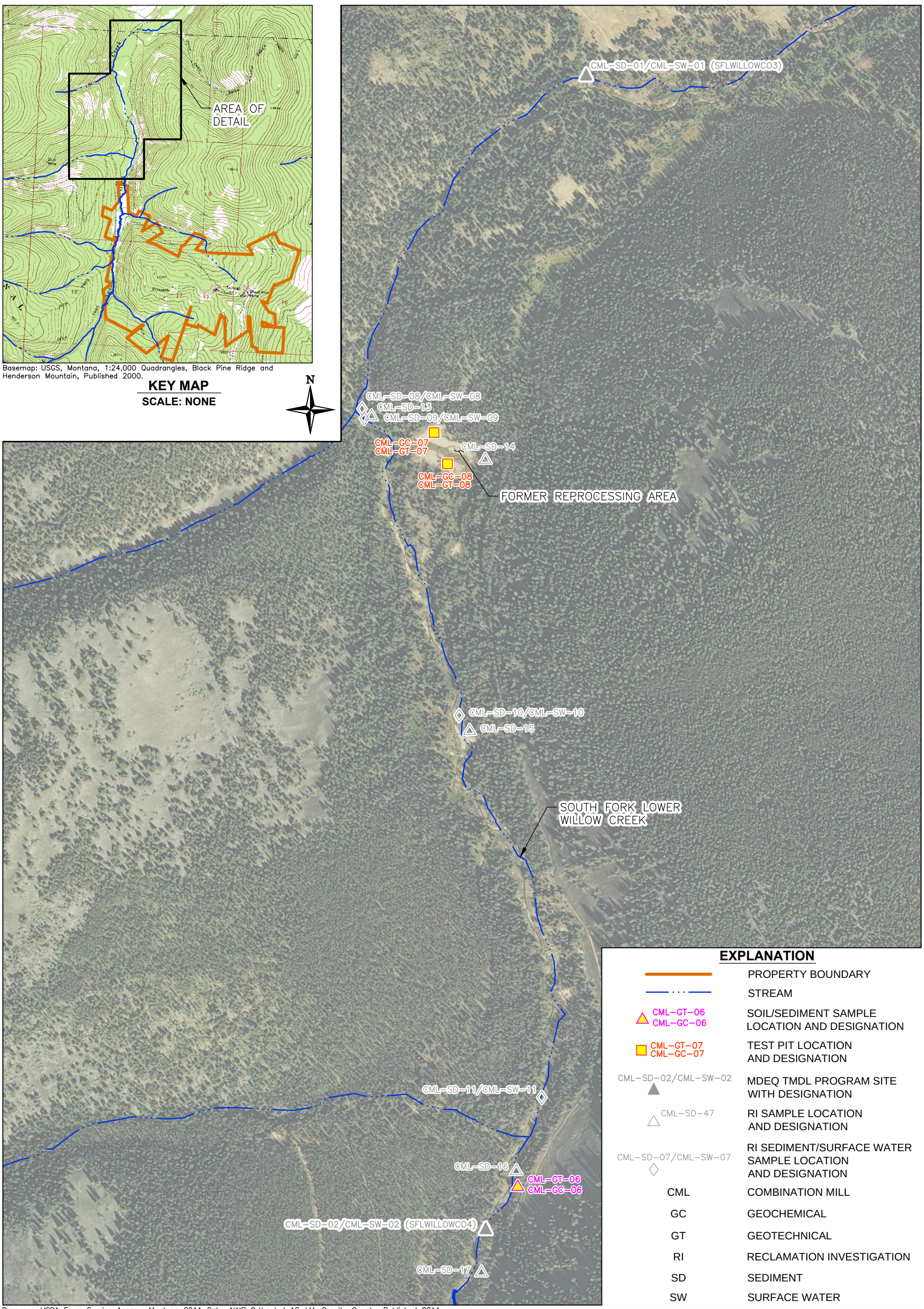
BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
MINE WASTE CLEANUP BUREAU

Drawn By: CJN	Checked By: AV	Scale: 1" = 300'	Date: 11/30/12	File: 776_RIR2012_SLM-COMB

Basemap: USGS, Montana, 1:24,000 Quadrangles, Black Pine Ridge and Henderson Mountain, Published 2000.

KEY MAP

SCALE: NONE



Basemap: USDA Farm Service Agency, Montana 2011 Color NAIP Orthophoto12-kM, Granite County. Published 2011.

EXPLANATION

	PROPERTY BOUNDARY
	STREAM
CML-GT-06 CML-GC-06	SOIL/SEDIMENT SAMPLE LOCATION AND DESIGNATION
CML-GT-07 CML-GC-07	TEST PIT LOCATION AND DESIGNATION
CML-SD-02/CML-SW-02	MDEQ TMDL PROGRAM SITE WITH DESIGNATION
CML-SD-47	RI SAMPLE LOCATION AND DESIGNATION
CML-SD-07/CML-SW-07	RI SEDIMENT/SURFACE WATER SAMPLE LOCATION AND DESIGNATION
CML	COMBINATION MILL
GC	GEOCHEMICAL
GT	GEOTECHNICAL
RI	RECLAMATION INVESTIGATION
SD	SEDIMENT
SW	SURFACE WATER

N

0 600'

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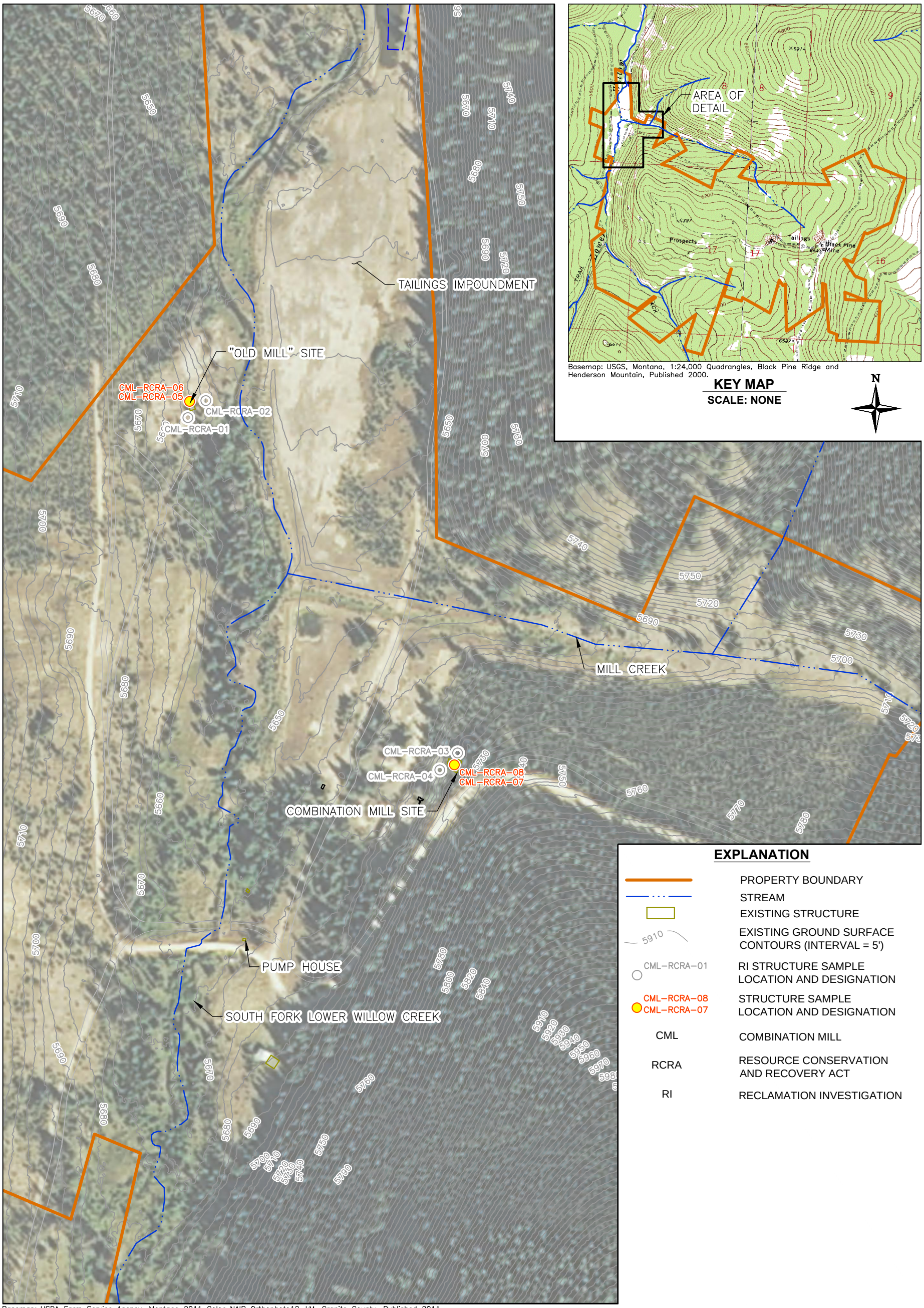
FIGURE 2-3

SAMPLE LOCATION MAP
SOUTH FORK LOWER WILLOW CREEK

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
MINE WASTE CLEANUP BUREAU

Drawn By: CJN	Checked By: AV	Scale: 1" = 600'	Date: 11/30/12	File: 776_RIR2012_SLM-COMB2



Basemap: USDA Farm Service Agency, Montana 2011 Color NAIP Orthophoto12-kM, Granite County. Published 2011.

Basemap: USGS, Montana, 1:24,000 Quadrangles, Black Pine Ridge and Henderson Mountain, Published 2000.

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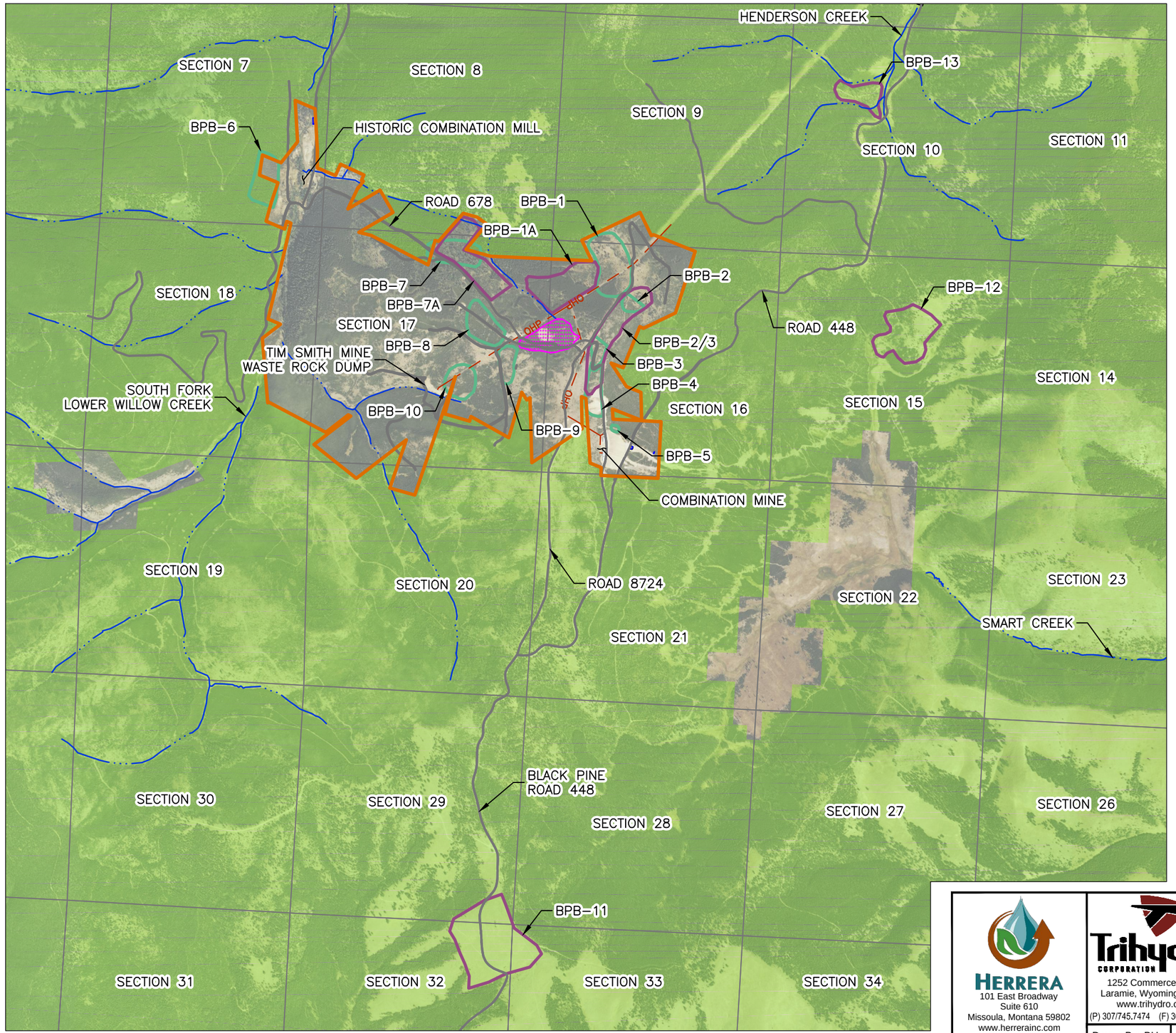
FIGURE 2-4

HAZARDOUS MATERIALS SAMPLE LOCATION MAP
COMBINATION MILL
AREA OF CONCERN

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
MINE WASTE CLEANUP BUREAU

Drawn By: CJN	Checked By: AV	Scale: 1" = 200'	Date: 11/30/12	File: 776_RIR2012_SLM-COMB3



Basemap: USDA Farm Service Agency, Montana 2011 Color NAIP Orthophoto12-kM, Granite County. Published 2011.

EXPLANATION

- PROPERTY BOUNDARY
- SECTION BOUNDARIES
- OHP — OVERHEAD POWER
- ROAD CENTERLINE
- PROPOSED REPOSITORY AREA
- OCTOBER 2000 BORROW AREAS (HYDROMETRICS)
- POTENTIAL BORROW AREA
- UNITED STATES FOREST SERVICE ADMINISTERED LANDS (APPROXIMATE)
- BPB — POTENTIAL BORROW AREA

NOTE:
BORROW AREA TEST PIT LOCATIONS ARE SHOWN ON FIGURES 2-6, 2-7, AND 2-8.

N

0 2,500'

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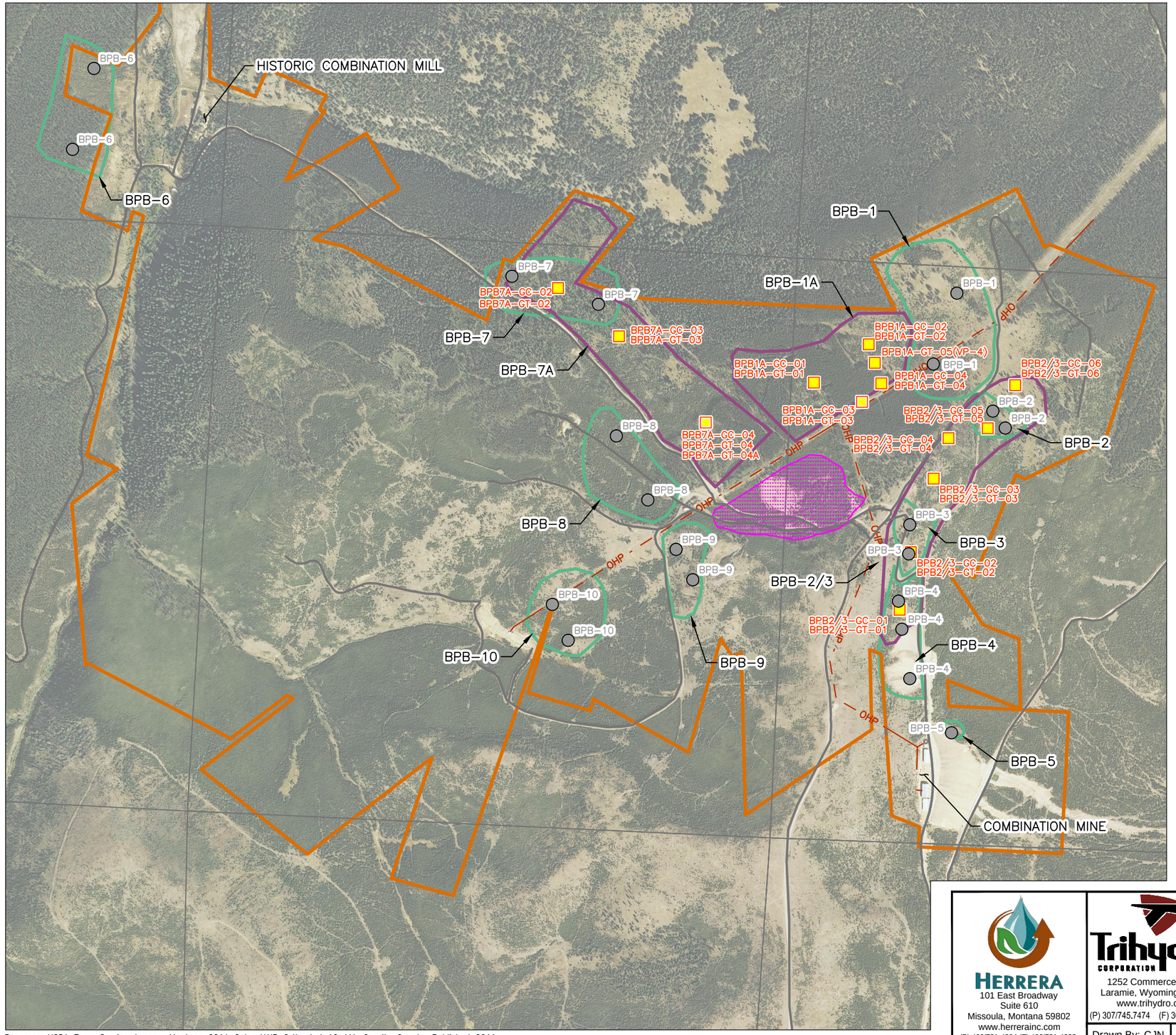
FIGURE 2-5

POTENTIAL BORROW AREAS

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
MINE WASTE CLEANUP BUREAU

Drawn By: BH	Checked By: MD	Scale: 1" = 2,500'	Date: 6/13/13	File: 776_RIR2012_POT-BORROW



EXPLANATION

	PROPERTY BOUNDARY
	SECTION BOUNDARIES
OHP	OVERHEAD POWER
	ROAD CENTERLINE
	PROPOSED REPOSITORY AREA
	OCTOBER 2000 BORROW AREAS (HYDROMETRICS)
	POTENTIAL BORROW AREA
BPB2/3-GC-01 BPB2/3-GT-01	TEST PIT LOCATION AND DESIGNATION
BPB-2	OCTOBER 2000 BORROW SOIL SAMPLE LOCATION AND DESIGNATION
BPB	POTENTIAL BORROW AREA
GT	GEOTECHNICAL
GC	GEOCHEMICAL
SS	SOIL SAMPLE

NOTE:
NUMBER AND LOCATION OF TEST PITS WERE ADJUSTED IN THE FIELD BASED ON ACCESS, FIELD CONDITIONS, AND SOIL PROPERTIES.

N

0 1,000'

Basemap: USDA Farm Service Agency, Montana 2011 Color NAIP Orthophoto12-kM, Granite County. Published 2011.

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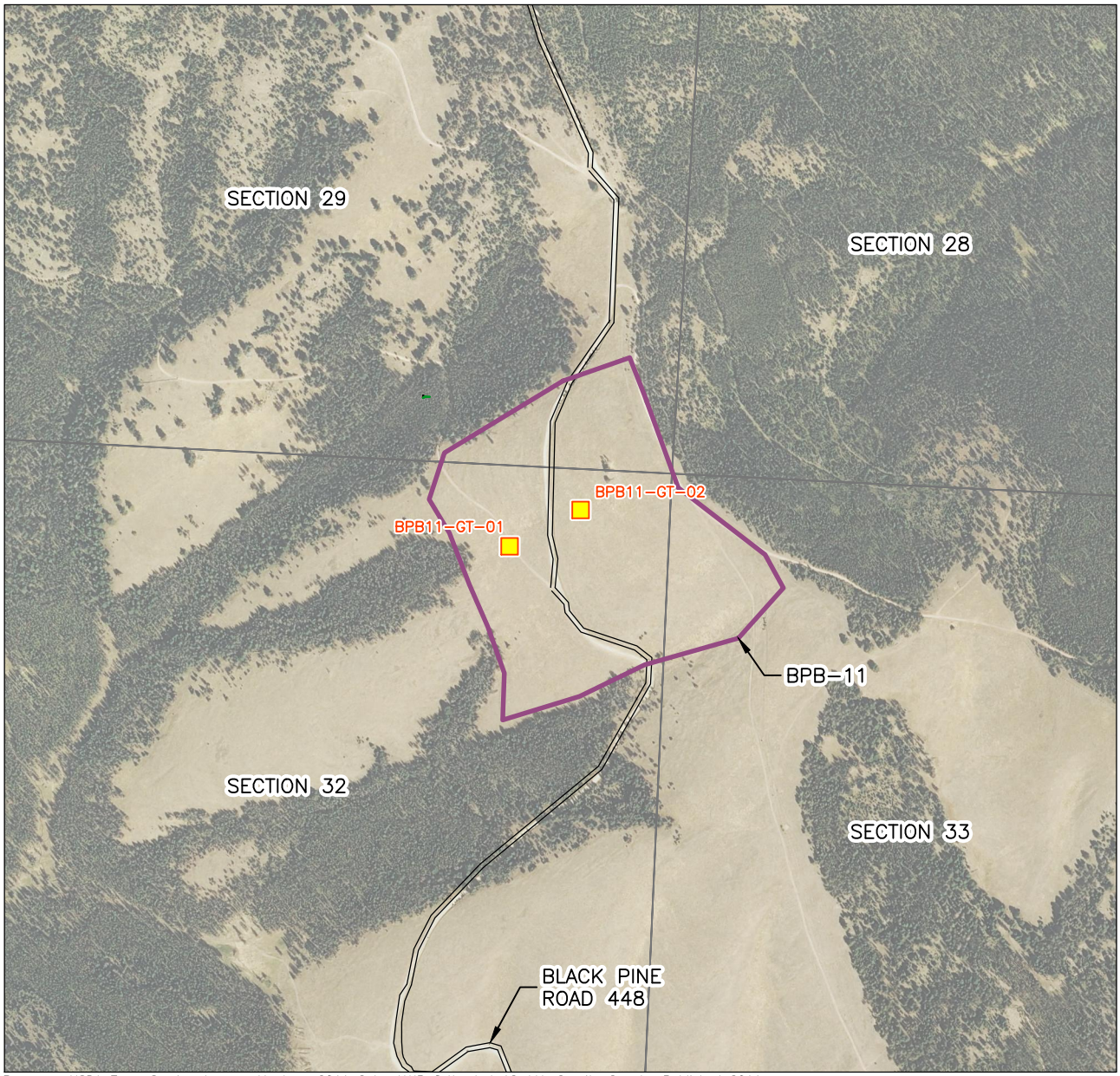
FIGURE 2-6

SAMPLE LOCATION MAP
POTENTIAL BORROW AREAS 2/3, 1A, AND 7A

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
MINE WASTE CLEANUP BUREAU

Drawn By: CJN	Checked By: MD	Scale: 1" = 1,000'	Date: 6/13/13	File: 776_RIR2012-BORROW2



Basemap: USDA Farm Service Agency, Montana 2011 Color NAIP Orthophoto12-kM, Granite County. Published 2011.

NOTE:
NUMBER AND LOCATION OF TEST PITS WERE ADJUSTED IN FIELD BASED ON ACCESS, FIELD CONDITIONS, AND SOIL PROPERTIES.

EXPLANATION

	SECTION BOUNDARIES
	EDGE OF ROAD
	POTENTIAL BORROW AREA
BPB11-GT-01	TEST PIT LOCATION AND DESIGNATION
BPB	POTENTIAL BORROW AREA
GT	GEOTECHNICAL

N

0 1,000'

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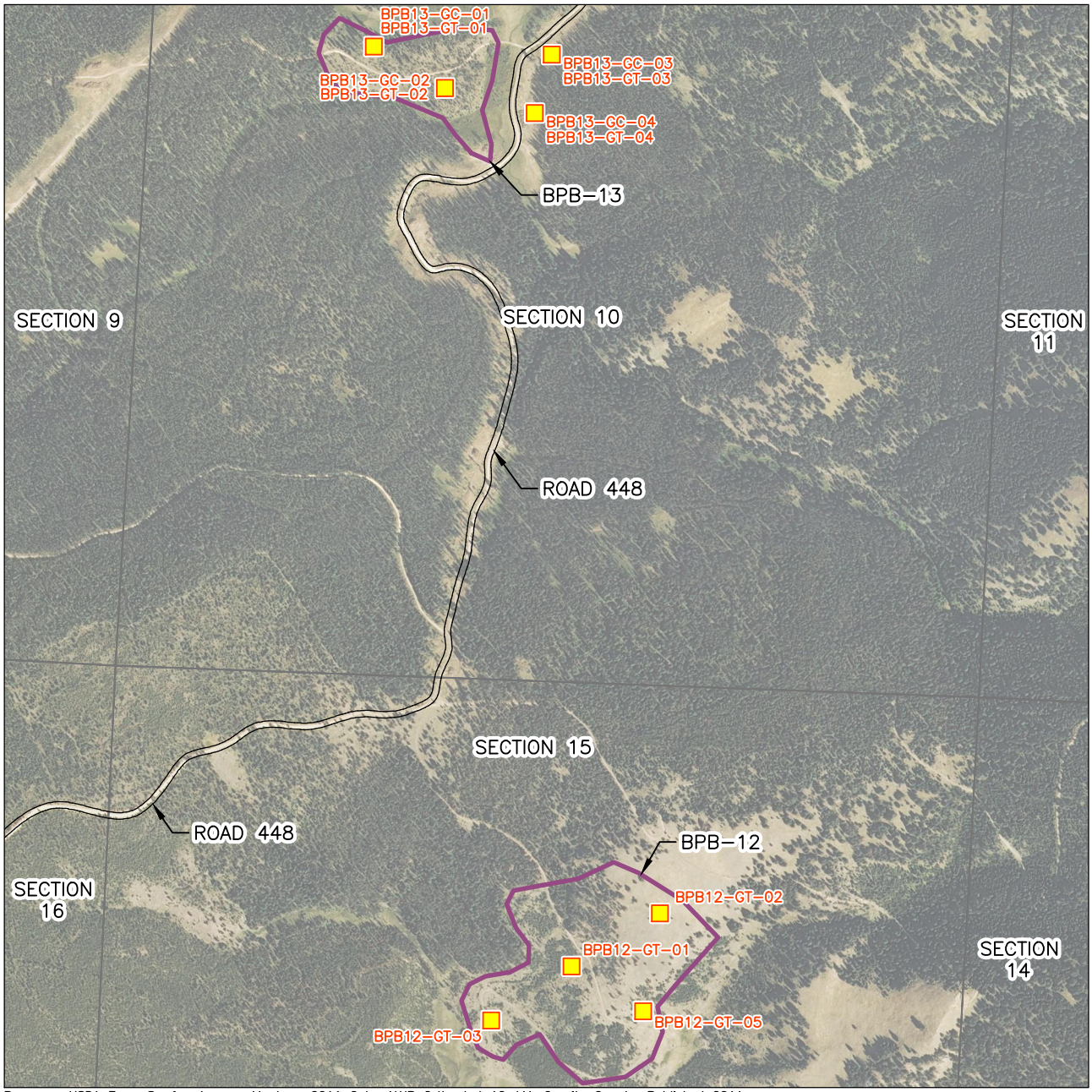
FIGURE 2-7

SAMPLE LOCATION MAP
POTENTIAL BORROW AREA 11

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
MINE WASTE CLEANUP BUREAU

Drawn By: CJN	Checked By: MRD	Scale: 1" = 1,000'	Date: 6/13/13	File: 776_RIR2012-BORROW1



Basemap: USDA Farm Service Agency, Montana 2011 Color NAIP Orthophoto12-kM, Granite County. Published 2011.

NOTE:
NUMBER AND LOCATION OF TEST PITS WERE ADJUSTED IN FIELD BASED ON ACCESS, FIELD CONDITIONS, AND SOIL PROPERTIES.

EXPLANATION

	SECTION BOUNDARIES
	EDGE OF ROAD
	POTENTIAL BORROW AREA
BPB-12-GC-5 BPB-12-GT-5	TEST PIT LOCATION AND DESIGNATION
BPB	POTENTIAL BORROW AREA
GT	GEOTECHNICAL
GC	GEOCHEMICAL

N

0 1,000'

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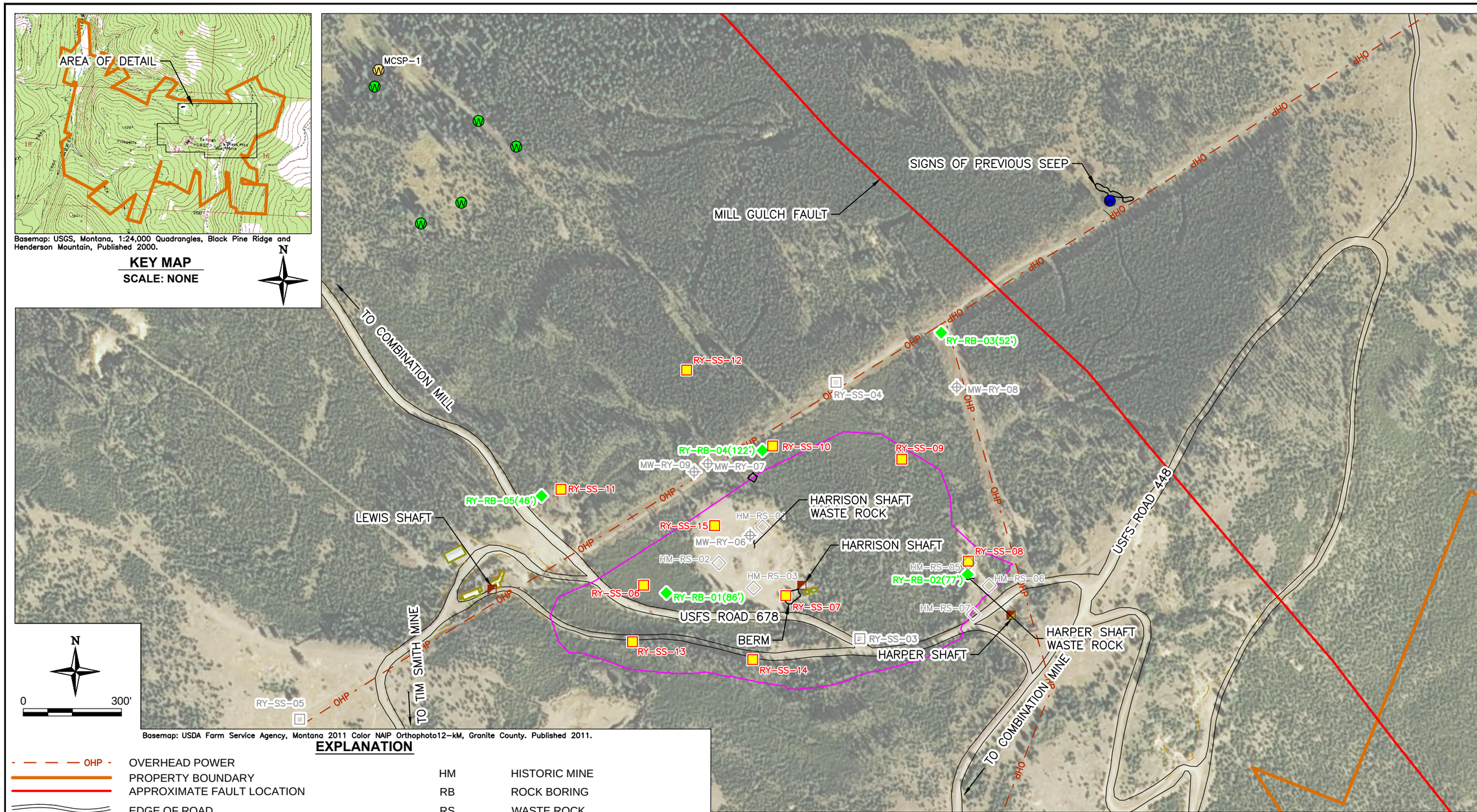
FIGURE 2-8

SAMPLE LOCATION MAP
POTENTIAL BORROW AREAS 12 AND 13

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
MINE WASTE CLEANUP BUREAU

Drawn By: CJN	Checked By: MRD	Scale: 1" = 1,000'	Date: 6/13/13	File: 776_RIR2012-BORROW1



EXPLANATION

OHP	OVERHEAD POWER
	PROPERTY BOUNDARY
	APPROXIMATE FAULT LOCATION
	EDGE OF ROAD
	EXISTING STRUCTURE
MCSP-1	ROUTINE SPRING/SEEP/SURFACE WATER MONITORING SITES
	SEEP LOCATION (MAY 2012)
	SEEP LOCATION (SEPTEMBER 2012)
RI	RECLAMATION INVESTIGATION
MW	MONITORING WELL
	PROPOSED REPOSITORY AREA
HM	HISTORIC MINE
RB	ROCK BORING
RS	WASTE ROCK
RY	REPOSITORY
SS	SOIL
RY-SS-06	TEST PIT LOCATION AND DESIGNATION
RY-RB-01(86')	BOREHOLE/CORING LOCATION, DESIGNATION AND DEPTH
MW-RY-07	EXISTING MONITORING WELL LOCATION AND DESIGNATION
RY-SS-04	RI TEST PIT LOCATION AND DESIGNATION
HM-RS-03	RI TEST PIT SAMPLE LOCATION AND DESIGNATION (WASTE ROCK)

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FIGURE 2-9

SAMPLE LOCATION MAP
PROPOSED REPOSITORY AREA

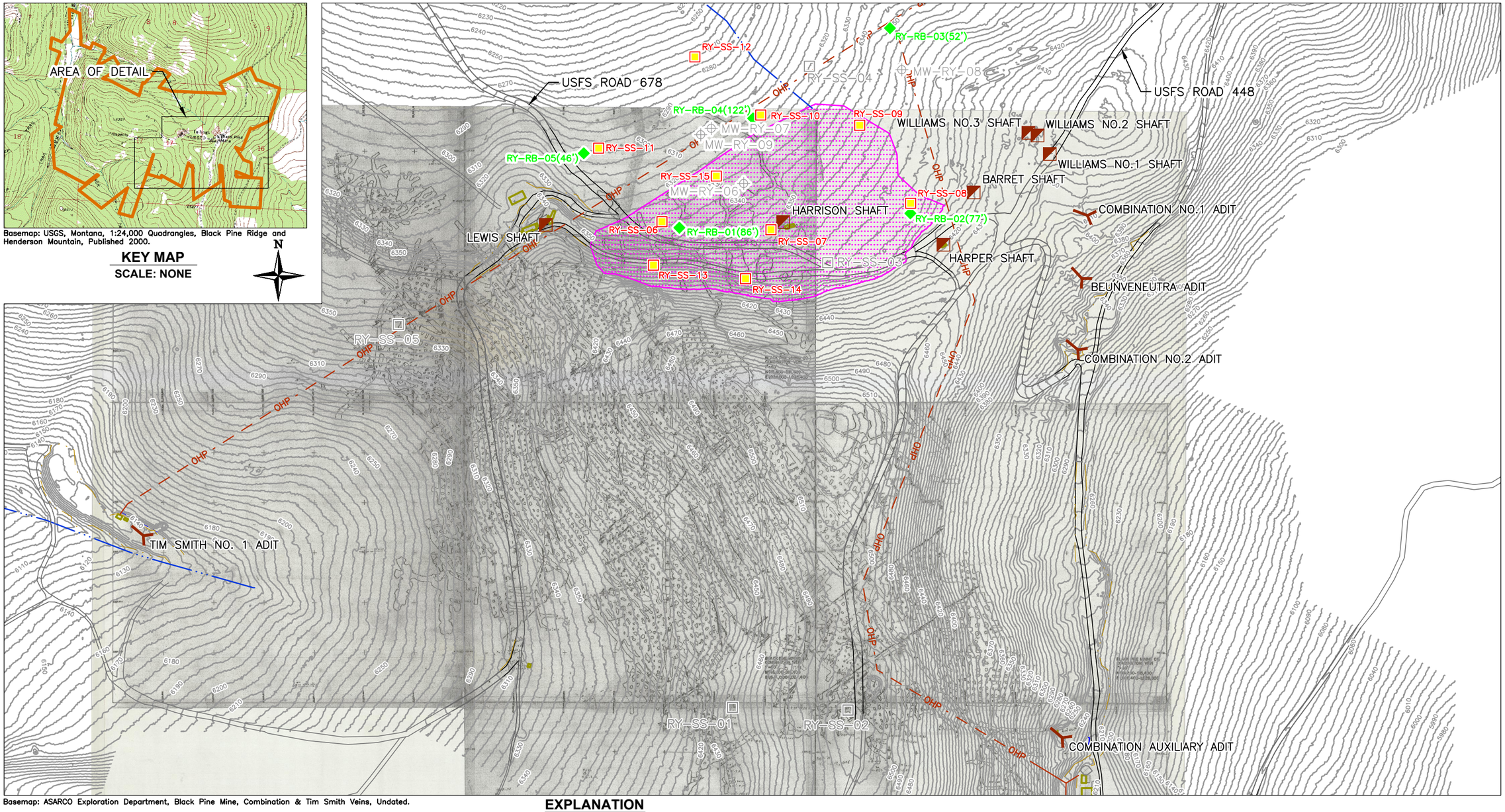
BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
MINE WASTE CLEANUP BUREAU

Drawn By: BH	Checked By: MD	Scale: AS SHOWN	Date: 6/13/13	File: 776_RIR2012-BORROW

Basemap: USGS, Montana, 1:24,000 Quadrangles, Black Pine Ridge and Henderson Mountain, Published 2000.

KEY MAP

SCALE: NONE



Basemap: ASARCO Exploration Department, Black Pine Mine, Combination & Tim Smith Veins, Undated.

NOTE:
UNDERGROUND MINE MAPS HAVE BEEN GEOREFERENCED BASED ON COORDINATE SYSTEM AND SURFACE FEATURES, LOCATIONS ARE APPROXIMATE.

- EXISTING GROUND SURFACE CONTOURS (5' INTERVALS)
- EDGE OF ROAD
- OHP — OVERHEAD POWER
- STREAMS
- EXISTING STRUCTURE
- PROPOSED REPOSITORY AREA
- SHAFT
- ADIT

EXPLANATION

RY-SS-13	TEST PIT LOCATION AND DESIGNATION
RY-RB-01(86')	BOREHOLE/CORING LOCATION, DESIGNATION, AND DEPTH
MW-RY-06	BORING LOCATION AND DESIGNATION
RY-SS-05	TEST PIT LOCATION AND DESIGNATION
MW	MONITORING WELL
RB	ROCK BORING
RY	REPOSITORY
SS	SOIL
USFS	UNITED STATES FORESTRY SERVICE

N

0 400'

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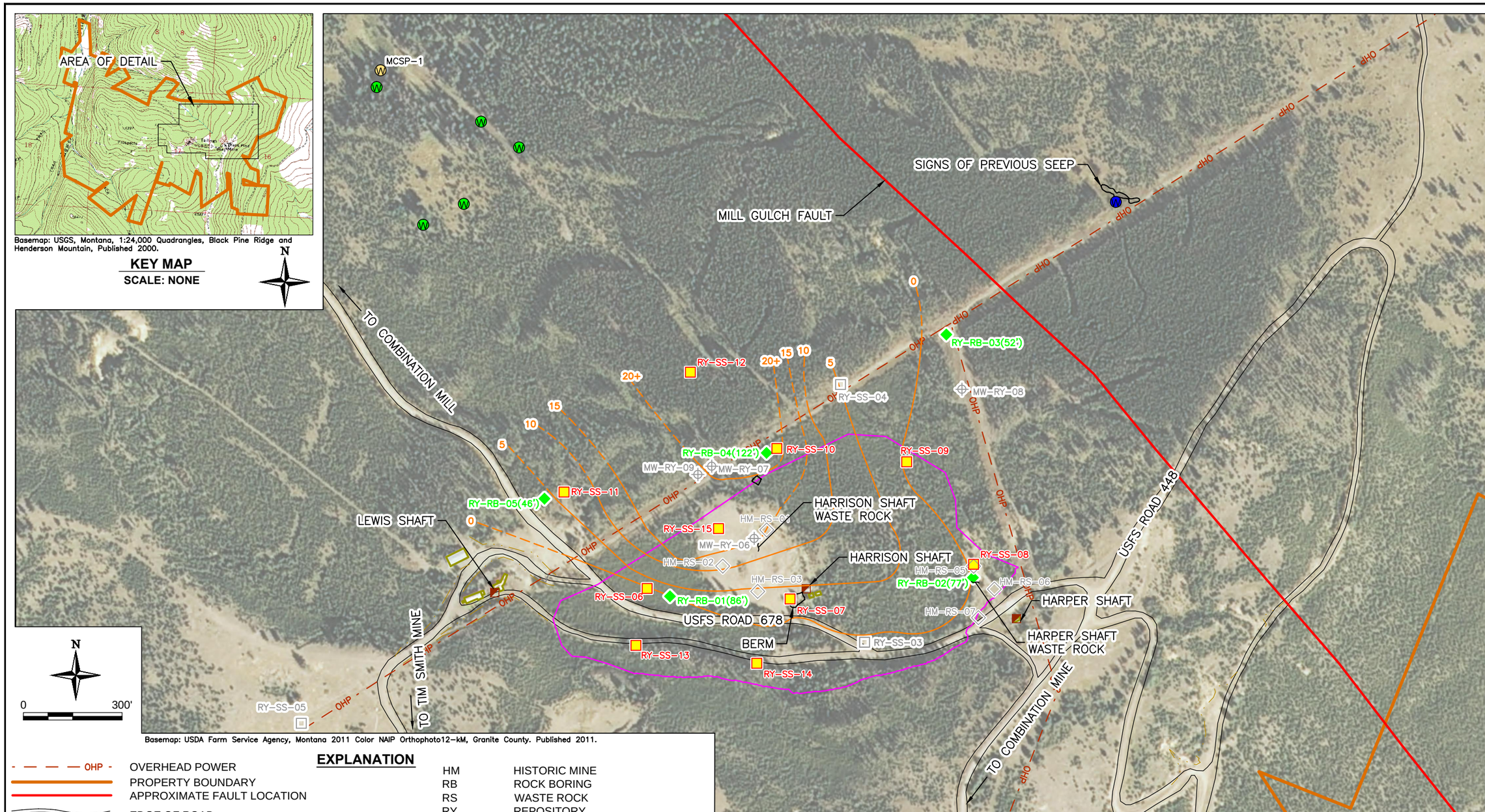
FIGURE 3-1

UNDATED HISTORIC COMBINATION VEIN MINE MAP

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
MINE WASTE CLEANUP BUREAU

Drawn By: DRT	Checked By: MRD	Scale: 1" = 400'	Date: 4/10/12	File: 776_RIR2012_UNDATEDCOMB



EXPLANATION

OHP	OVERHEAD POWER
	PROPERTY BOUNDARY
	APPROXIMATE FAULT LOCATION
	EDGE OF ROAD
	EXISTING STRUCTURE
MCSP-1	ROUTINE SPRING/SEEP/SURFACE WATER MONITORING SITES
	SEEP LOCATION (MAY 2012)
	SEEP LOCATION (SEPTEMBER 2012)
RI	RECLAMATION INVESTIGATION
MW	MONITORING WELL
	PROPOSED REPOSITORY AREA
HM	HISTORIC MINE
RB	ROCK BORING
RS	WASTE ROCK
RY	REPOSITORY
SS	SOIL
RY-SS-06	TEST PIT LOCATION AND DESIGNATION
RY-RB-01(86')	BOREHOLE/CORING LOCATION, DESIGNATION AND DEPTH
MW-RY-07	EXISTING MONITORING WELL LOCATION AND DESIGNATION
RY-SS-04	RI TEST PIT LOCATION AND DESIGNATION
HM-RS-03	RI TEST PIT SAMPLE LOCATION AND DESIGNATION (WASTE ROCK)
0	CLAY AND CLAYEY GRAVEL THICKNESS IN FEET, DASHED WHERE INFERRED

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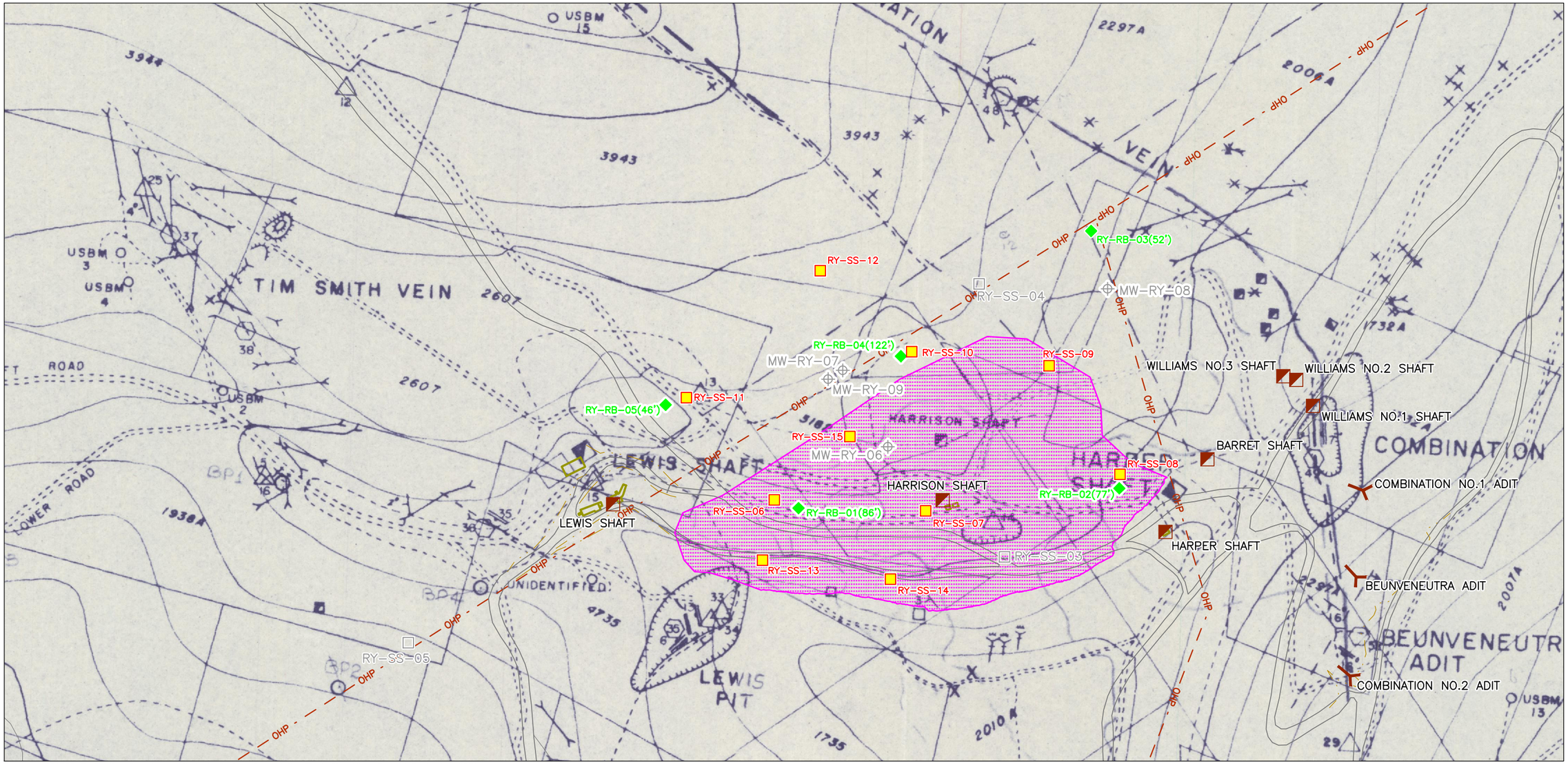
FIGURE 3-2

CLAY AND CLAYEY GRAVEL ISOPACHS
PROPOSED REPOSITORY AREA

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
MINE WASTE CLEANUP BUREAU

Drawn By: BH	Checked By: MD	Scale: AS SHOWN	Date: 6/6/13	File: 776_RIR2012-CLAYISO



Basemap: ASARCO Exploration Department, Geologic Surface Map of the Black Pine Mine, Revised September 1971

EXPLANATION

- EXISTING GROUND SURFACE CONTOURS (5' INTERVALS)
- EDGE OF ROAD
- OHP — OVERHEAD POWER
- EXISTING STRUCTURE
- PROPOSED REPOSITORY AREA
- SHAFT
- ADIT
- MW-RY-06 — BORING LOCATION AND DESIGNATION
- RY-SS-05 — TEST PIT LOCATION AND DESIGNATION
- RY-SS-06 — TEST PIT LOCATION AND DESIGNATION
- RY-RB-01(86') — BOREHOLE/CORING LOCATION, DESIGNATION AND DEPTH
- MW — MONITORING WELL
- RB — ROCK BORING
- RY — REPOSITORY
- SS — SOIL

N

0 300'

NOTE:
UNDERGROUND MINE MAPS HAVE BEEN GEOREFERENCED BASED ON COORDINATE SYSTEM AND SURFACE FEATURES, LOCATIONS ARE APPROXIMATE.

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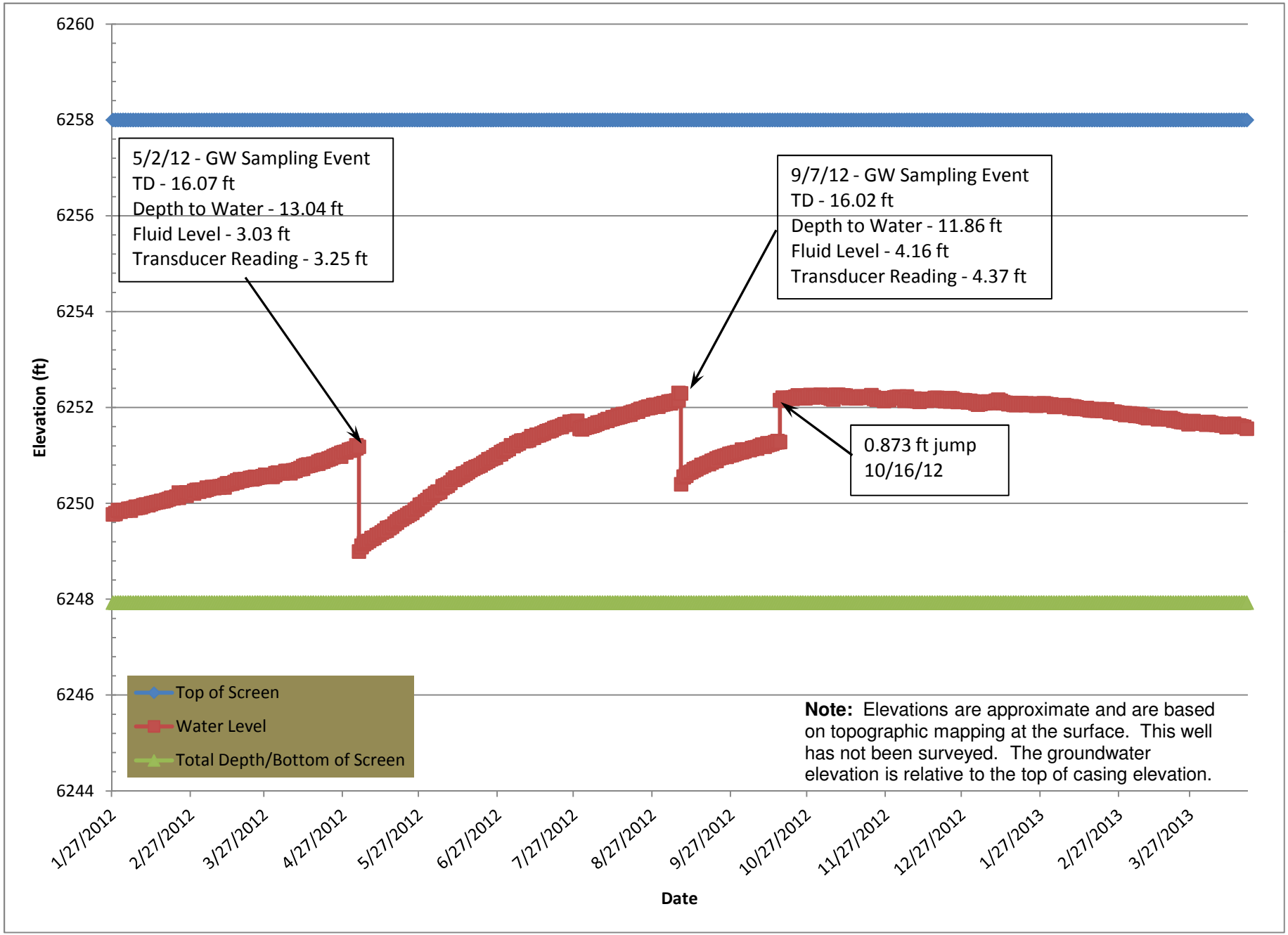
FIGURE 3-3

1971 GEOLOGICAL SURFACE MAP

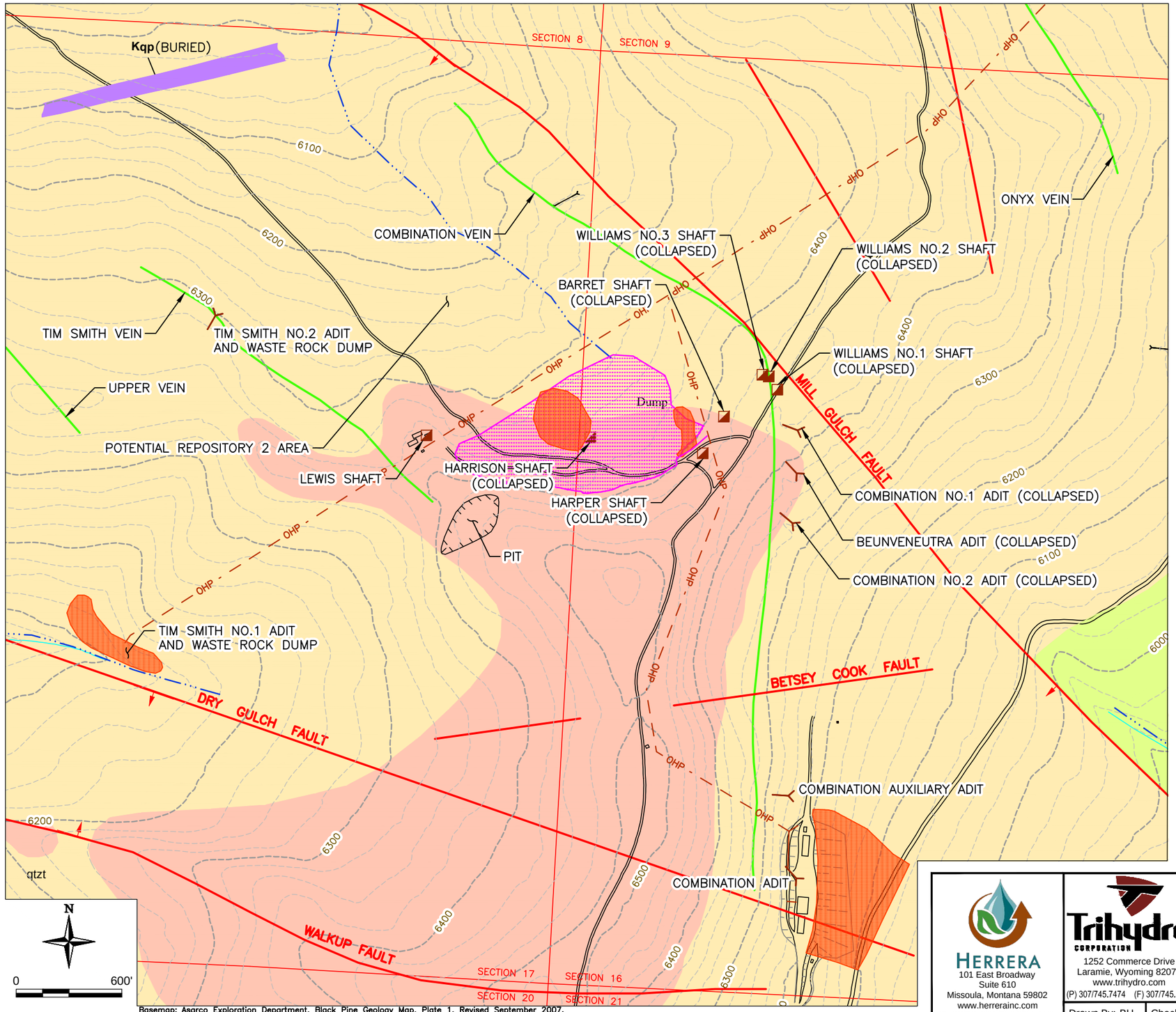
BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
MINE WASTE CLEANUP BUREAU

Drawn By: DRT	Checked By: MRD	Scale: 1"=300'	Date: 4/10/12	File: 776_RIR2012_71_GEOLOGIC

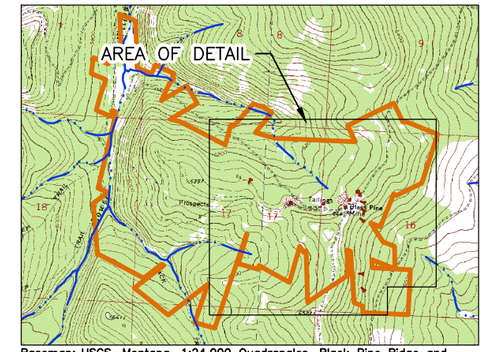
FIGURE 3-4. MW-RY-07 GROUNDWATER LEVEL
JANUARY 2012 - APRIL 2013



M:\GovState\MDEQAMS\BlackPineMine\ProjectDocs\RepositoryInvest\Reports\201305_DraftRI\3_Figures\FIG-3-4_201304_MW-RY-07.xlsx



Basemap: Asarco Exploration Department, Black Pine Geology Map, Plate 1, Revised September 2007.



Basemap: USGS, Montana, 1:24,000 Quadrangles, Black Pine Ridge and Henderson Mountain, Published 2000.

KEY MAP

SCALE: NONE

N

EXPLANATION

- EXISTING GROUND SURFACE CONTOURS (25' INTERVAL)
- OVERHEAD POWER
- PROPERTY BOUNDARY
- FAULT
- QUARTZ-SULFIDE VEINS ON THE SURFACE
- SECTION LINES
- EDGE OF ROAD
- MAXIMUM ANTICIPATED PRE-CONCEPTUAL REPOSITORY FOOT PRINT
- WASTE ROCK PILE
- BUILDING OR OTHER STRUCTURE
- TRENCH
- ADIT
- SHAFT

Rock Types

- **Kqp** Quartz porphyry dikes; weakly altered porphyry dikes with 35-50% rounded quartz phenocrysts to 1.5 cm. K-Ar age from sericite; 73.7±2.4 Ma.
- **pCmsu** Mt. Shields Fm., upper unit; brick-red to maroon argillite with interbedded argillaceous quartzite.
- **pCmsm** Mt. Shields Fm., middle unit; tan-colored feldspathic quartzite. Principal host rock for polymetallic veins at Black Pine.
- **pCmsl** Mt. Shields Fm., lower unit; interbedded sandstone-siltstone-argillite sequence.

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FIGURE 4-1

GEOLOGY MAP
PROPOSED REPOSITORY AREA

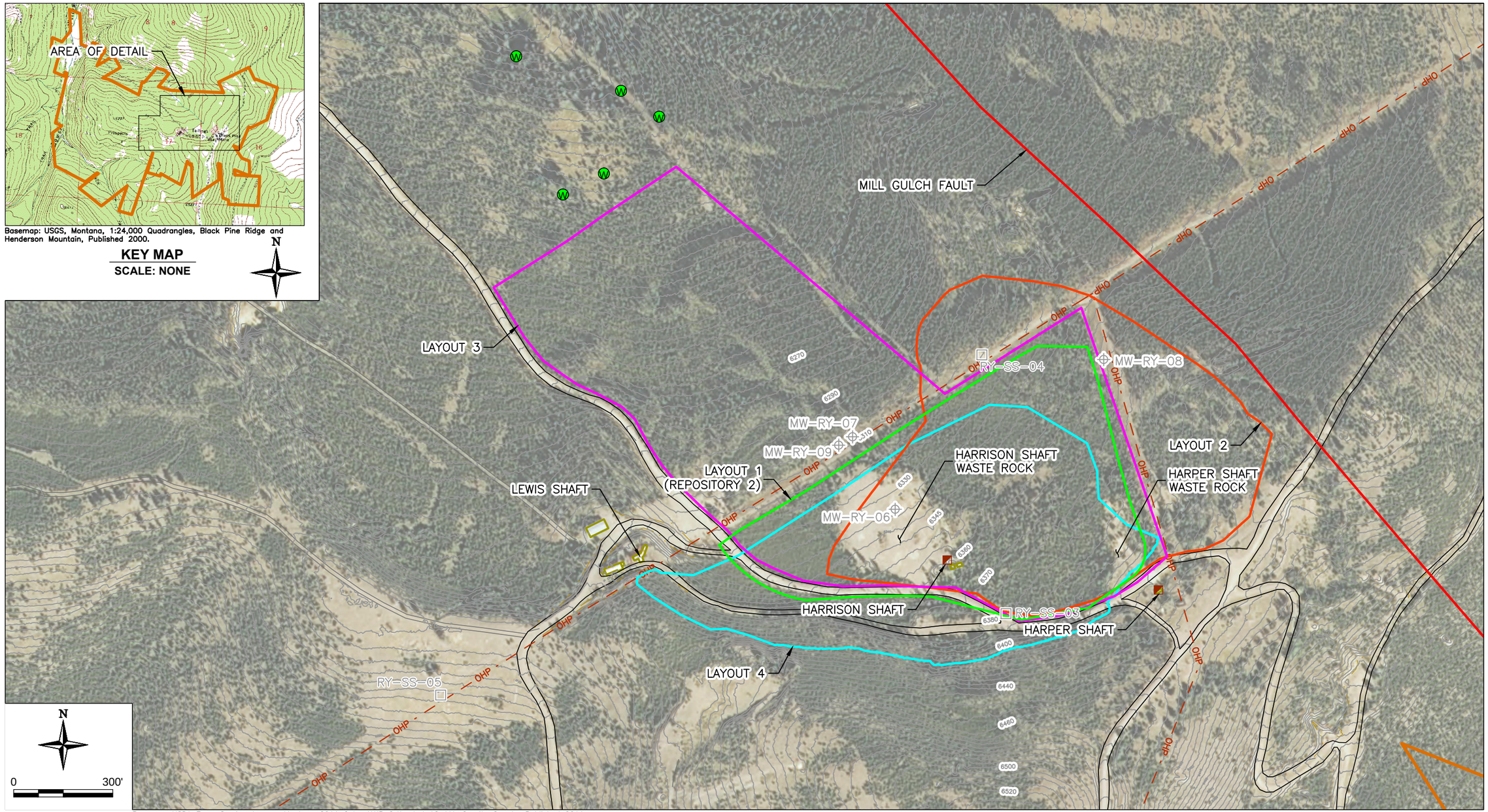
BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
MINE WASTE CLEANUP BUREAU

Drawn By: BH	Checked By: TS	Scale: AS SHOWN	Date: 6/13/13	File: 776_RIR2012_GEOLOGY

Basemap: USGS, Montana, 1:24,000 Quadrangles, Black Pine Ridge and Henderson Mountain, Published 2000.

KEY MAP

SCALE: NONE



Basemap: USDA Farm Service Agency, Montana 2011 Color NAIP Orthophoto12-kM, Granite County. Published 2011.

EXPLANATION

6260	EXISTING GROUND SURFACE CONTOURS (5' INTERVAL)	MW-RY-07	EXISTING MONITORING WELL LOCATION AND DESIGNATION
OHP	OVERHEAD POWER	RY-SS-04	RI TEST PIT LOCATION AND DESIGNATION
	PROPERTY BOUNDARY	SS	SOIL SAMPLE
	APPROXIMATE FAULT LOCATION	RB	ROCK BORING
	EDGE OF ROAD	MW	MONITORING WELL
	BUILDING	RY	REPOSITORY
W	SPRING LOCATION (MAY 2012)	RI	RECLAMATION INVESTIGATION

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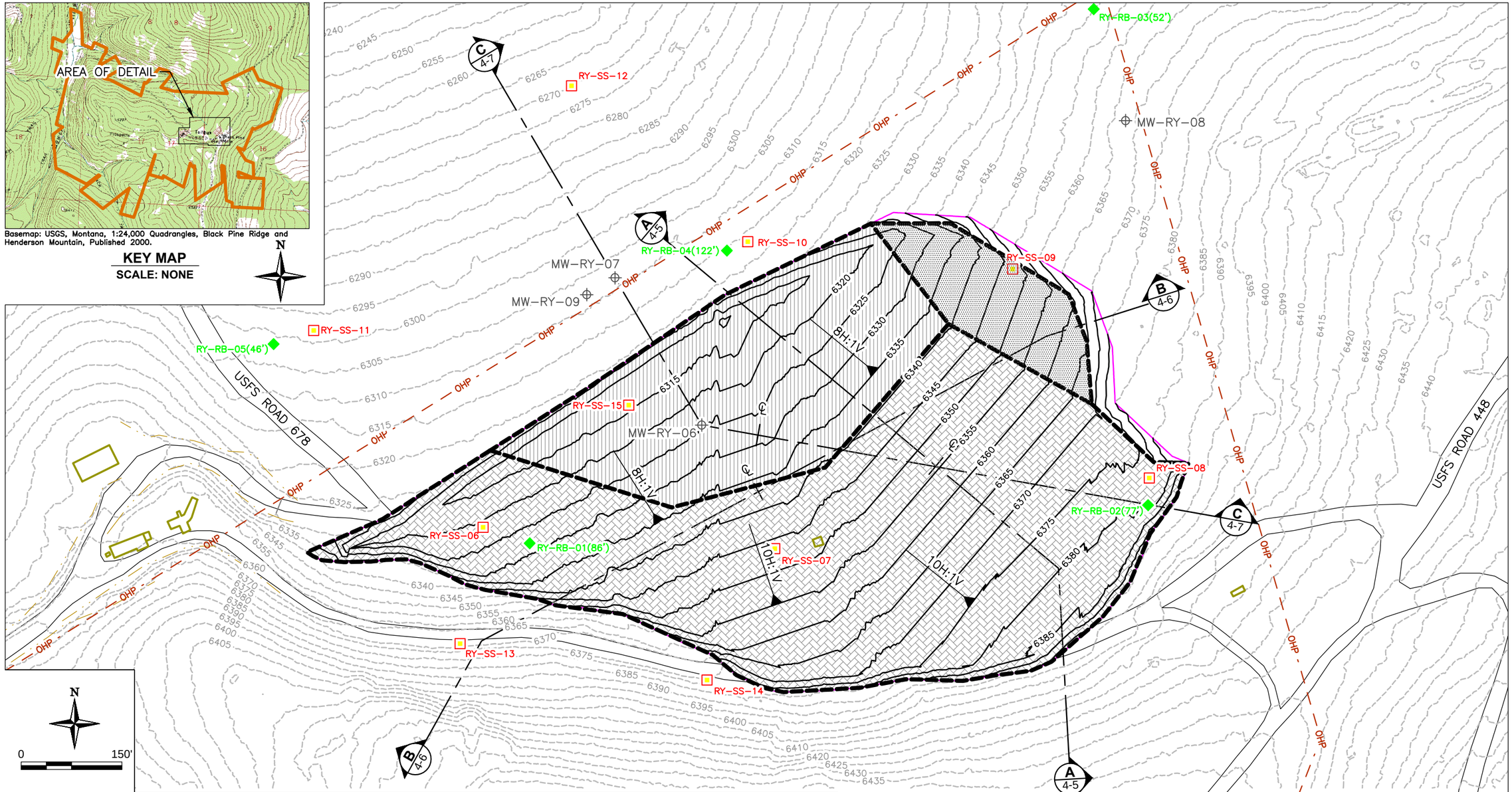
FIGURE 4-2

RECLAMATION INVESTIGATION WORK PLAN
PROPOSED REPOSITORY LAYOUTS

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
MINE WASTE CLEANUP BUREAU

Drawn By: BH	Checked By: MD	Scale: AS SHOWN	Date: 9/20/13	File: 776_RIR2012_BPM-REPO2



EXPLANATION

6260	EXISTING GROUND SURFACE CONTOURS (5' INTERVAL)
6260	PROPOSED EXCAVATED GROUND SURFACE CONTOURS (5' INTERVAL)
OHP	OVERHEAD POWER
	EXCAVATION LIMITS
	EDGE OF ROAD
	BUILDING
RY-SS-06	TEST PIT LOCATION AND DESIGNATION
RY-RB-01(86')	BOREHOLE/CORING LOCATION, DESIGNATION AND DEPTH
MW-RY-09	REMEDIAL INVESTIGATION BORING/MONITORING WELL
	CLAY (CL), SILT (ML), AND CLAYEY GRAVEL (GC)
	GRAVEL WITH SAND (GP) & SILT (GP-GM)
	SILTY GRAVEL WITH SAND & COBBLES (GM)
SS	SOIL
RB	ROCK BORING
MW	MONITORING WELL
RY	REPOSITORY

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FIGURE 4-3

PROPOSED REPOSITORY 10-FOOT EXCAVATION

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
MINE WASTE CLEANUP BUREAU

Drawn By: CJN	Checked By: MD	Scale: AS SHOWN	Date: 6/13/13	File: 776_BPM-10FT-EXCAVATED

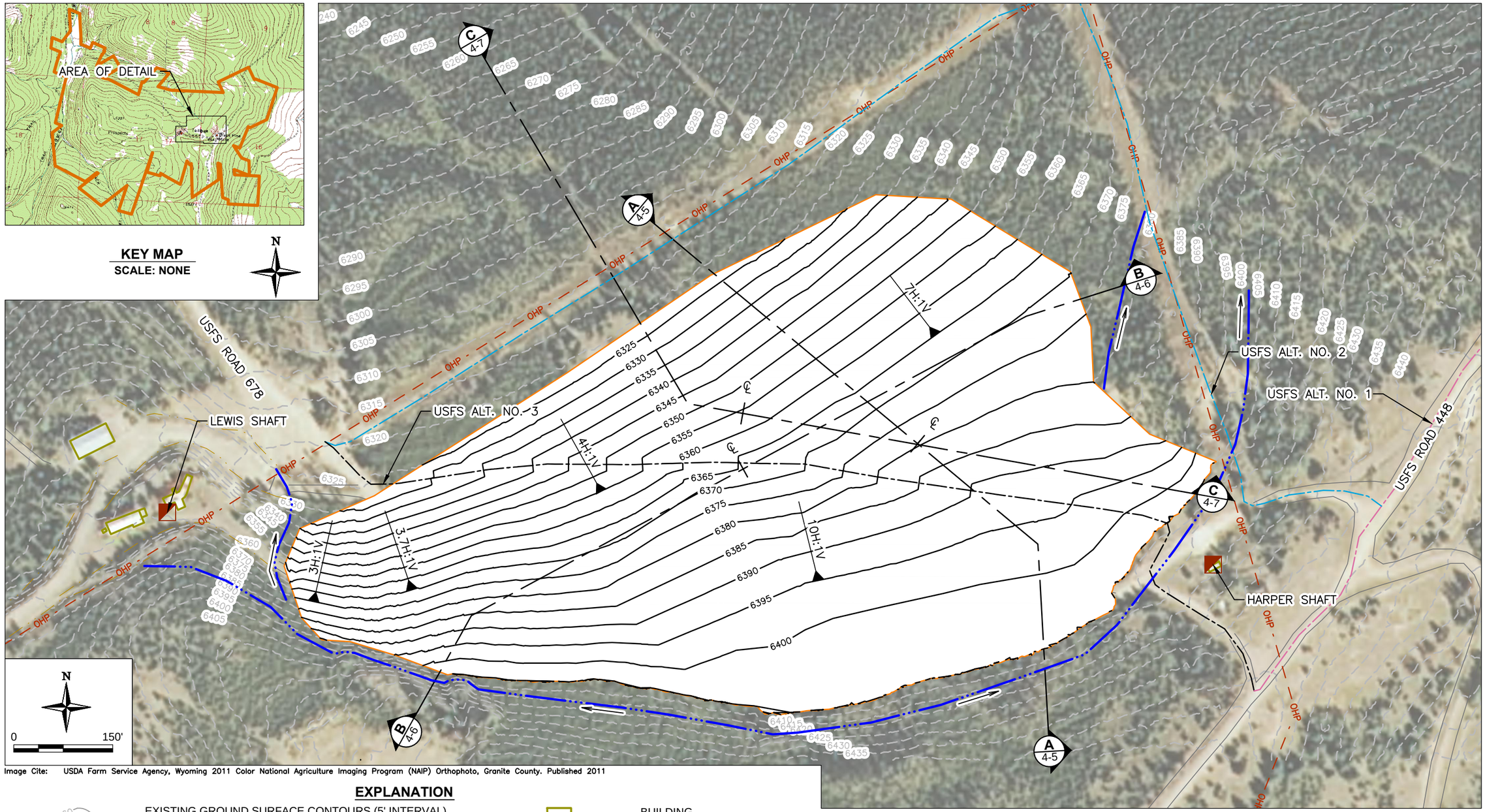

Image Cite: USDA Farm Service Agency, Wyoming 2011 Color National Agriculture Imaging Program (NAIP) Orthophoto, Granite County. Published 2011

EXPLANATION

EXISTING GROUND SURFACE CONTOURS (5' INTERVAL)	BUILDING
PROPOSED GROUND SURFACE CONTOURS (5' INTERVAL)	ALT. ALTERNATIVE
OVERHEAD POWER	NO. NUMBER
GRADING LIMITS	
EDGE OF ROAD	
INTERCEPTOR TRENCH/STORMWATER DIVERSION DITCH	
PROPOSED CENTERLINE USFS ROAD ALTERNATIVE NO. 1	
PROPOSED CENTERLINE USFS ROAD ALTERNATIVE NO. 2	
PROPOSED CENTERLINE USFS ROAD ALTERNATIVE NO. 3	

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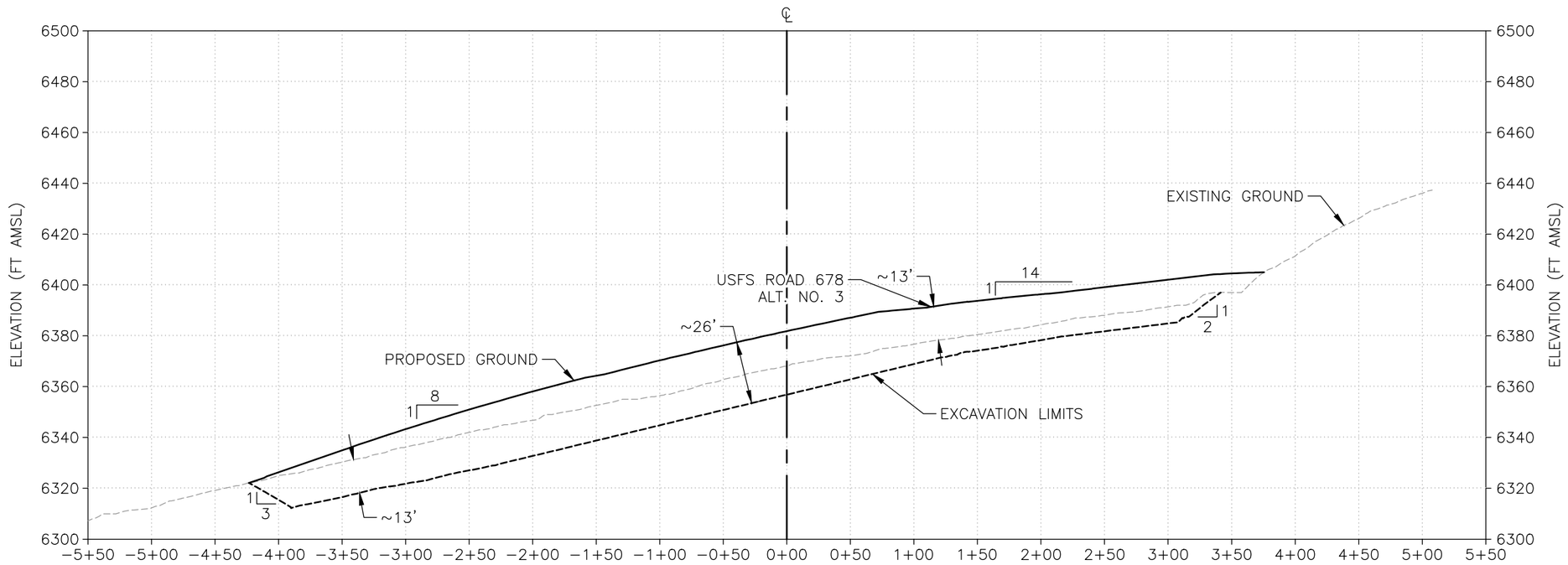
FIGURE 4-4

PROPOSED REPOSITORY SURFACE GRADING
10-FOOT EXCAVATION

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
MINE WASTE CLEANUP BUREAU

Drawn By: CJN	Checked By: MD	Scale: AS SHOWN	Date: 9/20/13	File: 776_BPM-10FT-GRADING



EXPLANATION

- - - - - - - - - -	EXISTING GROUND SURFACE
----------	EXCAVATION LIMITS
————	PROPOSED GROUND SURFACE
ALT.	ALTERNATIVE
FT AMSL	FEET ABOVE MEAN SEA LEVEL
NO.	NUMBER

0 100'
HORIZONTAL

0 50'
VERTICAL

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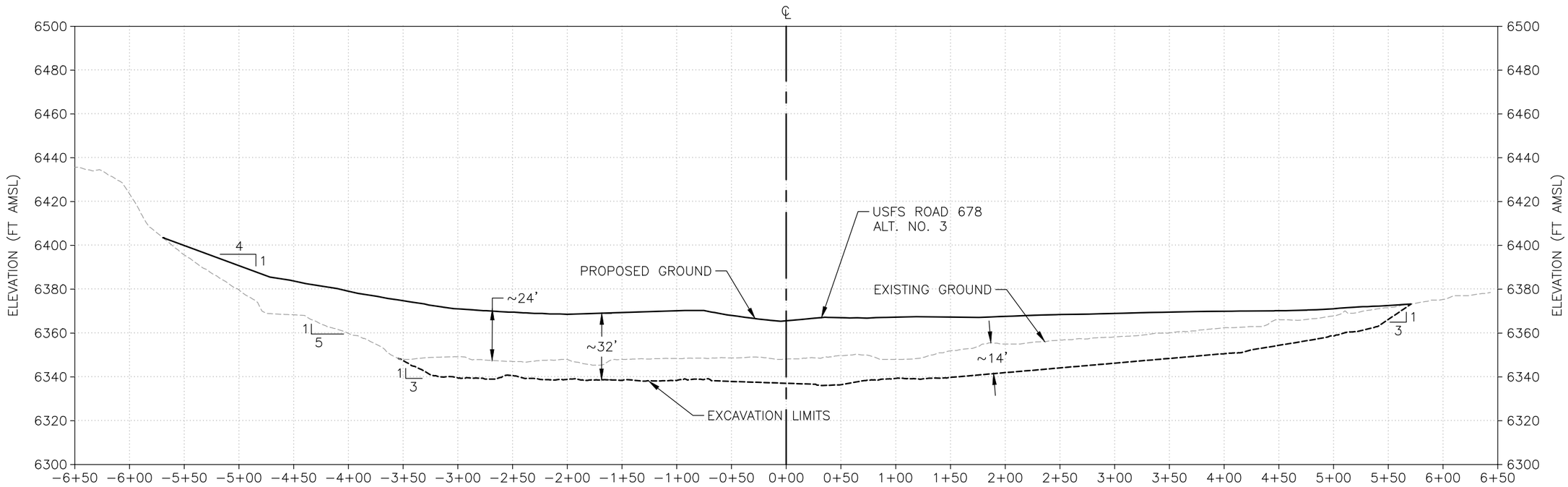
FIGURE 4-5

PROPOSED REPOSITORY CROSS SECTION A
10-FOOT INITIAL EXCAVATION

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
MINE WASTE CLEANUP BUREAU

Drawn By: KBW	Checked By: MD	Scale: AS SHOWN	Date: 3/28/13	File: 776_BPM-10FT-X-SEC



EXPLANATION

- - - - - - - - - -	EXISTING GROUND SURFACE
- - - - - - - - - -	EXCAVATION LIMITS
————	PROPOSED GROUND
ALT.	ALTERNATIVE
FT AMSL	FEET ABOVE MEAN SEA LEVEL
NO.	NUMBER

0 100'
HORIZONTAL

0 50'
VERTICAL

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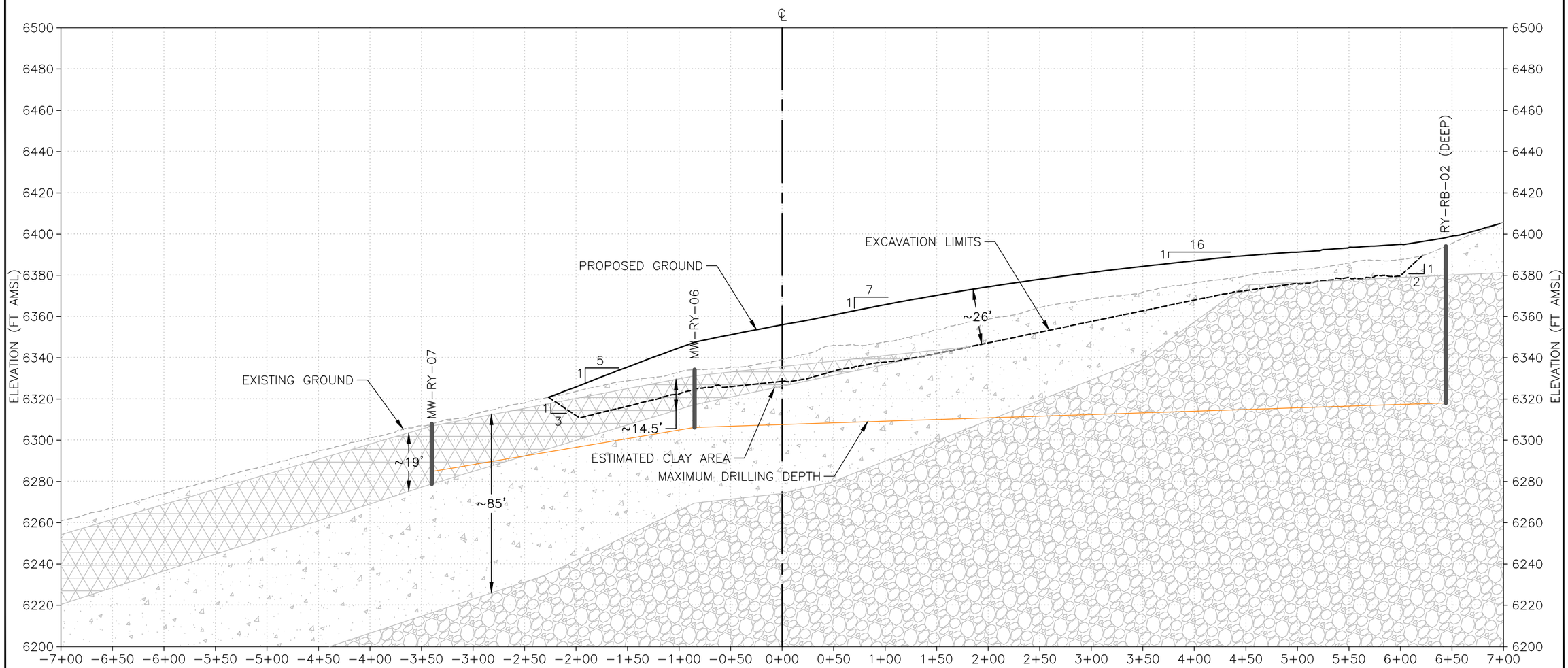
FIGURE 4-6

PROPOSED REPOSITORY CROSS SECTION B
10-FOOT INITIAL EXCAVATION

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
MINE WASTE CLEANUP BUREAU

Drawn By: KBW	Checked By: MD	Scale: AS SHOWN	Date: 3/28/13	File: 776_BPM-10FT-X-SEC



EXPLANATION

- - - - - - - -	EXISTING GROUND SURFACE		CLAYEY GRAVEL/CLAY
- - - - - - - -	EXCAVATION LIMITS		SILTY GRAVEL
————	PROPOSED GROUND		BEDROCK
FT AMSL	FEET ABOVE MEAN SEA LEVEL		
NO.	NUMBER		

0 100'
HORIZONTAL

0 50'
VERTICAL

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FIGURE 4-7

PROPOSED REPOSITORY CROSS SECTION C
10-FOOT INITIAL EXCAVATION

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
MINE WASTE CLEANUP BUREAU

Drawn By: KBW	Checked By: MD	Scale: AS SHOWN	Date: 3/28/13	File: 776_BPM-10FT-X-SEC

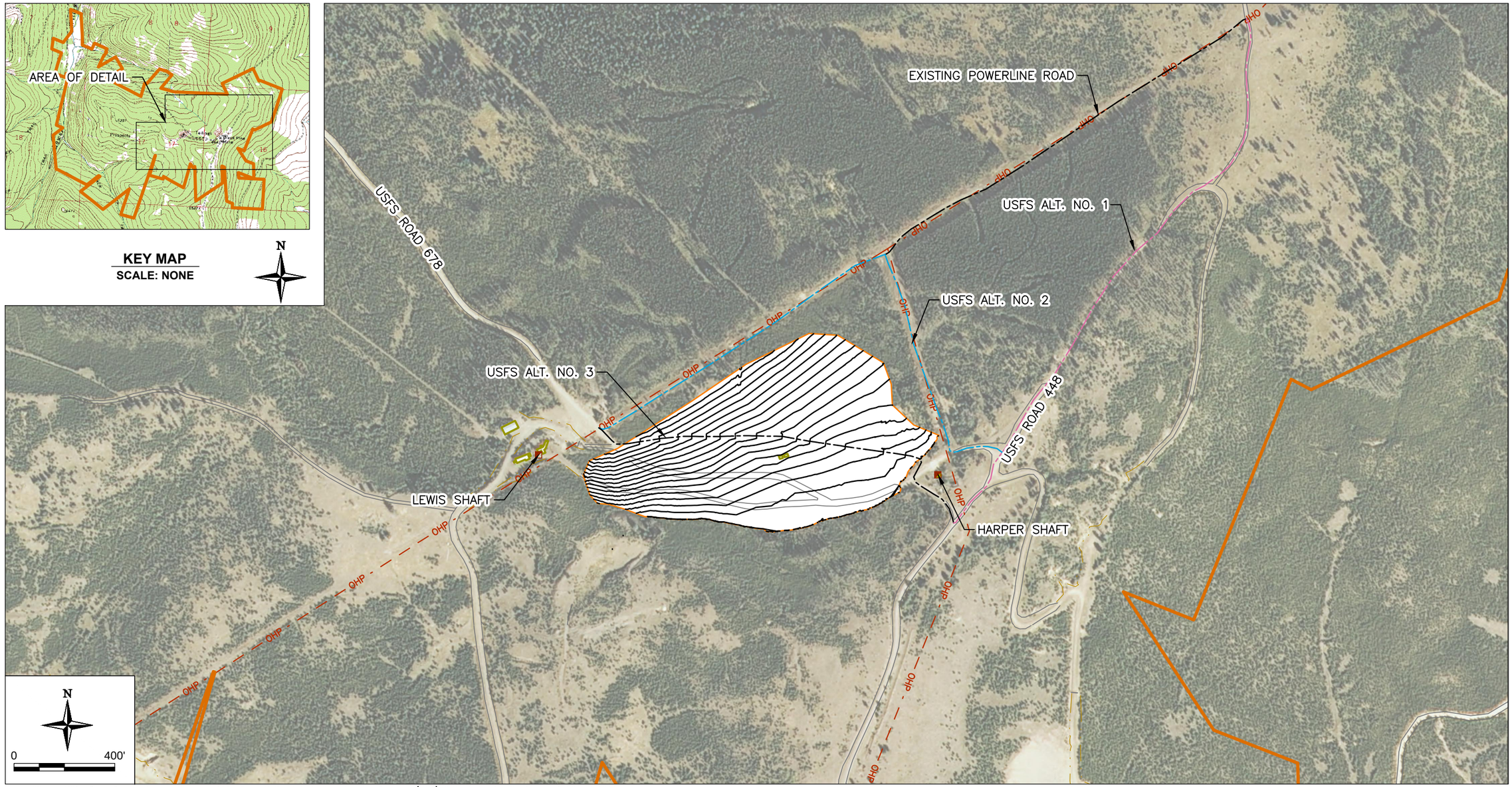

Image Cite: USDA Farm Service Agency, Wyoming 2011 Color National Agriculture Imaging Program (NAIP) Orthophoto, Granite County. Published 2011

EXPLANATION

- 6260 — PROPOSED GROUND SURFACE CONTOURS (5' INTERVAL)
- OHP — OVERHEAD POWER
- GRADING LIMITS
- EDGE OF ROAD
- PROPOSED CENTERLINE USFS ROAD ALTERNATIVES
- SITE BOUNDARY
- PROPOSED CENTERLINE USFS ROAD ALTERNATIVE NO. 1
- PROPOSED CENTERLINE USFS ROAD ALTERNATIVE NO. 2
- PROPOSED CENTERLINE USFS ROAD ALTERNATIVE NO. 3
- BUILDING
- ALT. NO. — ALTERNATIVE NUMBER

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FIGURE 4-8

PROPOSED REPOSITORY LOCATION AND POSSIBLE USFS ROAD ALIGNMENTS

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
MINE WASTE CLEANUP BUREAU

Drawn By: KBW	Checked By: MD	Scale: 1" = 400'	Date: 9/20/13	File: 776_BPM-USFSROADS

APPENDIX A

FIELD SAMPLING METHODS

A.1 Field Sampling Methods

Field samples were collected and processed in accordance with the RIWP, except as discussed in this section.

A.1.1 Shallow Impacted Sediment and Soils Sampling Procedures

Shallow impacted soil and sediment samples that were not obtained from a test pit were excavated by hand with a shovel. Each sample was collected by first removing the top layer of detritus. The sample was collected using the shovel and mixed thoroughly to obtain a homogenous sample representative of the sampling interval (typically 0-1inch). A sample of the material from each sample location was collected and submitted to the analytical laboratory for analysis of mercury. The soils from the test pit were spread on a tarp to allow mercury vapors to dissipate and then a second sample was collected and submitted for analysis of mercury. At that time, the sample for geotechnical testing was collected from the material spread on the tarp, placed in a 5-gallon bucket and covered with an air-tight lid. These samples were transported to Helena until receipt of the mercury analysis. These samples were then delivered to the geotechnical laboratory able to work with the reported levels of mercury.

Each sample location was photographed and logged in the field book. Sample information was also recorded on the chain-of-custody form. Remaining material was backfilled in the sample location and the top layer of material will be re-spread. The shovel and other sampling tools were decontaminated between each impacted waste sample location.

A.1.2 Test Pit Sampling Procedures

Test pits were excavated within the proposed Repository Area 2, potential borrow areas, and impacted waste areas as part of the subsurface exploration field program. Field tasks associated with the test pitting program included staking and mapping test pit locations, excavation and logging of observed lithologies and soil characteristics, and collecting representative soil samples for geotechnical and geochemical laboratory analysis.

Test pits were excavated with a tracked excavator. A typical test pit excavation proceeded as follows:

- Topsoil was stripped from the test pit areas and stockpiled adjacent to the test pit.
    - The topsoil stockpile was used to reclaim the test pit areas upon completion of the backfilling of the test pit.
- Subsoil, the soil beneath the topsoil, was excavated and placed on the side of the test pit.
    - Excavation of the test pit continued to bedrock, or refusal, or maximum reach of the equipment, or waste/soil interface as appropriate for the location sampled.
    - As different lithology was encountered during the excavation of the test pit. separate piles of material were made to segregate material for collecting samples.

- Samples were collected.
    - Topsoil was collected from the side wall of the test pit.
    - Composite samples of the subsoil were collected from the stock piles of the subsoil.
- Backfill of the test pit occurred in reverse order of the excavation.
    - Subsoil was placed and compacted back in the test pit.
    - Topsoil and vegetation was placed over the disturbed area.

Topsoil samples were collected from the sides of the excavation using a dedicated stainless steel trowel. The soil was placed into appropriate labeled containers and sealed tightly. The sampler scalped coarse material (>1 inch in diameter) from the sample. These samples were shipped to the analytical laboratory for analysis of agricultural parameters and ABA.

Aliquots from the soils, except for topsoil, encountered across the entire depth of the test pit was collected with a shovel and thoroughly mixed to create a composite sample. The composite sample was placed in a 5-gallon bucket and sealed with an air-tight lid, labeled with indelible ink, and the sample was logged in the field log book and chain of custody form. The sealed buckets were transported to a central holding location on the mine site.

Samples collected from Repository Area 2 were held for additional logging and future project reference, while samples collected from potential borrow areas and the Combination Mine waste rock pile was delivered immediately to the geotechnical laboratories. Samples suspected of containing mercury from the Combination Mill AOC and downstream along South Fork Lower Willow Creek were collected and sampled as described for shallow impacted sediment and soil. After receipt of the mercury analysis, the samples were delivered to the geotechnical laboratory able to work with the reported levels of mercury.

Field personnel observed the test pit excavations, obtained the samples, logged the in-situ soils and rock, and described the lithology and groundwater occurrence, if any, on the test pit log forms. Soils were classified using the Unified Soil Classification System (USCS). This information was also recorded on a test pit log. Each test pit log had a unique test pit label that included the test pit location. The test pit log listed the excavation equipment, depth to soil and bedrock unit interfaces (if encountered), groundwater (if encountered), sampling information, and soil and rock descriptions.

When the sampling of the test pit log was complete, the test pit was photographed and then backfilled. The sampling tools were then decontaminated between each sample location.

A.1.3 Geotechnical Drilling and Sampling Procedures

The RIWP indicated that the two deep borehole locations would be drilled first as they are situated over the underground mine workings in the Combination Vein. The bedrock at these

two locations was to be cored until 30 feet of competent bedrock was observed or until a depth of 100 feet was cored, whichever is shallower to identify faults, fractures, or voids that may be a failure mechanism for the repository siting. The depth to competent bedrock was to be averaged between the two deep boreholes and be used to determine the depth of the three shallow boreholes. The shallow boreholes would be advanced to the top of competent bedrock.

Boreholes were advanced using an air rotary rig. Soil samples were not collected as advancement of the bores was conducted with a tri-cone bit and cuttings ejected from the borehole annulus by pressurized air. General soil descriptions were logged and correlated to nearby test pits where possible. At the start of bedrock, bedrock cores were obtained using a diamond-impregnated bit attached to a core barrel. The core barrel was advanced until the core barrel plugged with fine cuttings or to 15-feet, the length of the barrel. The length of advancement and core recovery was recorded in the field logs. Recovered core samples were stored in cardboard core boxes, labeled with indelible ink, and recorded on the field logs.

A senior geologist observed the drilling, obtain the samples, and logged the recovered soils and bedrock to describe the lithology and groundwater occurrence, if any. Soils were classified using the USCS soil classification system. This information was recorded on a borehole log.

Upon completion of drilling, the borehole location was photographed and backfilled. The boreholes were abandoned by backfilling with drill cuttings. Sampling tools were not decontaminated between each borehole location as no samples were obtained for chemical evaluation. The samples were obtained for geological and geotechnical evaluations.

A.1.4 Groundwater Sampling Procedures

The groundwater level in existing repository monitoring wells (MW-RY-06, MW-RY-07, MW-WY-08, and MW-RY-09) was gaged prior to sampling. MW-RY-10 was not installed as explained in Section 2.3. The static groundwater levels and bottom of the monitoring wells were measured and recorded on a field form. A groundwater sample was collected from MW-RY-07 as it was the only well with measurable groundwater. Following gaging, three well casing volumes of groundwater were purged from MW-RY-07. Groundwater was hand bailed into a 5-gallon bucket to measure the approximate volume removed. Field parameter readings for pH, temperature, dissolved oxygen, and specific conductance were recorded on a field form for each casing volume of water removed. Observations about water quality conditions such as color, odor, and sediment were also recorded on the field form. Groundwater was purged and collected using a disposable bailer, 0.45 micron filter for dissolved metals, and twine.

Groundwater samples were placed into appropriately labeled bottles and the lids secured tightly. The samples were placed in a cooler, preserved at 4 degrees Celsius (ºC), and hand delivered to the analytical laboratory for analysis of dissolved metals. The sample was analyzed for antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver, and zinc. The sample was also analyzed for hardness as $CaCO_3$, dissolved potassium and sodium, total suspended solids, total dissolved solids, and sulfate.

A.1.5 Mill Debris Sampling Procedures

Sampling was performed by Herrera/Trihydro team member. Samples were obtained by drilling holes in wood and brick debris at the Combination Mill and "Old Mill" sites. A new drill bit was used for each sample. The drill cuttings were collected and placed into appropriately–labeled bottles and the lid will be secured tightly. The field identification number was recorded in the field logbook, and on the chain-of-custody form. The samples were placed in a cooler, preserved at 4 degrees Celsius (ºC), and shipped to the analytical laboratory for analysis of TCLP metals.

A.1.6 Quality Assurance Sampling Procedures

The project team collected one groundwater field duplicate sample. The sample was collected as described in Section A.1.4. The sample was submitted for analysis of dissolved metals including antimony, arsenic, barium, calcium, cadmium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, silver, and zinc, as well as hardness and laboratory parameters.

The project team collected equipment rinsate blank samples by pouring deionized water onto a decontaminated stainless steel spoon, and a decontaminated excavator bucket, and then into an appropriate sample container for total recoverable metals analysis. The samples were analyzed for total recoverable metals including antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver, and zinc.

APPENDIX B

TEST PIT LOGS AND FIELD NOTES

Trihydro CORPORATION

Lithology Log

Sheet 1 of 1

LOCATION ID: CMN-01

Project Name: BPM	Project Number:	Site ID: COMBINATION WASTE	
Excavation Company: MILE HIGH	Operator:	Ground Elevation:	Total Depth: 8' feet-bgs
Equipment: CAT 312 C	Weather: Sunny	Temperature: 68°F	Date/Time Started: 8-30-12 - 1700
Date/Time Total Depth Reached: 8-30-12/1715 8'			
Sampler: J MONGOVEN	Water Level (bgs): First ___ feet-bgs		
	Hydrogeologist:	Checked by/Date:	

Location Description (include sketch in field logbook):

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0-2' COVERSOIL							
				SANDY SILTY GRAVEL w/ COBBLES REDISH BROWN DRY							CMN-GT-01
1											
				2.0 LINER							
2			2' -	SANDY SILTY GRAVEL w/ COBBLES, YELLOWISH BROWN DAMP							
3				CAVING IN ON SIDES OF TEST-PIT. WASTE DOES NOT APPEAR TO BE COMPACTED.							
4											
5											
6											
7											
8				STOPPED DUE TO SLOUGHING AT 8'							
9											
10											

Trihydro CORPORATION

Lithology Log

Sheet 1 of 1

LOCATION ID: CMN-02			
Project Name: BFM	Project Number: 776-012-003	Site ID: COMBINATION WASTE DUMP	
Excavation Company: MILE HIGH	Operator: BRYAN	Ground Elevation: —	Total Depth: 8' feet-bgs
Equipment: CAT 312 C	Weather: SUNNY	Temperature: 68 °f	Date/Time Started: 8-30-12 / 1800	Date/Time Total Depth Reached: 8-30-12 / 1815 / 21'
Sampler: JMONGOVEN		Water Level (bgs): First — feet-bgs	
		Hydrogeologist: —	Checked by/Date:

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0 - 2.5 COVER SOIL -- SANDY SILTY GRAVEL W/ COBBLES BROWN TO REDISH BROWN, DRY							
1											
2				2.5 — 5.0 - COVER SOIL — SANDY SILTY GRAVEL W/ COBBLES BROWN TO YELLOWISH BROWN DAMP							CMN-GT-02
3											
4											
5				5.0 GRAVEL 4" MINUS W/ COBBLES WET							NO LINER SMELLS LIKE MINE WORKINGS DAMP MUSTY
6											
7				7.5'							
8				STOPPED DUE TO CAVING OF SIDE WALLS.							
9											
10											

Trihydro CORPORATION

Lithology Log

Sheet 1 of 1

LOCATION ID: CMN-GT-03			
Project Name: BPM	Project Number: 776-012-003	Site ID: COMBINATION WASTE DAMP	
Excavation Company: MILE HIGH	Operator: BRYAN	Ground Elevation: —	Total Depth: __ feet-bgs
Equipment: CAT 312C	Weather: SUNNY	Temperature: 66 °F	Date/Time Started: 8-30-12 / 1845
Date/Time Total Depth Reached: 8-30-12 / 1900			
Sampler: J MONGAUEN	Water Level (bgs): First __ feet-bgs		
Hydrogeologist: —	Checked by/Date		

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0			0-5'	CAP SANDY SILTY GRAVEL, BROWN TRACE COBBLES, DAMP							
1											
2											CMN-GT-03
3											
4											
5			5-	WASTE SILTY SANDY GRAVEL W/ GRAVEL, MOIST YELLOWISH BROWN							SMELLS LIKE MINE WASTE
6											
7											
8				STOPPED EXCAVATION @8'							
9											
10											

Trihydro CORPORATION

Lithology Log Sheet 1 of 1

LOCATION ID
CML-GT/GC-01

Project Name	Project Number	Site ID
Black Pine Mine	776-012-005	Combination Mill

Excavation Company	Operator	Ground Elevation	Total Depth
Mile High Excavation	Bryan		3 feet-bgs

Equipment	Weather	Temperature	Date/Time Started	Date/Time Total Depth Reached
	Sunny		9-05-12/1120	

Sampler	Water Level (bgs)
Luke Darnell, Brady Hanson	First ___ feet-bgs

Hydrogeologist	Checked by/Date

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0-1 ft bgs Topsoil - Sandy Gravel, light brown							Hg vapor 0.000-0.010 mg/m3
1				1-2 ft bgs Tailings - fines, pink/orange							CML-GT-01
2				2-3 ft bgs Gravel, Dark brown/black, "native"							
3				Bottom of Test Pit at 3 feet bgs hard bottom							
4											
5											
6											
7											
8											
9											
10											

Trihydro CORPORATION

Lithology Log Sheet 1 of 1

LOCATION ID: CML-GT/GC-02

Project Name: Black Pine Mine	Project Number: 776-012-005	Site ID: Combination Mill	
Excavation Company: Mile High Excavation	Operator: Bryan	Ground Elevation:	Total Depth: 2.5 feet-bgs
Equipment:	Weather: Sunny	Temperature:	Date/Time Started: 9-05-12/1105
Date/Time Total Depth Reached:			
Sampler: Luke Darnell, Brady Hanson		Water Level (bgs): First 2.5 feet-bgs	
		Hydrogeologist:	Checked by/Date:

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0-2 ft bgs Tailings - mixed with "native" Gravel, dark brown, not clearly delineated							Hg vapor 0.003-0.051 mg/m3 CML-GT-02
1											
2				2-2.5 ft bgs dark brown Gravel and Sand, "native" Water at 2.5 ft bgs							
3				Bottom of Test Pit at 2.5 feet bgs							
4											
5											
6											
7											
8											
9											
10											

Trihydro CORPORATION

Lithology Log Sheet 1 of 1

LOCATION ID
CML-GT/GC-03

Project Name	Project Number	Site ID
Black Pine Mine	776-012-005	Combination Mill

Excavation Company	Operator	Ground Elevation	Total Depth
Mile High Excavation	Bryan		5 feet-bgs

Equipment	Weather	Temperature	Date/Time Started	Date/Time Total Depth Reached
	Sunny		9-05-12/1050	

Sampler	Water Level (bgs)
Luke Darnell, Brady Hanson	First 4.5 feet-bgs

Hydrogeologist	Checked by/Date

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0-4.5 ft bgs Lean Clay, with sand and large gravel, dark brown/black	CL						Hg vapor 0.003-0.016 mg/m3
1											
2											CML-GT-03 2'-3'
3											
4				4.5-5 ft bgs Gravel, light brown/tan, wet Water at 4.5 ft bgs							
5				Bottom of Test Pit at 5 feet bgs							
6											
7											
8											
9											
10											

Trihydro CORPORATION

Lithology Log Sheet 1 of 1

LOCATION ID
CML-GT/GC-07

Project Name	Project Number	Site ID
Black Pine Mine	776-012-005	Amalgamation Mill

Excavation Company	Operator	Ground Elevation	Total Depth
Mile High Excavation			6 feet-bgs

Equipment	Weather	Temperature	Date/Time Started	Date/Time Total Depth Reached
	Sunny		9-05-12/0900	

Sampler	Water Level (bgs)
Luke Darnell, Brady Hanson	First __ feet-bgs

Hydrogeologist	Checked by/Date

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0-5.25 ft bgs Tailings, very fine, sandy, pink/ orange							Hg vapor 0.003-0.014 mg/m3
1											CML-GT-07 1.5' - 2'
2											
3											
4											
5											
				5.25-6 ft bgs large rounded Cobbles, Gravel, gray, "slimey" coating on rocks							
6				Bottom of Test Pit at 6 feet bgs							
7											
8											
9											
10											

Trihydro CORPORATION

Lithology Log Sheet 1 of 1

LOCATION ID
CML-GT/GC-08

Project Name	Project Number	Site ID
Black Pine Mine	776-012-005	Amalgamation Mill

Excavation Company	Operator	Ground Elevation	Total Depth
Mile High Excavation	Bryan		5 feet-bgs

Equipment	Weather	Temperature	Date/Time Started	Date/Time Total Depth Reached
	Sunny		9-05-12/0800	

Sampler	Water Level (bgs)
Luke Darnell, Brady Hanson	First __ feet-bgs

Hydrogeologist	Checked by/Date

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0-1.75 ft bgs Tailings, pink/orange, very fine, sandy	CL						Hg vapor 0.000-0.009 mg/m3
1											CML-GT-08 1' - 2'
				1.75-2.25/2.75 ft bgs silty sand, grey, no gravel, moist							
2											
				2.25/2.75-5 ft bgs dark grey/black, some clay, wet, silty sand with clay and gravel, subrounded, organic matter, odor							
3											
4											
5				Bottom of Test Pit at 5 feet bgs							
6											
7											
8											
9											
10											

NO SUBMIT

Trihydro CORPORATION

Lithology Log

Sheet 1 of 1

LOCATION ID: BPB1A-01			
Project Name: BPM	Project Number: 776-012-003	Site ID: BORROW AREA 01	
Excavation Company: MILE HIGH	Operator: BRYAN	Ground Elevation: —	Total Depth: __ feet-bgs
Equipment: CAT 312 C	Weather: PT CLOUDY	Temperature: 58 °F	Date/Time Started: 8-31-12 / 0830
Date/Time Total Depth Reached: 8-31-12 / 0845			
Sampler: J MONGOVEN	Water Level (bgs): First — __ feet-bgs		
Hydrogeologist: —	Checked by/Date: T SMITH 8/31/12		

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0.–0.25 DUFF TOPSOIL w/ GRAVEL, DRY, DK BROWN							BPB1A-GC-01
				0.25–4.5 HIGHLY WEATHERED BEDROCK – SILTY SANDY GRAVEL w/ COBBLES, TRACE ORGANICS DRY, BROWN							
1											
2											BPB1A-GT-01
3											
4				4.5 EXCAVATOR HIT REFUSAL							
5											
6											
7											
8											
9											
10											

SUBMIT FOR TESTING

Trihydro CORPORATION

Lithology Log

Sheet 1 of 2

LOCATION ID	BPB1A-GC/GT-02
Project Name	BPM
Project Number	776-012-003
Site ID	BPB 1A
Excavation Company	MILE HIGH
Operator	BRYAN
Ground Elevation	—
Total Depth	13.8 feet-bgs
Equipment	CAT 312
Weather	SUNNY
Temperature	82°F
Date/Time Started	1645
Date/Time Total Depth Reached	8-28-12 / 1705 / 13.8'
Sampler	J MONGOVEN
Water Level (bgs)	First — feet-bgs
Hydrogeologist	—
Checked by/Date	T SMITH 8/29/12

Location Description (include sketch in field logbook)
N SIDE OF REPOSITORY 2 IN POTENTIAL BORROW AREA 1A

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0.5 - DUFF - SILTY SAND GRAVEL TRC, ORGANICS. BRN DRY							BPB1A-GC-02
1				SILT & SANDY GRAVEL, TRACE COBBLES AND ROOTS, BROWN, DRY							BPB1A-GT-02
2											
3				- 3.0 LEAN CLAYEY SAND & GRAVEL WITH COBBLES, SHALE, ARGYLITE DARK YELLOWISH BROWN. DAMP							← GOOD BORROW SOURCE
4											POCKET PENETROMETER 3.5
5											
6											
7											
8											
9											
10											

Trihydro CORPORATION

Lithology Log (continued)

Sheet 2 of 2

LOCATION ID: BPB-1A-GC/GT-02

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
10											
11											
12											
13											
				13.8' MAX DEPTH OF EXCAVATOR							
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											

SUBMIT FOR TESTING

Trihydro CORPORATION

Lithology Log

Sheet 1 of 2

LOCATION ID: BPB1A-GC/GT-03

Project Name: BPM	Project Number: 776-012-003	Site ID: BORROW AREA 1A	
Excavation Company: MILE HIGH	Operator: BRYAN	Ground Elevation:	Total Depth: __ feet-bgs
Equipment: CAT 312 C	Weather: SUNNY	Temperature: 82	Date/Time Started: 8-28-12 / 1510
			Date/Time Total Depth Reached: 8-28-12 / 1545 / 12.5
Sampler: J MONGOVEN		Water Level (bgs): First — __ feet-bgs —	
		Hydrogeologist: —	Checked by/Date: T SMITH 8/29/12

Location Description (include sketch in field logbook): NW OF POWER LINE

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0.25 DUFF BLACK-DK BROWN							BPB1A-GC-03
				0.25-3'							
1				GRAVELLY SILT, WITH SAND, TRACE ORGANICS, BROWN, DRY, NON PLASTIC							
2											
3				3.0 HIGHLY WEATHERED BEDROCK SILTY SAND, WITH GRAVEL, TRACE COBBLES, DARK YELLOWISH BROWN, DRY							BPB1A-GC/GT-03*
4											
5				12.5 BOTTOM OF TEST PIT EXCAVATOR HIT REFUSAL							
6											
7											
8											
9											
10											

Trihydro CORPORATION

Lithology Log (continued)

Sheet 2 of 2

LOCATION ID: BPB1A-GC/GT-03

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
10											
11											
12				12.5 DRY EXCAVATOR HIT REFUSAL							
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											

SUBMIT FOR TESTING

Trihydro CORPORATION

Lithology Log

Sheet 1 of 1

LOCATION ID: BPB1A-GC/GT-04

Project Name	Project Number	Site ID
BPMINE	716-012-603	BORROW AREA 1A

Excavation Company	Operator	Ground Elevation	Total Depth
MILE HIGH	BRYAN	—	7' feet-bgs

Equipment	Weather	Temperature	Date/Time Started	Date/Time Total Depth Reached
CAT 312 C	SUNNY	82°F	1600 / 8-28-12	8-28-12 / 1530 / 7'

Sampler	Water Level (bgs)	Hydrogeologist	Checked by/Date
J MONGOVEN	First — feet-bgs —	—	T SMITH 8/28/12

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0.25 - DUFF - DARK BROWN							BPB1A-GC-04
				SILT, WITH SAND, TRACE GRAVEL AND ORGANICS, BROWN, DRY, NONPLASTIC							
1											
2											
3				3.0							
				SAND & GRAVEL, WITH SILT DARK YELLOWISH BROWN, DRY							BPB1A-GC/GT-04
4											
5											
6											
7				DRY EXCAVATOR HIT REFUSAL @ 7'							
8											
9											
10											

Trihydro CORPORATION

Lithology Log

Sheet 1 of 1

LOCATION ID ~~VP-4~~ BPB-1A-GT-05

Project Name: BLACK PINE MINE	Project Number:	Site ID:	
Excavation Company: MILE HIGH	Operator: BRIAN	Ground Elevation:	Total Depth: 9½ feet-bgs
Equipment: CAT 312 CL	Weather: Sunny	Temperature: 75	Date/Time Started: 9-6-12/1500
			Date/Time Total Depth Reached: 9-6-12/1520 / 9½ ft
Sampler: V. J. PERRONE		Water Level (bgs): First ___ feet-bgs	
		Hydrogeologist:	Checked by/Date:

Location Description (include sketch in field logbook): ~~REPOSITORY 1A Center~~ BORROW AREA 1A CENTER

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				TOPSOIL/FOREST DUFF							
1				6 inches silty GRAVEL with sand and cobbles, dense, tan, dry, angular to subangular gravel & cobbles, f-c sand.	GM						
2											
3				2½ ft clayey GRAVEL with sand, and cobbles, very dense, orange-brown, moist, angular to subangular gravel & cobbles.	GC						
4											
5											
6											
7											
8											
9				9½ ft Bottom at 9½ ft Excavator refusal							
10											

NO BM

Trihydro CORPORATION

Lithology Log

Sheet 1 of 1

LOCATION ID: BPB 2/3-01

Project Name: BPM	Project Number: 776-012-003	Site ID: BORROW AREA 2/3	
Excavation Company: MILE HIGH	Operator: BRYAN	Ground Elevation:	Total Depth: 7.5 feet-bgs
Equipment: CAT 312 C	Weather: SUNNY	Temperature: 62 °f	Date/Time Started: 8-29-12 / Date/Time Total Depth Reached: 8-29-12 / 1230 / 7.5
Sampler: J MONGOVEN		Water Level (bgs): First — feet-bgs	
		Hydrogeologist: —	Checked by/Date: T SMITH 8/29/12

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0.25 - TOPSOIL - W/ GRAVEL & COBBLES BROWN, DRY							BPB 2/3-GT-01
1				0.25'-5' SANDY SILT, W/ COBBLES & GRAVELS, LIGHT BROWN, DRY							BPB 2/3-GT-01
2											
3											
4											
5				5' - FINE SAND W/ GRAVEL & LEAN CLAY COATED COBBLES, DAMP DARK YELLOWISH BROWN.							
6											
7				7.-' EXCAVATOR HIT REFUSAL							
8											
9											
10											

Trihydro CORPORATION

Lithology Log

Sheet 1 of 1

LOCATION ID
BPB 2/3-02

Project Name	Project Number	Site ID
BPM	776-012-003	BORROW AREA 01

Excavation Company	Operator	Ground Elevation	Total Depth
MILE HIGH	BRYAN	—	5' feet-bgs

Equipment	Weather	Temperature	Date/Time Started	Date/Time Total Depth Reached
CAT 312C	SUNNY	65 °F	8-29-12	8-29-12 / 12:03 / 5'

Sampler	Water Level (bgs)
SIMON GOVEN	First — feet-bgs

Hydrogeologist	Checked by/Date
—	T SMITH 8/29/12

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0.3 TOPSOIL, W/ GRAVEL & ORGANICS DARK BROWN DRY							BPB 2/3-GC-02
				0.3- SILTY SAND, WITH GRAVEL AND COBBLES, LT. BROWN DRY TRACE ORGANICS,							
1											
2											BPB 2/3-GT-02*
3											
4											
5				5.0 EXCAVATOR HIT REFUSAL							
6											
7											
8											
9											
10											

Trihydro CORPORATION

Lithology Log

Sheet 1 of 1

LOCATION ID: BPB 2/3 - 03

Project Name: BLACK PINE MINE	Project Number: 776 · 012 - 003	Site ID: BORROW AREA 2/3	
Excavation Company: MILE HIGH	Operator: BRYAN	Ground Elevation: —	Total Depth: 7' feet-bgs
Equipment: CAT 312 C	Weather: SUNNY	Temperature: 59°F	Date/Time Started: 8-29-12
			Date/Time Total Depth Reached: 8-29-12 / 1010 / 7'
Sampler: J MONGOVEN		Water Level (bgs): First — feet-bgs	
		Hydrogeologist: —	Checked by/Date: T SMITH 8/29/12

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0.25 TOPSOIL - SANDY SILT, WITH ORGANICS AND COBBLES, DARK BROWN, DRY							BPB 2/3 - GC - 03
1				0.25 - SANDY SILT, WITH GRAVEL AND COBBLES, LT BROWN, DRY							BPB 2/3 - GT - 03
2											
3											
4											
5											
6											
7				7.0' EXCAVATOR HIT REFUSAL							
8											
9											
10											

Trihydro CORPORATION

Lithology Log

Sheet 1 of 1

LOCATION ID: BPB 2/3-04			
Project Name: BPM	Project Number: 776-012-003	Site ID: BORROW AREA 2/3	
Excavation Company: MILE HIGH	Operator: BRYAN	Ground Elevation: —	Total Depth: 7' feet-bgs
Equipment: CAT 312 C	Weather: SUNNY	Temperature: 58°F	Date/Time Started: 8-29-12 / 0900
			Date/Time Total Depth Reached: 8-29-12 / 0930 / 7'
Sampler: J MONGOVEN		Water Level (bgs): First — feet-bgs	
		Hydrogeologist: —	Checked by/Date: T SMITH 8/29/12

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				TOPSOIL - DARK BROWN, GRAVELLY SILT W/ ORGANICS, DRY							BPB 2/3-GC-04
				0.5							
1											
				SILT & SAND, W/ GRAVEL AND COBBLES, LT. BROWN, DRY TRACE ORGANICS;							
2											BPB 2/3-GT-04
3											
4				4.0							
5				SANDY GRAVEL, WITH SILT AND COBBLES, DAMP, REDDISH BROWN							
6											
7				7.0 - EXCAVATOR HIT REFUSAL							
8											
9											
10											

Trihydro CORPORATION

Lithology Log

Sheet 1 of 1

LOCATION ID: BPB 2/3 - 05

Project Name: BPM	Project Number: 776-012-003	Site ID: BORROW AREA 2/3	
Excavation Company: MILE HIGH	Operator: BRYAN	Ground Elevation: —	Total Depth: __ feet-bgs
Equipment: CAT 312 C	Weather: SUNNY	Temperature: 60°F	Date/Time Started: 8-29-12/1045
Date/Time Total Depth Reached: 8-29-12/1100/3.5'	Sampler: J MONGOVEN	Water Level (bgs) / First — __ feet-bgs	
Hydrogeologist:	Checked by/Date: T SMITH 8/31/12		

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0.25 TOPSOIL - ORGANICS w/ GRAVEL DARK BROWN							BPB 2/3 - GC - 05
1				SANDY SILT, w/ GRAVEL & COBBLES, TRACE ORGANICS, BROWN, DRY LT.							BPB 2/3 - GT - 05
2											
3				3.5' EXCAVATOR HIT REFUSAL							
4											
5											
6											
7											
8											
9											
10											

Trihydro CORPORATION

Lithology Log

Sheet 1 of 1

LOCATION ID: BPB 2/3 - 06

Project Name: BPM	Project Number: 776-012-003	Site ID: BORROW AREA 2/3	
Excavation Company: MILE HIGH	Operator: BRYAN	Ground Elevation:	Total Depth: 4.6 feet-bgs
Equipment: CAT 312C	Weather: SUNNY	Temperature: 50°F	Date/Time Started: 8-29-12 / 0845
			Date/Time Total Depth Reached: 8/29/12 / 0900 / 4.0'
Sampler: J MONGOVEN		Water Level (bgs) First — feet-bgs	
		Hydrogeologist: —	Checked by/Date: T SMITH 8/29/12

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0.25 TOPSOIL -- SILT & SAND, WITH GRAVEL TRACE ORGANICS, BROWN, DRY							BPB 2/3 - GC - 06
1				COBBLES AND GRAVEL WITH SILT & SAND, BROWN, DRY							BPB 2/3 - GT - 06
2											
3											
4				4.0 EXCAVATOR HIT REFUSAL							
5											
6											
7											
8											
9											
10											

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Lithology Log

Sheet 1 of 1

LOCATION ID: BPB7A-02			
Project Name: BPM	Project Number: 776-012-003	Site ID: BORROW AREA 7A	
Excavation Company: MILE HIGH	Operator: BRYAN	Ground Elevation: —	Total Depth: 7.5 feet-bgs
Equipment: CAT 312C	Weather: SUNNY	Temperature: 64°F	Date/Time Started: 8-31-12 / 1030
Date/Time Total Depth Reached: 8-31-12 / 1045 / 7.5			
Sampler: J MONGOVEN	Water Level (bgs): First — feet-bgs		
Hydrogeologist: —	Checked by/Date: T SMITH 8/31/12		

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0-0.25 DUFF TOPSOIL W/ GRAVEL DRY							BPB7A-GC-02
1				0.25-2.5 SANDY SILT, W/ COBBLES & GRAVEL, LT BROWN, TRACE ORGANICS. DRY							
2											
3				2.5-7.5 SILTY SANDY GRAVEL W/ COBBLES, REDISH BROWN DAMP							
4											
5											STEEP TERRAIN
6											
7				7.5 EXCAVATOR HIT REFUSAL							
8											
9											
10											

Trihydro CORPORATION

Lithology Log

Sheet 1 of 2

LOCATION ID: BPB 7A-03

Project Name: BPM	Project Number: 776-012-003	Site ID: BORROW AREA 07	
Excavation Company: MILE HIGH	Operator: BRYAN	Ground Elevation: —	Total Depth: 14' feet-bgs
Equipment: CAT 312C	Weather: SUNNY	Temperature: 62°F	Date/Time Started: 8-31-12 / 0545
			Date/Time Total Depth Reached: 8-31-12 / 1000 / 14
Sampler: J MONGOVEN		Water Level (bgs): First — feet-bgs	
		Hydrogeologist: —	Checked by/Date: T SMITH 8/31/12

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0-0.25 DARK TOPSOIL w/ TRACE GRAVEL DRY							BPB 7A-GC-03
1				0.25 - 1.5 SANDY SILT w/ GRAVELS, TRACE ORGANICS, LT BROWN, DRY							
2				1.5 - 4.0 SANDY SILT W/ GRAVEL & COBBLES, LT BROWN, DRY							
3											BPB 7A-GT-03*
4				4.0 - 8.0							
5				SILTY SANDY GRAVEL w/ COBBLES. REDISH BROWN, DAMP							
6											
7											
8				8.0 - GLACIAL TILL -- SANDY LEAN CLAY, WITH GRAVEL AND COBBLES. REDISH BROWN, DAMP TO MOIST.							POCKET PEN 2.5
9											
10											

Trihydro CORPORATION

Lithology Log (continued)

Sheet 2 of 2

LOCATION ID: BPB7A-03

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
10											
11											POCKET PEN 3.5
12											
13											
14				14.0 MAX REACH OF EXCAVATOR							
15											
16											
17											
18											
19											
20											
21											
22											
23											

Trihydro CORPORATION

Lithology Log

Sheet 1 of 1

LOCATION ID
BPB7A- -04

Project Name	Project Number	Site ID
BPM	776-012-003	BORROW AREA 04

Excavation Company	Operator	Ground Elevation	Total Depth
MILE HIGH	BRYAN	—	16 feet-bgs

Equipment	Weather	Temperature	Date/Time Started	Date/Time Total Depth Reached
CAT 312 C	SUNNY	66 °F	8-31-12 / 1230	8-31-12 / 1245 / 16'

Sampler	Water Level (bgs)	
J MANGOVEN	First — feet-bgs	
	Hydrogeologist —	Checked by/Date T SMITH 8/31/12

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0-0.25 DUFF-TOPSOIL w/ TRACE ORGANICS AND GRAVEL, DK BROWN, DRY							BPB7A-GC-04
1				0.25-2.5 SANDY SILT w/ GRAVEL & COBBLES, LT BROWN TRACE ORGANICS. DRY							
2											BPB7A-GT-04 * (COMPOSITE)
				2.5-4.0 SANDY SILT WITH GRAVEL & COBBLES, REDDISH BROWN, DAMP SLIGHTLY PLASTIC							
3											
4				4.0-16' GLACIAL TILL-- SANDY LEAN CLAY w/ COBBLES TRACE GRAVEL REDDISH BROWN, MOIST, OVERCONSOLIDATED							BPB7A-GT-04A * (4.0' → 16')
5											
6											
7											
8											
9											POCKET PEN 2.6
10											

Trihydro CORPORATION

Lithology Log (continued)

Sheet 2 of 2

LOCATION ID: BPB7A-04

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
10											POCKET PEN 2.8
11											
12											
13											
14											
15											
16				16.0 MAX REACH OF ECAVATOR							
17											
18											
19											
20											
21											
22											
23											

Trihydro CORPORATION

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Lithology Log

Sheet 1 of 1

LOCATION ID	
BPB 11- 01	

Project Name	Project Number	Site ID
BPB	776-012-603	BARROW AREA 11

Excavation Company	Operator	Ground Elevation	Total Depth
MILE HIGH	BRIAN	—	__ feet-bgs

Equipment	Weather	Temperature	Date/Time Started	Date/Time Total Depth Reached
CAT 312	SUNNY / WIND	68°F	8-29-12	8-29-12

Sampler	Water Level (bgs)
J MONGOVEN	First — __ feet-bgs

Hydrogeologist	Checked by/Date
—	T SMITH

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				TOPSOIL - ORGANICS - SAND W/SILT 0.5' GRAVELS, DARK BROWN DRY							BPB 11 - GC - 01
1				HIGHLY WEATHERED BED ROCK - SHALE SILTY SAND W/COBBLES & GRAVEL REDDISH BROWN, DRY							BPB 11 - GT - 01
2											
3				3.0 EXCAVATOR HIT REFUSAL							
4											
5											
6											
7											
8											
9											
10											

Trihydro CORPORATION

Lithology Log

Sheet 1 of 1

LOCATION ID: BPB 11-2

Project Name	Project Number	Site ID
BPM	776-012-003	BORROW AREA 11

Excavation Company	Operator	Ground Elevation	Total Depth
MILE HIGH	BRIAN	—	3.5 feet-bgs

Equipment	Weather	Temperature	Date/Time Started	Date/Time Total Depth Reached
CAT 312 C	SUNNY / WIND	68 °F	8-29-12 / 1440	8-29-12 / 1450 / 3.5

Sampler	Water Level (bgs)	Hydrogeologist	Checked by/Date
J MONGOVEN	First — feet-bgs	—	

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0.5 TOPSOIL - SANDY SILTY GRAVEL DRY DARK BROWN ORGANICS							BPB11-GC-02
				HIGHLY WEATHERED BEDROCK - SHALE GRAVEL, COBBLES, WITH SAND & SILT BROWN, DRY							BPB11-GT-02
1											
2											
3				3.5							
				EXCAVATOR HIT REFUSAL							
4											
5											
6											
7											
8											
9											
10											

HOLD

Trihydro CORPORATION

Lithology Log

Sheet 1 of 1

LOCATION ID: BPB12-01

Project Name: BPM	Project Number: 776-012-003	Site ID: BORROW AREA 12	
Excavation Company: MILE HIGH	Operator: BRYAN	Ground Elevation: —	Total Depth: 4.25 feet-bgs
Equipment: CAT 312C	Weather: SUNNY	Temperature: 72°F	Date/Time Started: 8-30-12 / 1420
			Date/Time Total Depth Reached: 8-30-12 / 1440 / 4.25
Sampler: J MONGOVEN		Water Level (bgs): First — feet-bgs	
		Hydrogeologist: —	Checked by/Date: T SMITH 8/31/12

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0-0.25 DUFF TOPSOIL w/ GRAVEL, DARK BROWN, DRY							BPB12-GC-01
1				SAND SILTY GRAVEL, SHALE, TRACE ORGANICS, REDISH BROWN DRY CONSOLIDATED							
2											
3				3.0-4.25 SANDY SILTY GRAVEL w/ COBBLES DARK REDISH BROWN, DAMP.							BPB12-GT-01
4				4.25 EXCAVATOR HIT REFUSAL							
5											
6											
7											
8											
9											
10											

Trihydro CORPORATION

SUBMIT FOR TESTING

Lithology Log

Sheet 1 of 1

LOCATION ID: BPB12-02

Project Name: BPM	Project Number: 776-012-003	Site ID: BORROW AREA 2	
Excavation Company: MILE HIGH	Operator: BRYAN	Ground Elevation: —	Total Depth: 7.5 feet-bgs
Equipment: CAT 312C	Weather: SUNNY	Temperature: 44°F	Date/Time Started: 8-30-12 / 0915
			Date/Time Total Depth Reached: 8-30-12 / 0930 / 7.5
Sampler: J MONGOVEN		Water Level (bgs): First — feet-bgs	
		Hydrogeologist: —	Checked by/Date: T SMITH 8/30/12

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0.3 TOPSOIL - ORGANICS - SANDY SILT W/ GRAVEL, DARK BROWN, DRY							BPB12-GC-02
1				0.3' - HIGHLY WEATHERED BED ROCK - SILTY SANDY GRAVEL, W/ COBBLES. SHALE REDISH BROWN, DRY - TRACE ORGANICS							
2											
3											BPB12-GT-02
4											
5											
6											
7				7.5 EXCAVATOR HIT REFUSAL							
8											
9											
10											

HOLD

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Lithology Log

Sheet 1 of 2

LOCATION ID: BPB12-03			
Project Name: BPM	Project Number: 776-012-003	Site ID: BORROW AREA 12	
Excavation Company: MILE HIGH	Operator: BRYAN	Ground Elevation: —	Total Depth: 11 feet-bgs
Equipment: CAT 312	Weather: SUNNY	Temperature: 69°f	Date/Time Started: 8-30-12/1500
			Date/Time Total Depth Reached: 8-30-12/1520 / 11'
Sampler: JMONGOVEN		Water Level (bgs): First — feet-bgs	
		Hydrogeologist: —	Checked by/Date: T SMITH 8/31/12

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0-0.5 TOPSOIL - DUFF DK BROWN							BPB12-GC-03
				0.5							
1				SANDY SILT w/ GRAVEL LT REDISH BROWN DRY TRACE ORGANICS.							
2				2'-							
				SANDY SILTY GRAVEL - DAMP REDISH BROWN TRACE COBBLES.							
3											
											BPB12-GT-03
4											
5				5							
				SANDY SILTY GRAVEL w/ COBBLES DK REDISH BROWN - MOIST							
6				SLIGHTLY PLASTIC							ATTERBERG LIMITS
7											
8											
9											
10											

Trihydro CORPORATION

Lithology Log (continued)

Sheet 2 of 2

LOCATION ID: BPB12-03

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
10											
11				EXCAVATOR HIT REFUSAL							POCKET PEN 1.6
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											

Trihydro CORPORATION

SUBMIT FOR TESTING

Lithology Log Sheet 1 of 2

LOCATION ID
BPB12-05

Project Name	Project Number	Site ID
BPM	776-012-003	BARROW AREA 12

Excavation Company	Operator	Ground Elevation	Total Depth
MILE HIGH	BRYAN	—	17.5 feet-bgs

Equipment	Weather	Temperature	Date/Time Started	Date/Time Total Depth Reached
CAT 312 C	SUNNY CALM	38°F	8-30-12 / 0820	8-30-12/0900 / 17.5

Sampler	Water Level (bgs)
J MONGOVEN	First — feet-bgs

Hydrogeologist	Checked by/Date
—	TSMITH 8/30/12

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				TOPSOIL - SILTY SAND W/ TRACE GRAVEL BROWN, DRY							BPB12-GL-01
1				1.0' SANDY SILT - WITH GRAVEL, TRACE COBBLES, REDISH BROWN, DRY							
2											
3											BPB12-GT-05
4											
5											
6											
7				7' MOIST - FINE SANDY SILT, WITH COBBLES & GRAVEL ~~YELLOWISH~~ BROWN, MOIST (AND REDDISH BROWN)							SLIGHT PLASTICITY
8											
9											
10											

Trihydro CORPORATION

Lithology Log (continued)

Sheet 2 of 2

LOCATION ID: BPB12-05

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
10											
11											
12											
13											
14											
15				– WET							
16											
17											
				17.5 MAXIMUM REACH OF EXCAVATOR							
18											
19											
20											
21											
22											
23											

SUBMIT FOR TESTING

Trihydro CORPORATION

Lithology Log Sheet 1 of 2

LOCATION ID	BPB13-01
Project Name	BPM
Project Number	776-012-003
Site ID	BORROW AREA 01
Excavation Company	MILE HIGH
Operator	BRYAN
Ground Elevation	—
Total Depth	16.5' feet-bgs
Equipment	CAT 312C
Weather	Sunny
Temperature	65°f
Date/Time Started	8-30-12 / 1030
Date/Time Total Depth Reached	8-30-12 / 1100 / 16.5'
Sampler	JMONGOVEN
Water Level (bgs)	First — feet-bgs
Hydrogeologist	—
Checked by/Date	T SMITH 8/30/12

Location Description (include sketch in field logbook)

N SIDE OF ROAD

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0-3' DUFF & TOPSOIL -- SANDY SILT, WITH ORGANICS, VERY DARK BROWN, DRY							BPB13-GC-01
1				↑ SILTY SAND AND GRAVEL, TRACE ORGANICS, LIGHT GRAY, DRY 3"-21"							
2				21" - 6¼' GLACIAL TILL SANDY LEAN TO FAT CLAY, WITH GRAVEL AND COBBLES, REDDISH BROWN, OVERCONSOLIDATED, DAMP							
3											POCKET PENETROMETER 3 TONS/sf
4											BPB13-GT-01
5											POCKET PENETROMETER 3 TONS/sf
6				6¼ - SILT, TRACE FINE SAND, AND LEAN CLAY, BROWNISH GRAY OVERCONSOLIDATED, DAMP							LAKE SEDIMENTS?
7											
8				-- WITH FINE SAND @ ~9'							
9											
10											

Trihydro CORPORATION

Lithology Log (continued)

Sheet 2 of ___

LOCATION ID: BPB 13-01

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
10											
11				-- CONSOLIDATION INCREASING & ~~HARD~~ DIFFICULT TO BREAK BY HAND @ ~11'							
12											
13											
14											
15											
16											
				BOP @ 16½' MAX REACH OF EXCAVATOR							
17											
18											
19											
20											
21											
22											
23											

HOLD

Trihydro CORPORATION

Lithology Log

Sheet 1 of 2

LOCATION ID: BPB13-02

Project Name: BPM	Project Number: 776-012-003	Site ID: BORROW AREA 2	
Excavation Company: MILE HIGH	Operator: BRYAN	Ground Elevation: —	Total Depth: __ feet-bgs
Equipment: CAT 312C	Weather: SUNNY	Temperature: 66°F	Date/Time Started: 8-30-12 / 1140
			Date/Time Total Depth Reached: 8-30-12 / 1200
Sampler: J MONGOVEN		Water Level (bgs): First __ feet-bgs	
		Hydrogeologist: —	Checked by/Date: T SMITH 8/30/12

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0-0.25 DUFF TOPSOIL							BPB13-GC-02
				0.25-2'5" SILTY SAND AND GRAVEL WITH COBBLES, LIGHT BROWN, DRY							
1											
				2'5"-4'3" SILTY GRAVEL AND COBBLES, WITH SAND, REDDISH BROWN, MOIST							UNCONSOLIDATED (GLACIAL TILL?)
2											POCKET PENETROMETER 1 TONS/SF
3											BPB 3-GT-02
				4'3" — FINE SANDY SILT, TRACE GRAVEL AND COBBLES, BROWNISH GRAY, MOIST							
4											UNCONSOLIDATED POCKET PENETROMETER >4 TONS/SF
5											EXCAVATES OK & BREAKS UP
6											
7											
8											
9											
10											

Trihydro CORPORATION

Lithology Log (continued)

Sheet 2 of 2

LOCATION ID: BP1313-02

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
10											
11											
12											
13											
14											
15				BOTTOM OF TEST PIT 15' MAX REACH OF EXCAVATOR							
16											
17											
18											
19											
20											
21											
22											
23											

HOLD

Trihydro CORPORATION

Lithology Log

Sheet 1 of 2

LOCATION ID: BPB13-03			
Project Name: BPM	Project Number: 776-0	Site ID: BORROW AREA 13	
Excavation Company: MILE HIGH	Operator: BRYAN	Ground Elevation: —	Total Depth: 16' feet-bgs
Equipment: CAT 312 C	Weather: SUNNY	Temperature: 69°F	Date/Time Started: 8-30-12 / 1230
			Date/Time Total Depth Reached: 8-30-12 / 1240 / 16'
Sampler: J MONGOVEN		Water Level (bgs): First — feet-bgs	
		Hydrogeologist: —	Checked by/Date: T SMITH 8/31/12

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0-0.25 TOPSOIL - ORGANICS. SILTY SAND DK BROWN DRY							BPB13-GC-03
1				0.25-1.0 SANDY SILT w/ TRACE GRAVEL, LT. BROWN, DRY TRACE ORGANICS							
2				1.0-16.0 SILTY SAND, w/ GRAVEL, MOIST, DARK BROWN							HARDER DIGGING
											BPBB-GT-03
3											
4											
5											
6											
7											
8											
9											
10											

Trihydro CORPORATION

Lithology Log (continued)

Sheet 2 of 2

LOCATION ID: BPB13-03

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
10											
11											
12											
13											
14											
15											
16				16.0' MAX DEPTH OF EXCAVATOR							
17											
18											
19											
20											
21											
22											
23											

SUBMIT FOR TESTING

Trihydro CORPORATION

Lithology Log

Sheet 1 of 2

LOCATION ID	BPB13-04
Project Name	BPM
Project Number	776-612-003
Site ID	BORROW AREA 13
Excavation Company	MILE HIGH
Operator	BRYAN
Ground Elevation	—
Total Depth	13.5 feet-bgs
Equipment	CAT 312 C
Weather	SUNNY
Temperature	69 F
Date/Time Started	8-30-12 / 1310
Date/Time Total Depth Reached	8-30-12 / 1330 / 13.5
Sampler	J MONGOVEN
Water Level (bgs)	First — feet-bgs
Hydrogeologist	—
Checked by/Date	T SMITH 8/31/12

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0-0.25 TOPSOIL-DUFF							BPB13-GC-04
1				0.25-1.0 SANDY SILT, TRACE GRAVEL, LT BROWN, DRY							POCKET PEN 1.7
2				1.0-2.5 - LEAN CLAYEY SAND w/ GRAVEL DAMP, DARK BROWNISH YELLOW SLIGHTLY PLASTIC							
3				2.5-5.0 SANDY SILT w/ GRAVEL LT. GRAYISH BROWN DAMP							BPB13-GT-04
4											
5				5.0-13.5 - CLAYEY SANDY SILT w/ GRAVEL DAMP, BROWN							HARD DIGGING
6											
7											
8											
9											
10											

Trihydro CORPORATION

Lithology Log (continued)

Sheet 2 of ___

LOCATION ID: BPB 13-04

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
10											
11											
12											
13				13.5'							
				EXCAVATOR HIT REFUSAL							
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											

Trihydro CORPORATION

Lithology Log

Sheet 1 of 1

LOCATION ID: RY-SS-06

Project Name: BPM	Project Number:	Site ID: RY-SS-06	
Excavation Company: MILE HIGH	Operator: BRIAN	Ground Elevation:	Total Depth: __ feet-bgs
Equipment: CAT 312C	Weather: SUNNY - 73	Temperature: 73°F	Date/Time Started: 2:00 PM
Date/Time Total Depth Reached:			
Sampler: KEVIN HOUCK		Water Level (bgs): First __ feet-bgs	
		Hydrogeologist:	Checked by/Date:

Location Description (include sketch in field logbook):

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0											3" TOPSOIL/VEGETATED LAYER
1											3"-4' TAN GRAVELLY SOIL - SANDY WITH 2"-3" MINUS GRAVEL
2											
3											[RY-SS-06-01 1'-3']
4											4'-7' ROCK. [RY-SS-06-02 4'-6'] COARSE RED/BROWN SOIL WITH BOTTOM OF EXCAVATION INTO LARGE (8" PLUS) FRACTURE ROCK. STOPPED DIGGING/EXCAVATION @ 7' BGS.
5											
6											
7											
8											
9											
10											

TAN SANDY SILT WITH GRAVEL (ML) [COLLUVIUM]

RED-BROWN SILTY GRAVEL WITH SAND AND COBBLES (GM) [GLACIAL TILL]

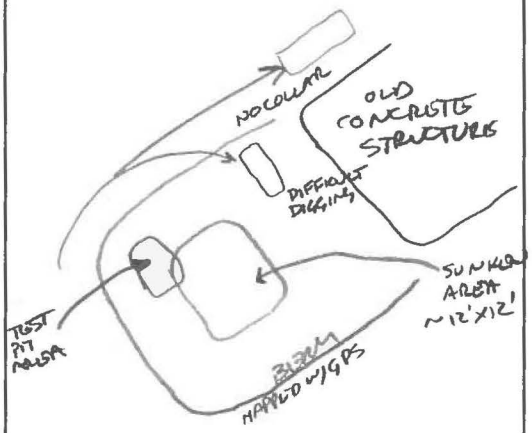
Trihydro CORPORATION

Lithology Log

Sheet 1 of 1

LOCATION ID: RY-SS-07			
Project Name: BPM	Project Number: 776-012-005	Site ID:	
Excavation Company: MILE HIGH	Operator: BRYAN	Ground Elevation:	Total Depth: __ feet-bgs
Equipment: CAT 312C	Weather: SUNNY	Temperature: 65 °F	Date/Time Started: 11:00
Date/Time Total Depth Reached:			
Sampler: T SMITH	Water Level (bgs): First ____ feet-bgs		
Hydrogeologist: ____	Checked by/Date:		

Location Description (include sketch in field logbook): W END OF HARRISON SHAFT

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0											COBBLES, GRAVEL, & SILT W/ SAND, DRY
1											@ ~2' ORANGE BRICKS BUT NOT ARRANGED/LAID
2											@ ~5' COLOR BECOMES DARK YELLOWISH BROWN & COBBLE CONTENT DECREASES
3											@ ~7' COBBLY GRAVELLY SILT WITH SAND, TRACE CLAY, MOIST, DARK YELLOWISH BROWN.
4											@ ~9' COBBLY, GRAVELLY SILT, WITH SAND, VERY MOIST, DARK BROWN
5											-Excavated to 13' and topped out due to reach of excavator. Still easy digging.
6											
7											
8											
9											
10											

Dark yellowish brown to brown, silty gravel with sand and cobbles (GM)

Trihydro CORPORATION

Lithology Log

Sheet 1 of 1

Project Name: BPM	Project Number: 776-012-005	Site ID: REPOSITORY 2	LOCATION ID: RY-SS-08
Excavation Company: MILO HIGH	Operator: BRYAN	Ground Elevation:	Total Depth: 7 feet-bgs
Equipment: CAT 312C	Weather: SUNNY	Temperature: 60°F	Date/Time Started: 9/4/12 9:00
			Date/Time Total Depth Reached: 9/4/12 9:10
Sampler: T SMITH		Water Level (bgs) First: NA feet-bgs	
		Hydrogeologist:	Checked by/Date:

Location Description (include sketch in field logbook)

NOMA RY-RB-02 4 PHOTOS OF TP

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0-1" GRAVEL AND DUFF, LIGHT BROWN, DRY							
				1"-16" SILTY SANDY GRAVEL, WITH COBBLES, TRACE ROOTS AND 1 ONSTAINING (WASTE ROCK FILL) BROWN RY							
1				16"-4' GRAVEL AND COBBLES, WITH SILT AND SAND, LIGHT BROWN, DRY							
2											
3											
4				4-B.O.P. SILTY GRAVEL AND COBBLES, WITH SAND, BROWN, SLIGHTLY MOIST			(GP-GM) [COLLUVIUM]				
5											
6											
7				B.O.P. = 7'							EXCAVATOR BUCKET REFUSAL - BARELY PULLING UP COBBLES THAT WILL COVER TEETH ON THE BUCKET.
8											
9											
10											

(GM) [COLLUVIUM]

Trihydro CORPORATION

Lithology Log

Sheet 1 of 1

LOCATION ID: RY-SS-09

Project Name: BLACK PINE MINE	Project Number:	Site ID:	
Excavation Company: MILE HIGH	Operator: BRIAN	Ground Elevation:	Total Depth: 7 feet-bgs
Equipment: CAT 312 CL	Weather: Sunny	Temperature: 78	Date/Time Started: 9-5-12 / 1800
Date/Time Total Depth Reached: 9-5-12 / 1820	Sampler: V. J. PERRONE	Water Level (bgs): First ___ feet-bgs	
Hydrogeologist:	Checked by/Date: VJ Perrone 9-5-12		

Location Description (include sketch in field logbook): NE Corner of Repository

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				Silty gravel with sand, trace cobbles, angular to subangular gravel & cobble, f-c sand, tan, dry, dense [COLLUVIUM]	GM						
1											S-1 at 2'
2											
3				3 ft Gravel and cobbles with silt and fine to coarse sand, angular gravel & cobbles, orangish-brown, moist, very dense [GLACIAL TILL]	GP-GM						
4											S-2 at 4'-6'
5											hard, slow digging
6											
7				7 ft Bottom at 7' Excavator Refusal							
8											
9											
10											

Trihydro CORPORATION

Lithology Log Sheet 1 of 2

LOCATION ID: RY-SS-10

Project Name: BLACK PINE MINE	Project Number:	Site ID:	
Excavation Company: MILE HIGH	Operator: BRIAN	Ground Elevation:	Total Depth: 17 feet-bgs
Equipment: CAT 312 CL	Weather: Sunny	Temperature: 75	Date/Time Started: 9-6-12/830
Sampler: V. J. PERRONE		Water Level (bgs): First ___ feet-bgs	Date/Time Total Depth Reached: 9-6-12/915/17 ft
		Hydrogeologist:	Checked by/Date:

Location Description (include sketch in field logbook): West side near Power Line * boring RY-RB-04

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				Silty gravel with sand, dense, tan, dry, few cobbles f-c sand, angular to subangular gravel & cobbles. [COLLVIUM]	SM						
1											
2											
3				3 ft.							
3				Clayey gravel with sand and few cobbles, very dense, orange-brown, moist, f-c sand, angular to subangular gravel & cobbles, low to moderately plastic clay. [GLACIAL TILL]	GC						
4											S-1 at 4 ft
5											
6											
7											
8											
9				9 ft							
9				gravelly clay with sand, very stiff, moist, orange-brown, low to moderately plastic, f-c sand, angular to subangular gravel	CL						
10											

Trihydro CORPORATION

Lithology Log (continued) Sheet 2 of 2

LOCATION ID

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
10				gravelly clay with sand (continued)							S-2 at 10 to 11 ft
11				[GLACIAL TILL]							
12											
13											
14											S-3 at 14-16' (Bulk)
15											
16											
17				17 ft							
				Bottom at 17 ft Maximum machine reach.							
18											
19											
20											
21											
22											
23											

Trihydro CORPORATION

Lithology Log

Sheet 1 of 2

LOCATION ID: RY-SS-41

Project Name: BLACK PINE MINE	Project Number:	Site ID: REPOSITORY	
Excavation Company: MILE HIGH	Operator: BRIAN	Ground Elevation:	Total Depth: 14.5 feet-bgs
Equipment: CAT 312 CL	Weather: Sunny / Temperature: 78	Date/Time Started: 9/5/12 1610	Date/Time Total Depth Reached: 9-5-12/1650
Sampler: V. J. PERRONE		Water Level (bgs): First ___ feet-bgs	
		Hydrogeologist:	Checked by/Date:

Location Description (include sketch in field logbook): REPOSITORY
Intersection of Powerline & Rd near Lewis Shaft

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				TOPSOIL/DUFF 0.5 ft							
1				Brown Sandy SILT, dense, tan, moist fine to medium sand, trace coarse sand. [COLLUVIUM]	ML						
2											S-1 at 2 ft
				2.5 ft Clayey gravel with sand & cobbles, very dense, orange-brown, moist, f-c sand, angular to subangular gravel & cobbles [GLACIAL TILL]	GC						
3											S-2 at 3 ft; S-3 Bulk 2½'-4'
4											
5											
6											
7				Increasing gravel & cobbles below 7½ ft.							S-4 at 7'; S-5 Bulk 6'-8'
8				8.0 ft Silty sand with gravel & cobbles, very dense, orange brown, moist, angular to subangular gravel & cobbles [GLACIAL TILL]	SM						
9											
10											

Trihydro CORPORATION

Lithology Log (continued)

Sheet 2 of 2

LOCATION ID: RY-SS-11

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
10				Silty sand with gravel & cobbles (continued)							
11				[GLACIAL TILL]							
12											
13											
14											
				14.5 ft = Bottom of T.P. Maximum Reach.							
15											
16											
17											
18											
19											
20											
21											
22											
23											

Trihydro CORPORATION

Lithology Log

Sheet 1 of 2

LOCATION ID: RY-SS-12

Project Name: BLACK PINE MINE	Project Number:	Site ID:	
Excavation Company: MILE HIGH	Operator:	Ground Elevation:	Total Depth: __ feet-bgs
Equipment: CAT 312 CL	Weather: Sunny	Temperature: 75	Date/Time Started: 9-6-12/1030
			Date/Time Total Depth Reached: 9-6-12/1145/17 ft
Sampler: V. J. PETRONE		Water Level (bgs): First __ feet-bgs	
		Hydrogeologist:	Checked by/Date:

Location Description (include sketch in field logbook): West of Power Lines

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				Silty gravel with sand, dense, tan, dry, f-c sand, angular to subangular gravel, trace organics, [COLLUVIUM]	GM						
1											
2											
3				4 ft							
4				grades orange-brown, moist, very dense [GLACIAL TILL]	GM						
5											
6				7 ft							
7				clayey gravel with sand, very dense, orange-brown, moist, angular to subangular, lean clay, f-c sand [GLACIAL TILL]	GC						
8				8 ft gravelly clay with sand, very stiff, orange-brown, moist, low to moderate plasticity, f-c sand, angular to subangular gravel [GLACIAL TILL]	CL						
9											
10											

Trihydro CORPORATION

Lithology Log (continued) Sheet 2 of 2

LOCATION ID

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
10				Gravelly clay with sand. (continued)							
11				[GLACIAL TILL]							
12											
13											
14											
15											
16											S-1 at 16 ft
				17 ft							
17				BOTTOM at 17 ft Maximum machine reach							
18											
19											
20											
21											
22											
23											

Trihydro CORPORATION

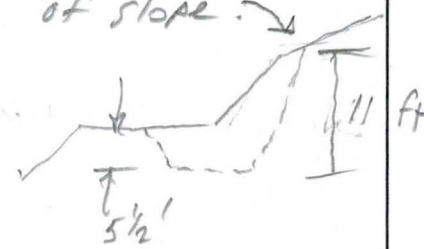
Lithology Log

Sheet 1 of 2

LOCATION ID: ~~VP-1~~ RY-SS-13

Project Name: BLACK PINE MINE	Project Number:	Site ID: REPOSITORY	
Excavation Company: MIKE HIGH	Operator: BRIAN	Ground Elevation:	Total Depth: 11 feet-bgs
Equipment: CAT 312CL	Weather: Sunny	Temperature: 78	Date/Time Started: 9-5-12/1535
			Date/Time Total Depth Reached: 9-5-12/1600
Sampler: V.J. PERRONE		Water Level (bgs): First — feet-bgs	
		Hydrogeologist: —	Checked by/Date:

Location Description (include sketch in field logbook): REPOSITORY UPPER LEWIS SHAFT ROAD

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				Silty gravel with sand, loose to med. dense, tan, dry, f-c sand, angular gravel, several roots	GM						Test pit excavated in road cut slope. Depth refers to top of slope.
1				[COLLUVIUM]							
				1.0 ft Silty gravel with sand, very dense, brownish gray, dry to moist (below 3 ft), few cobbles, f-c sand angular gravel & cobbles,	GM						
2											
3				[HIGHLY WEATHERED BEDROCK]							S-1 at 2'-5' (Bulk)
4											
5											
6											S-2 at 6 ft
7											
8											
9				8.5 ft Silty gravel with cobbles and fine to coarse sand, brownish gray, moist, angular gravel & cobbles, v. dense.	GM						
10											

Trihydro CORPORATION

Lithology Log (continued)

Sheet 2 of 2

LOCATION ID VP-1

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
10				silty gravel with cobbles (continued)							
				[WEATHERED BEDROCK]							
11				Bottom at 11 ft							
				Excavator. Refusal							
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											

Trihydro CORPORATION

Lithology Log Sheet 1 of 1

LOCATION ID ~~VP-2~~ RY-SS-14

Project Name: BLACK PINE MINE	Project Number:	Site ID: Repository	
Excavation Company: MILE HIGH	Operator: BRIAN	Ground Elevation:	Total Depth: 10 feet-bgs
Equipment: CAT 312CL	Weather: Sunny	Temperature: 78	Date/Time Started: 9-5-12/1615
			Date/Time Total Depth Reached: 9-5-12/1635
Sampler: V.J. PERRONE	Water Level (bgs): First ___ feet-bgs		
	Hydrogeologist:		Checked by/Date:

Location Description (include sketch in field logbook) REPOSITORY UPPER LEWIS SHAFT ROAD

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				Sandy gravel with SILT, angular gravel, tan, dry, loose	GP-GM						Test Pit excavated in road cut slope. Depth refers to top of slope.
1				[COLLUVIUM]							
2											S-1 at 2' to 3' (Bulk)
				3 ft							
3				Sandy gravel with few cobbles dense, brownish gray, moist, angular gravel & cobbles, f-c sand	GP						
				[HIGHLY WEATHERED BEDROCK]							
4				4 ft							
5				Cobbles with gravel, trace sand & silt, brownish gray, moist, v. dense							
				[HIGHLY WEATHERED BEDROCK]							
6											
7											
8											
9											
10				10 ft							

Bottom at 10 ft
Excavation refusal

Trihydro CORPORATION

Lithology Log

Sheet 1 of 2

LOCATION ID: ~~VP-3~~ RY-SS-15

Project Name: BLACK PINE MINE	Project Number:	Site ID:	
Excavation Company: MILE HIGH	Operator:	Ground Elevation:	Total Depth: 17½ feet-bgs
Equipment: CAT 312 CL	Weather: Sunny	Temperature: 75	Date/Time Started: 9-6-12/1210
			Date/Time Total Depth Reached: 9-6-12/1300
Sampler: V. J. PERRONE		Water Level (bgs): First __ feet-bgs	
		Hydrogeologist:	Checked by/Date:

Location Description (include sketch in field logbook): REPOSITORY SW area near POWER LINES

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				silty sand with gravel, loose, brown dry to moist, angular gravel, f-c sand, some organics [FILL]	SM						Waste Rock
1				1 ft gravelly SILT with sand, dense, tan, moist, f-c sand, angular to subangular gravel [COLLUVIUM]	ML						S-1 at 2 ft
2											
3											S-2 at 2'1"to4' (Bulk)
4				4 ft Clayey GRAVEL with cobbles and f-c sand, dense, moist, orange-brown, angular to subangular gravel. [GLACIAL TILL]	GC						
5											
6											
7											
8				8 ft gravelly CLAY with f-c sand & cobbles, v. stiff, orange-brown, moist, low to moderate plasticity [GLACIAL TILL]	CL						
9											
10											

Trihydro CORPORATION

Lithology Log (continued)

Sheet 2 of 2

LOCATION ID

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
10				gravelly clay (continued)							
				[GLACIAL TILL]							
11											
12											S-3 at 12 ft
13											
14											
15											
16											
17				17 1/2 ft							
				Bottom at 17 1/2 ft							
18				Maximum machine reach							
19											
20											
21											
22											
23											

Black Pine Mine / MDEQ 5/3/12
Overcast, Snow ~25° → 30°

1110 LD arrive on site to sample MW-RY-07
- Well recharged enough to purge and collect sample
- Attempted to change parameters on Rugged Troll. Not able to make changes

1315 LD off site

LD

Black Pine Mine / MDEQ 9/04/12
Sunny, Smoky 50° →

0745 LD arrive onsite
0800. Kevin Hauck + Alex Sundson (Hensen) onsite
- Mike (Mile High Erc)
0815 Tom Snow onsite
0830 Boland Drilling (2) onsite
0915 Setting up to measure travel time of SFLWC
1030 Travel time ~9 minutes per 200 ft
1130 Recon Non Trust sample locations
2000 LD off site

9/05/12

Sunny

0630 LD arrive onsite
MPE High Tide onsite

0700 Kevin & Brady (Hanford) onsite
Set up for test pitting

0800 Begin test pits

0845 CML-GT-08 · Hg 0.009 mg/m3
Tarping 0-20"
- Purple, orange, very fine
20"-28/32
- Silty sand, gray no gravel, moist
32" →
- Dark gray/Black, some clay, wet
silty sand with clay & gravel
large gravel, subrounded
organic matter, odor

0900 CML-GT-07
Hg 0.003-0.014 mg/m3
Tarping 5',3"
- Purple/orange, very fine
- light purple layer ~~0-5"~~
0-5
- large rocks, hard 5.5' →
* - coated w/ gray glassy material

cont

9/05/12
page 2

1050 CML-GT/GC-03
- Water @ ~ 4.5'
- Dark brown/black 0-4.5
- Sandy w/ clay and ~~gravel~~ large gravel
- 4.5' →
- light brown/tan, wet gravel
Hg 0.003-0.016 mg/m3
- highest at water table

1105 CML-GT/GC-02
- water ~2.5'
- Tarlayers 0-(0.5-2)
- ~~[illegible]~~ mixed into tarlayer, not clearly delineated
- Hg 0.003-0.051 mg/m3
→ NW corner of pit

1120 CML-GT/GC-01
Hg 0.000-0.010
0-1 Topsoil, light brown, sandy, gravel
1-2 Tarlayers
Orange, grey
2-3 Dark brown/black gravel
Hard bottom ~3'

cont

1700 LD offsite until ~1830
- Synoptic Sampling Event start
1840 LD and SH onsite
2100 Arrive at CML-SW-10
2130 CML-SW-10
T = 10.3°C
DO% 75.3%
DO 8.46 mg/L
SC 0.055 mS/cm
pH 7.39
pH mV ~~[illegible]~~ -26.5
ORP 57.7 mV
2133 collect sample
2250 CML-SW-09
T 10.1°C
DO% 75.5
DO 8.56 mg/L
SC 0.0057 mS/cm
pH 7.23
ORP 144.1 mV
2303 collect CML-SW-09
23010 arrive CML-SW-08

cont

CML-SW-08.
T 10.0°C
DO% 76.9.
DO 8.66 mg/L
SC 0.057 mS/cm
pH 7.15
ORP 130.3
2315 collect sample CML-SW-08
0110 CML-SW-01
T 9.8°C
DO% 81.7
DO 9.24 mg/L
SC 0.056 mS/cm
pH 7.37
ORP 191.7 mV
0115 collect CML-SW-01
0300 ~~[illegible]~~ NT-SW-04
T 9.2°C
DO% 79.9
DO 9.20 mg/L
SC 0.058 mS/cm
pH 7.45
ORP 200.2 mV
0305 collect NT-SW-04
0345 LD + SH offsite

1100 LD arrive onsite
Flat tire
1400 Gauge Repository wells
1415 MW-RY-07
DW 11.56 ft
TD 16.07 ft
1420 MW-RY-09
DW - Dry
TD 32.49 ft
1430 MW-RY-06
DW - Dry
TD 15.91 ft
1445 Collect transducer data from wells at CNN
1530 KH & LD go Anaconda to pick up tires
1800 Replace patched tires
1900 LD offsite

1300 LD arrive onsite
~~1330~~ 1330 Collect GW sample at MW-RY-07
1500 Hg vapor analyses on test pit samples Ambient 0.000
CML-GT-08 0.000 mg/m3
CML-GT-07 0.000 outside
0.005 - 0.018 when stirred
CML-GT-02 0.000
0.003 - 0.006
CML-GT-03 0.004 - 0.005
0.005 - 0.009
CML-GT-01 0.004 - 0.005
0.016 - 0.045
Ambient 0.000
CML-GT-04 0.000 - 0.004
0.000 - 0.003
CML-GT-05 0.000 - 0.004
0.000 - 0.003
CML-GT-06 0.003 - 0.004
0.000 - 0.004
1600 Collect samples CML-GC-01B → 08B
1700 Offsite

9-7-12 ①

Arrive 9:15 V.J. - Perrone

Comb Mine Site
3:1 (18°) slope - waste rock

CHN - GT-03
Si gr. f-c sand w/ cobbles (SM)
occ boulder to 12", angular to
subangular gravels, ~~rounded~~
* ~~to subrounded~~ cobbles

②

RPB 1A

T.P. ID.	Sample Type	#	Depth
GT-01	Bulk	(2)	0845
GT-02	Bulk	(2)	1200
GT-02	Bulk	(2)	1450

REPOSITORY

TP ID	Sample #	Depth	USCS
RY-SS-08	Bulk(2)	16"-7'	

J. L. DARLING CORP. TACOMA, WA 98424-1017
www.RiteintheRain.com
No. 352

BORROW AREAS

(4)

TP-ID	Samples No.	Depth	USCS	
BPB-1A-GT-01	0845			Bulk (2)
BPB-1A-GT-04	1630			Bulk (2)
BPB-13-GT-02	1200			Bulk (2)
BPB-11-GT-02	1450			2
BPB-11-GT-01	1510			2
BPB-2/3'-GT-04	0930			2
BPB-2/3-GT-01	1230			2
BPB-2/3-GT-03	1010			2
BPB-2/3-GT-06	0900			2
BPB-2/3-GT-05	1100			2
BPB-12-GT-05	0820			2
BPB-12-GT-01	1430			2
BPB-12-GT-02	0930			2
BPB-7A-GT-02	1045			2
BPB-12-GT-03	1530			2
COMBINATION MINE				
CMN-GT-01	1715			~~4~~ 6
CMN-GT-03	1855			6
CMN-GT-02	1810			6

REPOSITORY

(5)

TP I.D.		Samples #	Depth	USCS
RY-SS-11	Bag	1	2	ML
	Bag	2	3	GC
	Bulk	3	2½-4	GC
	Bag	4	7	GC
VP-1	Bulk	1	2-5	GP-GM
	Bag	2	6	GP-GM
VP-2	Bulk	1	2-3	GP
RY-SS-09	Bag	1	2	GP-GM
	Bulk	2	4-6	GC-GM/GP
RY-SS-10	Bag	1	4	GC
	Bag	2	10-11	CL
	Bulk	3	14-16	CL
RY-SS-12	Bag	1	16	CL
VP-3	~~Bulk~~ Bag	1	2-4	ML
	~~Bulk~~ Bag	2	12	CL
VP-4	NONE	3	12	CL
RY-SS-06	Bulk		0-4'	
	Bag			
RY-SS-06	Bulk		4-7'	
RY-SS-07	Bulk		5-13	
RY-SS-07	Bulk		9-13	
	Bag		7-9	
	Bag		9-13	

BLACK PINE MINE SEEP/GROUNDWATER SAMPLING

Project Number: 776-012-003

Sampled by: CD

Location ID MW-RY-07

Time 1330 Date 9/09/02

~~Seep~~/Monitoring Well

Well Diameter 2 in

Gallons/ft 0.163 gal

Total Depth 16.02 ft

Depth to Water 11.86 ft

Gallons/ Casing Volume 0.68 gal

Water Column 4.16 ft

Total Purge Volume 2.04 gal

FIELD MEASUREMENTS/WATER CONDITIONS

Time	Volume Removed	Flow, gal/min	pH	Temp, °C	Specific Conductance, S/m	Dissolved Oxygen, mg/L
1420	2/3	–	6.57	12.3	0.307 mS/cm	4.89
1424	1 1/3	–	6.46	11.5	0.274	5.34
1426	2	–	6.56	10.4	0.270	5.71

Comments/Observations: ORP 99.7

Brown cloudy

1430 Collected 4 Plastics (2 were filtered)

QA/QC: BD-1

APPENDIX C

2011 RI TEST PIT AND BOREHOLE LOGS

Trihydro CORPORATION

Lithology Log Sheet 1 of 2

LOCATION ID
Repository #2

Project Name	Project Number	Site ID
Black Pine Mine	776-012-002	RY-SS-03

Excavation Company	Operator	Ground Elevation	Total Depth
Mungas Co	Karl Konrad		14 feet-bgs

Equipment	Weather	Temperature	Date/Time Started	Date/Time Total Depth Reached
322 B	Sunny	60 F	7/12/11 1000	7/12/11 1040

Sampler	Water Level (bgs)
Mongoven	First __ feet-bgs none while digging

Hydrogeologist	Checked by/Date

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0 - 2' Topsoil / Colluvium - Silty GRAVEL, trace sand and roots, dark brown, damp the silt is slightly micaceous	GM		3.8	57.0	13.4	29.6	RY-SS-03-00 (0 - 1.5') (geochemical and geotechnical)
1											
2				2' - Weathered Shale Bedrock - Silty, Clayey COBBLES and GRAVEL, with sand, trace Mn coating and iron staining, dark reddish brown and brown, damp	GC-GM						
3											
4											
5											
6											
7											
8											
9											
10											

Trihydro CORPORATION

Lithology Log (continued)

Repository #2
RY-SS-03-01

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
10				2' - Weathered Shale Bedrock - Silty, Clayey COBBLES and GRAVEL, with sand, trace Mn coating and iron staining, dark reddish brown and brown, damp (continued)							
11											Hard digging
12											
13				-- black manganese streaking on cobbles @ ~ 13'	GC-GM		10.1	41.8	10.5	23.4	RY-SS-03-01 (13') (geochemical and geotechnical)
14				-- excavator refusal at 14' Bottom of excavation at 14'							backfilled
15											
16											
17											
18											
19											
20											
21											
22											
23											

Trihydro CORPORATION

Lithology Log Sheet 1 of 1

LOCATION ID	Project Name	Project Number	Site ID
Repository #2	Black Pine Mine	776-012-002	RY-SS-04

Excavation Company	Operator	Ground Elevation	Total Depth
Mungas Co	Karl Konrad		10.5 feet-bgs

Equipment	Weather	Temperature	Date/Time Started	Date/Time Total Depth Reached
322 B	Sunny	60 F	07/12/11 1110	7/12/11 1140

Sampler	Water Level (bgs)	Hydrogeologist	Checked by/Date
Mongoven	First 33 inches-bgs		

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	USCS Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0 - 0.8' Duff & Topsoil -Well graded GRAVEL with silt and organics, dark brown, dry	GW-GM		7.5	80.9	12.6	6.5	RY-SS-04 (0-1') (geochemical) RY-SS-04-00 (0-1.5') (geotechnical)
1				0.8 - 3' Colluvium - Silty SAND with cobbles and gravel, trace organics, dark brown, damp, weathered bedrock							
2				-- wet seam at ~ 33"							RY-SS-04 (2-4') (geochemical)
3				3' - Weathered Shale - Silty, Clayey COBBLES and GRAVEL, with Sand, trace iron staining, reddish brown and yellowish brown, with purple fines, silt is micaceous, damp	GC-GM						Some rocks can be broken by hand
4											
5											
6											
7											
8				-- Weathered Shale competency increasing at ~ 8'			5.5	43.5	17.9	38.5	RY-SS-04-01 (8') (geotechnical) Hard digging
9											RY-SS-04 (10-12') (geochemical)
10				Bottom of excavation at 10.5'							10.5' stopped digging

(MW-RY-06)

SOIL BORING AND MONITORING WELL CONSTRUCTION RECORD

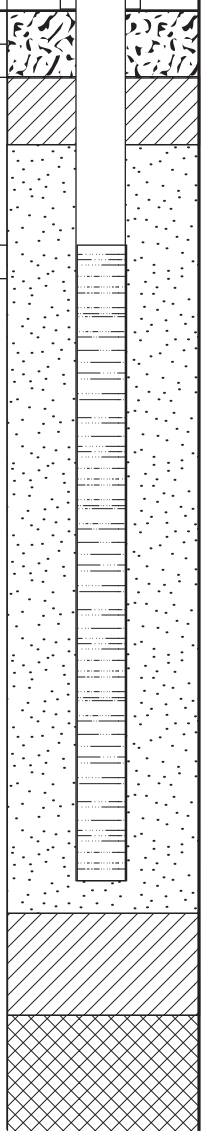
Boring # BP-RY-06
Total depth: 28 feet
Sheet 1 of 2

Project name:	Black Pine Mine	Drilling Contractor:	Boland Drilling	Well installed (y/n):	Yes
Project number:	06-03425-011	Drilling method:	Hollow-stem auger	Casing material:	PVC Sch 40
Client:	MDEQ	Sampling method:	2' split spoon for continuous sampling	Casing diameter:	2-inch
Location:	Center of Repository			Screen slot width:	10 slot
		Measuring point elev.:	6,290 feet HAE	Casing joint type:	Flush-threaded
HEC rep.:	BH	Ground elevation:	6,287 feet HAE	Filter pack:	#10-20 sand
Start Date:	08-16-2011	Air monitoring (y/n):	No	Annular seal:	Bentonite chips
Compl. Date:	08-16-2011	Instrument(s):	NA	Monument type:	3' metal stick-up

Depth to water	Dry Hole		
Reference point			
Date			

Monitoring well details: Cement, Filterpack, Native, Bentonite, Well screen

Sample type, interval	% recovery	Depth (feet, BGS)		Soil description	Geotechnical sample	Sample collected BY-RY-06-
2' - 3" diameter split spoon	100	1	ML	Light brown to reddish tan w/purple gravel (shale), gravelly SILT, trace sand, dry		00
		2	GP	Purple GRAVEL, dry		
2' - 2" diameter split spoon	40	3	CL	Reddish brown lean CLAY with purple gravel, moist (highly weathered shale bedrock)		04
		4				
2' - 3" diameter split spoon	100	5				
		6				
2' - 2" diameter split spoon	90	7				
		8				
2' - 3" diameter split spoon	100	9				
		10				
2' - 2" diameter split spoon	90	11				
		12		Reddish brown gravelly lean CLAY, Damp		
2' - 3" diameter split spoon	100	13				
		14				
2' - 2" diameter split spoon	30	15				
		16		Reddish brown lean CLAY with gravel, moist to damp		



Continued on sheet 2

SOIL BORING AND MONITORING WELL CONSTRUCTION RECORD

Boring # BP-RY-06
Total depth: 28 feet
Sheet 2 of 2

Sample type, interval	% recovery	Depth (feet, BGS)		Soil description	Geotechnical sample	Sample collected BY-RY-06-	Monitoring well details
2' - 3" diameter split spoon	100	17	CL	Reddish brown lean CLAY with gravel, moist to damp			
			ML	Reddish brown and purple gravelly SILT, dry, formation tightens (weathered shale bedrock)			
		18					
2' - 2" diameter split spoon	100	19					
		20		Gravel increases in size			
2' - 3" diameter split spoon	90	21					
		22					
2' - 2" diameter split spoon	100	23		Reddish brown and purple gravelly SILT, trace clay, damp			
		24		Dry			
2' - 3" diameter split spoon	90	25					
		26		Red, yellow, and black inclusions present, weathered and brittle			
2' - 2" diameter split spoon	100	27		Brown to reddish brown SHALE, dry, highly compacted			
		28		Refusal at 28' bgs			

SOIL BORING AND MONITORING WELL CONSTRUCTION RECORD

(MW-RY-07)
Boring # BP-RY-07
Total depth: 26 feet
Sheet 1 of 2

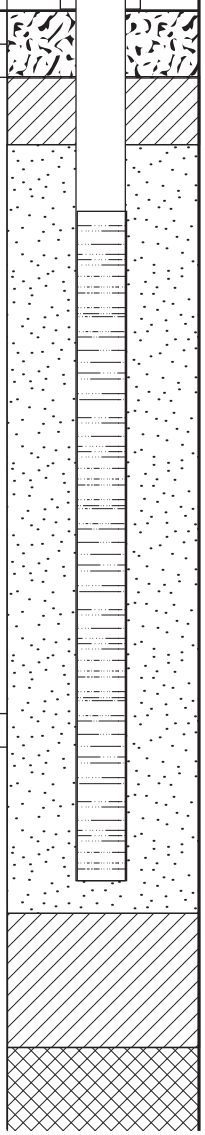
Project name:	Black Pine Mine	Drilling Contractor:	Boland Drilling	Well installed (y/n):	Yes
Project number:	06-03425-011	Drilling method:	Hollow-stem auger	Casing material:	PVC Sch 40
Client:	MDEQ	Sampling method:	2' split spoon for continuous sampling	Casing diameter:	2-inch
Location:	Down slope of Repository			Screen slot width:	10 slot
		Measuring point elev.:	6,264 feet HAE	Casing joint type:	Flush-threaded
HEC rep.:	BH	Ground elevation:	6,261 feet HAE	Filter pack:	#10-20 sand
Start Date:	08-17-2011	Air monitoring (y/n):	No	Annular seal:	Bentonite chips
Compl. Date:	08-17-2011	Instrument(s):	NA	Monument type:	3' metal stick-up

Depth to water	Dry Hole		
Reference point			
Date			

Monitoring well details: Cement, Filterpack, Native, Bentonite, Well screen

Sample type, interval	% recovery	Depth (feet, BGS)		Soil description	Geotechnical sample	Sample collected BY-RY-07-
2' - 3" diameter split spoon	80	1	ML	Dark brown gravelly SILT with sand, dry (organic layer)		
				Light tan gravelly SILT with clay, dry		00
		2		Light brown gravelly SILT, trace clay, dry		
2' - 2" diameter split spoon	60	3		Reddish brown lean CLAY with gravel, damp (purple shale gravel) (highly weathered shale bedrock)		
		4				
2' - 3" diameter split spoon	100	5				
		6				
2' - 2" diameter split spoon	5	7				
		8		Purplish gray shale stuck in tip of sampler		
2' - 3" diameter split spoon	5	9	CL			
		10		Purplish gray shale stuck in tip of sampler Reddish brown gravelly lean CLAY, damp, stiff		
2' - 2" diameter split spoon	100	11				10
		12				
2' - 3" diameter split spoon	50	13				
		14				
2' - 2" diameter split spoon	100	15				
		16		Formation tightens		

Monitoring well details



Continued on sheet 2

SOIL BORING AND MONITORING WELL CONSTRUCTION RECORD

Boring # BP-RY-07
Total depth: 26 feet
Sheet 2 of 2

Sample type, interval	% recovery	Depth (feet, BGS)		Soil description	Geotechnical sample	Sample collected BY-RY-07-	Monitoring well details
2' - 3" diameter split spoon	100	17					
		18		Reddish brown lean CLAY with gravel, damp (weathered shale bedrock)			
2' - 2" diameter split spoon	100	19		Reddish brown and purple gravelly lean CLAY, damp			
		20					
2' - 3" diameter split spoon	100	21		Reddish brown and purple lean CLAY with gravel, damp			
		22		Formation tightens, drill rig begins overheating			
2' - 2" diameter split spoon	100	23		Auger refusal at 22' bgs. Split spoon sampler was able to collect soil from 22' to 26' bgs. Gravel has black, yellow, and gray inclusions, purple shale present, damp			
		24					
2' - 3" diameter split spoon	100	25					
		26					

(MW-RY-08)

SOIL BORING AND MONITORING WELL CONSTRUCTION RECORD

Boring # BP-RY-08
Total depth: 10 feet
Sheet 1 of 1

Project name:	Black Pine Mine	Drilling Contractor:	Boland Drilling	Well installed (y/n):	Yes
Project number:	06-03425-011	Drilling method:	Hollow-stem auger	Casing material:	PVC Sch 40
Client:	MDEQ	Sampling method:	2' split spoon for continuous sampling	Casing diameter:	2-inch
Location:	East side of Repository			Screen slot width:	10 slot
		Measuring point elev.:	6,326 feet HAE	Casing joint type:	Flush-threaded
HEC rep.:	BH	Ground elevation:	6,323 feet HAE	Filter pack:	#10-20 sand
Start Date:	08-17-2011	Air monitoring (y/n):	No	Annular seal:	Bentonite chips
Compl. Date:	08-17-2011	Instrument(s):	NA	Monument type:	3' metal stick-up

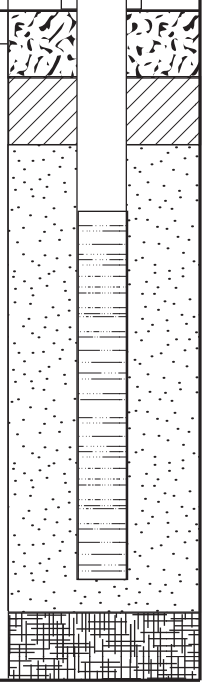
Depth to water	Dry Hole		
Reference point			
Date			

Monitoring well details
Cement
Filterpack
Weathered bedrock
Bentonite
Well screen

Sample type, interval	% recovery	Depth (feet, BGS)		Soil description	Geotechnical sample	Sample collected BY-RY-08-
2' - 3" diameter split spoon	80	1	ML	Light gray to light brown gravelly SILT with organics, dry		00
		2	GM	Tan to light gray silty GRAVEL, dry (highly weathered shale bedrock)		
2' - 2" diameter split spoon	20	3				
		4	ML	Brown to reddish brown gravelly SILT, trace clay, damp (highly weathered shale bedrock)		
2' - 3" diameter split spoon	100	5	GM	Tan to light brown silty GRAVEL, dry (weathered shale bedrock)		
		6		Pink, white, and yellow gravels present (5-1/2 to 6' bgs)		
2' - 2" diameter split spoon	100	7	Bedrock	Pink to white SHALE, fractured, dry (weathered bedrock)		
			GM	Brown to reddish brown silty GRAVEL, trace clay, damp		
		8	Bedrock	White to light gray SHALE, fractured, dry (weathered bedrock)		
2' - 3" diameter split spoon	50		ML	Brown clayey SILT with gravel, damp		
		9	Bedrock	Purple to gray SHALE		
		10				

Refusal at 10' bgs

Monitoring well details



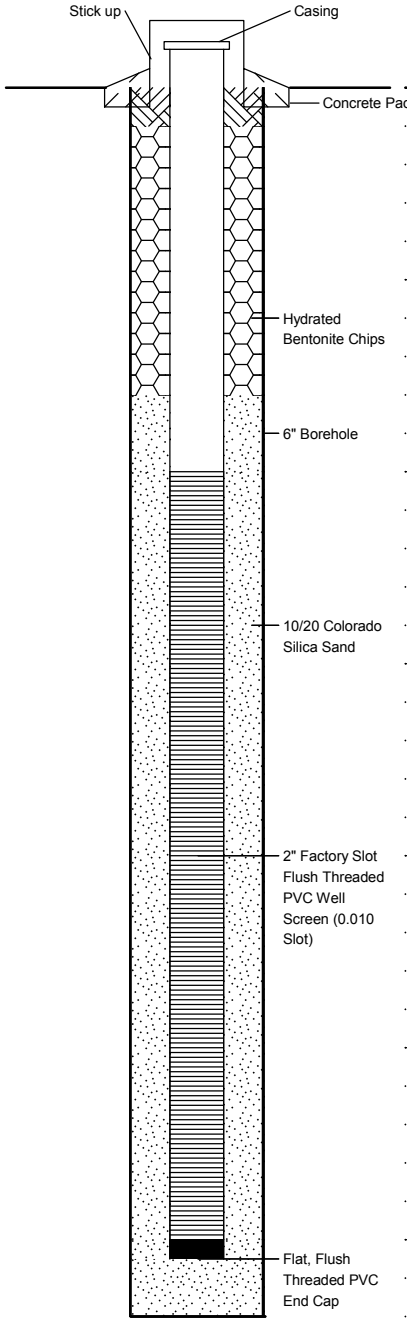
Borehole Log

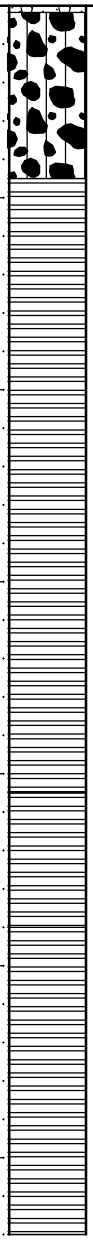
Borehole: **MW-RY-09**

Client: **Montana Department of Environmental Quality - Abandoned Mines Section**		
Date Started: **Jan 27, 12**	Date Completed: **Jan 27, 12**	Permit Number:
Logged By: **Tom Smith**	Driller: **Steve Malkovich**	1/4, 1/4, S, T, R:
Drilling Co.: **O' Keefe Drilling**	Drilling Rig: **R650**	Borehole Diameter: **6"**
Method: **Air rotary**	Measuring Point Elev. (ft.-msl): **6307.00**	Sample Type: **Chips**
Total Depth (ft): **32**	Ground Surface Elev. (ft.-msl): **6304.0**	Location: **~39' SW of MW-RY-07, Casing stick up at 33.25"**

N

CONSTRUCTION | **SAMPLING DATA** | **LITHOLOGY**





Depth, feet	TOV Values (ppmv)	Blow Count/ Recovery (feet)	Visual Description
			(0-0.17') Duff and Topsoil - Silty Gravel, dark brown, dry
			(0.17-4.5') Silty Gravel, with cobbles, brown, dry, easy drilling, dusty
5			(4.5-20.5') Highly weathered, fractured siliceous Shale, dark purple, dry, fractures are heavily coated with silt, easy drilling (@~19' softer zone in siliceous shale, cuttings are finer, dustier)
10			
15			
20			(20.5'-) Weathered, fractured siliceous Shale, dark purple, dry, fractures are heavily coated with silt (Rock chips are ~1/2" average, not as dusty while drilling)
25			(@~24') Rock appears more competent, chips are larger (Average ~1/2") not as dusty, chips thrown ~25' from rig, feel hammer pounding on ground (@~26' color becomes brownish purple)
30			Bottom of Boring 32', No groundwater while drilling, or after drilling. Transducer installed 6" above bottom of well

APPENDIX D

BOREHOLE LOGS

D1. RY-RB-01

D2. RY-RB-02

D3. RY-RB-03

D4. RY-RB-04

D5. RY-RB-05

APPENDIX D1

RY-RB-01

APPENDIX D1. RY-RB-01 BEDROCK CORE EVALUATION
BLACK PINE MINE

Bedrock was encountered at a depth of 11 feet bgs. The bedrock had RQD values that ranged from very poor to poor from 11 feet to 61 feet bgs. The number of joint patterns ranged from one plus a random joint set up to four or more joint sets with a random joint set. More than half of the core run in this depth interval contained three or more joints sets. The joint roughness ranged from smooth to rough and the joint faces ranged from planar to undulating. A fault zone was observed from 34.5 feet to 38 feet bgs and the rock was crushed in some portions down to sand sized particles; the fracture faces were smooth and planar but no slickensided fractures were observed.

The RQD improved to fair at 61 feet bgs, became good between 61 feet and 71 feet bgs, and continued good to 86 feet bgs, the bottom of the borehole. The number of joint patterns ranged from one plus a random joint set up to multiple joint sets that produced crushed rock. Two crushed rock zones, 67.5 feet to 68 feet bgs and 68.5 feet to 69 feet bgs, were observed and each had an estimated thickness of 6 inches with smooth planar, slightly altered joints. These zones were surrounded by rock that contained two joint sets plus a random joint set with smooth undulating, slightly altered joints. The remaining core in this interval had joint roughness that ranged from smooth and planar to rough/irregular and undulating. The alterations of the joint faces ranged from having surface staining to slightly altered.

Overall, the bedrock can generally be described as fractured. The recovered core contained a few small vugs and occasional thin zones, up to 6 inches in thickness, of finely laminated argillite within the quartzite. No slickensided fracture faces were observed within the fault zone. The fractures were relatively smooth and planar, which indicates that the rock was in a state of compression for a period of time, but no longer appears to be under that same stress. The formation of slickensides would have been expected if continued movement and grinding of the bedrock had occurred.

Core Drill Log

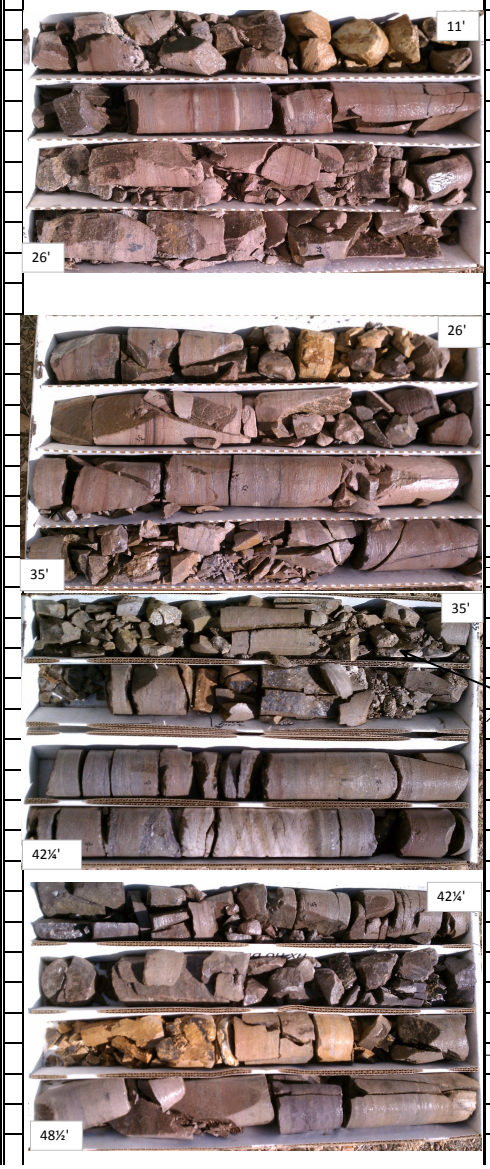
Trihydro Corporation

Site: Black Pine Mine Repository 2 Investigation
Hole ID: RY-RB-01

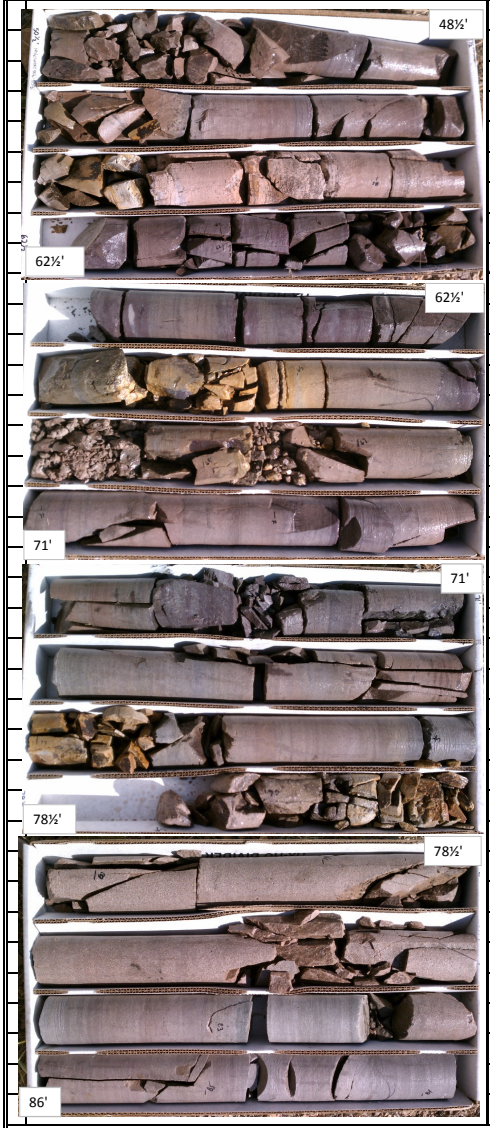
Date Start: 8/29/2012 Date complete: 8/31/2012
3" diameter core
Driller: Boland Drilling, Gardner-Denver, Rig D-1, air rotary
Logged by: Tom Smith

Location: Repository 2
Collar Easting: 993,729
Northing: 825,368
Elevation: 6,334

TD: 86 feet
Water Level: First: ~38' Final: NA



Hole FT	Description	Core Run	Recov. inches	RQD (%)	RMR Estimate Jn	Jr	Ja	Hole FT
0	**0 - 3" Duff and Topsoil - Sandy SILT**, with organics, dark brown, dry							0
	3" - 4' Sandy SILT, with gravel and cobbles, light brown, dry							
5	**4' - 11' Silty GRAVEL**, with sand and cobbles, light brown							5
10	**No Recovery 0' - 11'**							10
	Rock Bit - Start of coring at 11'							
	11' - 15' Quartzite, fractured, with manganese and iron coated fractures, brownish yellow	1	80	0%	15	1	1	
15								15
	15' - 26' Quartzite, fractured, with iron and manganese coated fractures, occasional purple argillite lenses, slightly micaceous, purple							
20					12	1	1	20
				71%				
	-- 2" thick dark purple argillite seam @ 23'							
	-- highly fractured from 23' - 31'			50%				
25	-- 2" thick seam of bluish-gray & brownish yellow quartzite, thinly laminated, alternating colors at 25' - 26'				15	1	8	25
	26'-29½' Quartzite, fractured, with iron stained fractures and trace manganese stained fractures, slightly micaceous, brownish yellow	2	114	8%				
30	**29½' - 46½' Quartzite**, with iron and manganese coated fractures, occasional purple argillite lenses, brownish pink and purple. Becomes brownish pink and degree of fracturing decreases at 31'.				6	1	2	30
	34½'-38'- Fault Zone - color becomes bluish gray. Quartzite							
35	is crushed at 35'. Shearing is diagonal to core axis.				15	1	8	35
	Fractures are smooth and occasionally undulate.	3	81	39%				
	-- color become brownish pink. Quartzite is pulverized @ 37'							
	-- driller noted hole making water (<1 GPM) @ ~38'							
	-- laminated argillite seams, dark bluish purple from 39½' - 40½'				3	2	2	
40	-- color becomes pink @ 40½'							40
	-- multiple healed fractures from 41' - 41½'				12	2	2	
	-- sand and dark purple argillite stringers from 41½'-42'							
	-- color becomes purple at 42'. Fracturing increases, very poor rock quality	4	126	38%	15	1	8	
45	-- small vug (1"wx¼"h) lined with black platy crystals @ 45½'				6	1	3	45
	46½'-48' Quartzite, with iron and manganese coated fractures, yellowish brown; milky quartz veinlet 0.25" thick followed by ¼" thick sulfide veinlet				15	1.5	2	
					9	1.5	2	
	48'-59' Quartzite, with iron and manganese coated fractures	5	45	47%				



Hole FT	Description	Core Run	Recov. inches	RQD (%)	RMR Estimate Jn	Jr	Ja	Hole FT
50	**48'-59' Quartzite**, with iron and manganese coated fractures	5	45	47%	15	3	2	50
	purple							
	-- color becomes bluish gray at 48¼'; then brownish pink at 48½'							
	-- No Recovery from 50½' to 55½'. Driller noted drilling to be							
	slower indicating better rock quality							
55					3	3	2	55
	55½' - 59' Quartzite, trace manganese coating on fractures,							
	brownish pink				6	1	2	
	59'-60' Quartzite, trace manganese coating on fractures,				15	1	2	
60	brownish yellow							60
	60'-64¼' Quartzite, trace manganese coating on fractures,				6	1	1	
	brownish pink. Color becomes purple at 61'. Fractured with							
	light gray to light blue coating on fractures. Thin argillite	6	82	50%	6	3	2	
	seams 61'6"-62'. Thin argillite seams, dark purple 63'-64'3".							
65	**64¼'-66' Quartzite**, manganese coating on fractures,				15	1	2	65
	brownish yellow. Highly fractured from 65'-66'				6	1	1	
	66'-EOD Quartzite, fractured manganese coating on fractures				20	1	2	
	brownish pink				6	2	2	
	-- quartzite crushed to coarse sand and gravel fragments				20	1	2	
70	at 67½' and color becomes brownish yellow from 67¾'-68½'				6	2	2	70
	-- quartzite crushed from 68½' to 69' (End of run)							
	-- thin dark purple argillite seams at 69½'. Diagonal fracturing	7	87	82%	15	2	2	
	across core from 70½'-71½'. Fragmented and crushed from				6	3	2	
	72'-72½'. Diagonal fracturing across core from 72½' to 74'							
75	-- color becomes bluish gray from 74¾' to 75'							75
	-- brownish yellow, highly fractured with heavier iron and				15	1	2	
	manganese coated fractures from 76'-77½'				15	1.5	1	
	-- quartzite becomes speckled with fine milky and rose				6	1.5	2	
	quartz crystals from 77½'-78½'	8	112	75%				
80	-- fractured and broken along core axis, minor fracture							80
	coating 79½'-81'							
	-- color becomes grayish green from 82½'-83'				3	1	1	
	-- color becomes green from 84'-85'				3	1	1	
85					6	1	1	85
86								86
T.D.	**End of Drilling (EOD) at 86'**							T.D.

Trihydro CORPORATION

Lithology Log

Sheet 1 of 7

LOCATION ID: RY-RB-01

Project Name	Project Number	Site ID
Black Pine Mine Repository 2 Investigation	776-012-004	REPOSITORY 2

Drilling Company	Driller	Ground Elevation	Total Drilled Depth
Boland Drilling	CHRIS BOLAND, JR JASON TREVOR		__ feet-bgs

Drilling Equipment	Drilling Method	Borehole Diameter	Date/Time Drilling Started	Date/Time Total Depth Reached
D-1 GARDNER - DENVER	AIR ROTARY	6 inches	8/29/12 3:30	8/31/12 3:35

Type of Sampling Device	Water Level (bgs)	
15' CORE BARREL	First ~40 feet-bgs	Final NA

Sample Hammer	Geological Engineer/Hydrogeologist	Checked by/Date
Type: Driving Weight: Drop:	Tom Smith, PE, PG	

Location Description (include sketch in field logbook)

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0-3" DUFF AND TOPSOIL -- SANDY SILT, WITH ORGANICS, DARK BROWN, DRY							11' CASING INSTALLED TO KEEP HOLE OPEN
			0.3'-11'	SANDY SILT, WITH GRAVEL AND COBBLES, LIGHT BROWN, DRY							POCKET PENETROMETER READING OF 2 TONS/SF @ 1'
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											

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Lithology Log (continued) Sheet 2 of 7

LOCATION ID: RY-RB-01

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	~~Lithology~~	~~Water Content~~ Jn	Estimate ~~% of~~ ~~Gr~~ Jr	~~Sa~~ Ja	~~Fi~~	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
10											
11				START OF CORING AT 11'			15	1	1	5	8/30/12 CORING 11-15½' OCCURRED RELATIVELY QUICK
12				11-15 QUARTZITE, FRACTURED, WITH MANGANESE AND IRON COATED FRACTURES, BROWNISH YELLOW							CORE RUN 1 11'-26' 80" RECOVERY VERY RQD 29"/80 (POOR)
13											RECOVERY 11'-21' VERY POOR 19" JAMIE TOOK PHOTOS OF RUN (5) BOX 1 11-26'
14											RQD 11'-21' = 0 RQD 21'-23' = 17/24 = FAIR RQD 23'-26 = 18/36 (POOR/FAIR)
15				15'-26' QUARTZITE, WITH IRON AND MANGANESE COATED FRACTURES, OCCASIONAL PURPLE ARGILLITE LENSES, PURPLE SLIGHTLY MICACEOUS							RQD 26'-30 = 4/48 (VERY POOR)
16											
17						CORE RUN 1					
18											
19											
20											
21							12	1	1		
22				--2" THICK DARK PURPLE ARGILLITE SEAM JUST BEFORE 23'							
23											

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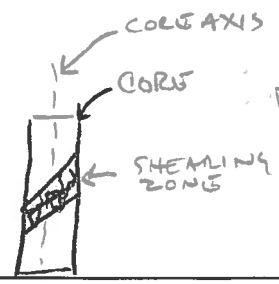
Lithology Log (continued) Sheet 3 of 7

LOCATION ID: RY-RB-01

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate ~~% of~~ Jr (~~Gr~~)	Ja (~~Sa~~)	~~Fi~~	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
23				-- HIGHLY FRACTURED FROM 23'-31'							
24						CORE RUN 1					
25				-- 2" THICK SEAM OF BLUISH GRAY AND BROWNISH YELLOW QUARTZITE (THINLY LAMINATED & COLORS ALTERNATE)			15	1	8		
26				26-29½' QUARTZITE, FRACTURED, WITH IRON STAINED FRACTURES AND TRACE MANGANESE STAINED FRACTURES, SLIGHTLY MICACEOUS, BROWNISH YELLOW		26'					CORE RUN 2 - BIT CLOGGED AT 12'; PULLED RECOVERY 9'6" RQD 40"/12' (POOR)
27											
28											
29											
30				29½-46½' QUARTZITE, WITH IRON AND MANGANESE COATED FRACTURES, OCCASIONAL PURPLE ARGILLITE LENSES, BROWNISH PINK AND PURPLE							RQD 30-34½ 27/54 (POOR-FAIR)
31				-- COLOR BECOMES BROWNISH PINK & DEGREE OF FRACTURING DECREASES AT 31'		CORE RUN 2					FRACTURING DECREASES TO 2-3 PLANES
32							6	1	2		
33											NO SLICKENSIDES OBSERVED
34				FAULT ZONE 34½-38' COLOR BECOMES BLUISH GRAY -- QUARTZITE IS CRUSHED PULVERIZED @ ~ 35'							 RQD = 0
35							15	1	8		
36				SHEARING IS DIAGONAL TO CORE AXIS							

FRACTURES ARE SMOOTH & FLAT & OCCASIONALLY UNDULATE

Trihydro CORPORATION

Lithology Log (continued) Sheet 4 of 7

LOCATION ID: BY-RP-01

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Jn	Estimate % of Jr (Gr)	Ja (Sa)	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
36						CORE RUN 2					
37				-- COLOR BECOMES BROWNISH PINK @ ~37' & QUARTZITE IS PULVERIZED							
38				-- DRILL GRADED HOLE MAKING WATER @ ~38' (<1 GPM)		38	3	2	2		CORE BARREL CLOGGED 12' INTO RUN RQD 38-42'3" 33/51 (FAIR)
39				-- ARGILLITE SEAMS & LAMINATED FROM 39½ - 40½' DARK BLUISH PURPLE							
40				-- COLOR BECOMES PINK @ ~40½'							CORE RUN 3 7' RECOVERY = 6'9" RQD = 33"/84" (POOR)
41				-- MULTIPLE HEALED FRACTURES FROM 41 - 41½'			12	2	2		
42				-- 41½ - 42 SAND & DK PURPLE ARGILLITE STRINGERS -- COLOR BECOMES PURPLE @ 42' AND FRACTURING INCREASES, VERY POOR ROCK QUALITY		CORE RUN 3					RQD 42'3" - 45' 4/33 (VERY POOR)
43							15	1	8		
44											CORE BARREL CLOGGED 7' INTO 3RD RUN
45				-- SMALL VUG (1" W x ¼" H) LINED W/ BLACK PLATY CRYSTALS @ ~45½'		45	6	1	3		DRILLING & CORING DEEPER THAN 45' HAS SLOWED DOWN INDICATING BEDROCK IS HARDER
46				46½' - 48' QUARTZITE, WITH IRON & MANGANESE COATED FRACTURES, YELLOWISH BROWN			15	1.5	2		
47				MILKY QUARTZ VEINLET ¼" THICK FOLLOWED BY ¼" THICK SULFIDE VEINLET		CORE RUN 4	9	1.5	2		DRILLED 10½' NOT ALL RECOVERED, BIT KEPT CUTTING; CORE JAMMED & WASHED OUT THE ROCK 5½' - 10½'
48				48' - 59' QUARTZITE, WITH IRON AND MANGANESE COATED FRACTURES, PURPLE -- COLOR BECOMES BLUISH GRAY @ ~48¾'							RECOVERY - INCREASED FRACTURING OF RECOVERED CORE RQD 46/66 45 - 50½' (FAIR)
49											TOTAL CORE RUN 4 LENGTH = 10½'

-- COLOR BECOMES BROWNISH PINK @ ~48½'

Trihydro CORPORATION

Lithology Log (continued) Sheet 5 of 7

LOCATION ID: RY-RP-01

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content (Jn)	Estimate (Jr / Ja / Jw)			Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
49							15	3	2		
50				50½-55½ NO RECOVERY/ DRILLER NOTED DRILLING TO BE SLOWER INDICATING BETTER ROCK QUALITY							
51											
52						CORE RUN 4					
53											
54											
55											
56				QUARTZITE, TRACE MANGANESE COATING ON FRACTURES, BROWNISH PINK			3	3	2		RECOVERY 45" RQD = 34"/78" (POOR) 45%
57						CORE RUN 5	6	1	2		
58											
59				59'-60' QUARTZITE, TRACE MANGANESE COATING ON FRACTURES, BROWNISH YELLOW			15	1	2		
60				60'-64¼' QUARTZITE, TRACE MANGANESE COATING ON FRACTURES, BROWNISH PINK -- COLOR BECOMES PURPLE @ ~61' FRACTURED, WITH LIGHT GRAY TO LIGHT BLUE COATING ON FRACTURES -- THIN ARGILLITE SEAMS @ 61½-62'							GASSER DRILLING 59'-61'
61						61 CORE RUN 6	6	1	1		8/31/12 START OF DRILLING HOLE CONTAINED ~40' OF WATER
62											

DRILLING IS SLOW & INDICATION THAT ROCK IS HARD/MORE COMPETENT

Trihydro CORPORATION

Lithology Log (continued)

LOCATION ID: RY-RP-01

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	~~Water Content~~ Jn	Estimate ~~% of~~ Jr ~~Gr~~	Ja ~~Sa~~	Jw ~~Fi~~	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
62							4	1	1	1	CORE RUN 6 RECOVERY 82" RQD 48/96 (POOR-FAIR)
63				-- THIN ARGILLITE SEAMS DARK PURPLE FROM 63-64¼'			6	3	2	1	
64				64¼'-66' QUARTZITE, MANGANESE COATING ON FRACTURES, BROWNISH YELLOW							
65				-- HIGHLY FRACTURED FROM 65-66'		CORE RUN 6 (85% RECOVERY)	15	1	2	1	
66				66'-67½' QUARTZITE, FRACTURED, MANGANESE COATING ON FRACTURES, BROWNISH PINK			6	1	1	1	
67				-- QUARTZITE CRUSHED TO COARSE SAND & GRAVEL FRAGMENTS @ 67½' & COLOR BECOMES BROWNISH YELLOW FROM 67¾'-68½'. QUARTZITE CRUSHED FROM 68½' TO END OF CORE RUN (69')			20	1	2	1	
68							6	2	2	1	
							20	1	2	1	
69				-- THIN DARK PURPLE ARGILLITE SEAMS @ 69½'			6	2	2	1	CORE RUN 7 (7') RECOVERY 87" RQD = 69/87 (GOOD)
70				-- DIAGONAL FRACTURE NG ACROSS CORE FROM 70½' - 71½'							
71											
72				- FRAGMENTED & CRUSHED FROM 72-72½' -- DIAGONAL FRACTURING ACROSS CORE FROM 72½ - 74'		CORE RUN 7	15	2	2	1	
73							6	3	2	1	
74				-- COLOR BECOMES BROWNISH GRAY FROM 74¾-75'							
75											

Trihydro CORPORATION

Lithology Log (continued) Sheet 7 of 7

LOCATION ID: RY-RP-01

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Jn ~~Minor Constituent~~	Estimate ~~% of~~ Jr ~~Gr~~	Ja ~~Sa~~	Jw ~~Fi~~	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
75						CORE RUN 7					
76				-- BECOMES BROWNISH YELLOW, HIGHLY FRACTURED WITH HEAVIER IRON AND MANGANESE COATED FRACTURES FROM 76'-77½		76	15	1	2	1	CORE RUN 8 10' RECOVERY 112" RQD = 90"/120" (GOOD)
77				-- QUARTZITE BECOMES SPECKLED WITH MILKY AND ROSE QUARTZ CRYSTALS FROM 77½'-78½' FINE							
78						CORE RUN 8	15	1.5	1	1	
							6	1.5	2	1	
79				-- FRACTURED & BROKEN ALONG CORE AXIS FROM 79½'-81', MINOR FRACTURE COATINGS							
80											
81											
82				-- COLOR BECOMES GRAYISH GREEN FROM 82½-83'			3	1	1	1	
83											
84				-- COLOR BECOMES GRAYISH GREEN FROM 84-85'			3	1	1	1	
85							6	1	1	1	
86				END OF DRILLING @ 86'		86					
87											
88											

APPENDIX D2

RY-RB-02

APPENDIX D2. RY-RB-02 BEDROCK CORE EVALUATION
BLACK PINE MINE

Bedrock was encountered at a depth of 10 feet bgs and had RQD values in the fair category to a depth of 30 feet. The number of joint patterns ranged from two to two plus a random joint set. The joint roughness ranged from smooth to rough/irregular, and joint faces ranged from planar to undulating. The alterations of the joint faces ranged from being unaltered to coated with a thin layer of clay. The portion of fracture faces containing a coating of clay were also on fractures that were rough/irregular and undulating. A fracture zone was observed from 20 feet to 23.5 feet bgs. The interval from 22 feet to 23 feet bgs is an alteration zone in which the fractures have a white coating. Two seams were also observed in this zone that contained vugs less than 0.75 inches in diameter that were lined with fine, very dark gray crystals.

The RQD degrades to poor from 30 feet to 35 feet bgs. This interval appears to be a fracture zone in which the number of fractures increased to four or more joint sets. The fracture faces were smooth, planar, and unaltered.

The RQD varied from fair to excellent from 35 feet to 76.8 feet bgs, the bottom of the borehole. The number of joint patterns ranged from one plus a random joint set to two plus a random joint set. The joint roughness ranged from smooth to rough/irregular and the joint faces were undulating. The alterations of the joint faces ranged from having tightly healed joints to slightly altered joint faces. Poor recovery was observed from 45 feet to 46 feet bgs in an apparent fractured quartz layer, which resulted in an RQD rating of fair for the bedrock in this interval.

Overall, the bedrock can be described as fractured. The recovered core contained a few small vugs and occasional thin zones, up to 6 inches in thickness, of finely laminated argillite within the quartzite. One slickensided vertical fracture face was observed below a fracture zone at 37.5 feet bgs. The slickensided area of the fracture face was small, approximately 1 inch by 1.5 inches, and is a possible indication of vertical shearing. However, observing only one small sheared area is not cause for concern for the repository site.

Core Drill Log

Trihydro Corporation

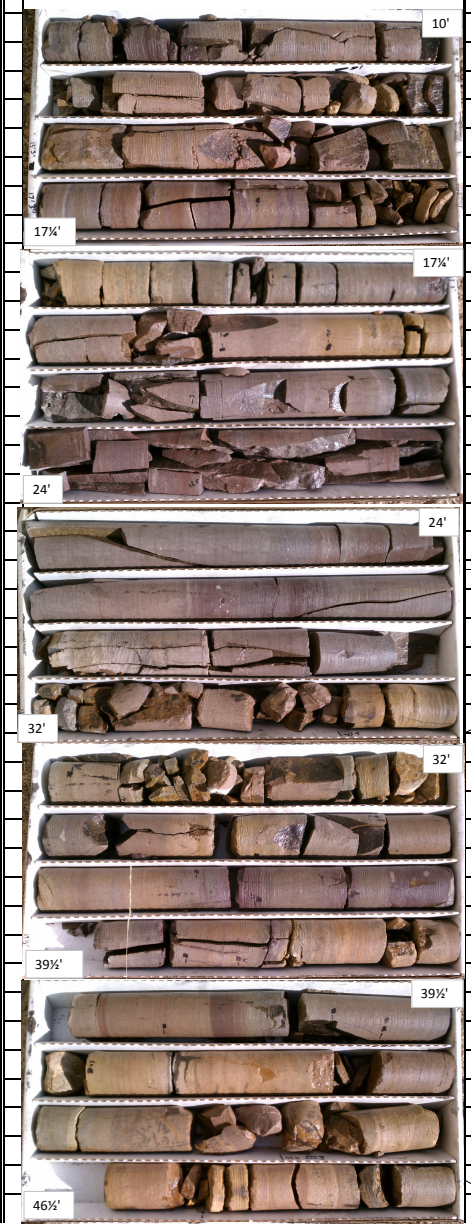
Site: Black Pine Mine Repository 2 Investigation
Hole ID: RY-RB-02

Date Start: 8/27/2012 Date complete: 8/29/2012
3" diameter core
Driller: Boland Drilling, Gardner-Denver, Rig D-1, air rotary
Logged by: Tom Smith

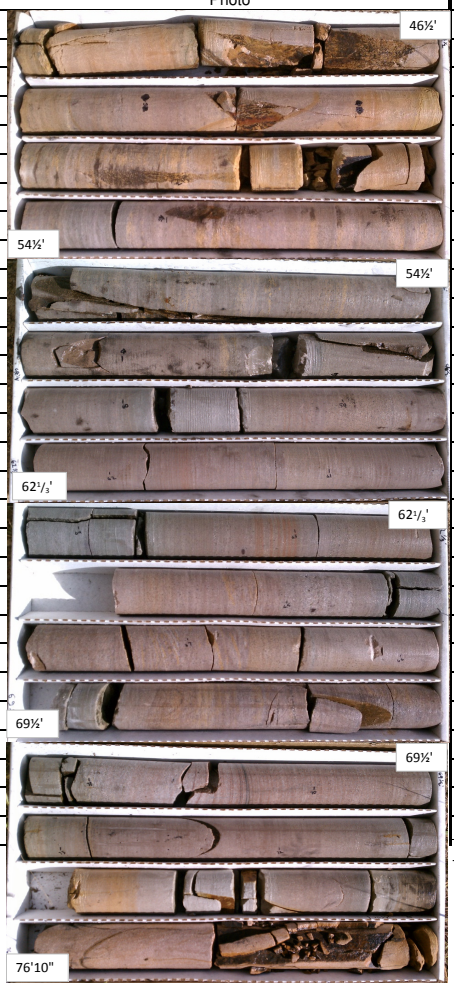
Location: Repository 2
Collar Easting: 994,650
Northing: 825,425
Elevation: 6,388

TD: 76' 10'' feet

Water Level: First: ~30' Final: NA
driller noted hole making water (<1 GPM) 30 - 45' bgs



Hole FT	Description	Core Run	Recov. inches	RQD	RMR Estimate Jn	Jr	Ja	Hole FT
0	**0-1" GRAVEL and DUFF,** dry, brown							0
	1"-16" Silty Sandy GRAVEL, with cobbles, trace roots, brown, dry (Waste Rock Fill)							
	16"-4' GRAVEL and COBBLES, with silt and sand, light brown, dry							
5	**4'-9' Silty GRAVEL and COBBLES**, with sand, slightly moist, brown							5
	9'-18' Argillite, with manganese coated fractures, slightly							
10	micaceous, purple							10
		1		68%	6	2	3	
	-- purple lenses at 11½' - 12'				4	2	1	
	-- color becomes brownish yellow at 12'							
	-- vertical joint fracture lined with dark yellow brown clay from							
15	13' - 14'; color becomes purple at 13¼', then yellow at 14'							15
	-- color alternates between purple and brownish yellow seams	2		65%				
	from ~ 15' - 18'				6	3	4	
	18'-19½' Quartzite, manganese and iron stained			56%				
	fractures, brownish yellow							
20	**19½'-25½' Quartzite**, manganese and iron stained fractures, purple							20
	-- fractured zone at 20'-23½'							
	-- white coated fractures, vugs (<¾") lined with dark gray fine							
	crystals, two seams from 22' - 23'							
	-- thin seams of milky quartz sand in argillite matrix from 23'-25'				6	1	1	
25	-- rock quality improves from 24'-28'			74%				25
	25½'-31' Quartzite, manganese and iron stained fractures,							
	brown.							
	-- milky quartz sand seam (~2"t) in matrix at 27'							
30	-- fracture zone (poor rock quality) from 30' - 34'							30
	31'-45'- Quartzite, manganese and iron stained fractures,	3		35%	15	1	1	
	purple							
	-- color becomes gray at 32'; purple at 33' & brownish gray at 34'							
	-- some healed fractures between 34' - 40'							
35	-- manganese coating of fractures is thicker at 35'				6	2	2	35
	-- possible vertical shearing observed in core at fracturing face.			90%				
	-- alternating seams of purple and pale green at 36' - 42'							
	-- shaly lenses, purple at ~ 39'							
	-- possible quartzite (?) from 39½' - 40½'							
40								40
	-- color becomes dark brownish yellow at 42'							
	-- milky quartz and manganese lens at ~ 42½'							
	-- color is mottled dark brownish yellow and dark gray at 43'							
		4		75%	3	2	1	
45	**45'-46' Quartz** fractured with iron staining and black coating on							45
	fractured faces, dark brownish yellow, black, and white. Poor				6	2	0.75	
	recovery of this layer (1").							
	46'- Quartzite, (description on next page)							



Hole FT	Description	Core Run	Recov. inches	RQD	RMR Estimate Jn	Jr	Ja	Hole FT
	46'- Quartzite, manganese and iron stained fractures,							
50	brownish pink. Healed fractures are manganese and iron							50
	stained. Color becomes greenish gray at 49'. Color							
	becomes brownish pink at 50½'; then grayish green at 51'							
	-- color becomes brownish pink at 51½'; then grayish green at 52½'							
	-- color becomes brownish pink at 54½'							
55	-- color becomes grayish green at 55½'							55
	-- color becomes brownish pink at 56½'							
	-- color becomes grayish green at 57'							
	-- color becomes brownish pink at 57½'							
	-- color is grayish green between 59'6" and 60'.	5		91%	4	3	2	
60								60
	-- color is grayish green 63'5"-65'							
65								65
	-- color is grayish green from 69'-69½'							
70								70
	-- color is grayish green from 71'-74½'							
		6		81%				
75	-- near vertical fracture face is iron stained and coated with							75
76	black sulfide (?) at ~ 75'							76
77								77
T.D.	**End of Drilling at 76' 10"**							T.D.

Trihydro CORPORATION

Lithology Log

Sheet 1 of 7

LOCATION ID: RY-RB-02

Project Name	Project Number	Site ID
Black Pine Mine Repository 2 Investigation	776-012-0085	REPOSITORY 2

Drilling Company	Driller	Ground Elevation	Total Drilled Depth
Boland Drilling	CHRIS BOLAND JR	+1' FOR DRILL PAD	76'10" feet-bgs

Drilling Equipment	Drilling Method	Borehole Diameter	Date/Time Drilling Started	Date/Time Total Depth Reached
D-1 GARDNER DENVER AIR ROTARY RIG	AIR ROTARY	6 inches	8/27/12 2:30	8/29/12 1:30

Type of Sampling Device	Water Level (bgs)	
3" ϕ CORE BARREL 15'L	BETWEEN 30-45' OBSERVED WHILE DRILLING First ___ feet-bgs	Final ___

~~Sample Hammer~~	Geological Engineer/Hydrogeologist	Checked by/Date
~~Type~~ ~~Driving Weight~~ ~~Drop~~	Tom Smith, PE, PG	

Location Description (include sketch in field logbook)

BUILT UP DRILL PAD FOR RIG ACCESS & WORKING AREA

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	~~Coring Run Lithology~~	~~Water Content~~	RMR ESTIMATE ~~Estimate % of~~ Jr ~~Gr~~	Ja ~~Sa~~	Jw ~~Fn~~	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0-9' SILTY SANDY GRAVEL, BROWN ARGILLITE -- COLOR BECOMES REDDISH BROWN, PURPLE @ ~6' -- COLOR BECOMES PURPLE @ ~8' -- BANDS OF BROWN ARGILLITE & QUARTZ BROWN & BROWNISH YELLOW -- OCCASIONAL MANGANESE COATING ON FRACTURES							TRICONE BIT & SETTING CASING THROWING DUST & GVL OUT DISCHARGE HOSE 1ST CASING L = 8'7" 2ND CASING L = 9'
1											
2											NO SAMPLES TAKEN 0-10' AIR HOSE EXPELLING DUST & GRAVEL; GRAVEL IS ARGILLITE, PURPLE
3											
4											
5											
6											
7											
8											
9				9'-18' ARGILLITE, WITH MANGANESE COATED FRACTURES, SLIGHTLY MICACEOUS, PURPLE							
10											READY FOR CORING @ 10'

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Lithology Log (continued) Sheet 2 of 7 RMR

LOCATION ID: RY-RD-02

Depth	Interval	Recovery	~~Water Content~~	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	~~Lithology~~	~~Water Content~~ Jn	Estimate ~~% of~~ Jr ~~Gr.~~	Ja ~~Sa.~~	Jw ~~Fi.~~	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
10				ARGILLITE, W/ MANGANESE COATED FRACTURE FACES, SLIGHTLY MICACEOUS PURPLE		10'	6	2	3	0.66	BOX 1 RMR 10-15
							4	2	1		RQD (43/63) 15-17'3" (FAIR)
11				-- PURPLE SHALY LENSES 11½-12'		(100%)					
12				-- COLOR BECOMES BROWNISH YELLOW @ ~12'		CORE RUN 1					
13				-- VERTICAL JOINT FRACTURE LINED WITH DARK YELLOWISH BROWN CLAY 13-14'							
				-- COLOR BECOMES PURPLE @ ~13½'							
14				-- COLOR BECOMES BROWNISH YELLOW @ ~14'							
15						15'3"					PURPLE SEAMS CORE FASTER THAN YELLOWISH BROWN SEAMS
				-- COLOR ALTERNATES PURPLE & BROWNISH YELLOW SEAMS TO 18'							
16											
17						(100%)	6	3	4?	1	BOX 2 RMR 17'3"-22
											22-24
											RQD 45/81 (FAIR)
18				18'-19½' QUARTZITE, MANGANESE & IRON STAINED FRACTURES, BROWNISH YELLOW							
19				19½'-25½' QUARTZITE, MANGANESE & IRON STAINED FRACTURES, PURPLE		CORE RUN 2					
20				-- FRACTURED ZONE @ ~20'-23½'							
21											
22				-- ALTERATION ZONE 22'-23' WHITE COATED FRACTURES VUGS (< 3/4" Φ) LINED W/ V DK GRAY FINE CRYSTALS, 2 SEAMS							POOR ZONE OF ROCK QUALITY
23											

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Lithology Log (continued) Sheet 3 of 7

LOCATION ID: RY-RB-02

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	~~Water Content~~ Jn	Estimate ~~of~~ Jr ~~Gr~~	Va ~~Sa~~	~~Fr~~	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
23				-- THIN SEAMS OF MILKY QUARTZ SAND IN ARGILLITE MATRIX FROM ~23' - 25'							
24				-- ROCK QUALITY IMPROVES 24-28' (LESS FRACTURES/JOINTING)			6	1	1		BOX 3 RQD 71/96 (GOOD)
25				25½' - 31' QUARTZITE, MANGANESE & IRON STAINED FRACTURES, BROWN							
26											
27				-- MILKY QUARTZ SAND SEAM IN MATRIX @ ~27'; THICKNESS ~2"		CORE RUN 2					
28											
29											
30				-- FRACTURE ZONE 30 - 34' (POOR ROCK QUALITY)		30'3"	15	1	1		30 - 35' RQD 21/60 (POOR) DRILLER OBSERVED THAT HOLE IS PRODUCING WATER BETWEEN 30 & 43.5 FT ESTIMATES FLOW TO BE <1 gpm
31				31' - 45' QUARTZITE, MANGANESE & IRON STAINED FRACTURES, PURPLE							
32				-- COLOR BECOMES GRAY @ ~32'							BOX 4 RQD 58/90 (FAIR)
33				-- COLOR BECOMES PURPLE @ ~33'		CORE RUN 3					
34				-- COLOR BECOMES BROWNISH GRAY @ ~34' -- SOME HEALED FRACTURES BETWEEN 34 - 40'							
35				-- MANGANESE COATING OF FRACTURES IS THICKER @ ~35' -- POSSIBLE VERTICAL SHEARING OBSERVED IN CORE @ FRACTURE FACE (PORTION SMOOTH & SLICKENSIDED)			6	2	2		35 - 43½ RQD 92/102 (EXCELLENT) SLICKENSIDE IS ~1" x ½"
36											

'12 7 84

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Lithology Log (continued)

Sheet 4 of 7

LOCATION ID: RY-RB-02

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	~~Water Content~~ Jn	Estimate ~~% of~~ Jr ~~Gr~~	Jc ~~Sa~~	~~Fi~~	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
36				-- ALTERN NG SEAMS OF PURPLE & PALE GRN @ ~36'-42'							
37						%					
38											
39				-- SHALY LENSES, PURPLE @ ~39' QUARTZITE? FROM ~39½-40½'		CORE RUN 3 (RECOVERY					
40											
41											
42				-- COLOR BECOMES DARK BROWNISH YELLOW @ ~42' -- MILKY QUARTZ & MANGANESE LENS @ ~42½'							
43				-- COLOR IS MOTTLED DARK BROWNISH YELLOW & DARK GRAY @ ~43'							43½ - 45 RQD 12/18 (FAIR)
						43½	3	2	1		43½' END OF RUN 3
44						%					
45				45-46 QUARTZ, FRACTURED, WITH IRON STAINING, & BLACK COATING ON FRACTURE FACES, DARK BROWNISH YELLOW, BLACK, AND WHITE POOR RECOVERY OF THIS LAYER (1")		CORE RUN 4 (RECOVERY					-- ROCK CHIPS OCCASIONALLY THROWN TO SURFACE WHILE DRILLING; FRACTURED BEDROCK (QUARTZ LAYER)
46				QUARTZITE, MANGANESE AND IRON STAINED FRACTURES, BROWNISH PINK HEALED FRACTURES ARE MANGANESE AND IRONSTAINED 46'-			6	2	0.75		RUN 4 RECOVERY 14'2"/15' 46 - 58½ RQD 13/150 (FAIR) BETTER ROCK QUALITY AFTER 46'
47											
48											
49				-- COLOR BECOMES GREENISH GRAY @	~49'						

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Lithology Log (continued) Sheet 5 of 7

LOCATION ID: RY-RB-02

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
49											
50				-- COLOR BECOMES BROWNISH PINK @ ~50½'							
51				-- COLOR BECOMES GRAYISH GREEN @ ~51'							-- CORING BROKE THE CORE INTO PIECES @ A JOINT @ 51' (BREAKS LOOK FRESH)
52				-- COLOR BECOMES BROWNISH PINK @ ~51½'							
				-- COLOR BECOMES GRAYISH GREEN @ ~52½'							
53											
54				-- COLOR BECOMES BROWNISH PINK @ ~54½'							
55				-- COLOR BECOMES GRAYISH GREEN @ ~55½'		CORE RUN 4					
56				-- COLOR BECOMES BROWNISH PINK @ ~56½'							
57				-- COLOR BECOMES GRAYISH GREEN @ ~57'							
				-- COLOR BECOMES BROWNISH PINK @ 57½'							
58						58½					END OF DRILLING 8/28/12
59				-- COLOR IS GRAYISH GREEN 59½-60'			4	3	2		START OF DRILLING ON 8/29, DRILLER OBSERVED ~20' OF WATER IN HOLE, CLEARED W/ AIR
60						CORE RUN 5					CORE RUN 5 RECOVERY 100% RQD 163½/165 (EXCELLENT)
61											RMR FOR 58½' - EOD
62											

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Lithology Log (continued)

Sheet 6 of 7 RMR

LOCATION ID

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
62											
63				--COLOR IS GRAYISH GREEN 63½-65'							
64											
65											
66											
67											
68						CORE RUN 5 100% RECOVERY					
69				--COLOR IS GRAYISH GREEN 69'-69½'							
70											
71				--COLOR IS GRAYISH GREEN 71-74½'							
72											
73						73½					
74						CORE RUN 6					3'4" RQD = 32½"/40" (GOOD)
75											

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Lithology Log (continued) Sheet 7 of 7

LOCATION ID: RY-12B-02

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	~~Water Content~~ Jn	Estimate ~~% of~~ ~~Gr~~ Jr	~~Sa~~ Ja	~~Fi~~ Jw	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
75				-- NEAR VERTICAL FRACTURE FACE IS IRON STAINED & COATED WITH BLACK SULFIDE (?)		CORE RUN 6					
76											
77				TOTAL DEPTH 76' 10" END OF DRILLING (EOD)							
78											
79											
80											RQD SUMMARY
81											15-17'3" 43/63 FAIR 17'3"-24 45/81 FAIR 22-23 POOR 24- 71/96 GOOD BOX 3 30-35 21/60 POOR 58/90 FAIR BOX 4
82											35-43½ 92/102 EXCELLENT 43½-45 12/18 FAIR 45-46 0/12 POOR 46-58½ 133/150 FAIR
83											
84											58½-73½ 163½/165 EXCELLENT 73½-76'10" 32½/40 GOOD
85											
86											
87											
88											

APPENDIX D3

RY-RB-03

APPENDIX D3. RY-RB-03 BEDROCK CORE EVALUATION
BLACK PINE MINE

Bedrock was encountered at a depth of 7 feet bgs and coring began at a depth of 8 feet bgs. The bedrock quality was very poor to 13 feet bgs based on RQD values. The number of joint patterns was two plus a random joint set. The joint roughness was rough/irregular with undulating, slightly altered joint faces. The bedrock from 7 feet to 11.5 feet bgs is a highly fractured, vuggy, iron-stained, milky quartz layer that is an oxidized sulfide ore zone. A shear zone was also observed from 9 feet to 11 feet bgs. Shear zones are commonly associated with oxidized sulfide ore zones.

The RQD varied from fair to good between 13 feet and 52 feet bgs, the bottom of the borehole. The number of joint patterns ranged from two plus a random joint set to four or more joint sets. A crushed rock interval occurred from 17.5 feet to 23.25 feet bgs. Highly fractured zones occurred from 24.5 feet to 25 feet bgs, 28.5 feet to 29 feet bgs, and 30 feet to 34 feet bgs. Slickensided fracture faces were observed at 22 feet bgs between the crushed rock and upper fracture zone. The joint roughness ranged from smooth to rough/irregular and the joint faces ranged from planar to undulating. The majority of the joint faces were observed to be undulating. The alterations of the joint faces ranged from having slightly altered joints to silty or sandy-clay coated joint faces. The interval from 23 feet to 24 feet bgs contained a soft clayey fracture coating.

Overall, this location is situated on a low ridge at the northern end of the proposed repository. The top bedrock oxidized sulfide ore layer was significantly different than the quartzite or argillite observed in the other boreholes. Exposure of this layer can create acid rock drainage (ARD). The remaining portion of the recovered core was also fractured and contained occasional metalliferous veinlets and veins with a few small vugs. This borehole is near the Combination vein outcrop (Figure 3-2), and the veins and oxides in the core are likely associated with it. This borehole is also the closest to the Mill Gulch Fault (Figures 2-9 and 3-2).

Core Drill Log

Trihydro Corporation

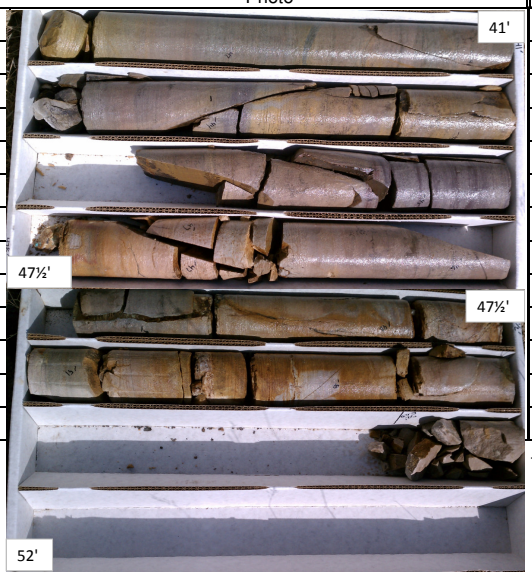
Site: Black Pine Mine Repository 2 Investigation
Hole ID: RY-RB-03

Location: Repository 2
Collar Easting: 994,569
Northing: 826,164
Elevation: 6,350

TD: 52 feet
Water Level: First: --- Final: ---

Date Start: 9/6/2012 Date complete: 9/6/2012
3" diameter core
Driller: Boland Drilling, Gardner-Denver, Rig D-1, air rotary
Logged by: Tom Smith

Hole FT	Description	Core Run	Recov. inches	RQD	RMR Estimate Jn	Jr	Ja	Hole FT
0	**0-2" Duff** and topsoil							0
	2"-4' Sandy Gravely Silt, with cobbles, trace organics, light brown, dry							
	4'-7' Highly Fractured Quartzite, soft, dark yellowish							
5	brown. Rock becomes harder @ ~6'							5
	7'-11½' Milky Quartz, massive, with iron and gossan seams, highly fractured, vuggy, dark yellow brown and white (oxidized ore zone)							
	-- shear zone 9'-11'	1	55	25%	6	3	2	
10	**Rock Bit - Start of coring at 8'**							10
	11½'-35½' Quartzite, iron stained, fractured, brownish pink, and dark yellowish brown, slightly micaceous				6	3	2	
	Fractures are healed and lined with milky quartz; newer							
	fractures occur across the quartz lined fractures, iron	2	136	65%				
15	stained fractures.							15
	-- milky quartz & iron staining/gossan veinlet @ ~ 16½'							
	-- iron staining of core decreasing @ 16½' & color is mainly brownish pink				9	3	3	
	-- becomes highly fractured diagonally across core axis from ~17½' - 23¼'				20	1	1	
20	-- alternating brownish pink & gray layers from 20' - 28'				12	0.5	2	20
	-- manganese staining on fractures							
	-- chrysocolla (copper) coating on fractures. Colors include light green, yellow, light gray, and blue from 21' - 25'				12	1	4	
	-- slickenside fractures at 22'				15	1.5	1	
25	-- highly fractured from ~ 24½' - 25'				9	1.5	2	25
	-- color becomes brownish yellow from 24½' - 25½'	3	65	51%				
	-- iron staining of core more prevalent & color becomes dark brownish yellow @ ~27½' - 28½'				15	1.5	2	
	-- highly fractured with heavier iron & manganese coating				9	1.5	1	
30	of fractures from ~ 28½' - 29'				15	3	2	30
	-- highly fractured from 30' - 34'							
	-- heavy manganese & sulfide (?) coating on diagonal fractures from ~ 33½' - 35'							
	-- rock quality improves @ ~ 34'	4	82	62%	6	1.5	2	
35								35
	35½' - Quartzite, manganese & iron coated fractures, gray							
	-- heavily iron stained milky quartz vein (1"t); color changes to dark brownish yellow from 37½' - 38'				6	1.5	2	
	-- color changes to gray from 38½' - 41'							

Photo	Hole FT	Description	Core Run	Recov. inches	RQD	RMR Estimate Jn	Jr	Ja	Hole FT
	40	-- heavy manganese coating on fractures @ ~ 39½' - 41½'							40
			5	139	83%	6	2	3	
						6	1	3	
		-- purple argillite veinlets from 44½' - 45'							
	45								45
		-- color becomes brownish yellow from 47' - 51'							
		-- quartz veinlet with chrysacolla speckles @ ~ 47½'							
		-- zone of healed fractures & heavy manganese							
	50	coating on fractures from 48' - 49'							50
		-- 1" thick iron stained milky quartz vein @ ~ 50½'							
	52	-- color becomes greenish gray @ ~ 51'							52
	T.D.	**End Of Drilling at 52'**							T.D.

Trihydro CORPORATION

Lithology Log

Sheet 1 of 5

LOCATION ID
RM-RB-03

Project Name	Project Number	Site ID
Black Pine Mine Repository 2 Investigation	776-012-004/5	BPM

Drilling Company	Driller	Ground Elevation	Total Drilled Depth
Boland Drilling	Chris Boland Jr TRONOX		52 feet-bgs

Drilling Equipment	Drilling Method	Borehole Diameter	Date/Time Drilling Started	Date/Time Total Depth Reached
D-1 GARDNER DENVER AIR ROTARY RIG	AIR ROTARY	6 inches	9/6/12 8:10	9/6/12

Type of Sampling Device	Water Level (bgs)
3" Ø CORE BARREL 15' L	First ___ feet-bgs Final

Sample Hammer	Geological Engineer/Hydrogeologist	Checked by/Date
Type Driving Weight Drop	Tom Smith, PE, PG	

Location Description (include sketch in field logbook)

ON THE RIDGE BETWEEN THE POWER LINE SPLIT (RMR ESTIMATE

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Jn ~~Water Content~~	~~Estimate % of~~ Jr ~~Gr~~	Ja ~~Sa~~	w ~~Fi~~	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0-2" DUFF AND TOPSOIL 2"-4' SANDY GRAVELLY SILT, WITH COBBLES, TRACE ORGANICS, LIGHT BROWN, DRY							USING TRI-CONE BIT, AT 6' LOSING ~1/2 OF THE AIR PRESSURE TO CLEAR CUTTINGS FROM HOLE. MOVED ~10' NORTH ON THE DRILL PAD & TRIED AGAIN. MOVING WORKED. STEEL CASING SET TO 8' AND STARTED CORING.
1											
2											
3											
4				4'-7' HIGHLY FRACTURED QUARTZITE, SOFT, DARK YELLOWISH BROWN							
5											
6				-- ROCK BECOMES HARDER @ ~6'							
7				7-11 1/2' MASSIVE MILKY QUARTZ WITH IRON AND GOSSAN SEAMS, HIGHLY FRACTURED, VUGGY, DARK YELLOWISH BROWN AND WHITE (OXIDIZED ORE ZONE)							
8						CORE RUN 1	6	3	2		RQD 8-11 1/2' = 8"/42"
9				-- SHEAR ZONE ~9' & 11'							
10											DRILLING WATER IS DARK YELLOWISH BROWN (ORANGE)

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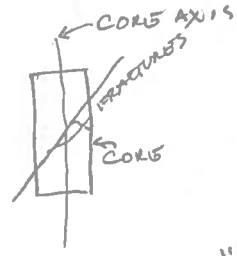
Lithology Log (continued) Sheet 2 of 5

LOCATION ID: RY-RB-03

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content Jn	Estimate of RMR Estimate Jr Gr	Ja Sa	Jw Fl	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
10											DRILL WATER IS ALTERNATING BETWEEN DARK YELLOWISH BROWN AND YELLOW FROM CUTTINGS.
11						CORE RUN 1					
12				11½ - 35½' IRON STAINED QUARTZITE, FRACTURED, BROWNISH PINK AND DARK YELLOWISH BROWN, SLIGHTLY MICACEOUS (CAN SCRATCH WITH A KNIFE) FRACTURES ARE HEALED AND LINED WITH MILKY QUARTZ; NEWER FRACTURES OCCUR ACROSS THE QUARTZ LINED FRACTURES, IRON STAINED FRACTURES			6	3	2	1	CORE RUN 1 OF 5' TO CHECK ROCK AND RECOVERY RECOVERY = 55"/60" RQD = 15/60 (POOR) RQD 11½ - 17' = 29"/66"
13											--WHILE DRILLING ROCK QUALITY APPEARS TO IMPROVE AT ~13' (LESS FRACTURED & BROKEN)
14											
15				--MILKY QUARTZ, IRON STAINING/GOSSAN VEINLET AT ~15.3'							CORE RUN 2 OF 12' RECOVERY = 136/144 RQD = 94/144
16											NO CORE IN BARREL PHOTOS TAKEN
17				--MILKY QUARTZ & IRON STAINING/GOSSAN VEINLET @ ~16½'; IRON STAINING OF CORE DECREASING @ ~16½' & COLOR IS MAINLY BROWNISH PINK. --BECOMES HIGHLY FRACTURED FROM ~17½'-23¼' FRACTURES OCCUR DIAGONALLY ACROSS THE CORE AXIS		CORE RUN 2	9	3	3		
18											
19							20	1	1		RQD 17'-21' = 38"/48"
20				--ALTERNATING BROWNISH PINK AND GRAY LAYERS FROM ~20'-~28' MANGANESE STAINING ON FRACTURES			12	0.5	2		
21				--CHRYSOCOLA (COPPER) COATING ON FRACTURES FROM 21'-25' COATING COLORS INCLUDE LIGHT GREEN, YELLOW, LIGHT GRAY, BLUE							RQD 21'-25' = 21/48"
22				--SLICKENSIDE FRACTURES @ ~22'							
23											

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Lithology Log (continued)

Sheet 3 of 5

LOCATION ID: RY-R13-03

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
23						CORE RUN 2	12	1	4	1	
24				-- HIGHLY FRACTURED FROM ~24¼'-25'			15	1.5	1	1	
				-- COLOR BECOMES BROWNISH YELLOW FROM ~24½'-25½'							
25						25'	9	1.5	2	1	CORE RUN 3 = 8' RECOVERY = 65" RQD = 49"/96" (FAIR)
26											RQD 25'-29' = 32"/48"
27				-- IRON STAINING OF CORE MORE PREVALENT & COLOR BECOMES DARK BROWNISH YELLOW FROM 27½'-28½'		CORE RUN 3					
28							15	1.5	2	1	
				-- HIGHLY FRACTURED FROM ~28½'-29' WITH HEAVIER IRON AND MANGANESE COATING OF FRACTURES							
29							9	1.5	1	1	RQD 29'-34' = 16"/60"
30				-- HIGHLY FRACTURED FROM ~30'-34'			15	3	2	1	
31											
32											
33						33'					CORE RUN 4 = 7' RECOVERY 6'10" = 82"
				-- HEAVY MANGANESE & SULFIDES(?) COATING ON DIAGONAL FRACTURES FROM ~33½'-35'							
34				-- ROCK QUALITY IMPROVES @ ~34'		CORE RUN 4	6	1.5	2	1	RQD = 52"/84" RQD 34'-40' = 52"/72"
35				35½' - QUARTZITE, MANGANESE & IRON COATED FRACTURES, GRAY							
36											

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Lithology Log (continued)

Sheet 4 of 5

LOCATION ID: RY-RB-03

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate ~~% of~~ Gr	Ba	Fr	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
36											
37				-- HEAVILY IRON STAINED MILKY QUARTZ VEIN (1" THICK) @ ~ 37½', COLOR CHANGES TO DARK BROWNISH YELLOW FROM ~ 37½ - 38'		CORE RUN 4	6	1.5	2	1	
38				-- COLOR CHANGES TO GRAY FROM 38½' TO 41'							
39				-- HEAVY MANGANESE COATING ON FRACTURES @ ~ 39½' - 41½'							
40						40'	6	2	3	1	CORE RUN 5 = 12' RECOVERY = 139/144 11'7" RQD = 120/144
41											
42						CORE RUN 5					
43							6	1	3	1	
44				-- PURPLE ARGILLITE VEINLETS FROM 44½ - 45'							
45											
46											
47				-- COLOR BECOMES BROWNISH YELLOW FROM ~ 47 - 51'							
48				-- QUARTZ VEINLET W/ CHRYSACOLA SPOTS @ ~ 47½' -- ZONE OF HEALED FRACTURES AND HEAVY MANGANESE COATING ON FRACTURES FROM 48' - 49'							
49											

Trihydro CORPORATION

Lithology Log (continued)

Sheet 5 of 5

LOCATION ID: RY-RB-03

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate ~~% of~~ Jr ~~Gr~~	Ja ~~Sa~~	~~Fi~~	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
49											
50				-- 1" THICK IRON STAINED MILKY QUARTZ VEIN @ ~ 50½'		CORE RUN 5					
51				-- COLOR IS BROWISH GREENISH GRAY @ ~ 51'							
52				TOTAL DEPTH 52' END OF DRILLING (EOD)		52'					
53											
54											
55											
56											
57											
58											
59											
60											
61											
62											

APPENDIX D4

RY-RB-04

APPENDIX D4. RY-RB-04 BEDROCK CORE EVALUATION
BLACK PINE MINE

Bedrock was not cored in this borehole as the depth to bedrock, 120.5 feet bgs, was deeper than available casing (45 feet) to keep the borehole from sloughing during coring operations.

Core Drill Log

Trihydro Corporation

Site: Black Pine Mine Repository 2 Investigation
Hole ID: RY-RB-04

Location: Repository 2
Collar Easting: 994,023
Northing: 825,804
Elevation: 6,316

TD: 122 feet
Water Level: First: --- Final: ---

Date Start: 9/5/2012 Date complete: 9/5/2012
3" diameter core
Driller: Boland Drilling, Gardner-Denver, Rig D-1, air rotary
Logged by: Tom Smith

Photo	Hole FT	Description	Core Run	Recov. inches	RQD	RMR Estimate Jn	Jr	Ja	Hole FT
Photo of cuttings after drilling	0	**0-2" Duff and Topsoil**							0
		2"-3' Silt and Gravel, with sand, trace organics and cobbles, dry, light brown							
		3'-9' Lean Clayey Gravel, with sand, trace cobbles,							
	5	moist, dark yellowish brown, very dense							5
		-- the lean clay is slightly overconsolidated							
		9'-17' Gravelly Lean Clay, with sand, very stiff, moist,							
	10	dark yellowish brown							10
	15								15
		17'- 120.5' Lean Clayey Gravel, with sand and cobbles, moist, dark yellowish brown							
	20								20
	25								25
		-- soil becomes drier and firmer from ~ 29'-37'							
	30								30
	35								35
		-- soil becomes more moist from ~ 37'-45'							
	40								40
	45	-- soil becomes drier and firmer from ~ 45' -							45
	49								

Photo	Hole FT	Description	Core Run	Recov. inches	RQD	RMR Estimate Jn	Jr	Ja	Hole FT
	50	**17'- 120.5' Lean Clayey Gravel**, with sand and cobbles, moist, dark yellowish brown							50
	55								55
	60								60
	65								65
	70								70
	75								75
	80								80
	85								85
	90								90
	95								95
	100	-- drill rig bucking occasionally from ~ 101' - 110'							100
	105								105

Photo	Hole FT	Description	Core Run	Recov. inches	RQD	RMR Estimate Jn	Jr	Ja	Hole FT
	106	**17'- 120.5' Lean Clayey Gravel**, with sand and							106
		cobbles, moist, dark yellowish brown							
	110								110
	115								115
		-- harder drilling at ~ 116'							
	120	-- very hard drilling at ~ 120.5'							120
		120.5' - Quartzite, brownish yellow							
	122								122
	T.D.	**End Of Drilling at 122'**							T.D.

Trihydro CORPORATION

Lithology Log

Sheet 1 of ___

LOCATION ID: RY-RB-04

Project Name: Black Pine Mine Repository 2 Investigation	Project Number: 776-012-005		Site ID: REPOSITORY 2
Drilling Company: Boland Drilling	Driller: CHRIS BOLAND, JR (TRUNOR)	Ground Elevation:	Total Drilled Depth: 122 feet-bgs
Drilling Equipment: D-1 GARDNER DENVER AIR ROTARY RIG	Drilling Method: AIR ROTARY	Borehole Diameter: 6 inches	Date/Time Drilling Started: 9/5/12 9:00
			Date/Time Total Depth Reached: 9/5/12 4:30
Type of Sampling Device: NONE		Water Level (bgs): First ___ feet-bgs	Final
Sample Hammer: Type / Driving Weight / Drop		Geological Engineer/Hydrogeologist: Tom Smith, PE, PG	Checked by/Date

Location Description (include sketch in field logbook): LOCATION MOVED UPHILL OF POWERLINE & ROAD

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0-2" DUFF/TOPSOIL							
				2"-3' SILT AND GRAVEL, WITH SAND, TRACE ORGANICS & COBBLES, DRY, LIGHT BROWN							
1											
2											
3				3'-9' LEAN CLAYEY GRAVEL WITH SAND, TRACE COBBLES, MOIST, DARK YELLOWISH BROWN, VERY DENSE							PLASTIC MAY BE DIFFICULT TO SCREEN THE LEAN CLAY FROM THE COBBLES. THE LEAN CLAY IS SLIGHTLY OVERCONSOLIDATED.
4											
5											
6											
7											
8											
9				9-17 GRAVELLY LEAN CLAY, WITH SAND, VERY STIFF, MOIST DARK YELLOWISH BROWN							
10											

Trihydro CORPORATION

Lithology Log (continued) Sheet 2 of ___

LOCATION ID: RY-RB-04

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	~~Water Content~~ Jn	Estimate % of ~~Gr~~ Jr	~~Sa~~ Ja	~~Fi~~ Jw	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
10											
11											
12											
13											
14											
15											
16											CASING SET TO 17'
17				17- LEAN CLAYEY GRAVEL, WITH SAND AND COBBLES, MOIST, DARK YELLOWISH BROWN							CORE RUN 1 17'-31', MUST HAVE HAMMERED ON A LARGE COBBLE AT 17', RECOVERY OF 2" & BIT ADVANCED QUICKLY SO STILL IN LEAN CLAY LAYER WILL TRY TRICONE & ADVANCE CASING UNTIL BEDROCK IS REACHED. -- HOLE CAVED TO 19', SHUT DOWN ~ 1140 - CHRIS GOING TO MAKE A CALL FOR 1 DGAS. OFFSET ~ 10' SW OF HOLE & TRYING AGAIN (MY 1 AGA) THIS LAYER APPEARS EASIER TO SCREEN THAN THE 3'-17' LAYER.
18											
19											
20											
21											
22											
23											

Trihydro CORPORATION

Lithology Log (continued) Sheet 3 of ___

LOCATION ID: RY-RB-04

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
23											
24											
25											
26											
27											
28											
29				-- SOIL BECOMES DRIER AND FIRMER FROM ~29 - 37'							
30											
31											
32											
33											
34											
35											
36											

Trihydro CORPORATION

Lithology Log (continued) Sheet 4 of ___

LOCATION ID: RY-RB-04

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
36											
37				-- SOIL BECOMES MORE MOIST FROM ~37' TO 45'							
38											
39											
40											
41											
42											
43											
44											
45				-- SOIL BECOMES DRIER AND FIRMER FROM ~45'-							
46											
47											
48											
49											

Trihydro CORPORATION

LOCATION ID

Lithology Log (continued)

Sheet 5 of ___

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
49											
50											
51											
52											
53											
54											
55											
56											
57											
58											
59											
60											
61											
62											

Trihydro CORPORATION

Lithology Log (continued)

Sheet 6 of ___

LOCATION ID: R4-RB-04

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
62											
63											
64											
65											
66											
67											
68											
69											
70											
71											
72											
73											
74											
75											

Trihydro CORPORATION

Lithology Log (continued)

Sheet 7 of ___

LOCATION ID: R4-RB-04

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
75											
76											
77											
78											
79											
80											
81											
82											
83											
84											
85											
86											
87											
88											

Trihydro CORPORATION

Lithology Log (continued)

Sheet 8 of ___

LOCATION ID: RY-RB-04

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Water Content	Estimate % of Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
88											
89											
90											
91											DRILL RIG BUCKING FROM 101 – 110 OCCASSIONALLY
92											HARDER DRILLING @ ~116' VERY HARD DRILLING @ ~120½'
93											FROM THE ROCK CHIPS BEING EJECTING FROM THE BOREHOLE, BEDROCK APPEARS TO BE BROWNISH YELLOW QUARTZITE (4:20)
94											TOP OF BEDROCK 120½'
95											BOB 122' (4:35)
96											
97											
98											
99											
100											
101											

APPENDIX D5

RY-RB-05

APPENDIX D5. RY-RB-05 BEDROCK CORE EVALUATION
BLACK PINE MINE

Bedrock was encountered at a depth of 16 feet bgs. The bedrock quality ranged from very poor to poor down to a total depth of 46 feet bgs based on RQD values. The number of joint patterns ranged from two joint sets up to multiple joint sets that produced crushed rock. More than half of the core run in this depth interval contained three or more joints sets. The joint roughness ranged from smooth to rough and the joint faces ranged from planar to undulating. The alterations of the joint faces ranged from surface stained joints to silty or sandy-clay coated joint faces. In three narrow zones where the bedrock was crushed or soft, at 32.5 feet, 34 feet, and 37 feet bgs, the joint alterations included bands of silty or sandy clay on the joints or softening clay on the joints.

Overall, the bedrock can generally be described as highly fractured. The recovered core contained occasional seams of silty sand, sand, argillite, or crushed/soft zones. The crushed and soft zones could be fault zones; however, no slickensided fracture faces were observed.

Core Drill Log

Trihydro Corporation

Site: Black Pine Mine Repository 2 Investigation
Hole ID: RY-RB-05

Date Start: 9/4/2012 Date complete: 9/4/2012
3" diameter core
Driller: Boland Drilling, Gardner-Denver, Rig D-1, air rotary
Logged by: Tom Smith

Location: Repository 2
Collar Easting: 993,348
Northing: 825,665
Elevation: 6,300

TD: 46 feet
Water Level: First: --- Final: ---

Photo	Hole FT	Description	Core Run	Recov. inches	RQD	RMR Estimate Jn	Jr	Ja	Hole FT
	0	**0-2" Duff**							0
		2"-2.5' Sandy Silt, with gravel, trace organics and cobbles,							
		dry, light brown							
		2.5'-16' Lean Clayey Gravel, with sand and cobbles, dark							
		yellowish brown, moist							
	5								5
	10								10
	15	**No Recovery 0' - 16'**							15
		Rock Bit - Start of coring at 16'							
16' 31'		**16'- Quartzite,** highly fractured, with iron and manganese	1	64	20%				
		coated fractures, brownish yellow				15	3	2	
		-- color becomes brownish gray from ~18' - 19'							
	20	-- color becomes brown @ ~19'							20
		-- color becomes grayish brown @ ~21'							
		-- color becomes dark gray @ ~24'							
		-- color alternates between seams of brownish gray & pink				12	3	3	
	25	from 25' - 26'. Color becomes brownish gray @ ~ 26'.				6	3	3	25
		-- ½" thick silty sand seam, purplish brown @ ~27'							
		-- color becomes brownish green from 27.5' - 28'				15	1	2	
		-- dark purple, slightly micaceous, argillite seam @ ~ 28'	2	70	29%	12	3	2	
		-- color becomes gray at 28½'; greenish gray @ ~ 29'							
	30	-- color becomes dark yellowish brown @ ~29½'							30
31' 40'		-- color alternates from dark brownish gray to brown from				6	1	1	
		30-31½'; color becomes brownish pink at 31¼'				20	1	5	
		-- color alternates between seams of gray & brownish				6	4	1	
		pink from 32' - 32½'				20	1	5	
	35	-- 4" thick seam of highly broken core @ ~ 32½' with				15	1	1	35
		thin rows of sand grains	3	43	27%	15	1	3	
		-- soft section (4" thick) of core (breaks to fine sand) @ ~ 34'				20	1	8	
		-- color becomes grayish green from 37'-37½' where core is				6	3	2	
		fractured diagonal to core axis. Upper portion is crushed				20	3	2	
40' 46' HX-HO DIVIDER	40	& lower portion is pinkish gray in color				6	3	2	40
		-- color becomes pink @ ~ 38'	4	15	0%				
						4	3	1	
						15	1	2	
	45								45
		-- color becomes green @ ~ 45½'	5	12	0%				
	T.D.	**End Of Drilling at 46'**							T.D.

Trihydro CORPORATION

Lithology Log

Sheet 1 of 4

LOCATION ID: RY-RB-05

Project Name: Black Pine Mine Repository 2 Investigation	Project Number: 776-012-005		Site ID: REPOSITORY 2
Drilling Company: Boland Drilling	Driller: CHRIS BOLAND, JR (TRENCH)	Ground Elevation: -1' FOR CUTTING DRILL PAD	Total Drilled Depth: 46 feet-bgs
Drilling Equipment: D-1 GARDNER DENVER AIR ROTARY RIG	Drilling Method: AIR ROTARY	Borehole Diameter: 6 inches	Date/Time Drilling Started: 9/4/12 9:00
			Date/Time Total Depth Reached: 9/4/12 4:15
Type of Sampling Device: 3" Ø CORE BARREL 15'L		Water Level (bgs): First __ feet-bgs	Final
~~Sample Hammer~~ Type / Driving Weight / Drop		Geological Engineer/Hydrogeologist: Tom Smith, PE, PG	Checked by/Date

Location Description (include sketch in field logbook): WEST OF THE POWER LINE & LOWER IN ELEVATION

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	~~Water Content~~	~~Estimate % of~~ (RMR ESTIMATE) Gr	Sa	Fi	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
0				0-2" DUFF 2"-16' SANDY SILT W/ GRAVEL, TRACE ORGANICS & COBBLES, DRY, LIGHT BROWN							
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											

Trihydro CORPORATION

Lithology Log (continued) Sheet 2 of 4

LOCATION ID: RY-RB-05

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	~~Water Content~~ Jn	~~Estimate % of~~ ~~Gr~~ Jr	~~Sa~~ Ja	~~Fi~~	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
10											
11											
12											
13											
14											
15				SET CASING TO 16' START OF CORING							
16				16'– QUARTZITE, HIGHLY FRACTURED, WITH IRON AND MANGANESE COATED FRACTURES, BROWNISH YELLOW		CORE RUN 1					CORE RUN 1 16'-27' RECOVERY 64"/11' RQD = 27"/11' (VERY POOR)
17											
18				--COLOR BECOMES BROWNISH GRAY FROM ~18'-19'			15	3	2		
19											
20				--COLOR BECOMES BROWN @ ~20'							
21				--COLOR BECOMES GRAYISH BROWN @ ~21'							
22											
23											

Trihydro CORPORATION

Lithology Log (continued) Sheet 3 of 4

LOCATION ID: RM-RB-05

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Jn ~~Water Content~~	Estimate % of: Jr ~~Gr~~	Ja ~~Sa~~	~~Fi~~	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
23											
24				-- COLOR BECOMES DARK GRAY @ ~ 24'			12	3	3		
25				-- COLOR ALTERNATES BETWEEN SEAMS OF BROWNISH GRAY AND PINK FROM 25'-26'		CORE RUN 1	6	3	3		
26				-- COLOR BECOMES BROWNISH GRAY @ ~ 26'							
27				-- ~ ½" THICK SILTY SAND SEAM, PURPLISH BROWN @ ~ 27'		27	15	1	2		CORE RUN 2: 8' RECOVERY: 5' 10" RQD = 28"/96" (POOR)
				-- COLOR BECOMES BROWNISH GREEN ~~FROM~~ 27½ - 28'							
28				-- DARK PURPLE, SLIGHTLY MICACEOUS ARGILLITE SEAM @ ~ 28'			12	3	2		
				-- COLOR BECOMES GRAY @ ~ 28½'							
29				-- COLOR BECOMES GREENISH GRAY FROM 28½ - 29'		CORE RUN 2					
				-- COLOR BECOMES DARK YELLOWISH BROWN @ ~ 29½							
30				-- COLOR ALTERNATES FROM DARK BROWNISH GRAY TO BROWN FROM 30 - 31½'							
31				-- COLOR BECOMES BROWNISH PINK @ ~ 31½'			6	1	1		
32				-- COLOR ALTERNATES BETWEEN SEAMS OF GRAY & DARK BROWNISH PINK FROM 32 - 32½			20	1	5		
33				-- 4" THICK SEAM OF HIGHLY BROKEN CORE (DOWN TO SAND & GRAVEL) @ ~ 32½' WITH THIN ROWS OF SAND GRAINS			6	4	1		
34				-- SOFT SECTION (4' THICK) OF CORE (BREAKS DOWN TO FINE SAND) @ ~ 34'			20	1	5		
35						35'	15	1	1		CORE RUN 3 5' RECOVERY 43" RQD = 16"/60" (POOR)
36						CORE RUN 3					

Trihydro CORPORATION

Lithology Log (continued) Sheet 4 of 4

LOCATION ID: RY-RB-05

Depth	Interval	Recovery	Blow Counts	Description (Include lithology, grain size, sorting, angularity, Munsell color name & notation, minerology, bedding, plasticity, density, consistency, etc., as applicable)	ASTM Code	Lithology	Jn ~~Water Content~~	Jr ~~Gr~~	Ja ~~Sa~~	~~Fi~~	Remarks (Include all sample types & depth, odor, organic vapor measurements, etc.)
36							15	1	3		
37				--COLOR BECOMES GRAYISH GREEN FROM ~37-37½ WHERE CORE IS FRACTURED DIAGONAL TO CORE AXIS. UPPER PORTION IS CRUSHED AND LOWER PORTION IS PINKISH GRAY IN COLOR			20	1	8		
38				-- COLOR BECOMES PINK @ ~38'		CORE RUN 3	6	3	2		
39							20	3	2		
40							6	3	2		CORE RUN 4: 5' RECOVERY 15" RQD: 0
41											
42						CORE RUN 4	4	3	1		
43											
44							15	1	2		
45				--COLOR BECOMES GREEN @ ~45½'		CORE RUN 5					--DRILL LOST CIRCULATION OF DRILLING FLUIDS AT ~45' --TRYING AGAIN WITH CORE RUN 5 - RECOVERY & CIRCULATION ARE NOT EXPECTED TO BE GOOD.
46				END OF DRILLING 46'							--HOLE CAVED ~1' & COULDN'T KEEP AIR PRESSURE OR WATER CIRCULATION, SINCE NOT ENOUGH CASING ON SITE TO INSTALL TO >45', HAD TO CALL AN END TO DRILLING AT THIS LOCATION. CHRIS DID NOT OBSERVE ANY IMPROVEMENT OF ROCK QUALITY. ROCK IS HIGHLY FRACTURED. 4:15 PM 9/4/12
47											
48											
49											

CORE RUN 5 = 1'
RECOVERY = 1'
RQD = 0

APPENDIX E

LABORATORY REPORTS

E1. TCLP LABORATORY ANALYTICAL REPORTS

E2. GEOCHEMICAL LABORATORY ANALYTICAL REPORTS

E3. GEOTECHNICAL LABORATORY REPORTS

E4. AGRONOMIC LABORATORY ANALYTICAL REPORTS

E5. RECLAMATION INVESTIGATION GEOTECHNICAL TESTING RESULTS

E6. RECLAMATION INVESTIGATION SOIL MOISTURE RESULTS

APPENDIX E1

TCLP LABORATORY ANALYTICAL REPORTS

ANALYTICAL SUMMARY REPORT

October 17, 2012

MT DEQ-Abandoned Mines
PO Box 200901
Helena, MT 59620-0901

Workorder No.: H12090110 Quote ID: H765 - Black Pine Mine 2012 sampling

Project Name: Black Pine Mine

Energy Laboratories Inc Helena MT received the following 7 samples for MT DEQ-Abandoned Mines on 9/10/2012 for analysis.

Sample ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
H12090110-001	CML-RCRA-08	09/07/12 9:45	09/10/12	Solid	Metals by ICP/ICPMS, Total Mercury, TCLP Digestion, Mercury by CVAA TCLP Extraction, Mercury TCLP Extraction, Non-volatiles
H12090110-002	CML-RCRA-07	09/07/12 10:00	09/10/12	Solid	Same As Above
H12090110-003	CML-RCRA-06	09/07/12 11:35	09/10/12	Solid	Same As Above
H12090110-004	CML-RCRA-05	09/07/12 11:30	09/10/12	Solid	Same As Above
H12090110-005	CML-GC-04	09/07/12 10:30	09/10/12	Soil	Metals by ICP/ICPMS, Total Mercury in Solid By CVAA Digestion, Total Metals Digestion, Mercury by CVAA
H12090110-006	CML-GC-05	09/07/12 11:15	09/10/12	Soil	Same As Above
H12090110-007	CML-GC-06	09/07/12 12:10	09/10/12	Soil	Same As Above

The analyses presented in this report were performed by Energy Laboratories, Inc., 3161 E. Lyndale Ave., Helena, MT 59604, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

CLIENT: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Sample Delivery Group: H12090110

Report Date: 10/17/12

CASE NARRATIVE

Tests associated with analyst identified as ELI-B were subcontracted to Energy Laboratories, 1120 S. 27th St., Billings, MT, EPA Number MT00005.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090110-001
Client Sample ID CML-RCRA-08

Report Date: 10/17/12
Collection Date: 09/07/12 09:45
DateReceived: 09/10/12
Matrix: Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TCLP EXTRACTABLE							
Arsenic	1.0	mg/L		0.5	5	SW6020	09/13/12 21:47 / eli-b2
Barium	ND	mg/L		10	100	SW6020	09/15/12 02:13 / eli-b
Cadmium	ND	mg/L		0.1	1	SW6020	09/13/12 21:47 / eli-b2
Chromium	ND	mg/L		0.5	5	SW6020	09/13/12 21:47 / eli-b2
Lead	1.5	mg/L		0.5	5	SW6020	09/13/12 21:47 / eli-b2
Mercury	ND	mg/L		0.002	0.2	SW7470A	09/12/12 14:43 / eli-b4
Selenium	ND	mg/L		0.1	1	SW6020	09/13/12 21:47 / eli-b2
Silver	ND	mg/L		0.5	5	SW6020	09/13/12 21:47 / eli-b2

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090110-002
Client Sample ID CML-RCRA-07

Report Date: 10/17/12
Collection Date: 09/07/12 10:00
DateReceived: 09/10/12
Matrix: Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TCLP EXTRACTABLE							
Arsenic	ND	mg/L		0.5	5	SW6020	09/13/12 21:50 / eli-b2
Barium	ND	mg/L		10	100	SW6020	09/15/12 02:16 / eli-b
Cadmium	ND	mg/L		0.1	1	SW6020	09/13/12 21:50 / eli-b2
Chromium	ND	mg/L		0.5	5	SW6020	09/13/12 21:50 / eli-b2
Lead	ND	mg/L		0.5	5	SW6020	09/13/12 21:50 / eli-b2
Mercury	0.018	mg/L		0.002	0.2	SW7470A	09/14/12 13:49 / eli-b4
Selenium	ND	mg/L		0.1	1	SW6020	09/13/12 21:50 / eli-b2
Silver	ND	mg/L		0.5	5	SW6020	09/13/12 21:50 / eli-b2

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090110-003
Client Sample ID CML-RCRA-06

Report Date: 10/17/12
Collection Date: 09/07/12 11:35
DateReceived: 09/10/12
Matrix: Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TCLP EXTRACTABLE							
Arsenic	ND	mg/L		0.5	5	SW6020	09/13/12 21:53 / eli-b2
Barium	ND	mg/L		10	100	SW6020	09/15/12 02:19 / eli-b
Cadmium	ND	mg/L		0.1	1	SW6020	09/13/12 21:53 / eli-b2
Chromium	ND	mg/L		0.5	5	SW6020	09/13/12 21:53 / eli-b2
Lead	1.3	mg/L		0.5	5	SW6020	09/13/12 21:53 / eli-b2
Mercury	ND	mg/L		0.002	0.2	SW7470A	09/12/12 14:57 / eli-b4
Selenium	ND	mg/L		0.1	1	SW6020	09/13/12 21:53 / eli-b2
Silver	ND	mg/L		0.5	5	SW6020	09/13/12 21:53 / eli-b2

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090110-004
Client Sample ID CML-RCRA-05

Report Date: 10/17/12
Collection Date: 09/07/12 11:30
DateReceived: 09/10/12
Matrix: Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TCLP EXTRACTABLE							
Arsenic	ND	mg/L		0.5	5	SW6020	09/13/12 21:56 / eli-b2
Barium	ND	mg/L		10	100	SW6020	09/15/12 02:22 / eli-b
Cadmium	ND	mg/L		0.1	1	SW6020	09/13/12 21:56 / eli-b2
Chromium	ND	mg/L		0.5	5	SW6020	09/13/12 21:56 / eli-b2
Lead	1.7	mg/L		0.5	5	SW6020	09/13/12 21:56 / eli-b2
Mercury	0.012	mg/L		0.002	0.2	SW7470A	09/14/12 13:56 / eli-b4
Selenium	ND	mg/L		0.1	1	SW6020	09/13/12 21:56 / eli-b2
Silver	ND	mg/L		0.5	5	SW6020	09/13/12 21:56 / eli-b2

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090110-005
Client Sample ID CML-GC-04

Report Date: 10/17/12
Collection Date: 09/07/12 10:30
DateReceived: 09/10/12
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
3050 EXTRACTABLE METALS							
Antimony	282	mg/kg		5		SW6010B	09/20/12 18:27 / sld
Arsenic	157	mg/kg		5		SW6010B	09/14/12 13:33 / sld
Barium	958	mg/kg		5		SW6010B	09/14/12 13:33 / sld
Cadmium	8	mg/kg		1		SW6010B	09/14/12 13:33 / sld
Chromium	25	mg/kg		5		SW6010B	09/14/12 13:33 / sld
Copper	2830	mg/kg		5		SW6010B	09/14/12 13:33 / sld
Iron	32900	mg/kg		5		SW6010B	09/14/12 13:33 / sld
Lead	910	mg/kg	D	6		SW6010B	09/14/12 13:33 / sld
Manganese	2630	mg/kg		5		SW6010B	09/14/12 13:33 / sld
Nickel	19	mg/kg		5		SW6010B	09/14/12 13:33 / sld
Silver	26	mg/kg		5		SW6010B	09/20/12 18:27 / sld
Zinc	288	mg/kg		5		SW6010B	09/14/12 13:33 / sld
METALS, TOTAL							
Mercury	110	mg/kg	D	50		SW7471A	09/18/12 12:58 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090110-006
Client Sample ID CML-GC-05

Report Date: 10/17/12
Collection Date: 09/07/12 11:15
DateReceived: 09/10/12
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
3050 EXTRACTABLE METALS							
Antimony	613	mg/kg	D	9		SW6010B	09/20/12 18:31 / sld
Arsenic	440	mg/kg		5		SW6010B	09/13/12 14:50 / sld
Barium	465	mg/kg		5		SW6010B	09/13/12 14:50 / sld
Cadmium	13	mg/kg		1		SW6010B	09/13/12 14:50 / sld
Chromium	13	mg/kg		5		SW6010B	09/13/12 14:50 / sld
Copper	2440	mg/kg		5		SW6010B	09/13/12 14:50 / sld
Iron	17600	mg/kg		5		SW6010B	09/13/12 14:50 / sld
Lead	2640	mg/kg		5		SW6010B	09/13/12 14:50 / sld
Manganese	184	mg/kg		5		SW6010B	09/13/12 14:50 / sld
Nickel	8	mg/kg		5		SW6010B	09/13/12 14:50 / sld
Silver	36	mg/kg		5		SW6010B	09/20/12 18:31 / sld
Zinc	323	mg/kg		5		SW6010B	09/13/12 14:50 / sld
METALS, TOTAL							
Mercury	110	mg/kg	D	49		SW7471A	09/18/12 13:00 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090110-007
Client Sample ID CML-GC-06

Report Date: 10/17/12
Collection Date: 09/07/12 12:10
DateReceived: 09/10/12
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
3050 EXTRACTABLE METALS							
Antimony	958	mg/kg	D	9		SW6010B	09/20/12 18:35 / sld
Arsenic	541	mg/kg		5		SW6010B	09/13/12 14:54 / sld
Barium	355	mg/kg		5		SW6010B	09/13/12 14:54 / sld
Cadmium	13	mg/kg		1		SW6010B	09/13/12 14:54 / sld
Chromium	6	mg/kg		5		SW6010B	09/13/12 14:54 / sld
Copper	2530	mg/kg		5		SW6010B	09/13/12 14:54 / sld
Iron	19800	mg/kg		5		SW6010B	09/13/12 14:54 / sld
Lead	3380	mg/kg		5		SW6010B	09/13/12 14:54 / sld
Manganese	210	mg/kg		5		SW6010B	09/13/12 14:54 / sld
Nickel	5	mg/kg		5		SW6010B	09/13/12 14:54 / sld
Silver	61	mg/kg		5		SW6010B	09/20/12 18:35 / sld
Zinc	524	mg/kg		5		SW6010B	09/13/12 14:54 / sld
METALS, TOTAL							
Mercury	120	mg/kg	D	50		SW7471A	09/18/12 13:03 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 10/17/12

Project: Black Pine Mine **Work Order:** H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.7									Analytical Run: ICP2-HE_120913B	
Sample ID: ICV	10	Initial Calibration Verification Standard							09/13/12 12:51	
Arsenic		0.768	mg/L	0.0092	96	90	110			
Barium		0.799	mg/L	0.10	100	90	110			
Cadmium		0.378	mg/L	0.0010	94	90	110			
Chromium		0.774	mg/L	0.010	97	90	110			
Copper		0.801	mg/L	0.010	100	90	110			
Iron		4.00	mg/L	0.030	100	90	110			
Lead		0.780	mg/L	0.013	98	90	110			
Manganese		3.97	mg/L	0.010	99	90	110			
Nickel		0.763	mg/L	0.010	95	90	110			
Zinc		0.783	mg/L	0.010	98	90	110			
Sample ID: ICSA	10	Interference Check Sample A							09/13/12 13:06	
Arsenic		-0.0117	mg/L	0.0092		0	0			
Barium		0.00179	mg/L	0.10		0	0			
Cadmium		0.00191	mg/L	0.0010		0	0			
Chromium		0.00764	mg/L	0.012		0	0			
Copper		-0.00148	mg/L	0.010		0	0			
Iron		187	mg/L	0.030	94	80	120			
Lead		0.0349	mg/L	0.013		0	0			
Manganese		-0.000740	mg/L	0.010		0	0			
Nickel		0.00440	mg/L	0.010		0	0			
Zinc		0.00827	mg/L	0.010		0	0			
Sample ID: ICSAB	10	Interference Check Sample AB							09/13/12 13:10	
Arsenic		1.05	mg/L	0.0092	105	80	120			
Barium		0.509	mg/L	0.10	102	80	120			
Cadmium		0.919	mg/L	0.0010	92	80	120			
Chromium		0.511	mg/L	0.012	102	80	120			
Copper		0.509	mg/L	0.010	102	80	120			
Iron		188	mg/L	0.030	94	80	120			
Lead		0.974	mg/L	0.013	97	80	120			
Manganese		0.475	mg/L	0.010	95	80	120			
Nickel		0.918	mg/L	0.010	92	80	120			
Zinc		1.01	mg/L	0.010	101	80	120			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 10/17/12

Project: Black Pine Mine **Work Order:** H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.7									Analytical Run: ICP2-HE_120914B	
Sample ID: ICV	10	Initial Calibration Verification Standard							09/14/12 10:03	
Arsenic		0.834	mg/L	0.0092	104	90	110			
Barium		0.800	mg/L	0.10	100	90	110			
Cadmium		0.397	mg/L	0.0010	99	90	110			
Chromium		0.810	mg/L	0.010	101	90	110			
Copper		0.816	mg/L	0.010	102	90	110			
Iron		4.02	mg/L	0.030	101	90	110			
Lead		0.809	mg/L	0.013	101	90	110			
Manganese		4.07	mg/L	0.010	102	90	110			
Nickel		0.810	mg/L	0.010	101	90	110			
Zinc		0.818	mg/L	0.010	102	90	110			
Sample ID: ICSA	10	Interference Check Sample A							09/14/12 10:18	
Arsenic		0.00116	mg/L	0.0092		0	0			
Barium		0.00113	mg/L	0.10		0	0			
Cadmium		0.00233	mg/L	0.0010		0	0			
Chromium		0.0149	mg/L	0.010		0	0			
Copper		0.00235	mg/L	0.010		0	0			
Iron		187	mg/L	0.030	93	80	120			
Lead		0.0369	mg/L	0.013		0	0			
Manganese		-0.000870	mg/L	0.010		0	0			
Nickel		0.00764	mg/L	0.010		0	0			
Zinc		0.00768	mg/L	0.010		0	0			
Sample ID: ICSAB	10	Interference Check Sample AB							09/14/12 10:22	
Arsenic		1.08	mg/L	0.0092	108	80	120			
Barium		0.513	mg/L	0.10	103	80	120			
Cadmium		0.877	mg/L	0.0010	88	80	120			
Chromium		0.483	mg/L	0.010	97	80	120			
Copper		0.522	mg/L	0.010	104	80	120			
Iron		187	mg/L	0.030	94	80	120			
Lead		0.940	mg/L	0.013	94	80	120			
Manganese		0.486	mg/L	0.010	97	80	120			
Nickel		0.912	mg/L	0.010	91	80	120			
Zinc		0.986	mg/L	0.010	99	80	120			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Report Date: 10/17/12
Project: Black Pine Mine
Work Order: H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.7									Analytical Run: ICP2-HE_120920B	
Sample ID: ICV	2	Initial Calibration Verification Standard							09/20/12 09:41	
Antimony		0.784	mg/L	0.050	98	90	110			
Silver		0.381	mg/L	0.0054	95	90	110			
Sample ID: ICSA	2	Interference Check Sample A							09/20/12 09:56	
Antimony		0.0108	mg/L	0.050		0	0			
Silver		0.0357	mg/L	0.0054		0	0			
Sample ID: ICSAB	2	Interference Check Sample AB							09/20/12 10:00	
Antimony		0.988	mg/L	0.050	99	80	120			
Silver		1.01	mg/L	0.0054	101	80	120			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 10/17/12

Project: Black Pine Mine **Work Order:** H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B										Batch: 17930
Sample ID: MB-17930	10	Method Blank				Run: ICP2-HE_120913B				09/13/12 14:03
Arsenic		0.5	mg/kg	0.4						
Barium		ND	mg/kg	0.02						
Cadmium		ND	mg/kg	0.01						
Chromium		ND	mg/kg	0.07						
Copper		ND	mg/kg	0.2						
Iron		2	mg/kg	0.7						
Lead		1	mg/kg	1						
Manganese		ND	mg/kg	0.04						
Nickel		ND	mg/kg	0.08						
Zinc		0.2	mg/kg	0.1						
Sample ID: LFB-17930	10	Laboratory Fortified Blank				Run: ICP2-HE_120913B				09/13/12 14:06
Arsenic		50.1	mg/kg	1.0	99	80	120			
Barium		51.1	mg/kg	1.0	102	80	120			
Cadmium		25.1	mg/kg	1.0	101	80	120			
Chromium		51.6	mg/kg	1.0	103	80	120			
Copper		51.3	mg/kg	1.0	103	80	120			
Iron		258	mg/kg	5.0	102	80	120			
Lead		51.1	mg/kg	1.0	99	80	120			
Manganese		252	mg/kg	1.0	101	80	120			
Nickel		50.5	mg/kg	1.0	101	80	120			
Zinc		51.8	mg/kg	1.0	103	80	120			
Sample ID: LCS-17930	10	Laboratory Control Sample				Run: ICP2-HE_120913B				09/13/12 14:10
Arsenic		270	mg/kg	1.5	79	72.3	106.4			
Barium		529	mg/kg	1.0	87	80.6	112.2			
Cadmium		118	mg/kg	1.0	87	73	105.1			
Chromium		68.3	mg/kg	1.0	91	72.8	109.1			
Copper		242	mg/kg	1.0	87	77.5	109.6			
Iron		18600	mg/kg	5.0	82	39.6	138.3			
Lead		175	mg/kg	3.1	94	75.9	108.6			
Manganese		340	mg/kg	1.0	93	80.8	115.7			
Nickel		51.1	mg/kg	1.0	85	72.3	103.4			
Zinc		188	mg/kg	1.0	89	74.2	109.9			
Sample ID: H12080454-001AMS	10	Sample Matrix Spike				Run: ICP2-HE_120913B				09/13/12 14:36
Arsenic		72.1	mg/kg	1.5	120	75	125			
Barium		106	mg/kg	1.0	94	75	125			
Cadmium		23.0	mg/kg	1.0	93	75	125			
Chromium		59.0	mg/kg	1.0	97	75	125			
Copper		101	mg/kg	1.0	121	75	125			
Iron		9640	mg/kg	5.0		75	125			A
Lead		126	mg/kg	3.1	164	75	125			S
Manganese		777	mg/kg	1.0	113	75	125			
Nickel		52.2	mg/kg	1.0	92	75	125			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 10/17/12

Project: Black Pine Mine **Work Order:** H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B										Batch: 17930
Sample ID: H12080454-001AMS	10	Sample Matrix Spike				Run: ICP2-HE_120913B			09/13/12 14:36	
Zinc		160	mg/kg	1.0	113	75	125			
Sample ID: H12080454-001AMSD	10	Sample Matrix Spike Duplicate				Run: ICP2-HE_120913B			09/13/12 14:39	
Arsenic		67.9	mg/kg	1.5	112	75	125	5.9	20	
Barium		103	mg/kg	1.0	87	75	125	3.3	20	
Cadmium		22.9	mg/kg	1.0	92	75	125	0.7	20	
Chromium		61.4	mg/kg	1.0	101	75	125	4.0	20	
Copper		106	mg/kg	1.0	131	75	125	4.7	20	S
Iron		10100	mg/kg	5.0		75	125	4.6	20	A
Lead		146	mg/kg	3.1	205	75	125	15	20	S
Manganese		848	mg/kg	1.0	141	75	125	8.7	20	S
Nickel		52.0	mg/kg	1.0	92	75	125	0.5	20	
Zinc		155	mg/kg	1.0	103	75	125	3.2	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 10/17/12

Project: Black Pine Mine **Work Order:** H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B										Batch: 17930
Sample ID: MB-17930	10	Method Blank				Run: ICP2-HE_120914B			09/14/12 13:00	
Arsenic		0.5	mg/kg	0.4						
Barium		ND	mg/kg	0.02						
Cadmium		ND	mg/kg	0.01						
Chromium		ND	mg/kg	0.7						
Copper		0.3	mg/kg	0.2						
Iron		2	mg/kg	0.7						
Lead		ND	mg/kg	1						
Manganese		0.04	mg/kg	0.04						
Nickel		0.1	mg/kg	0.08						
Zinc		ND	mg/kg	0.1						
Sample ID: H12080454-001AMS	10	Sample Matrix Spike				Run: ICP2-HE_120914B			09/14/12 13:26	
Arsenic		69.3	mg/kg	1.5	106	75	125			
Barium		107	mg/kg	1.0	95	75	125			
Cadmium		22.8	mg/kg	1.0	90	75	125			
Chromium		57.4	mg/kg	1.0	94	75	125			
Copper		105	mg/kg	1.0	123	75	125			
Iron		9680	mg/kg	5.0		75	125			A
Lead		122	mg/kg	3.1	141	75	125			S
Manganese		805	mg/kg	1.0	121	75	125			
Nickel		50.6	mg/kg	1.0	89	75	125			
Zinc		156	mg/kg	1.0	103	75	125			
Sample ID: H12080454-001AMSD	10	Sample Matrix Spike Duplicate				Run: ICP2-HE_120914B			09/14/12 13:30	
Arsenic		67.7	mg/kg	1.5	103	75	125	2.4	20	
Barium		102	mg/kg	1.0	86	75	125	4.5	20	
Cadmium		24.3	mg/kg	1.0	96	75	125	6.3	20	
Chromium		63.2	mg/kg	1.0	106	75	125	9.7	20	
Copper		107	mg/kg	1.0	129	75	125	2.7	20	S
Iron		10100	mg/kg	5.0		75	125	4.4	20	A
Lead		152	mg/kg	3.1	201	75	125	22	20	SR
Manganese		874	mg/kg	1.0	149	75	125	8.3	20	S
Nickel		53.7	mg/kg	1.0	95	75	125	6.1	20	
Zinc		160	mg/kg	1.0	111	75	125	2.5	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

R - RPD exceeds advisory limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 10/17/12

Project: Black Pine Mine **Work Order:** H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B										Batch: 18014
Sample ID: MB-18014	2	Method Blank				Run: ICP2-HE_120920B				09/20/12 18:16
Antimony		ND	mg/kg	1						
Silver		ND	mg/kg	0.2						
Sample ID: LFB-18014	2	Laboratory Fortified Blank				Run: ICP2-HE_120920B				09/20/12 18:20
Antimony		50.6	mg/kg	1.0	101	80	120			
Silver		23.4	mg/kg	1.0	94	80	120			
Sample ID: LCS-18014	2	Laboratory Control Sample				Run: ICP2-HE_120920B				09/20/12 18:23
Antimony		51.7	mg/kg	2.1	41	2.2	92.9			
Silver		60.0	mg/kg	1.0	88	67.8	112.8			
Sample ID: H12090110-007AMS	2	Sample Matrix Spike				Run: ICP2-HE_120920B				09/20/12 18:46
Antimony		1160	mg/kg	8.6		75	125			A
Silver		151	mg/kg	4.1	91	75	125			
Sample ID: H12090110-007AMSD	2	Sample Matrix Spike Duplicate				Run: ICP2-HE_120920B				09/20/12 18:49
Antimony		1060	mg/kg	8.6		75	125	9.4	20	A
Silver		156	mg/kg	4.1	96	75	125	3.2	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 10/17/12

Project: Black Pine Mine **Work Order:** H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6020									Analytical Run: SUB-B191707	
Sample ID: QCS	6	Initial Calibration Verification Standard							09/13/12 19:56	
Arsenic		0.0492	mg/L	0.0010	98	90	110			
Cadmium		0.0254	mg/L	0.0010	101	90	110			
Chromium		0.0493	mg/L	0.0010	99	90	110			
Lead		0.0483	mg/L	0.0010	97	90	110			
Selenium		0.0503	mg/L	0.0010	101	90	110			
Silver		0.0248	mg/L	0.0010	99	90	110			
Sample ID: ICSA	6	Interference Check Sample A							09/13/12 08:35	
Arsenic		-3.00E-05	mg/L	0.0010						
Cadmium		0.00117	mg/L	0.0010						
Chromium		0.00151	mg/L	0.0010						
Lead		0.000490	mg/L	0.0010						
Selenium		-0.000530	mg/L	0.0010						
Silver		0.000100	mg/L	0.0010						
Sample ID: ICSAB	6	Interference Check Sample AB							09/13/12 08:38	
Arsenic		0.00930	mg/L	0.0010	93	70	130			
Cadmium		0.0106	mg/L	0.0010	106	70	130			
Chromium		0.0203	mg/L	0.0010	101	70	130			
Lead		0.000490	mg/L	0.0010		0	0			
Selenium		0.00897	mg/L	0.0010	90	70	130			
Silver		0.0191	mg/L	0.0010	96	70	130			
Method: SW6020									Batch: B_65394	
Sample ID: MB-65394	7	Method Blank				Run: SUB-B191707			09/13/12 21:41	
Arsenic		ND	mg/L	0.004						
Barium		0.04	mg/L	0.0007						
Cadmium		ND	mg/L	0.002						
Chromium		0.009	mg/L	0.001						
Lead		ND	mg/L	0.001						
Selenium		ND	mg/L	0.005						
Silver		ND	mg/L	0.001						
Sample ID: H12090110-004A	7	Serial Dilution				Run: SUB-B191707			09/13/12 21:59	
Arsenic		0.0697	mg/L	0.20		0	0		10	N
Barium		0.527	mg/L	1.0		0	0		10	
Cadmium		0.0340	mg/L	0.10		0	0		10	N
Chromium		0.00950	mg/L	0.20		0	0		10	N
Lead		1.75	mg/L	0.20		0	0	2.2	10	
Selenium		ND	mg/L	0.10		0	0		10	
Silver		ND	mg/L	0.020		0	0		10	
Sample ID: LCS-65394	7	Laboratory Control Sample				Run: SUB-B191707			09/13/12 22:02	
Arsenic		0.480	mg/L	0.20	96	85	115			
Barium		5.00	mg/L	1.0	90	85	115			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

N - The analyte concentration was not sufficiently high to calculate a RPD for the serial dilution test.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 10/17/12

Project: Black Pine Mine **Work Order:** H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6020										Batch: B_65394
Sample ID: LCS-65394	7	Laboratory Control Sample				Run: SUB-B191707				09/13/12 22:02
Cadmium		0.255	mg/L	0.10	102	85	115			
Chromium		0.552	mg/L	0.20	109	85	115			
Lead		0.512	mg/L	0.20	102	85	115			
Selenium		0.494	mg/L	0.10	99	85	115			
Silver		0.0511	mg/L	0.020	102	85	115			
Sample ID: LCSD-65394	7	Laboratory Control Sample Duplicate				Run: SUB-B191707				09/13/12 22:05
Arsenic		0.479	mg/L	0.20	96	85	115	0.0	20	
Barium		4.85	mg/L	1.0	87	85	115	0.0	20	
Cadmium		0.253	mg/L	0.10	101	85	115	0.0	20	
Chromium		0.549	mg/L	0.20	108	85	115	0.0	20	
Lead		0.510	mg/L	0.20	102	85	115	0.0	20	
Selenium		0.490	mg/L	0.10	98	85	115	0.0	20	
Silver		0.0508	mg/L	0.020	101	85	115	0.0	20	
Sample ID: H12090110-002A	7	Sample Matrix Spike				Run: SUB-B191707				09/13/12 22:20
Arsenic		0.525	mg/L	0.20	96	75	125			
Barium		5.10	mg/L	1.0	88	75	125			
Cadmium		0.255	mg/L	0.10	100	75	125			
Chromium		0.556	mg/L	0.20	110	75	125			
Lead		0.783	mg/L	0.20	102	75	125			
Selenium		0.494	mg/L	0.10	99	75	125			
Silver		0.0574	mg/L	0.020	103	75	125			
Sample ID: H12090110-001A	7	Sample Matrix Spike				Run: SUB-B191707				09/13/12 22:23
Arsenic		1.51	mg/L	0.20	103	75	125			
Barium		6.53	mg/L	1.0	93	75	125			
Cadmium		0.295	mg/L	0.10	105	75	125			
Chromium		0.568	mg/L	0.20	112	75	125			
Lead		2.05	mg/L	0.20	109	75	125			
Selenium		0.499	mg/L	0.10	99	75	125			
Silver		0.0524	mg/L	0.020	105	75	125			
Sample ID: H12090110-003A	7	Sample Matrix Spike				Run: SUB-B191707				09/13/12 22:29
Arsenic		0.558	mg/L	0.20	96	75	125			
Barium		5.25	mg/L	1.0	88	75	125			
Cadmium		0.305	mg/L	0.10	100	75	125			
Chromium		0.554	mg/L	0.20	109	75	125			
Lead		1.81	mg/L	0.20	108	75	125			
Selenium		0.488	mg/L	0.10	98	75	125			
Silver		0.0504	mg/L	0.020	101	75	125			
Sample ID: H12090110-004A	7	Sample Matrix Spike				Run: SUB-B191707				09/13/12 22:32
Arsenic		0.557	mg/L	0.20	98	75	125			
Barium		5.48	mg/L	1.0	90	75	125			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 10/17/12

Project: Black Pine Mine **Work Order:** H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6020										Batch: B_65394
Sample ID: H12090110-004A	7	Sample Matrix Spike				Run: SUB-B191707				09/13/12 22:32
Cadmium		0.278	mg/L	0.10	101	75	125			
Chromium		0.556	mg/L	0.20	110	75	125			
Lead		2.20	mg/L	0.20	98	75	125			
Selenium		0.500	mg/L	0.10	100	75	125			
Silver		0.0560	mg/L	0.020	102	75	125			
Method: SW6020										Analytical Run: SUB-B191793
Sample ID: QCS		Initial Calibration Verification Standard								09/15/12 01:31
Barium		0.0475	mg/L	0.0010	95	90	110			
Sample ID: ICSA		Interference Check Sample A								09/15/12 01:37
Barium		0.000200	mg/L	0.0010						
Sample ID: ICSAB		Interference Check Sample AB								09/15/12 01:40
Barium		0.000130	mg/L	0.0010		0	0			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 10/17/12

Project: Black Pine Mine **Work Order:** H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW7470A									Analytical Run: SUB-B191584	
Sample ID: QCS		Initial Calibration Verification Standard							09/12/12 11:21	
Mercury		0.0019	mg/L	0.0020	96	90	110			
Method: SW7470A									Batch: B_65359	
Sample ID: MB-65359		Method Blank				Run: SUB-B191584			09/12/12 14:29	
Mercury		ND	mg/L	0.0002						
Sample ID: LCS-65359		Laboratory Control Sample				Run: SUB-B191584			09/12/12 14:31	
Mercury		0.0093	mg/L	0.0020	93	80	120			
Sample ID: LCSD-65359		Laboratory Control Sample Duplicate				Run: SUB-B191584			09/12/12 14:34	
Mercury		0.0090	mg/L	0.0020	89	80	120	3.8	10	
Sample ID: B12081719-004ADIL		Serial Dilution				Run: SUB-B191584			09/12/12 14:39	
Mercury		ND	mg/L	0.0020		0	0		10	
Sample ID: H12090110-001A		Sample Matrix Spike				Run: SUB-B191584			09/12/12 14:46	
Mercury		0.0092	mg/L	0.0020	93	75	125			
Sample ID: H12090110-002A		Sample Matrix Spike				Run: SUB-B191584			09/12/12 14:50	
Mercury		0.026	mg/L	0.0020	83	75	125			
Sample ID: H12090110-003A		Sample Matrix Spike				Run: SUB-B191584			09/12/12 15:21	
Mercury		0.011	mg/L	0.0020	98	75	125			
Sample ID: H12090110-004A		Sample Matrix Spike				Run: SUB-B191584			09/12/12 15:26	
Mercury		0.022	mg/L	0.0020	89	75	125			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 10/17/12

Project: Black Pine Mine **Work Order:** H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW7470A									Analytical Run: SUB-B191781	
Sample ID: QCS		Initial Calibration Verification Standard							09/14/12 13:34	
Mercury		0.0018	mg/L	0.0020	91	90	110			
Method: SW7470A									Batch: B_65404	
Sample ID: MB-65404		Method Blank				Run: SUB-B191781			09/14/12 13:42	
Mercury		ND	mg/L	0.0002						
Sample ID: LCS-65404		Laboratory Control Sample				Run: SUB-B191781			09/14/12 13:44	
Mercury		0.0094	mg/L	0.0020	94	80	120			
Sample ID: LCSD-65404		Laboratory Control Sample Duplicate				Run: SUB-B191781			09/14/12 13:47	
Mercury		0.0094	mg/L	0.0020	94	80	120	0.0	10	
Sample ID: H12090110-002A		Serial Dilution				Run: SUB-B191781			09/14/12 13:51	
Mercury		0.015	mg/L	0.0020		0	0	15	10	R
Sample ID: H12090110-002A		Sample Matrix Spike				Run: SUB-B191781			09/14/12 13:54	
Mercury		0.026	mg/L	0.0020	85	75	125			
Sample ID: H12090110-004A		Sample Matrix Spike				Run: SUB-B191781			09/14/12 13:59	
Mercury		0.021	mg/L	0.0020	86	75	125			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

R - RPD exceeds advisory limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 10/17/12

Project: Black Pine Mine **Work Order:** H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW7471A								Analytical Run: HGCV201-H_120918A		
Sample ID: ICV		Initial Calibration Verification Standard								09/18/12 11:54
Mercury		0.00098	mg/kg	0.50	98	90	110			
Sample ID: ICV		Initial Calibration Verification Standard								09/18/12 12:36
Mercury		0.00099	mg/kg	0.50	99	90	110			
New Calibration										
Sample ID: CCV		Continuing Calibration Verification Standard								09/18/12 12:38
Mercury		0.00096	mg/kg	0.50	96	90	110			
Sample ID: ICV		Initial Calibration Verification Standard								09/18/12 14:46
Mercury		0.00099	mg/kg	0.50	99	90	110			
New Calibration										
Sample ID: ICV		Initial Calibration Verification Standard								09/18/12 16:09
Mercury		0.00099	mg/kg	0.50	99	90	110			
New Calibration										
Sample ID: ICV		Initial Calibration Verification Standard								09/18/12 16:58
Mercury		0.00099	mg/kg	0.50	99	90	110			
New Calibration										
Method: SW7471A										Batch: 17928
Sample ID: MB-17928		Method Blank				Run: HGCV201-H_120918A				09/18/12 12:43
Mercury		0.024	mg/kg	0.0020						
Sample ID: LCS-17928		Laboratory Control Sample				Run: HGCV201-H_120918A				09/18/12 12:45
Mercury		5.4	mg/kg	0.50	107	80	120			
Sample ID: H12090058-002AMS		Sample Matrix Spike				Run: HGCV201-H_120918A				09/18/12 12:50
Mercury		1.2	mg/kg	0.50	111	80	120			
Sample ID: H12090058-002AMSD		Sample Matrix Spike Duplicate				Run: HGCV201-H_120918A				09/18/12 12:53
Mercury		1.1	mg/kg	0.50	110	80	120	0.5	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

Standard Reporting Procedures

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Workorder Receipt Checklist

MT DEQ-Abandoned Mines H12090110

Login completed by: Wanda Johnson
Date Received: 9/10/2012
Reviewed by: BL2000\sdull
Received by: elm
Reviewed Date: 9/17/2012
Carrier name: Hand Del

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shipping container/cooler?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received?	Yes ☐	No ☑	Not Applicable ☐
Container/Temp Blank temperature:	2.3°C On Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	Not Applicable ☑

Contact and Corrective Action Comments:

Samples left in locked entry. The chain of custody is signed when samples were relinquished & received, however they do not match due to samples were left in the locked entry. Energy Laboratories staff did not process samples until 9/10/12. Received a sample jar for CML-RCRA-07, no sample in jar but received in a plastic bag. Wj 9/10/12

ENERGY

Chain of Custody and Analytical Request Record

Page 1 of 1

PLEASE PRINT (Provide as much information as possible.)

Company Name:	Project Name, PWS, Permit, Etc.	Sample Origin	EPA/State Compliance:
TRIHYDRO	BLACK PINE MINE	State: MT	Yes ☐ No ☐
Report Mail Address:	Contact Name: / Phone/Fax:	Email:	Sampler: (Please Print)
	Thomas Smith		Brady Hanson
Invoice Address:	Invoice Contact & Phone:	Purchase Order:	Quote/Bottle Order:

Special Report/Formats:

☐ DW
☐ POTW/WWTP
☐ State: _____
☐ Other: _____
☐ EDD/EDT (Electronic Data) Format: _____
☐ LEVEL IV
☐ NELAC

ANALYSIS REQUESTED

Standard Turnaround (TAT)

R U S H

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments:

Shipped by: Hand Left in locked entry

Cooler ID(s): 4

Receipt Temp 2.3 °C

On Ice: (Y) N

Custody Seal: On Bottle Y (N); On Cooler Y (N)

Intact Y N

Signature Match Y N

	SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX (Number of Containers; Sample Type: A W S V B O DW; Air Water Soils/Solids Vegetation Bioassay Other DW - Drinking Water)	TCLP - RCRA 8 metals	Total recoverable metals + Hg	SEE ATTACHED		
1	CML-RCRA-08	09/07/12	9:45	Solid	✓			Brick	1112090110
2	CML-RCRA-07	09/07/12	10:10	Solid	✓			Wood	
3	CML-RCRA-06	09/07/12	11:35	Solid	✓			Brick	
4	CML-RCRA-05	09/07/12	11:30	Solid	✓			Wood	
5	CML-GC-04	09/07/12	10:30	Soils		✓			
6	CML-GC-05	09/07/12	11:15	Soils		✓			
7	CML-GC-06	09/07/12	12:10	Soils		✓			
8									
9									
10									

LABORATORY USE ONLY

Custody Record MUST be Signed

Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Luke Dorrell	9/6/12 1200	[signature]			
Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
			Received by Laboratory: Esther Merritt	Date/Time: 9/10/12 8:00	Signature: Esther Merritt

Sample Disposal: Return to Client: _____ Lab Disposal: _____

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report. Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

APPENDIX E2

GEOCHEMICAL LABORATORY ANALYTICAL REPORTS

Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

June 07, 2012

Kevin Houck
Herrera Environmental Consultants
101 East Broadway, Suite 610
Missoula, MT 59802

RE: Project: Black Pine Mine
Pace Project No.: 10191119

Dear Kevin Houck:
Enclosed are the analytical results for sample(s) received by the laboratory on May 04, 2012. The results relate only to the samples included in this report. Results reported herein conform to the most current TNI standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Kyna M Hogg

kyna.hogg@pacelabs.com
Project Manager

Enclosures

cc: Devin Clary, Montana Dept. of Environmental Quality
Mark Donner, Trihydro
Jamie Mongoven, Montana Dept. of Environmental

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

CERTIFICATIONS

Project: Black Pine Mine
Pace Project No.: 10191119

Minnesota Certification IDs
1700 Elm Street SE Suite 200, Minneapolis, MN 55414
A2LA Certification #: 2926.01
Alaska Certification #: UST-078
Alaska Certification #MN00064
Arizona Certification #: AZ-0014
Arkansas Certification #: 88-0680
California Certification #: 01155CA
EPA Region 8 Certification #: Pace
Florida/NELAP Certification #: E87605
Georgia Certification #: 959
Idaho Certification #: MN00064
Illinois Certification #: 200011
Iowa Certification #: 368
Kansas Certification #: E-10167
Louisiana Certification #: 03086
Louisiana Certification #: LA080009
Maine Certification #: 2007029
Maryland Certification #: 322
Michigan DEQ Certification #: 9909
Minnesota Certification #: 027-053-137
Mississippi Certification #: Pace
Montana Certification #: MT CERT0092
Nevada Certification #: MN_00064
Nebraska Certification #: Pace
New Jersey Certification #: MN-002
New Mexico Certification #: Pace
New York Certification #: 11647
North Carolina Certification #: 530
North Dakota Certification #: R-036
North Dakota Certification #: R-036A
Ohio VAP Certification #: CL101
Oklahoma Certification #: D9921
Oklahoma Certification #: 9507
Oregon Certification #: MN200001
Pennsylvania Certification #: 68-00563
Puerto Rico Certification
Tennessee Certification #: 02818
Texas Certification #: T104704192
Washington Certification #: C754
Wisconsin Certification #: 999407970

Montana Certification IDs
602 South 25th Street, Billings, MT 59101
EPA Region 8 Certification #: 8TMS-Q
Idaho Certification #: MT00012
Montana Certification #: MT CERT0040
NVLAP Certification #: 101292-0
Minnesota Dept of Health Certification #: 030-999-442

Washington Certification IDs
940 South Harney Street, Seattle, WA 98108
Alaska CS Certification #: UST-025
Arizona Certification #: AZ0770
California Certification #: 01153CA
Florida/NELAP Certification #: E87617
Oregon Certification #: WA200007
Washington Certification #: C555

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(406)254-7226

SAMPLE SUMMARY

Project: Black Pine Mine
Pace Project No.: 10191119

Lab ID	Sample ID	Matrix	Date Collected	Date Received
10191119001	**MW-RY-07**	Water	05/03/12 11:55	05/04/12 10:05

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SAMPLE ANALYTE COUNT

Project: Black Pine Mine
Pace Project No.: 10191119

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
10191119001	**MW-RY-07**	EPA 200.7	IP	13	PASI-M
		EPA 7470	TEM	1	PASI-M
		EPA 7470	TEM	1	PASI-M
		SM 2310	CAC	1	PASI-MT
		SM 2540C	DH1	1	PASI-MT
		SM 2540D	DH1	1	PASI-MT
		SM 2320B	MWD	1	PASI-M
		EPA 300.0	CMS	1	PASI-S

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PROJECT NARRATIVE

Project: Black Pine Mine
Pace Project No.: 10191119

Method: **EPA 200.7**
Description: 200.7 MET ICP, Dissolved
Client: Montana Dept. of Environmental Quality
Date: June 07, 2012

General Information:
1 sample was analyzed for EPA 200.7. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Sample Preparation:
The samples were prepared in accordance with EPA 200.7 with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

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PROJECT NARRATIVE

Project: Black Pine Mine
Pace Project No.: 10191119

Method: **EPA 7470**
Description: 7470 Mercury
Client: Montana Dept. of Environmental Quality
Date: June 07, 2012

General Information:
1 sample was analyzed for EPA 7470. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Sample Preparation:
The samples were prepared in accordance with EPA 7470 with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

QC Batch: MERP/6867

A matrix spike and matrix spike duplicate (MS/MSD) were performed on the following sample(s): 10191097001,10191246008

M1: Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.

- MS (Lab ID: 1200834)
  - Mercury
- MSD (Lab ID: 1200833)
  - Mercury

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

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PROJECT NARRATIVE

Project: Black Pine Mine
Pace Project No.: 10191119

Method: **EPA 7470**
Description: 7470 Mercury, Dissolved
Client: Montana Dept. of Environmental Quality
Date: June 07, 2012

General Information:
1 sample was analyzed for EPA 7470. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

H1: Analysis conducted outside the recognized method holding time.
- MW-RY-07 (Lab ID: 10191119001)

Sample Preparation:
The samples were prepared in accordance with EPA 7470 with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

QC Batch: MERP/6911

A matrix spike and matrix spike duplicate (MS/MSD) were performed on the following sample(s): 10193234001

M1: Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.
- MS (Lab ID: 1208065)
  - Mercury, Dissolved
- MSD (Lab ID: 1208066)
  - Mercury, Dissolved

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

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PROJECT NARRATIVE

Project: Black Pine Mine
Pace Project No.: 10191119

Method: **SM 2310**
Description: 2310 Acidity
Client: Montana Dept. of Environmental Quality
Date: June 07, 2012

General Information:
1 sample was analyzed for SM 2310. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Internal Standards:
All internal standards were within QC limits with any exceptions noted below.

Surrogates:
All surrogates were within QC limits with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

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PROJECT NARRATIVE

Project: Black Pine Mine
Pace Project No.: 10191119

Method: **SM 2540C**
Description: 2540C Total Dissolved Solids
Client: Montana Dept. of Environmental Quality
Date: June 07, 2012

General Information:
1 sample was analyzed for SM 2540C. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Internal Standards:
All internal standards were within QC limits with any exceptions noted below.

Surrogates:
All surrogates were within QC limits with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

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PROJECT NARRATIVE

Project: Black Pine Mine
Pace Project No.: 10191119

Method: **SM 2540D**
Description: 2540D Total Suspended Solids
Client: Montana Dept. of Environmental Quality
Date: June 07, 2012

General Information:
1 sample was analyzed for SM 2540D. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Internal Standards:
All internal standards were within QC limits with any exceptions noted below.

Surrogates:
All surrogates were within QC limits with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

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PROJECT NARRATIVE

Project: Black Pine Mine
Pace Project No.: 10191119

Method: **SM 2320B**
Description: 2320B Alkalinity
Client: Montana Dept. of Environmental Quality
Date: June 07, 2012

General Information:
1 sample was analyzed for SM 2320B. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

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PROJECT NARRATIVE

Project: Black Pine Mine
Pace Project No.: 10191119

Method: **EPA 300.0**
Description: 300.0 IC Anions 28 Days
Client: Montana Dept. of Environmental Quality
Date: June 07, 2012

General Information:
1 sample was analyzed for EPA 300.0. All samples were received in acceptable condition with any exceptions noted below.

Hold Time:
The samples were analyzed within the method required hold times with any exceptions noted below.

Initial Calibrations (including MS Tune as applicable):
All criteria were within method requirements with any exceptions noted below.

Continuing Calibration:
All criteria were within method requirements with any exceptions noted below.

Method Blank:
All analytes were below the report limit in the method blank with any exceptions noted below.

Laboratory Control Spike:
All laboratory control spike compounds were within QC limits with any exceptions noted below.

Matrix Spikes:
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

QC Batch: WETA/2559

A matrix spike and matrix spike duplicate (MS/MSD) were performed on the following sample(s): 10190768001,10190792003

M1: Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.

- MS (Lab ID: 114868)
  - Sulfate

Duplicate Sample:
All duplicate sample results were within method acceptance criteria with any exceptions noted below.

Additional Comments:

This data package has been reviewed for quality and completeness and is approved for release.

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ANALYTICAL RESULTS

Project: Black Pine Mine
Pace Project No.: 10191119

Sample: MW-RY-07 **Lab ID: 10191119001** Collected: 05/03/12 11:55 Received: 05/04/12 10:05 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
200.7 MET ICP, Dissolved	Analytical Method: EPA 200.7 Preparation Method: EPA 200.7							
Antimony, Dissolved	**<20.0**	ug/L	20.0	1	05/12/12 10:04	05/14/12 15:18	7440-36-0	
Arsenic, Dissolved	**<20.0**	ug/L	20.0	1	05/12/12 10:04	05/14/12 15:18	7440-38-2	
Barium, Dissolved	**53.0**	ug/L	10.0	1	05/12/12 10:04	05/14/12 15:18	7440-39-3	
Cadmium, Dissolved	**<2.0**	ug/L	2.0	1	05/12/12 10:04	05/14/12 15:18	7440-43-9	
Chromium, Dissolved	**<10.0**	ug/L	10.0	1	05/12/12 10:04	05/14/12 15:18	7440-47-3	
Copper, Dissolved	**<10.0**	ug/L	10.0	1	05/12/12 10:04	05/14/12 15:18	7440-50-8	
Iron, Dissolved	**<50.0**	ug/L	50.0	1	05/12/12 10:04	05/14/12 15:18	7439-89-6	
Lead, Dissolved	**<3.0**	ug/L	3.0	1	05/12/12 10:04	05/14/12 15:18	7439-92-1	
Manganese, Dissolved	**737**	ug/L	5.0	1	05/12/12 10:04	05/14/12 15:18	7439-96-5	
Nickel, Dissolved	**<20.0**	ug/L	20.0	1	05/12/12 10:04	05/14/12 15:18	7440-02-0	
Silver, Dissolved	**<10.0**	ug/L	10.0	1	05/12/12 10:04	05/14/12 15:18	7440-22-4	
Total Hardness by 2340B, Dissolved	**68400**	ug/L	3300	1	05/12/12 10:04	05/14/12 15:18		
Zinc, Dissolved	**1250**	ug/L	20.0	1	05/12/12 10:04	05/14/12 15:18	7440-66-6	
7470 Mercury	Analytical Method: EPA 7470 Preparation Method: EPA 7470							
Mercury	**0.27**	ug/L	0.20	1	05/24/12 08:34	05/24/12 13:55	7439-97-6	
7470 Mercury, Dissolved	Analytical Method: EPA 7470 Preparation Method: EPA 7470							
Mercury, Dissolved	**<0.20**	ug/L	0.20	1	05/31/12 00:00	06/04/12 14:29	7439-97-6	H1
2310 Acidity	Analytical Method: SM 2310							
Acidity	**14.0**	mg/L	5.0	1		05/11/12 00:00		
2540C Total Dissolved Solids	Analytical Method: SM 2540C							
Total Dissolved Solids	**223**	mg/L	20.0	1		05/08/12 18:00		
2540D Total Suspended Solids	Analytical Method: SM 2540D							
Total Suspended Solids	**12400**	mg/L	34.5	1		05/10/12 14:30		
2320B Alkalinity	Analytical Method: SM 2320B							
Alkalinity, Total as CaCO3	**42.0**	mg/L	5.0	1		05/08/12 11:37		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0							
Sulfate	**51.0**	mg/L	5.0	5		05/15/12 17:06	14808-79-8	

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QUALITY CONTROL DATA

Project: Black Pine Mine
Pace Project No.: 10191119

QC Batch: MERP/6867 | Analysis Method: EPA 7470
QC Batch Method: EPA 7470 | Analysis Description: 7470 Mercury
Associated Lab Samples: 10191119001

METHOD BLANK: 1200830 | Matrix: Water
Associated Lab Samples: 10191119001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Mercury	ug/L	<0.20	0.20	05/24/12 13:22	

LABORATORY CONTROL SAMPLE: 1200831

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Mercury	ug/L	5	5.0	99	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1200832 1200833

Parameter	Units	10191097001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Mercury	ug/L	<0.0000 37 mg/L	5	5	4.5	4.0	89	79	80-120	12	20	M1

MATRIX SPIKE SAMPLE: 1200834

Parameter	Units	10191246008 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Mercury	ug/L	<0.037	5	3.3	65	80-120	M1

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QUALITY CONTROL DATA

Project: Black Pine Mine
Pace Project No.: 10191119

QC Batch: MERP/6911 | Analysis Method: EPA 7470
QC Batch Method: EPA 7470 | Analysis Description: 7470 Mercury Dissolved
Associated Lab Samples: 10191119001

METHOD BLANK: 1208060 | Matrix: Water
Associated Lab Samples: 10191119001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Mercury, Dissolved	ug/L	<0.20	0.20	06/04/12 14:25	

LABORATORY CONTROL SAMPLE: 1208061

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Mercury, Dissolved	ug/L	5	4.9	99	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1208065 1208066

Parameter	Units	10193234001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Mercury, Dissolved	ug/L	<0.0002 0 mg/L	5	5	3.7	4.0	73	79	80-120	8	20	M1

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QUALITY CONTROL DATA

Project: Black Pine Mine
Pace Project No.: 10191119

QC Batch: MPRP/32390 | Analysis Method: EPA 200.7
QC Batch Method: EPA 200.7 | Analysis Description: 200.7 MET Dissolved
Associated Lab Samples: 10191119001

METHOD BLANK: 1195173 | Matrix: Water
Associated Lab Samples: 10191119001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Antimony, Dissolved	ug/L	<20.0	20.0	05/14/12 14:16	
Arsenic, Dissolved	ug/L	<20.0	20.0	05/14/12 14:16	
Barium, Dissolved	ug/L	<10.0	10.0	05/14/12 14:16	
Cadmium, Dissolved	ug/L	<2.0	2.0	05/14/12 14:16	
Chromium, Dissolved	ug/L	<10.0	10.0	05/14/12 14:16	
Copper, Dissolved	ug/L	<10.0	10.0	05/14/12 14:16	
Iron, Dissolved	ug/L	<50.0	50.0	05/14/12 14:16	
Lead, Dissolved	ug/L	<3.0	3.0	05/14/12 14:16	
Manganese, Dissolved	ug/L	<5.0	5.0	05/14/12 14:16	
Nickel, Dissolved	ug/L	<20.0	20.0	05/14/12 14:16	
Silver, Dissolved	ug/L	<10.0	10.0	05/14/12 14:16	
Total Hardness by 2340B, Dissolved	ug/L	<3300	3300	05/14/12 14:16	
Zinc, Dissolved	ug/L	<20.0	20.0	05/14/12 14:16	

LABORATORY CONTROL SAMPLE: 1195174

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Antimony, Dissolved	ug/L	1000	999	100	85-115	
Arsenic, Dissolved	ug/L	1000	999	100	85-115	
Barium, Dissolved	ug/L	1000	997	100	85-115	
Cadmium, Dissolved	ug/L	1000	996	100	85-115	
Chromium, Dissolved	ug/L	1000	988	99	85-115	
Copper, Dissolved	ug/L	1000	979	98	85-115	
Iron, Dissolved	ug/L	10000	10300	103	85-115	
Lead, Dissolved	ug/L	1000	1010	101	85-115	
Manganese, Dissolved	ug/L	1000	1000	100	85-115	
Nickel, Dissolved	ug/L	1000	999	100	85-115	
Silver, Dissolved	ug/L	500	491	98	85-115	
Total Hardness by 2340B, Dissolved	ug/L		69300			
Zinc, Dissolved	ug/L	1000	1020	102	85-115	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1195175 1195176

Parameter	Units	10190792001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Antimony, Dissolved	ug/L	<20.0	1000	1000	1020	1010	102	101	70-130	1	30	
Arsenic, Dissolved	ug/L	<20.0	1000	1000	1040	1020	103	102	70-130	2	30	
Barium, Dissolved	ug/L	304	1000	1000	1320	1310	102	100	70-130	.9	30	

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QUALITY CONTROL DATA

Project: Black Pine Mine
Pace Project No.: 10191119

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1195175 1195176

Parameter	Units	10190792001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Cadmium, Dissolved	ug/L	<2.0	1000	1000	1010	1000	101	100	70-130	.8	30	
Chromium, Dissolved	ug/L	<10.0	1000	1000	1000	998	100	100	70-130	.5	30	
Copper, Dissolved	ug/L	<10.0	1000	1000	1010	1000	100	99	70-130	.3	30	
Iron, Dissolved	ug/L	478	10000	10000	11100	11000	106	105	70-130	.5	30	
Lead, Dissolved	ug/L	4.2	1000	1000	1030	1020	103	101	70-130	1	30	
Manganese, Dissolved	ug/L	60.0	1000	1000	1080	1070	102	101	70-130	.8	30	
Nickel, Dissolved	ug/L	<20.0	1000	1000	1010	1010	101	100	70-130	.7	30	
Silver, Dissolved	ug/L	<10.0	500	500	499	497	100	99	70-130	.4	30	
Total Hardness by 2340B, Dissolved	ug/L	28400			100000	99800				.7		
Zinc, Dissolved	ug/L	25.7	1000	1000	1060	1050	103	102	70-130	.9	30	

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QUALITY CONTROL DATA

Project: Black Pine Mine
Pace Project No.: 10191119

QC Batch: MT/8697 | Analysis Method: SM 2310
QC Batch Method: SM 2310 | Analysis Description: 2310 Acidity
Associated Lab Samples: 10191119001

METHOD BLANK: 1191646 | Matrix: Water
Associated Lab Samples: 10191119001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Acidity	mg/L	<5.0	5.0	05/11/12 00:00	

SAMPLE DUPLICATE: 1191648

Parameter	Units	10190792002 Result	Dup Result	RPD	Max RPD	Qualifiers
Acidity	mg/L	<5.0	<5.0		20	

SAMPLE DUPLICATE: 1191798

Parameter	Units	10191119001 Result	Dup Result	RPD	Max RPD	Qualifiers
Acidity	mg/L	14.0	15.9	13	20	

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QUALITY CONTROL DATA

Project: Black Pine Mine
Pace Project No.: 10191119

QC Batch: MT/8715 | Analysis Method: SM 2540C
QC Batch Method: SM 2540C | Analysis Description: 2540C Total Dissolved Solids
Associated Lab Samples: 10191119001

METHOD BLANK: 1192675 | Matrix: Water
Associated Lab Samples: 10191119001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Total Dissolved Solids	mg/L	<20.0	20.0	05/08/12 18:00	

LABORATORY CONTROL SAMPLE: 1192676

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Total Dissolved Solids	mg/L	1000	982	98	80-120	

SAMPLE DUPLICATE: 1192677

Parameter	Units	10190768008 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Dissolved Solids	mg/L	85.9	75.0	14	20	

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Pace Analytical Services, Inc.
602 S 25th Street
Billings, MT 591014549
(406)254-7226

QUALITY CONTROL DATA

Project: Black Pine Mine
Pace Project No.: 10191119

QC Batch: MT/8739 | Analysis Method: SM 2540D
QC Batch Method: SM 2540D | Analysis Description: 2540D Total Suspended Solids
Associated Lab Samples: 10191119001

METHOD BLANK: 1194218 | Matrix: Water
Associated Lab Samples: 10191119001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Total Suspended Solids	mg/L	<1.0	1.0	05/10/12 14:30	

LABORATORY CONTROL SAMPLE & LCSD: 1194219 1194585

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% Rec Limits	RPD	Max RPD	Qualifiers
Total Suspended Solids	mg/L	25	24.2	22.1	97	88	71-129	9	20	

SAMPLE DUPLICATE: 1194220

Parameter	Units	10191434001 Result	Dup Result	RPD	Max RPD	Qualifiers
Total Suspended Solids	mg/L	94.0	115	20	20	

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QUALITY CONTROL DATA

Project: Black Pine Mine
Pace Project No.: 10191119

QC Batch: WET/25823 | Analysis Method: SM 2320B
QC Batch Method: SM 2320B | Analysis Description: 2320B Alkalinity
Associated Lab Samples: 10191119001

METHOD BLANK: 1192059 | Matrix: Water
Associated Lab Samples: 10191119001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Alkalinity, Total as CaCO3	mg/L	<5.0	5.0	05/08/12 10:58	

LABORATORY CONTROL SAMPLE & LCSD: 1192060 1192061

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% Rec Limits	RPD	Max RPD	Qualifiers
Alkalinity, Total as CaCO3	mg/L	40	40.6	40.9	102	102	90-110	.6	30	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1192062 1192063

Parameter	Units	10191246027 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Alkalinity, Total as CaCO3	mg/L	52.7	40	40	91.3	92.3	96	99	80-120	1	30	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1192064 1192065

Parameter	Units	10191246001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Alkalinity, Total as CaCO3	mg/L	67.4	40	40	106	106	97	96	80-120	.2	30	

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QUALITY CONTROL DATA

Project: Black Pine Mine
Pace Project No.: 10191119

QC Batch: WETA/2559 | Analysis Method: EPA 300.0
QC Batch Method: EPA 300.0 | Analysis Description: 300.0 IC Anions
Associated Lab Samples: 10191119001

METHOD BLANK: 114866 | Matrix: Water
Associated Lab Samples: 10191119001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Sulfate	mg/L	<1.0	1.0	05/14/12 23:41	

LABORATORY CONTROL SAMPLE: 114867

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Sulfate	mg/L	15	15.0	100	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 114868 114869

Parameter	Units	10190768001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Sulfate	mg/L	28.4	30	30	61.8	59.9	111	105	90-110	3	10	M1

MATRIX SPIKE SAMPLE: 114870

Parameter	Units	10190792003 Result	Spike Conc.	MS Result	MS % Rec	% Rec Limits	Qualifiers
Sulfate	mg/L	1.9	15	16.9	100	90-110	

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QUALIFIERS

Project: Black Pine Mine
Pace Project No.: 10191119

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to changes in sample preparation, dilution of the sample aliquot, or moisture content.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PRL - Pace Reporting Limit.

RL - Reporting Limit.

S - Surrogate

1,2-Diphenylhydrazine (8270 listed analyte) decomposes to Azobenzene.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

LABORATORIES

PASI-M	Pace Analytical Services - Minneapolis
PASI-MT	Pace Analytical Services - Montana
PASI-S	Pace Analytical Services - Seattle

ANALYTE QUALIFIERS

H1	Analysis conducted outside the recognized method holding time.
M1	Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.

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(406)254-7226

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: Black Pine Mine
Pace Project No.: 10191119

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
10191119001	**MW-RY-07**	EPA 200.7	MPRP/32390	EPA 200.7	ICP/13389
10191119001	**MW-RY-07**	EPA 7470	MERP/6867	EPA 7470	MERC/7682
10191119001	**MW-RY-07**	EPA 7470	MERP/6911	EPA 7470	MERC/7700
10191119001	**MW-RY-07**	SM 2310	MT/8697		
10191119001	**MW-RY-07**	SM 2540C	MT/8715		
10191119001	**MW-RY-07**	SM 2540D	MT/8739		
10191119001	**MW-RY-07**	SM 2320B	WET/25823		
10191119001	**MW-RY-07**	EPA 300.0	WETA/2559		

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CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page: 1 of 1

1519759

Section A Required Client Information:

Company: Tetra Tech
Address: 2708 Broadwater Ave
Helena, MT 59602
Email To: ~~406 558 4150~~ ldornell@tetratech.com
Phone: 406 558 4150 Fax:
Requested Due Date/TAT:

Section B Required Project Information:

Report To: Mark Donner
Copy To: Kevin Hoch
Luke Dornell
Purchase Order No.:
Project Name: Block Pom Mine
Project Number:

Section C Invoice Information:

Attention:
Company Name:
Address:
Pace Quote Reference:
Pace Project Manager:
Pace Profile #:

REGULATORY AGENCY: ☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER ☐ UST ☐ RCRA ☐ OTHER

Site Location STATE: MT

Section D Required Client Information

SAMPLE ID (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE

Matrix Codes (MATRIX / CODE): Drinking Water DW; Water WT; Waste Water WW; Product P; Soil/Solid SL; Oil OL; Wipe WP; Air AR; Tissue TS; Other OT

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED Composite Start DATE	COLLECTED Composite Start TIME	COLLECTED Composite End/Grab DATE	COLLECTED Composite End/Grab TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1	MW-RY-07	W		5/3/12	1155				6	X		X							001
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			

Requested Analysis Filtered (Y/N) — Analysis Test:

Analysis Test	Y/N
Dissolved Metals/Mercury	Y
Sulfate 300.0	Y
Alkalinity 310.1	Y
TDS 160.1	Y
Acidity	Y
TSS 160.2	Y
Metals 200.7 ICP	Y

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME
	[signature] / Tetra Tech	5/3/12	1500			
	Fedex	5/4/12	1005	Norma C. Tankelo/Pace	5/4/12	1005

SAMPLE CONDITIONS

Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)
1.8	Y	Y	Y

ORIGINAL

SAMPLER NAME AND SIGNATURE
PRINT Name of SAMPLER: Luke Dornell
SIGNATURE of SAMPLER: [signature] DATE Signed (MM/DD/YY): 5/3/12

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days.

F-ALL-Q-020rev.07, 15-May-2007

Pace Analytical®	Document Name: **Sample Condition Upon Receipt Form**	Revised Date: 01Nov2011 Page 1 of 1
	Document Number: **F-MT-C-184 Rev.00**	Issuing Authority: Pace Minnesota Quality Office

Sample Condition Upon Receipt

Client Name: Tri Hydro

Project #: 1019119

Courier: ☒ Fed Ex ☐ UPS ☐ USPS ☐ Client ☐ Commercial ☐ Pace Other _____

Tracking #: 5296-8870-3545 Return

[redacted]

Custody Seal on Cooler/Box Present: ☒ yes ☐ no **Seals intact:** ☒ yes ☐ no

Packing Material: ☒ Bubble Wrap ☐ Bubble Bags ☐ None ☐ Other _____ Temp Blank: Yes X No _____

Thermometer Used 1383045 of 135 **Type of Ice:** (Wet) Blue None ☒ Samples on ice, cooling process has begun

Cooler Temperature 1.8 **Biological Tissue is Frozen:** Yes No

Temp should be above freezing to 6°C

Date and Initials of person examining contents: MW 5-4-12

Comments:

				Comments
Chain of Custody Present:	☒ Yes	☐ No	☐ N/A	1.
Chain of Custody Filled Out:	☒ Yes	☐ No	☐ N/A	2.
Chain of Custody Relinquished:	☒ Yes	☐ No	☐ N/A	3.
Sampler Name & Signature on COC:	☒ Yes	☐ No	☐ N/A	4.
Samples Arrived within Hold Time:	☒ Yes	☐ No	☐ N/A	5.
Short Hold Time Analysis (<72hr):	☐ Yes	☒ No	☐ N/A	6.
Rush Turn Around Time Requested:	☐ Yes	☒ No	☐ N/A	7.
Sufficient Volume:	☒ Yes	☐ No	☐ N/A	8. Sample bottle for 300.0 analysis dropped during shipout in SR, spilled half of sample & sent remainder out for testing (half full bottle) NCT 5/4/12
Correct Containers Used:	☒ Yes	☐ No	☐ N/A	9.
-Pace Containers Used:	☒ Yes	☐ No	☐ N/A	
Containers Intact:	☒ Yes	☐ No	☐ N/A	10.
Filtered volume received for Dissolved tests	☒ Yes	☐ No	☐ N/A	11.
Sample Labels match COC:	☒ Yes	☐ No	☐ N/A	12.
-Includes date/time/ID/Analysis Matrix: H2O				
All containers needing acid/base preservation have been checked. Noncompliance are noted in 13.	☒ Yes	☐ No	☐ N/A	13. ☒ HNO3 ☐ H2SO4 ☐ NaOH ☐ HCl Samp # 001 (2/2) HNO3
All containers needing preservation are found to be in compliance with EPA recommendation.	☒ Yes	☐ No	☐ N/A	
Exceptions: VOA,Coliform, TOC, Oil and Grease, WI-DRO (water)	☐ Yes	☒ No		Initial when completed MW Lot # of added preservative
Samples checked for dechlorination:	☐ Yes	☐ No	☒ N/A	14.
Headspace in VOA Vials (>6mm):	☐ Yes	☐ No	☒ N/A	15.
Trip Blank Present:	☐ Yes	☐ No	☒ N/A	16.
Trip Blank Custody Seals Present	☐ Yes	☐ No	☒ N/A	
Pace Trip Blank Lot # (if purchased):				

Client Notification/ Resolution: Field Data Required? Y / N

Person Contacted: _____ Date/Time: _____

Comments/ Resolution: _____

Project Manager Review: [signature] **Date:** 05/04/12

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers)

2512063

Chain of Custody

Pace Analytical®
www.pacelabs.com

Workorder: 10191119 **Workorder Name:** Black Pine Mine **Owner Received Date:** 5/4/2012 **Results Requested By:** 5/17/2012

Report To

Kyna M Hogg
Pace Analytical Services, Inc.
1700 Elm Street, Suite 200
Minneapolis, MN 55414
Phone (612)607-1700
Fax (612)607-6444

Subcontract To

Pace Analytical Seattle
940 South Harney
Seattle, WA 98108
Phone (206)767-5060

Requested Analysis

Item	Sample ID	Sample Type	Collect Date/Time	Lab ID	Matrix	Preserved Containers: Unpreserved	Sulfates by 300.0	LAB USE ONLY
1	MW-RY-07	PS	5/3/2012 11:55	10191119001	Water	1	X	
2								
3								
4								
5								

Transfers	Released By	Date/Time	Received By	Date/Time
1	Norma C. Trendel/Pace	5/4/12 1630		
2				
3	Fedex	5/5/12 0913	Jyothi Swamy	5/5/12 0913

Comments

Std Reporting

Cooler Temperature on Receipt 0.1 °C **Custody Seal** Y or N **Received on Ice** Y or N **Samples Intact** Y or N

27 of 30

2512063

Pace Analytical®
www.pacelabs.com

INTER_LABORATORY WORK ORDER # 10191119
(To be completed by sending lab)

Ship To:
Pace Analytical Seattle
940 South Harney
Seattle, WA 98108
Phone (206)767-5060

Sending Project No:	10191119
Receiving Project No:	
Check Box for Consolidated Invoice:	☐
Date Prepared:	05/04/12
REQUESTED COMPLETION DATE:	**5/17/2012**

Sending Region	IR10-Minnesota	Sending Project Mgr.	Kyna M Hogg
Receiving Region	IR25-Seattle	External Client	Montana Dept. of Environmental Quality
State of Sample Origin	MT	QC Deliverable	STD REPORT

All questions should be addressed to sending project manager.

Requested Reportable Units _____ Report Wet or Dry Weight? Dry Weight Cert. Needed _____

WORK REQUESTED

Method Description	Container Type	Quantity of containers	Preservative	Quantity of Samples	Unit Price	Amount
sulfates by 300.0	BP3U		Unpreserved	1	$8.00	$8.00
					TOTAL	$8.00

Special Requirements: _____

Receiving Region Department	Acctg. Code	Totals from above	Revenue Allocation	
			Receiving Region (80%)	Client Services Dept. Sending Region (20%)
Wet Chemistry	21	$8.00	$6.40	$1.60
* Custom Revenue Allocation	**TOTAL**	$8.00	$6.40	$1.60

FOR ANALYTICAL WORK COMPLETED THIS SECTION ALSO

Chain of Custody Included: ☒ Yes ☐ No Return Samples to Sending Region: ☐ Yes ☒ No

Matrix: ☐ Soil ☒ Water ☐ Air ☐ Other (identify) _____

CONFIRMATION OF WORK COMPLETED

Date Completed: _____ Receiving Project Manager: _____

DISPOSITION of FORM

Original sent to the receiving lab - Copy kept at the sending lab.

When work completed: Original sent to the ABM at the receiving laboratory. Copies are made to corporate as needed.

Sample Container Count

2512063

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CLIENT: PACE MT

COC PAGE 1 of 1
COC ID#

Trip Blank(s) Provided?
Y / N

Sample Line Item	VG9H	AG1H	AG1U	BP1U	BP2U	BP3U	BP3N	BP3S	WGKU	WGFU	WG2U	DG9M	DG9B	VG9W	VSG				Comments
1						1													
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			

AG1H	1 liter HCL amber glass	BP2S	500mL H2SO4 plastic	JGFU	4 oz amber glass soil jar
AG1U	1liter unpreserved amber glass	BP2U	500mL unpreserved plastic	WGKU	8 oz clear glass soil jar
AG2S	500mL H2SO4 amber glass	BP2Z	500mL NaOH, Zn Ac	WGFU	4 oz clear glass soil jar
AG2U	500mL unpreserved amber glass	BP3C	250mL NaOH plastic	WG2U	2 oz clear glass soil jar
AG3S	250mL H2SO4 amber glass	BP3N	250mL HNO3 plastic	JGFM	4 oz amber glass soil jar with MeOH
BG1H	1 liter HCL clear glass	BP3S	250mL H2SO4 plastic	VG9U	40mL unpreserved clear vial
BG1U	1 liter unpreserved glass	BP3U	250mL unpreserved plastic	VG9W	40mL clear vial pre-weighted with DI water
BP1N	1 liter HNO3 plastic	DG9B	40mL Na Bisulfate clear vial	VSG	Headspace septa vial
BP1S	1 liter H2SO4 plastic	DG9H	40mL HCL amber voa vial	VG9H	40mL HCL clear vial
BP1U	1 liter unpreserved plastic	DG9M	40mL MeOH clear vial	WGFX	4oz wide jar w/hexane wipe
BP1Z	1 liter NaOH, Zn, Ac	DG9T	40mL Na Thio amber vial	VG9T	40mL Na Thio. clear vial
BP2N	500mL HNO3 plastic	DG9U	40mL unpreserved amber vial	ZPLC	Ziploc Bag
BP2O	500mL NaOH plastic	I	Wipe/Swab	U	Summa Can

F-SEA-C-014-rev.01, 10Nov2011

Sample Condition Upon Receipt

Pace Analytical

Client Name: PACE MT Project # 2512063

Courier: ☑ Fed Ex ☐ UPS ☐ USPS ☐ Client ☐ Commercial ☐ Pace Other _____

Tracking #: 5296 8870 9464

Custody Seal on Cooler/Box Present: ☑ Yes ☐ No Seals intact: ☑ Yes ☐ No

Packing Material: ☐ Bubble Wrap ☐ Bubble Bags ☑ None ☐ Other _____ Temp. Blank (Yes) ____ No ____

Thermometer Used 132013 or 101731962 or 226099 **Type of Ice:** (Wet) Blue None ☐ Samples on ice, cooling process has begun

Cooler Temperature 0.1°C **Biological Tissue is Frozen:** Yes No

Temp should be above freezing ≤ 6°C

Date and Initials of person examining contents: MD 050512

Comments:

				Comments
Chain of Custody Present:	☑Yes	☐No	☐N/A	1.
Chain of Custody Filled Out:	☑Yes	☐No	☐N/A	2.
Chain of Custody Relinquished:	☑Yes	☐No	☐N/A	3.
Sampler Name & Signature on COC:	☐Yes	☑No	☐N/A	4.
Samples Arrived within Hold Time:	☑Yes	☐No	☐N/A	5.
Short Hold Time Analysis (<72hr):	☐Yes	☑No	☐N/A	6.
Rush Turn Around Time Requested:	☐Yes	☑No	☐N/A	7.
Follow Up / Hold Analysis Requested:	☐Yes	☑No	☐N/A	8.
Sufficient Volume:	☑Yes	☐No	☐N/A	9.
Correct Containers Used:	☑Yes	☐No	☐N/A	10.
-Pace Containers Used:	☑Yes	☐No	☐N/A	Non-Seattle.
Containers Intact:	☑Yes	☐No	☐N/A	11.
Filtered volume received for Dissolved tests	☐Yes	☐No	☑N/A	12.
Sample Labels match COC:	☑Yes	☐No	☐N/A	13.
-Includes date/time/ID/Analysis Matrix: Water				
All containers needing preservation have been checked.	☐Yes	☐No	☑N/A	14.
All containers needing preservation are found to be in compliance with EPA recommendation.	☐Yes	☐No	☑N/A	
Exceptions: VOA, coliform, TOC, O&G	☐Yes	☐No	☑N/A	Initial when completed / Lot # of added preservative
Samples checked for dechlorination:	☐Yes	☐No	☑N/A	15.
Headspace in VOA Vials (>6mm):	☐Yes	☐No	☑N/A	16.
Trip Blanks Present:	☐Yes	☐No	☑N/A	17.
Trip Blank Custody Seals Present	☐Yes	☐No	☑N/A	
Pace Trip Blank Creation Date:				

Client Notification/ Resolution: Field Data Required? Y / N

Person Contacted: _____ Date/Time: _____

Comments/ Resolution: _____

Project Manager Review: PL **Date:** 5/7

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers)

ANALYTICAL SUMMARY REPORT

September 28, 2012

MT DEQ-Abandoned Mines
PO Box 200901
Helena, MT 59620-0901

Workorder No.: H12090108 Quote ID: H765 - Black Pine Mine 2012 sampling

Project Name: Black Pine Mine

Energy Laboratories Inc Helena MT received the following 4 samples for MT DEQ-Abandoned Mines on 9/10/2012 for analysis.

Sample ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
H12090108-001	MW-RY-07	09/07/12 14:30	09/10/12	Groundwater	Metals by ICP/ICPMS, Dissolved Conductivity Mercury, Dissolved Hardness as CaCO3 Anions by Ion Chromatography Digestion, Mercury by CVAA Preparation for TSS Solids, Total Dissolved Solids, Total Suspended
H12090108-002	BD-1	09/07/12 14:30	09/10/12	Groundwater	Same As Above
H12090108-003	Spoon Rinsate	09/07/12 10:46	09/10/12	Aqueous	Metals by ICP/ICPMS, Tot. Rec. Mercury, Total Recoverable Metals Digestion by EPA 200.2 Digestion, Mercury by CVAA
H12090108-004	Excavator Bucket	09/07/12 10:37	09/10/12	Aqueous	Same As Above

The analyses presented in this report were performed by Energy Laboratories, Inc., 3161 E. Lyndale Ave., Helena, MT 59604, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090108-001
Client Sample ID MW-RY-07

Report Date: 09/28/12
Collection Date: 09/07/12 14:30
DateReceived: 09/10/12
Matrix: Groundwater

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL PROPERTIES							
Solids, Total Suspended TSS @ 105 C	642	mg/L		10		A2540 D	09/11/12 09:33 / cmm
Solids, Total Dissolved TDS @ 180 C	196	mg/L		10		A2540 C	09/11/12 09:55 / cmm
INORGANICS							
Sulfate	71	mg/L	D	2		E300.0	09/12/12 16:29 / cmm
Hardness as CaCO3	84	mg/L		1		A2340 B	09/13/12 11:26 / sld
METALS, DISSOLVED							
Antimony	ND	mg/L		0.001		E200.8	09/12/12 19:58 / dck
Arsenic	ND	mg/L		0.001		E200.8	09/12/12 19:58 / dck
Barium	0.07	mg/L		0.05		E200.8	09/12/12 19:58 / dck
Cadmium	ND	mg/L		0.00008		E200.8	09/12/12 19:58 / dck
Calcium	21	mg/L		1		E200.7	09/12/12 14:26 / sld
Chromium	ND	mg/L		0.005		E200.8	09/12/12 19:58 / dck
Copper	ND	mg/L		0.005		E200.8	09/12/12 19:58 / dck
Iron	0.07	mg/L		0.03		E200.8	09/12/12 19:58 / dck
Lead	ND	mg/L		0.001		E200.8	09/12/12 19:58 / dck
Magnesium	8	mg/L		1		E200.7	09/12/12 14:26 / sld
Manganese	0.100	mg/L		0.001		E200.8	09/12/12 19:58 / dck
Mercury	ND	mg/L		0.0001		E245.1	09/17/12 17:08 / dck
Nickel	ND	mg/L		0.005		E200.8	09/12/12 19:58 / dck
Potassium	3	mg/L		1		E200.7	09/12/12 14:26 / sld
Silver	ND	mg/L		0.001		E200.8	09/12/12 19:58 / dck
Sodium	17	mg/L		1		E200.7	09/12/12 14:26 / sld
Zinc	0.05	mg/L		0.01		E200.8	09/12/12 19:58 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090108-002
Client Sample ID BD-1

Report Date: 09/28/12
Collection Date: 09/07/12 14:30
DateReceived: 09/10/12
Matrix: Groundwater

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL PROPERTIES							
Solids, Total Suspended TSS @ 105 C	884	mg/L		10		A2540 D	09/11/12 09:34 / cmm
Solids, Total Dissolved TDS @ 180 C	172	mg/L		10		A2540 C	09/11/12 09:56 / cmm
INORGANICS							
Sulfate	74	mg/L	D	2		E300.0	09/12/12 16:41 / cmm
Hardness as CaCO3	83	mg/L		1		A2340 B	09/13/12 11:26 / sld
METALS, DISSOLVED							
Antimony	ND	mg/L		0.001		E200.8	09/12/12 20:02 / dck
Arsenic	ND	mg/L		0.001		E200.8	09/12/12 20:02 / dck
Barium	0.07	mg/L		0.05		E200.8	09/12/12 20:02 / dck
Cadmium	ND	mg/L		0.00008		E200.8	09/12/12 20:02 / dck
Calcium	21	mg/L		1		E200.7	09/12/12 14:30 / sld
Chromium	ND	mg/L		0.005		E200.8	09/12/12 20:02 / dck
Copper	ND	mg/L		0.005		E200.8	09/12/12 20:02 / dck
Iron	ND	mg/L		0.03		E200.8	09/12/12 20:02 / dck
Lead	ND	mg/L		0.001		E200.8	09/12/12 20:02 / dck
Magnesium	8	mg/L		1		E200.7	09/12/12 14:30 / sld
Manganese	0.087	mg/L		0.001		E200.8	09/12/12 20:02 / dck
Mercury	ND	mg/L		0.0001		E245.1	09/17/12 17:15 / dck
Nickel	ND	mg/L		0.005		E200.8	09/12/12 20:02 / dck
Potassium	3	mg/L		1		E200.7	09/12/12 14:30 / sld
Silver	ND	mg/L		0.001		E200.8	09/12/12 20:02 / dck
Sodium	17	mg/L		1		E200.7	09/12/12 14:30 / sld
Zinc	0.04	mg/L		0.01		E200.8	09/12/12 20:02 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090108-003
Client Sample ID Spoon Rinsate

Report Date: 09/28/12
Collection Date: 09/07/12 10:46
DateReceived: 09/10/12
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL RECOVERABLE							
Antimony	ND	mg/L		0.001		E200.8	09/12/12 20:07 / dck
Arsenic	ND	mg/L		0.001		E200.8	09/12/12 20:07 / dck
Barium	ND	mg/L		0.05		E200.8	09/12/12 20:07 / dck
Cadmium	ND	mg/L		0.00008		E200.8	09/12/12 20:07 / dck
Chromium	ND	mg/L		0.005		E200.8	09/12/12 20:07 / dck
Copper	ND	mg/L		0.005		E200.8	09/12/12 20:07 / dck
Iron	ND	mg/L		0.03		E200.8	09/12/12 20:07 / dck
Lead	ND	mg/L		0.001		E200.8	09/12/12 20:07 / dck
Manganese	ND	mg/L		0.005		E200.8	09/12/12 20:07 / dck
Mercury	ND	mg/L		0.0001		E245.1	09/17/12 17:18 / dck
Nickel	ND	mg/L		0.01		E200.8	09/12/12 20:07 / dck
Silver	ND	mg/L		0.005		E200.8	09/12/12 20:07 / dck
Zinc	ND	mg/L		0.01		E200.8	09/12/12 20:07 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090108-004
Client Sample ID Excavator Bucket

Report Date: 09/28/12
Collection Date: 09/07/12 10:37
DateReceived: 09/10/12
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL RECOVERABLE							
Antimony	0.002	mg/L		0.001		E200.8	09/12/12 20:12 / dck
Arsenic	0.001	mg/L		0.001		E200.8	09/12/12 20:12 / dck
Barium	ND	mg/L		0.05		E200.8	09/12/12 20:12 / dck
Cadmium	ND	mg/L		0.00008		E200.8	09/12/12 20:12 / dck
Chromium	ND	mg/L		0.005		E200.8	09/12/12 20:12 / dck
Copper	0.005	mg/L		0.005		E200.8	09/12/12 20:12 / dck
Iron	1.26	mg/L		0.03		E200.8	09/12/12 20:12 / dck
Lead	0.010	mg/L		0.001		E200.8	09/12/12 20:12 / dck
Manganese	0.028	mg/L		0.005		E200.8	09/12/12 20:12 / dck
Mercury	ND	mg/L		0.0001		E245.1	09/17/12 17:20 / dck
Nickel	ND	mg/L		0.01		E200.8	09/12/12 20:12 / dck
Silver	ND	mg/L		0.005		E200.8	09/12/12 20:12 / dck
Zinc	ND	mg/L		0.01		E200.8	09/12/12 20:12 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Report Date: 09/28/12
Project: Black Pine Mine
Work Order: H12090108

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A2540 C									Batch: TDS120911A	
Sample ID: MB-26_120911A		Method Blank				Run: ACCU-124 (14410200)_120911			09/11/12 09:54	
Solids, Total Dissolved TDS @ 180 C		ND	mg/L	3						
Sample ID: LCS-27_120911A		Laboratory Control Sample				Run: ACCU-124 (14410200)_120911			09/11/12 09:54	
Solids, Total Dissolved TDS @ 180 C		2000	mg/L	10	100	90	110			
Sample ID: H12090100-012A DUP		Sample Duplicate				Run: ACCU-124 (14410200)_120911			09/11/12 09:55	
Solids, Total Dissolved TDS @ 180 C		674	mg/L	10				0.4	5	
Sample ID: H12090108-001A MS		Sample Matrix Spike				Run: ACCU-124 (14410200)_120911			09/11/12 09:55	
Solids, Total Dissolved TDS @ 180 C		2190	mg/L	10	100	80	120			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Report Date: 09/28/12
Project: Black Pine Mine
Work Order: H12090108

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: A2540 D										Batch: 17919
Sample ID: MB-17919		Method Blank				Run: ACCU-124 (14410200)_120911				09/11/12 09:31
Solids, Total Suspended TSS @ 105 C		ND	mg/L	2						
Sample ID: LCS-17919		Laboratory Control Sample				Run: ACCU-124 (14410200)_120911				09/11/12 09:31
Solids, Total Suspended TSS @ 105 C		1980	mg/L	10	99	70	130			
Sample ID: H12090092-019ADUP		Sample Duplicate				Run: ACCU-124 (14410200)_120911				09/11/12 09:31
Solids, Total Suspended TSS @ 105 C		32.0	mg/L	10					5	
Sample ID: H12090108-001ADUP		Sample Duplicate				Run: ACCU-124 (14410200)_120911				09/11/12 09:34
Solids, Total Suspended TSS @ 105 C		638	mg/L	10				0.6	5	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 09/28/12

Project: Black Pine Mine **Work Order:** H12090108

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.7									Analytical Run: ICP2-HE_120912A	
Sample ID: ICV	4	Initial Calibration Verification Standard							09/12/12 09:08	
Calcium		40.8	mg/L	1.0	102	95	105			
Magnesium		39.9	mg/L	1.0	100	95	105			
Potassium		39.5	mg/L	1.0	99	95	105			
Sodium		40.3	mg/L	1.0	101	95	105			
Sample ID: CCV-1	4	Continuing Calibration Verification Standard							09/12/12 09:12	
Calcium		25.3	mg/L	1.0	101	95	105			
Magnesium		24.4	mg/L	1.0	98	95	105			
Potassium		24.4	mg/L	1.0	98	95	105			
Sodium		24.3	mg/L	1.0	97	95	105			
Sample ID: ICSA	4	Interference Check Sample A							09/12/12 09:23	
Calcium		474	mg/L	1.0	95	80	120			
Magnesium		495	mg/L	1.0	99	80	120			
Potassium		-0.0236	mg/L	1.0		0	0			
Sodium		0.0587	mg/L	1.0		0	0			
Sample ID: ICSAB	4	Interference Check Sample AB							09/12/12 09:27	
Calcium		491	mg/L	1.0	98	80	120			
Magnesium		505	mg/L	1.0	101	80	120			
Potassium		21.2	mg/L	1.0	106	80	120			
Sodium		21.3	mg/L	1.0	106	80	120			
Sample ID: CCV	4	Continuing Calibration Verification Standard							09/12/12 14:15	
Calcium		25.3	mg/L	1.0	101	90	110			
Magnesium		25.3	mg/L	1.0	101	90	110			
Potassium		23.9	mg/L	1.0	96	90	110			
Sodium		24.0	mg/L	1.0	96	90	110			
Sample ID: CCV	4	Continuing Calibration Verification Standard							09/12/12 15:47	
Calcium		25.2	mg/L	1.0	101	90	110			
Magnesium		25.4	mg/L	1.0	101	90	110			
Potassium		24.0	mg/L	1.0	96	90	110			
Sodium		24.0	mg/L	1.0	96	90	110			
Method: E200.7										Batch: R82882
Sample ID: ICB	4	Method Blank				Run: ICP2-HE_120912A			09/12/12 09:35	
Calcium		0.05	mg/L	0.02						
Magnesium		ND	mg/L	0.007						
Potassium		ND	mg/L	0.02						
Sodium		ND	mg/L	0.02						
Sample ID: LFB	4	Laboratory Fortified Blank				Run: ICP2-HE_120912A			09/12/12 09:39	
Calcium		48.8	mg/L	1.0	97	85	115			
Magnesium		46.9	mg/L	1.0	94	85	115			
Potassium		46.8	mg/L	1.0	94	85	115			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 09/28/12

Project: Black Pine Mine **Work Order:** H12090108

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.7										Batch: R82882
Sample ID: LFB	4	Laboratory Fortified Blank				Run: ICP2-HE_120912A			09/12/12 09:39	
Sodium		47.5	mg/L	1.0	95	85	115			
Sample ID: H12090107-001BMS2	4	Sample Matrix Spike				Run: ICP2-HE_120912A			09/12/12 14:53	
Calcium		247	mg/L	1.0		70	130			A
Magnesium		169	mg/L	1.0	103	70	130			
Potassium		65.3	mg/L	1.0	98	70	130			
Sodium		119	mg/L	1.0	102	70	130			
Sample ID: H12090107-001BMSD2	4	Sample Matrix Spike Duplicate				Run: ICP2-HE_120912A			09/12/12 14:57	
Calcium		248	mg/L	1.0		70	130	0.3	20	A
Magnesium		168	mg/L	1.0	101	70	130	0.6	20	
Potassium		66.4	mg/L	1.0	100	70	130	1.7	20	
Sodium		120	mg/L	1.0	103	70	130	0.4	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 09/28/12

Project: Black Pine Mine **Work Order:** H12090108

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.8								Analytical Run: ICPMS204-B_120912A		
Sample ID: ICV STD	12	Initial Calibration Verification Standard								09/12/12 10:39
Antimony		0.0511	mg/L	0.050	102	90	110			
Arsenic		0.0496	mg/L	0.0050	99	90	110			
Barium		0.0516	mg/L	0.10	103	90	110			
Cadmium		0.0264	mg/L	0.0010	105	90	110			
Chromium		0.0494	mg/L	0.010	99	90	110			
Copper		0.0513	mg/L	0.010	103	90	110			
Iron		0.270	mg/L	0.030	108	90	110			
Lead		0.0502	mg/L	0.010	100	90	110			
Manganese		0.255	mg/L	0.010	102	90	110			
Nickel		0.0508	mg/L	0.010	102	90	110			
Silver		0.0259	mg/L	0.0050	104	90	110			
Zinc		0.0512	mg/L	0.010	102	90	110			
Sample ID: ICSA	12	Interference Check Sample A								09/12/12 10:44
Antimony		0.000327	mg/L	0.050						
Arsenic		6.00E-05	mg/L	0.0050						
Barium		-0.000165	mg/L	0.10						
Cadmium		0.000888	mg/L	0.0010						
Chromium		0.00112	mg/L	0.010						
Copper		0.000155	mg/L	0.010						
Iron		101	mg/L	0.030	101	70	130			
Lead		0.000129	mg/L	0.010						
Manganese		0.000143	mg/L	0.010						
Nickel		0.000635	mg/L	0.010						
Silver		0.000141	mg/L	0.0050						
Zinc		0.00137	mg/L	0.010						
Sample ID: ICSAB	12	Interference Check Sample AB								09/12/12 10:48
Antimony		0.000311	mg/L	0.050		0	0			
Arsenic		0.0101	mg/L	0.0050	101	70	130			
Barium		-0.000202	mg/L	0.10		0	0			
Cadmium		0.0103	mg/L	0.0010	103	70	130			
Chromium		0.0207	mg/L	0.010	103	70	130			
Copper		0.0199	mg/L	0.010	100	70	130			
Iron		102	mg/L	0.030	102	70	130			
Lead		0.000157	mg/L	0.010		0	0			
Manganese		0.0196	mg/L	0.010	98	70	130			
Nickel		0.0205	mg/L	0.010	102	70	130			
Silver		0.0187	mg/L	0.0050	94	70	130			
Zinc		0.0103	mg/L	0.010	103	70	130			
Sample ID: ICV STD	12	Initial Calibration Verification Standard								09/12/12 15:59
Antimony		0.0510	mg/L	0.050	102	90	110			
Arsenic		0.0513	mg/L	0.0050	103	90	110			
Barium		0.0508	mg/L	0.10	102	90	110			

Qualifiers:

RL - Analyte reporting limit. ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 09/28/12

Project: Black Pine Mine **Work Order:** H12090108

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.8								Analytical Run: ICPMS204-B_120912A		
Sample ID: ICV STD	12	Initial Calibration Verification Standard								09/12/12 15:59
Cadmium		0.0262	mg/L	0.0010	105	90	110			
Chromium		0.0503	mg/L	0.010	101	90	110			
Copper		0.0529	mg/L	0.010	106	90	110			
Iron		0.262	mg/L	0.030	105	90	110			
Lead		0.0499	mg/L	0.010	100	90	110			
Manganese		0.254	mg/L	0.010	102	90	110			
Nickel		0.0525	mg/L	0.010	105	90	110			
Silver		0.0259	mg/L	0.0050	104	90	110			
Zinc		0.0541	mg/L	0.010	108	90	110			
Sample ID: ICSA	12	Interference Check Sample A								09/12/12 16:04
Antimony		0.000305	mg/L	0.050						
Arsenic		8.70E-05	mg/L	0.0050						
Barium		-0.000121	mg/L	0.10						
Cadmium		0.00100	mg/L	0.0010						
Chromium		0.00114	mg/L	0.010						
Copper		0.000157	mg/L	0.010						
Iron		99.5	mg/L	0.030	100	70	130			
Lead		0.000136	mg/L	0.010						
Manganese		0.000161	mg/L	0.010						
Nickel		0.000639	mg/L	0.010						
Silver		0.000111	mg/L	0.0050						
Zinc		0.00166	mg/L	0.010						
Sample ID: ICSAB	12	Interference Check Sample AB								09/12/12 16:08
Antimony		0.000303	mg/L	0.050		0	0			
Arsenic		0.0104	mg/L	0.0050	104	70	130			
Barium		-0.000116	mg/L	0.10		0	0			
Cadmium		0.0104	mg/L	0.0010	104	70	130			
Chromium		0.0209	mg/L	0.010	105	70	130			
Copper		0.0205	mg/L	0.010	102	70	130			
Iron		98.6	mg/L	0.030	99	70	130			
Lead		0.000159	mg/L	0.010		0	0			
Manganese		0.0192	mg/L	0.010	96	70	130			
Nickel		0.0209	mg/L	0.010	104	70	130			
Silver		0.0186	mg/L	0.0050	93	70	130			
Zinc		0.0116	mg/L	0.010	116	70	130			
Method: E200.8										Batch: 17914
Sample ID: MB-17914	12	Method Blank				Run: ICPMS204-B_120912A				09/12/12 13:58
Antimony		4E-05	mg/L	3E-05						
Arsenic		ND	mg/L	3E-05						
Barium		ND	mg/L	0.00010						
Cadmium		ND	mg/L	2E-05						
Chromium		ND	mg/L	6E-05						

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 09/28/12

Project: Black Pine Mine **Work Order:** H12090108

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.8										Batch: 17914
Sample ID: MB-17914	12	Method Blank				Run: ICPMS204-B_120912A				09/12/12 13:58
Copper		0.0003	mg/L	0.0003						
Iron		0.0010	mg/L	0.0007						
Lead		ND	mg/L	2E-05						
Manganese		ND	mg/L	5E-05						
Nickel		ND	mg/L	0.0001						
Silver		ND	mg/L	6E-05						
Zinc		0.002	mg/L	0.0007						
Sample ID: LCS-17914	12	Laboratory Control Sample				Run: ICPMS204-B_120912A				09/12/12 14:03
Antimony		0.541	mg/L	0.0010	108	85	115			
Arsenic		0.512	mg/L	0.0010	102	85	115			
Barium		0.529	mg/L	0.050	106	85	115			
Cadmium		0.262	mg/L	0.0010	105	85	115			
Chromium		0.508	mg/L	0.0050	102	85	115			
Copper		0.501	mg/L	0.0050	100	85	115			
Iron		2.70	mg/L	0.030	108	85	115			
Lead		0.534	mg/L	0.0010	107	85	115			
Manganese		2.54	mg/L	0.0010	101	85	115			
Nickel		0.506	mg/L	0.0050	101	85	115			
Silver		0.0517	mg/L	0.0010	103	85	115			
Zinc		0.495	mg/L	0.010	99	85	115			
Sample ID: H12090108-004AMS3	12	Sample Matrix Spike				Run: ICPMS204-B_120912A				09/12/12 20:16
Antimony		0.557	mg/L	0.0010	111	70	130			
Arsenic		0.518	mg/L	0.0010	103	70	130			
Barium		0.553	mg/L	0.050	109	70	130			
Cadmium		0.259	mg/L	0.0010	104	70	130			
Chromium		0.512	mg/L	0.0050	102	70	130			
Copper		0.517	mg/L	0.0050	102	70	130			
Iron		3.88	mg/L	0.030	105	70	130			
Lead		0.551	mg/L	0.0010	108	70	130			
Manganese		2.54	mg/L	0.0010	101	70	130			
Nickel		0.516	mg/L	0.0050	103	70	130			
Silver		0.0530	mg/L	0.0010	106	70	130			
Zinc		0.520	mg/L	0.010	103	70	130			
Sample ID: H12090108-004AMSD3	12	Sample Matrix Spike Duplicate				Run: ICPMS204-B_120912A				09/12/12 20:21
Antimony		0.554	mg/L	0.0010	110	70	130	0.5	20	
Arsenic		0.502	mg/L	0.0010	100	70	130	3.1	20	
Barium		0.542	mg/L	0.050	107	70	130	2.0	20	
Cadmium		0.257	mg/L	0.0010	103	70	130	0.9	20	
Chromium		0.503	mg/L	0.0050	100	70	130	1.8	20	
Copper		0.507	mg/L	0.0050	100	70	130	2.1	20	
Iron		3.85	mg/L	0.030	104	70	130	0.6	20	
Lead		0.544	mg/L	0.0010	107	70	130	1.3	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 09/28/12

Project: Black Pine Mine **Work Order:** H12090108

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.8										Batch: 17914
Sample ID: H12090108-004AMSD3	12	Sample Matrix Spike Duplicate				Run: ICPMS204-B_120912A			09/12/12 20:21	
Manganese		2.54	mg/L	0.0010	101	70	130	0.0	20	
Nickel		0.506	mg/L	0.0050	101	70	130	2.0	20	
Silver		0.0523	mg/L	0.0010	104	70	130	1.3	20	
Zinc		0.508	mg/L	0.010	100	70	130	2.3	20	
Method: E200.8										Batch: R82893
Sample ID: ICB	12	Method Blank				Run: ICPMS204-B_120912A			09/12/12 11:16	
Antimony		4E-05	mg/L	1E-05						
Arsenic		ND	mg/L	5E-05						
Barium		ND	mg/L	5E-05						
Cadmium		ND	mg/L	5E-06						
Chromium		ND	mg/L	2E-05						
Copper		ND	mg/L	2E-05						
Iron		ND	mg/L	0.0002						
Lead		ND	mg/L	1E-05						
Manganese		ND	mg/L	5E-05						
Nickel		ND	mg/L	4E-05						
Silver		ND	mg/L	3E-05						
Zinc		0.0007	mg/L	0.0004						
Sample ID: LFB	12	Laboratory Fortified Blank				Run: ICPMS204-B_120912A			09/12/12 11:21	
Antimony		0.0484	mg/L	0.050	97	85	115			
Arsenic		0.0478	mg/L	0.0050	96	85	115			
Barium		0.0487	mg/L	0.10	97	85	115			
Cadmium		0.0459	mg/L	0.0010	92	85	115			
Chromium		0.0485	mg/L	0.010	97	85	115			
Copper		0.0466	mg/L	0.010	93	85	115			
Iron		5.05	mg/L	0.030	101	85	115			
Lead		0.0487	mg/L	0.010	97	85	115			
Manganese		0.0489	mg/L	0.010	98	85	115			
Nickel		0.0476	mg/L	0.010	95	85	115			
Silver		0.0189	mg/L	0.0050	95	85	115			
Zinc		0.0461	mg/L	0.010	91	85	115			
Sample ID: H12090100-007BMS	12	Sample Matrix Spike				Run: ICPMS204-B_120912A			09/12/12 18:48	
Antimony		0.0988	mg/L	0.0010	98	70	130			
Arsenic		0.104	mg/L	0.0010	104	70	130			
Barium		0.156	mg/L	0.050	98	70	130			
Cadmium		0.0903	mg/L	0.0010	90	70	130			
Chromium		0.0968	mg/L	0.0050	97	70	130			
Copper		0.0958	mg/L	0.0050	94	70	130			
Iron		9.30	mg/L	0.030	92	70	130			
Lead		0.0965	mg/L	0.0010	96	70	130			
Manganese		0.106	mg/L	0.0010	95	70	130			
Nickel		0.0951	mg/L	0.0050	95	70	130			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 09/28/12

Project: Black Pine Mine **Work Order:** H12090108

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.8										Batch: R82893
Sample ID: H12090100-007BMS	12	Sample Matrix Spike				Run: ICPMS204-B_120912A			09/12/12 18:48	
Silver		0.0375	mg/L	0.0010	94	70	130			
Zinc		0.0966	mg/L	0.010	92	70	130			
Sample ID: H12090100-007BMSD	12	Sample Matrix Spike Duplicate				Run: ICPMS204-B_120912A			09/12/12 18:52	
Antimony		0.0985	mg/L	0.0010	98	70	130	0.3	20	
Arsenic		0.105	mg/L	0.0010	105	70	130	0.3	20	
Barium		0.155	mg/L	0.050	97	70	130	0.3	20	
Cadmium		0.0907	mg/L	0.0010	91	70	130	0.4	20	
Chromium		0.0973	mg/L	0.0050	97	70	130	0.5	20	
Copper		0.0959	mg/L	0.0050	94	70	130	0.2	20	
Iron		9.40	mg/L	0.030	93	70	130	1.1	20	
Lead		0.0964	mg/L	0.0010	96	70	130	0.1	20	
Manganese		0.106	mg/L	0.0010	95	70	130	0.2	20	
Nickel		0.0961	mg/L	0.0050	96	70	130	1.0	20	
Silver		0.0372	mg/L	0.0010	93	70	130	0.8	20	
Zinc		0.0977	mg/L	0.010	93	70	130	1.1	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Report Date: 09/28/12
Project: Black Pine Mine
Work Order: H12090108

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E245.1								Analytical Run: HGCV201-H_120917A		
Sample ID: ICV		Initial Calibration Verification Standard								09/17/12 13:17
Mercury		0.00021	mg/L	0.00010	104	90	110			
New calibration										
Sample ID: CCV		Continuing Calibration Verification Standard								09/17/12 13:20
Mercury		0.00019	mg/L	0.00010	97	95	105			
Sample ID: CCV		Continuing Calibration Verification Standard								09/17/12 16:49
Mercury		0.00021	mg/L	0.00010	104	90	110			
Method: E245.1										Batch: 17946
Sample ID: MB-17946		Method Blank				Run: HGCV201-H_120917A				09/17/12 17:03
Mercury		1E-05	mg/L	6E-06						
Sample ID: LCS-17946		Laboratory Control Sample				Run: HGCV201-H_120917A				09/17/12 17:06
Mercury		0.00019	mg/L	0.00010	90	90	110			
Sample ID: H12090108-001BMS		Sample Matrix Spike				Run: HGCV201-H_120917A				09/17/12 17:11
Mercury		0.00022	mg/L	0.00010	109	70	130			
Sample ID: H12090108-001BMSD		Sample Matrix Spike Duplicate				Run: HGCV201-H_120917A				09/17/12 17:13
Mercury		0.00022	mg/L	0.00010	105	70	130	4.0	30	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 09/28/12

Project: Black Pine Mine **Work Order:** H12090108

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E300.0									Analytical Run: IC102-H_120912A	
Sample ID: ICV091212-12		Initial Calibration Verification Standard							09/12/12 11:01	
Sulfate		430	mg/L	1.0	107	90	110			
Sample ID: CCV091212-31		Continuing Calibration Verification Standard							09/12/12 15:13	
Sulfate		430	mg/L	1.0	107	90	110			
Method: E300.0									Batch: R82888	
Sample ID: ICB091212-13		Method Blank				Run: IC102-H_120912A			09/12/12 11:14	
Sulfate		ND	mg/L	0.1						
Sample ID: LFB091212-14		Laboratory Fortified Blank				Run: IC102-H_120912A			09/12/12 11:26	
Sulfate		210	mg/L	1.1	107	90	110			
Sample ID: H12090146-001AMS		Sample Matrix Spike				Run: IC102-H_120912A			09/12/12 17:57	
Sulfate		220	mg/L	1.1	106	90	110			
Sample ID: H12090146-001AMSD		Sample Matrix Spike Duplicate				Run: IC102-H_120912A			09/12/12 18:10	
Sulfate		220	mg/L	1.1	106	90	110	0.2	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

Standard Reporting Procedures

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Workorder Receipt Checklist

MT DEQ-Abandoned Mines H12090108

Login completed by: Tracy L. Lorash
Date Received: 9/10/2012
Reviewed by: BL2000\sdull
Received by: elm
Reviewed Date: 9/14/2012
Carrier name: Hand Del

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shipping container/cooler?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☐	No ☑	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received?	Yes ☑	No ☐	Not Applicable ☐
Container/Temp Blank temperature:	3.2°C On Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☑	No ☐	Not Applicable ☐

Contact and Corrective Action Comments:

Samples left in locked entry. Sample ID on COC and metals bottle is MW-RY-07 - ID on 1 liter bottle is MW-RY-01. Logged in with ID from COC. No collection time on bottle or COC for BD-1. Sample time estimated in laboratory.
Spoon Rinsate and Excavator Bucket samples are to be analyzed for Surface Water parameters per Tom Smith. TI 9/10/12

ENERGY

Chain of Custody and Analytical Request Record

PLEASE PRINT (Provide as much information as possible.)

Company Name:	Project Name, PWS, Permit, Etc.	Sample Origin	EPA/State Compliance:
Trihydro	Black Pine Mine	State:	Yes ☐ No ☐
Report Mail Address:	**Contact Name:**	**Phone/Fax:**	**Email:**
2707 Broadwater Ave Helena, MT 59602	Tom Smith	406 505 4150	tsmith@trihydro.com
Invoice Address:	**Invoice Contact & Phone:**	**Purchase Order:**	**Quote/Bottle Order:**

Sampler: (Please Print) Luke Darnell

Special Report/Formats:

☐ DW
☐ POTW/WWTP
☐ State: _____
☐ Other: _____
☐ EDD/EDT (Electronic Data) Format: _____
☐ LEVEL IV
☐ NELAC

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments:

Shipped by: Hand delivered (left in entry)

Cooler ID(s): 4

Receipt Temp 3.2 °C TB

On Ice: Y N

Custody Seal: On Bottle Y N; On Cooler Y N

Intact Y N

Signature Match Y N

LABORATORY USE ONLY H12690108

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX (Number of Containers; Sample Type: A W S V B O DW; Air Water Soils/Solids Vegetation Bioassay Other DW - Drinking Water)	A3540C TDS	A3540D TSS	E300.0 Anions	Dissolved Metals ICP/ICPMS	Hardness as CaCO3	Dissolved Mercury				SEE ATTACHED	Standard Turnaround (TAT)	RUSH	Comments
1	MW-24-07	9/7/12	1430	W	X	X	X	X	X	X							Field Filtered
2	BD-1	9/7/12	—	W	X	X	X	X	X	X							Field Filtered
3	Spoon Rinsate	9/7/12	1046	W				X	X	X							Not Filtered
4	Preservator Blank	9/7/12	1037	W				X	X	X							Not Filtered
5																	
6																	
7																	
8																	
9																	
10																	

Custody Record MUST be Signed

Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Luke Darnell	9/8/12 1000	[signature]			
Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
			Received by Laboratory: Esther Merritt	Date/Time: 9/10/12 9:30	Signature: Esther Merritt

Sample Disposal: Return to Client: _____ Lab Disposal: X

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report.
Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

ENERGY LAB
www.energylab.com
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Helena, MT 877-472-0711 • Billings, MT 800-735-4489 • Casper, WY 888-235-0515
Gillette, WY 866-686-7175 • Rapid City, SD 888-672-1225 • College Station, TX 888-690-2218

BOTTLE ORDER 10496

SHIPPED TO: MT DEQ-Abandoned Mines

Contact: John Koerth
PO Box 200901
Helena MT 59620-0901

Phone:

Project: Black Pine Mine 2012 sampling

Order Created by: Wanda Johnson
Shipped From: Helena, MT
Ship Date: 8/17/2012
VIA: Ground
Quote Used: 765

Bottle Size/Type	Bottles Per Samp	Method	Tests	Critical Hold Time	Preservative	Notes	Num of Samp
Acid Base Potential (6 Sets)							
4 oz Wide Mouth Amber Glass	1	Sobek Modified	Acid/Base Potential				1
		Sobek Modified	Sulfur Forms				
Ground Water (6 Sets)							
1 Liter Plastic	1	A2540 C	Solids, Total Dissolved				1
		A2540 D	Solids, Total Suspended				
		E300.0	Anions by Ion Chromatography				
250 mL Plastic	1	E200.7_8	Metals by ICP/ICPMS, Dissolved		HNO3	Filter before preservation	1
		A2340 B	Hardness as CaCO3				
		E245.1	Mercury, Dissolved				
Metals (12 Sets)							
4 oz Wide Mouth Amber Glass	1	E6010.20	Metals by ICP/ICPMS, Total				1
		SW7471A	Mercury in Solid By CVAA				

Soil Sampling

Ziplock	1	ASA15-5	Particle Size Analysis / Texture				26
		ASA12-3	Lime Requirement, SMP Buffer				
		ASAM10-3.2	pH, Saturated Paste				
		D2974	Moisture				
		E6010.20	Cations, NHO4Ac Extractable				
		ASA29-3	Organic Matter-Walkley/Black				
		ASAM10-3	Conductivity, Saturated Paste Extract				
		ASA33-8	Nitrate as N, KCL Extract				
		ASA24-5	Phosphorus-Olsen				
		E6010.20	Cation Exchange Capacity				

Surface water (3 Sets)

250 mL Plastic	1	E200.7_8	Metals by ICP/ICPMS, Tot. Rec.		■ HNO3		1
		E245.1	Mercury, Total Recoverable				

TCLP (4 Sets)

8 oz Wide Mouth Amber Glass	1	E6010.20	Metals by ICP/ICPMS, Total				1
		SW7470A	Mercury, TCLP				

■ HNO3 - Nitric Acid ☐ H2SO4 - Sulfuric Acid ■ NaOH - Sodium Hydroxide

■ ZnAc - Zinc Acetate ■ HCl - Hydrochloric Acid ☐ H3PO4 - Phosphoric Acid

We strongly suggest that the samples are shipped the same day as they are collected.

Material Safety Data Sheets(MSDS) Available @ EnergyLab.com ->Services -> MSDS Sheets

Corrosive Chemicals: Nitric, Sulfuric, Phosphoric, Hydrochloric Acids and Sodium Hydroxide. Zinc Acetate is a skin irritant.

Subcontracting of sample analyses to an outside laboratory may be required. If so, Energy Laboratories will utilize its branch laboratories or qualified contract laboratories for this service. Any such laboratories will be indicated within the Laboratory Analytical Report.

ANALYTICAL SUMMARY REPORT

September 28, 2012

MT DEQ-Abandoned Mines
PO Box 200901
Helena, MT 59620-0901

Workorder No.: H12090111 Quote ID: H765 - Black Pine Mine 2012 sampling

Project Name: Black Pine Mine

Energy Laboratories Inc Helena MT received the following 5 samples for MT DEQ-Abandoned Mines on 9/10/2012 for analysis.

Sample ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
H12090111-001	CML-GC-08A	09/05/12 10:30	09/10/12	Soil	Mercury in Solid By CVAA Digestion, Mercury by CVAA Soil Preparation
H12090111-002	CML-GC-07A	09/05/12 10:35	09/10/12	Soil	Same As Above
H12090111-003	CML-GC-03A	09/05/12 11:00	09/10/12	Soil	Same As Above
H12090111-004	CML-GC-02A	09/05/12 11:10	09/10/12	Soil	Same As Above
H12090111-005	CML-GC-01A	09/05/12 11:20	09/10/12	Soil	Same As Above

The analyses presented in this report were performed by Energy Laboratories, Inc., 3161 E. Lyndale Ave., Helena, MT 59604, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090111-001
Client Sample ID CML-GC-08A

Report Date: 09/28/12
Collection Date: 09/05/12 10:30
DateReceived: 09/10/12
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL							
Mercury	0.47	mg/kg	D	0.049		SW7471A	09/18/12 17:06 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090111-002
Client Sample ID CML-GC-07A

Report Date: 09/28/12
Collection Date: 09/05/12 10:35
DateReceived: 09/10/12
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL							
Mercury	7.4	mg/kg	D	2.5		SW7471A	09/18/12 17:08 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090111-003
Client Sample ID CML-GC-03A

Report Date: 09/28/12
Collection Date: 09/05/12 11:00
DateReceived: 09/10/12
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL							
Mercury	37	mg/kg	D	25		SW7471A	09/18/12 17:27 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090111-004
Client Sample ID CML-GC-02A

Report Date: 09/28/12
Collection Date: 09/05/12 11:10
DateReceived: 09/10/12
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL							
Mercury	160	mg/kg	D	50		SW7471A	09/18/12 13:17 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090111-005
Client Sample ID CML-GC-01A

Report Date: 09/28/12
Collection Date: 09/05/12 11:20
DateReceived: 09/10/12
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL							
Mercury	190	mg/kg	D	50		SW7471A	09/18/12 13:20 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 09/28/12

Project: Black Pine Mine **Work Order:** H12090111

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW7471A								Analytical Run: HGCV201-H_120918A		
Sample ID: ICV		Initial Calibration Verification Standard							09/18/12 11:54	
Mercury		0.00098	mg/kg	0.50	98	90	110			
Sample ID: ICV		Initial Calibration Verification Standard							09/18/12 12:36	
Mercury		0.00099	mg/kg	0.50	99	90	110			
New Calibration										
Sample ID: CCV		Continuing Calibration Verification Standard							09/18/12 12:38	
Mercury		0.00096	mg/kg	0.50	96	90	110			
Sample ID: CCV		Continuing Calibration Verification Standard							09/18/12 13:08	
Mercury		0.0010	mg/kg	0.50	104	90	110			
Sample ID: ICV		Initial Calibration Verification Standard							09/18/12 14:46	
Mercury		0.00099	mg/kg	0.50	99	90	110			
New Calibration										
Sample ID: CCV		Continuing Calibration Verification Standard							09/18/12 14:49	
Mercury		0.00098	mg/kg	0.50	98	90	110			
Sample ID: ICV		Initial Calibration Verification Standard							09/18/12 16:09	
Mercury		0.00099	mg/kg	0.50	99	90	110			
New Calibration										
Sample ID: CCV		Continuing Calibration Verification Standard							09/18/12 16:12	
Mercury		0.00095	mg/kg	0.50	95	90	110			
Sample ID: ICV		Initial Calibration Verification Standard							09/18/12 16:58	
Mercury		0.00099	mg/kg	0.50	99	90	110			
New Calibration										
Sample ID: CCV		Continuing Calibration Verification Standard							09/18/12 17:01	
Mercury		0.0010	mg/kg	0.50	101	90	110			
Method: SW7471A									Batch: 17928	
Sample ID: MB-17928		Method Blank				Run: HGCV201-H_120918A			09/18/12 12:43	
Mercury		0.024	mg/kg	0.050						
Sample ID: LCS-17928		Laboratory Control Sample				Run: HGCV201-H_120918A			09/18/12 12:45	
Mercury		5.4	mg/kg	0.50	107	80	120			
Sample ID: H12090058-002AMS		Sample Matrix Spike				Run: HGCV201-H_120918A			09/18/12 12:50	
Mercury		1.2	mg/kg	0.50	111	80	120			
Sample ID: H12090058-002AMSD		Sample Matrix Spike Duplicate				Run: HGCV201-H_120918A			09/18/12 12:53	
Mercury		1.1	mg/kg	0.50	110	80	120	0.5	20	
Sample ID: H12090113-004AMS		Sample Matrix Spike				Run: HGCV201-H_120918A			09/18/12 13:32	
Mercury		140	mg/kg	50		80	120			A
Sample ID: H12090113-004AMSD		Sample Matrix Spike Duplicate				Run: HGCV201-H_120918A			09/18/12 13:35	
Mercury		150	mg/kg	50		80	120	7.0	20	A

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Report Date: 09/28/12
Project: Black Pine Mine
Work Order: H12090111

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW7471A										Batch: 17928
Sample ID: H12090113-004AMS		Sample Matrix Spike				Run: HGCV201-H_120918A				09/18/12 17:53
Mercury		220	mg/kg	10.0		80	120			A
Sample ID: H12090113-004AMSD		Sample Matrix Spike Duplicate				Run: HGCV201-H_120918A				09/18/12 17:55
Mercury		230	mg/kg	10.0		80	120	4.1	20	A

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

Standard Reporting Procedures

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Workorder Receipt Checklist

MT DEQ-Abandoned Mines H12090111

Login completed by: Wanda Johnson
Date Received: 9/10/2012
Reviewed by: BL2000\kwiegand
Received by: elm
Reviewed Date: 9/13/2012
Carrier name: Hand Del

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shipping container/cooler?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received?	Yes ☑	No ☐	Not Applicable ☐
Container/Temp Blank temperature:	1.8°C On Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	Not Applicable ☑

Contact and Corrective Action Comments:

Samples left in locked entry. The chain of custody is signed when samples were relinquished & received, however they do not match due to samples were left in the locked entry. Energy Laboratories staff did not process samples until 9/10/12. Wj 9/10/12

Chain of Custody and Analytical Request Record

PLEASE PRINT (Provide as much information as possible.)

Company Name:	Project Name, PWS, Permit, Etc.	Sample Origin	EPA/State Compliance:
TRIHYDRO	Black Pine Mine	State: MT	Yes ☐ No ☐
Report Mail Address:	**Contact Name:** / **Phone/Fax:**	**Email:**	**Sampler: (Please Print)**
2707 Broadwater Ave Helena, MT 59602	Tom Smith 406 556 4130		BRADY HANSON LUKE DARNELL
Invoice Address:	**Invoice Contact & Phone:**	**Purchase Order:**	**Quote/Bottle Order:**

Special Report/Formats:

☐ DW
☐ POTW/WWTP
☐ State: _____
☐ Other: _____
☐ EDD/EDT (Electronic Data) Format: _____
☐ LEVEL IV
☐ NELAC

ANALYSIS REQUESTED

Standard Turnaround (TAT) — RUSH

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments:

Shipped by: Hand-Delivered
Cooler ID(s): 1
Receipt Temp: 1.8 °C
On Ice: Y N
Custody Seal: On Bottle Y N; On Cooler Y N
Intact: Y N
Signature Match: Y N

LABORATORY USE ONLY: #12090111

	SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	Number of Containers / Sample Type: A W S V B O DW / Air Water Soils/Solids Vegetation Bioassay Other DW - Drinking Water	TotMn ALLOW LEAVE Hg								SEE ATTACHED
1	CML-GC-08A	9-5-12	1030	Soil		X								
2	CML-GC-07A		1035	Soil		X								
3	CML-GC-03A		1100	Soil		X								
4	CML-GC-02A		1110	Soil		X								
5	CML-GC-01A		1120	Soil		X								
6														
7														
8														
9														
10														

Custody Record MUST be Signed

Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Luke Darnell	9/8/12 1000				
Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Sample Disposal: Return to Client: _____ Lab Disposal: _____			Received by Laboratory:	Date/Time: 9/10/12 8:00	Signature:

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report. Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

ANALYTICAL SUMMARY REPORT

October 17, 2012

MT DEQ-Abandoned Mines
PO Box 200901
Helena, MT 59620-0901

Workorder No.: H12090110 Quote ID: H765 - Black Pine Mine 2012 sampling

Project Name: Black Pine Mine

Energy Laboratories Inc Helena MT received the following 7 samples for MT DEQ-Abandoned Mines on 9/10/2012 for analysis.

Sample ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
H12090110-001	CML-RCRA-08	09/07/12 9:45	09/10/12	Solid	Metals by ICP/ICPMS, Total Mercury, TCLP Digestion, Mercury by CVAA TCLP Extraction, Mercury TCLP Extraction, Non-volatiles
H12090110-002	CML-RCRA-07	09/07/12 10:00	09/10/12	Solid	Same As Above
H12090110-003	CML-RCRA-06	09/07/12 11:35	09/10/12	Solid	Same As Above
H12090110-004	CML-RCRA-05	09/07/12 11:30	09/10/12	Solid	Same As Above
H12090110-005	CML-GC-04	09/07/12 10:30	09/10/12	Soil	Metals by ICP/ICPMS, Total Mercury in Solid By CVAA Digestion, Total Metals Digestion, Mercury by CVAA
H12090110-006	CML-GC-05	09/07/12 11:15	09/10/12	Soil	Same As Above
H12090110-007	CML-GC-06	09/07/12 12:10	09/10/12	Soil	Same As Above

The analyses presented in this report were performed by Energy Laboratories, Inc., 3161 E. Lyndale Ave., Helena, MT 59604, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

CLIENT: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Sample Delivery Group: H12090110

Report Date: 10/17/12

CASE NARRATIVE

Tests associated with analyst identified as ELI-B were subcontracted to Energy Laboratories, 1120 S. 27th St., Billings, MT, EPA Number MT00005.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090110-001
Client Sample ID CML-RCRA-08

Report Date: 10/17/12
Collection Date: 09/07/12 09:45
DateReceived: 09/10/12
Matrix: Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TCLP EXTRACTABLE							
Arsenic	1.0	mg/L		0.5	5	SW6020	09/13/12 21:47 / eli-b2
Barium	ND	mg/L		10	100	SW6020	09/15/12 02:13 / eli-b
Cadmium	ND	mg/L		0.1	1	SW6020	09/13/12 21:47 / eli-b2
Chromium	ND	mg/L		0.5	5	SW6020	09/13/12 21:47 / eli-b2
Lead	1.5	mg/L		0.5	5	SW6020	09/13/12 21:47 / eli-b2
Mercury	ND	mg/L		0.002	0.2	SW7470A	09/12/12 14:43 / eli-b4
Selenium	ND	mg/L		0.1	1	SW6020	09/13/12 21:47 / eli-b2
Silver	ND	mg/L		0.5	5	SW6020	09/13/12 21:47 / eli-b2

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090110-002
Client Sample ID CML-RCRA-07

Report Date: 10/17/12
Collection Date: 09/07/12 10:00
DateReceived: 09/10/12
Matrix: Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TCLP EXTRACTABLE							
Arsenic	ND	mg/L		0.5	5	SW6020	09/13/12 21:50 / eli-b2
Barium	ND	mg/L		10	100	SW6020	09/15/12 02:16 / eli-b
Cadmium	ND	mg/L		0.1	1	SW6020	09/13/12 21:50 / eli-b2
Chromium	ND	mg/L		0.5	5	SW6020	09/13/12 21:50 / eli-b2
Lead	ND	mg/L		0.5	5	SW6020	09/13/12 21:50 / eli-b2
Mercury	0.018	mg/L		0.002	0.2	SW7470A	09/14/12 13:49 / eli-b4
Selenium	ND	mg/L		0.1	1	SW6020	09/13/12 21:50 / eli-b2
Silver	ND	mg/L		0.5	5	SW6020	09/13/12 21:50 / eli-b2

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090110-003
Client Sample ID CML-RCRA-06

Report Date: 10/17/12
Collection Date: 09/07/12 11:35
DateReceived: 09/10/12
Matrix: Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TCLP EXTRACTABLE							
Arsenic	ND	mg/L		0.5	5	SW6020	09/13/12 21:53 / eli-b2
Barium	ND	mg/L		10	100	SW6020	09/15/12 02:19 / eli-b
Cadmium	ND	mg/L		0.1	1	SW6020	09/13/12 21:53 / eli-b2
Chromium	ND	mg/L		0.5	5	SW6020	09/13/12 21:53 / eli-b2
Lead	1.3	mg/L		0.5	5	SW6020	09/13/12 21:53 / eli-b2
Mercury	ND	mg/L		0.002	0.2	SW7470A	09/12/12 14:57 / eli-b4
Selenium	ND	mg/L		0.1	1	SW6020	09/13/12 21:53 / eli-b2
Silver	ND	mg/L		0.5	5	SW6020	09/13/12 21:53 / eli-b2

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090110-004
Client Sample ID CML-RCRA-05

Report Date: 10/17/12
Collection Date: 09/07/12 11:30
DateReceived: 09/10/12
Matrix: Solid

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TCLP EXTRACTABLE							
Arsenic	ND	mg/L		0.5	5	SW6020	09/13/12 21:56 / eli-b2
Barium	ND	mg/L		10	100	SW6020	09/15/12 02:22 / eli-b
Cadmium	ND	mg/L		0.1	1	SW6020	09/13/12 21:56 / eli-b2
Chromium	ND	mg/L		0.5	5	SW6020	09/13/12 21:56 / eli-b2
Lead	1.7	mg/L		0.5	5	SW6020	09/13/12 21:56 / eli-b2
Mercury	0.012	mg/L		0.002	0.2	SW7470A	09/14/12 13:56 / eli-b4
Selenium	ND	mg/L		0.1	1	SW6020	09/13/12 21:56 / eli-b2
Silver	ND	mg/L		0.5	5	SW6020	09/13/12 21:56 / eli-b2

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090110-005
Client Sample ID CML-GC-04

Report Date: 10/17/12
Collection Date: 09/07/12 10:30
DateReceived: 09/10/12
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
3050 EXTRACTABLE METALS							
Antimony	282	mg/kg		5		SW6010B	09/20/12 18:27 / sld
Arsenic	157	mg/kg		5		SW6010B	09/14/12 13:33 / sld
Barium	958	mg/kg		5		SW6010B	09/14/12 13:33 / sld
Cadmium	8	mg/kg		1		SW6010B	09/14/12 13:33 / sld
Chromium	25	mg/kg		5		SW6010B	09/14/12 13:33 / sld
Copper	2830	mg/kg		5		SW6010B	09/14/12 13:33 / sld
Iron	32900	mg/kg		5		SW6010B	09/14/12 13:33 / sld
Lead	910	mg/kg	D	6		SW6010B	09/14/12 13:33 / sld
Manganese	2630	mg/kg		5		SW6010B	09/14/12 13:33 / sld
Nickel	19	mg/kg		5		SW6010B	09/14/12 13:33 / sld
Silver	26	mg/kg		5		SW6010B	09/20/12 18:27 / sld
Zinc	288	mg/kg		5		SW6010B	09/14/12 13:33 / sld
METALS, TOTAL							
Mercury	110	mg/kg	D	50		SW7471A	09/18/12 12:58 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090110-006
Client Sample ID CML-GC-05

Report Date: 10/17/12
Collection Date: 09/07/12 11:15
DateReceived: 09/10/12
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
3050 EXTRACTABLE METALS							
Antimony	613	mg/kg	D	9		SW6010B	09/20/12 18:31 / sld
Arsenic	440	mg/kg		5		SW6010B	09/13/12 14:50 / sld
Barium	465	mg/kg		5		SW6010B	09/13/12 14:50 / sld
Cadmium	13	mg/kg		1		SW6010B	09/13/12 14:50 / sld
Chromium	13	mg/kg		5		SW6010B	09/13/12 14:50 / sld
Copper	2440	mg/kg		5		SW6010B	09/13/12 14:50 / sld
Iron	17600	mg/kg		5		SW6010B	09/13/12 14:50 / sld
Lead	2640	mg/kg		5		SW6010B	09/13/12 14:50 / sld
Manganese	184	mg/kg		5		SW6010B	09/13/12 14:50 / sld
Nickel	8	mg/kg		5		SW6010B	09/13/12 14:50 / sld
Silver	36	mg/kg		5		SW6010B	09/20/12 18:31 / sld
Zinc	323	mg/kg		5		SW6010B	09/13/12 14:50 / sld
METALS, TOTAL							
Mercury	110	mg/kg	D	49		SW7471A	09/18/12 13:00 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090110-007
Client Sample ID CML-GC-06

Report Date: 10/17/12
Collection Date: 09/07/12 12:10
DateReceived: 09/10/12
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
3050 EXTRACTABLE METALS							
Antimony	958	mg/kg	D	9		SW6010B	09/20/12 18:35 / sld
Arsenic	541	mg/kg		5		SW6010B	09/13/12 14:54 / sld
Barium	355	mg/kg		5		SW6010B	09/13/12 14:54 / sld
Cadmium	13	mg/kg		1		SW6010B	09/13/12 14:54 / sld
Chromium	6	mg/kg		5		SW6010B	09/13/12 14:54 / sld
Copper	2530	mg/kg		5		SW6010B	09/13/12 14:54 / sld
Iron	19800	mg/kg		5		SW6010B	09/13/12 14:54 / sld
Lead	3380	mg/kg		5		SW6010B	09/13/12 14:54 / sld
Manganese	210	mg/kg		5		SW6010B	09/13/12 14:54 / sld
Nickel	5	mg/kg		5		SW6010B	09/13/12 14:54 / sld
Silver	61	mg/kg		5		SW6010B	09/20/12 18:35 / sld
Zinc	524	mg/kg		5		SW6010B	09/13/12 14:54 / sld
METALS, TOTAL							
Mercury	120	mg/kg	D	50		SW7471A	09/18/12 13:03 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 10/17/12

Project: Black Pine Mine **Work Order:** H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.7									Analytical Run: ICP2-HE_120913B	
Sample ID: ICV	10	Initial Calibration Verification Standard							09/13/12 12:51	
Arsenic		0.768	mg/L	0.0092	96	90	110			
Barium		0.799	mg/L	0.10	100	90	110			
Cadmium		0.378	mg/L	0.0010	94	90	110			
Chromium		0.774	mg/L	0.010	97	90	110			
Copper		0.801	mg/L	0.010	100	90	110			
Iron		4.00	mg/L	0.030	100	90	110			
Lead		0.780	mg/L	0.013	98	90	110			
Manganese		3.97	mg/L	0.010	99	90	110			
Nickel		0.763	mg/L	0.010	95	90	110			
Zinc		0.783	mg/L	0.010	98	90	110			
Sample ID: ICSA	10	Interference Check Sample A							09/13/12 13:06	
Arsenic		-0.0117	mg/L	0.0092		0	0			
Barium		0.00179	mg/L	0.10		0	0			
Cadmium		0.00191	mg/L	0.0010		0	0			
Chromium		0.00764	mg/L	0.012		0	0			
Copper		-0.00148	mg/L	0.010		0	0			
Iron		187	mg/L	0.030	94	80	120			
Lead		0.0349	mg/L	0.013		0	0			
Manganese		-0.000740	mg/L	0.010		0	0			
Nickel		0.00440	mg/L	0.010		0	0			
Zinc		0.00827	mg/L	0.010		0	0			
Sample ID: ICSAB	10	Interference Check Sample AB							09/13/12 13:10	
Arsenic		1.05	mg/L	0.0092	105	80	120			
Barium		0.509	mg/L	0.10	102	80	120			
Cadmium		0.919	mg/L	0.0010	92	80	120			
Chromium		0.511	mg/L	0.012	102	80	120			
Copper		0.509	mg/L	0.010	102	80	120			
Iron		188	mg/L	0.030	94	80	120			
Lead		0.974	mg/L	0.013	97	80	120			
Manganese		0.475	mg/L	0.010	95	80	120			
Nickel		0.918	mg/L	0.010	92	80	120			
Zinc		1.01	mg/L	0.010	101	80	120			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 10/17/12

Project: Black Pine Mine **Work Order:** H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.7									Analytical Run: ICP2-HE_120914B	
Sample ID: ICV	10	Initial Calibration Verification Standard							09/14/12 10:03	
Arsenic		0.834	mg/L	0.0092	104	90	110			
Barium		0.800	mg/L	0.10	100	90	110			
Cadmium		0.397	mg/L	0.0010	99	90	110			
Chromium		0.810	mg/L	0.010	101	90	110			
Copper		0.816	mg/L	0.010	102	90	110			
Iron		4.02	mg/L	0.030	101	90	110			
Lead		0.809	mg/L	0.013	101	90	110			
Manganese		4.07	mg/L	0.010	102	90	110			
Nickel		0.810	mg/L	0.010	101	90	110			
Zinc		0.818	mg/L	0.010	102	90	110			
Sample ID: ICSA	10	Interference Check Sample A							09/14/12 10:18	
Arsenic		0.00116	mg/L	0.0092		0	0			
Barium		0.00113	mg/L	0.10		0	0			
Cadmium		0.00233	mg/L	0.0010		0	0			
Chromium		0.0149	mg/L	0.010		0	0			
Copper		0.00235	mg/L	0.010		0	0			
Iron		187	mg/L	0.030	93	80	120			
Lead		0.0369	mg/L	0.013		0	0			
Manganese		-0.000870	mg/L	0.010		0	0			
Nickel		0.00764	mg/L	0.010		0	0			
Zinc		0.00768	mg/L	0.010		0	0			
Sample ID: ICSAB	10	Interference Check Sample AB							09/14/12 10:22	
Arsenic		1.08	mg/L	0.0092	108	80	120			
Barium		0.513	mg/L	0.10	103	80	120			
Cadmium		0.877	mg/L	0.0010	88	80	120			
Chromium		0.483	mg/L	0.010	97	80	120			
Copper		0.522	mg/L	0.010	104	80	120			
Iron		187	mg/L	0.030	94	80	120			
Lead		0.940	mg/L	0.013	94	80	120			
Manganese		0.486	mg/L	0.010	97	80	120			
Nickel		0.912	mg/L	0.010	91	80	120			
Zinc		0.986	mg/L	0.010	99	80	120			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Report Date: 10/17/12
Project: Black Pine Mine
Work Order: H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.7									Analytical Run: ICP2-HE_120920B	
Sample ID: ICV	2	Initial Calibration Verification Standard							09/20/12 09:41	
Antimony		0.784	mg/L	0.050	98	90	110			
Silver		0.381	mg/L	0.0054	95	90	110			
Sample ID: ICSA	2	Interference Check Sample A							09/20/12 09:56	
Antimony		0.0108	mg/L	0.050		0	0			
Silver		0.0357	mg/L	0.0054		0	0			
Sample ID: ICSAB	2	Interference Check Sample AB							09/20/12 10:00	
Antimony		0.988	mg/L	0.050	99	80	120			
Silver		1.01	mg/L	0.0054	101	80	120			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 10/17/12

Project: Black Pine Mine **Work Order:** H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B										Batch: 17930
Sample ID: MB-17930	10	Method Blank				Run: ICP2-HE_120913B				09/13/12 14:03
Arsenic		0.5	mg/kg	0.4						
Barium		ND	mg/kg	0.02						
Cadmium		ND	mg/kg	0.01						
Chromium		ND	mg/kg	0.07						
Copper		ND	mg/kg	0.2						
Iron		2	mg/kg	0.7						
Lead		1	mg/kg	1						
Manganese		ND	mg/kg	0.04						
Nickel		ND	mg/kg	0.08						
Zinc		0.2	mg/kg	0.1						
Sample ID: LFB-17930	10	Laboratory Fortified Blank				Run: ICP2-HE_120913B				09/13/12 14:06
Arsenic		50.1	mg/kg	1.0	99	80	120			
Barium		51.1	mg/kg	1.0	102	80	120			
Cadmium		25.1	mg/kg	1.0	101	80	120			
Chromium		51.6	mg/kg	1.0	103	80	120			
Copper		51.3	mg/kg	1.0	103	80	120			
Iron		258	mg/kg	5.0	102	80	120			
Lead		51.1	mg/kg	1.0	99	80	120			
Manganese		252	mg/kg	1.0	101	80	120			
Nickel		50.5	mg/kg	1.0	101	80	120			
Zinc		51.8	mg/kg	1.0	103	80	120			
Sample ID: LCS-17930	10	Laboratory Control Sample				Run: ICP2-HE_120913B				09/13/12 14:10
Arsenic		270	mg/kg	1.5	79	72.3	106.4			
Barium		529	mg/kg	1.0	87	80.6	112.2			
Cadmium		118	mg/kg	1.0	87	73	105.1			
Chromium		68.3	mg/kg	1.0	91	72.8	109.1			
Copper		242	mg/kg	1.0	87	77.5	109.6			
Iron		18600	mg/kg	5.0	82	39.6	138.3			
Lead		175	mg/kg	3.1	94	75.9	108.6			
Manganese		340	mg/kg	1.0	93	80.8	115.7			
Nickel		51.1	mg/kg	1.0	85	72.3	103.4			
Zinc		188	mg/kg	1.0	89	74.2	109.9			
Sample ID: H12080454-001AMS	10	Sample Matrix Spike				Run: ICP2-HE_120913B				09/13/12 14:36
Arsenic		72.1	mg/kg	1.5	120	75	125			
Barium		106	mg/kg	1.0	94	75	125			
Cadmium		23.0	mg/kg	1.0	93	75	125			
Chromium		59.0	mg/kg	1.0	97	75	125			
Copper		101	mg/kg	1.0	121	75	125			
Iron		9640	mg/kg	5.0		75	125			A
Lead		126	mg/kg	3.1	164	75	125			S
Manganese		777	mg/kg	1.0	113	75	125			
Nickel		52.2	mg/kg	1.0	92	75	125			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 10/17/12

Project: Black Pine Mine **Work Order:** H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B										Batch: 17930
Sample ID: H12080454-001AMS	10	Sample Matrix Spike				Run: ICP2-HE_120913B			09/13/12 14:36	
Zinc		160	mg/kg	1.0	113	75	125			
Sample ID: H12080454-001AMSD	10	Sample Matrix Spike Duplicate				Run: ICP2-HE_120913B			09/13/12 14:39	
Arsenic		67.9	mg/kg	1.5	112	75	125	5.9	20	
Barium		103	mg/kg	1.0	87	75	125	3.3	20	
Cadmium		22.9	mg/kg	1.0	92	75	125	0.7	20	
Chromium		61.4	mg/kg	1.0	101	75	125	4.0	20	
Copper		106	mg/kg	1.0	131	75	125	4.7	20	S
Iron		10100	mg/kg	5.0		75	125	4.6	20	A
Lead		146	mg/kg	3.1	205	75	125	15	20	S
Manganese		848	mg/kg	1.0	141	75	125	8.7	20	S
Nickel		52.0	mg/kg	1.0	92	75	125	0.5	20	
Zinc		155	mg/kg	1.0	103	75	125	3.2	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 10/17/12

Project: Black Pine Mine **Work Order:** H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B										Batch: 17930
Sample ID: MB-17930	10	Method Blank				Run: ICP2-HE_120914B			09/14/12 13:00	
Arsenic		0.5	mg/kg	0.4						
Barium		ND	mg/kg	0.02						
Cadmium		ND	mg/kg	0.01						
Chromium		ND	mg/kg	0.7						
Copper		0.3	mg/kg	0.2						
Iron		2	mg/kg	0.7						
Lead		ND	mg/kg	1						
Manganese		0.04	mg/kg	0.04						
Nickel		0.1	mg/kg	0.08						
Zinc		ND	mg/kg	0.1						
Sample ID: H12080454-001AMS	10	Sample Matrix Spike				Run: ICP2-HE_120914B			09/14/12 13:26	
Arsenic		69.3	mg/kg	1.5	106	75	125			
Barium		107	mg/kg	1.0	95	75	125			
Cadmium		22.8	mg/kg	1.0	90	75	125			
Chromium		57.4	mg/kg	1.0	94	75	125			
Copper		105	mg/kg	1.0	123	75	125			
Iron		9680	mg/kg	5.0		75	125			A
Lead		122	mg/kg	3.1	141	75	125			S
Manganese		805	mg/kg	1.0	121	75	125			
Nickel		50.6	mg/kg	1.0	89	75	125			
Zinc		156	mg/kg	1.0	103	75	125			
Sample ID: H12080454-001AMSD	10	Sample Matrix Spike Duplicate				Run: ICP2-HE_120914B			09/14/12 13:30	
Arsenic		67.7	mg/kg	1.5	103	75	125	2.4	20	
Barium		102	mg/kg	1.0	86	75	125	4.5	20	
Cadmium		24.3	mg/kg	1.0	96	75	125	6.3	20	
Chromium		63.2	mg/kg	1.0	106	75	125	9.7	20	
Copper		107	mg/kg	1.0	129	75	125	2.7	20	S
Iron		10100	mg/kg	5.0		75	125	4.4	20	A
Lead		152	mg/kg	3.1	201	75	125	22	20	SR
Manganese		874	mg/kg	1.0	149	75	125	8.3	20	S
Nickel		53.7	mg/kg	1.0	95	75	125	6.1	20	
Zinc		160	mg/kg	1.0	111	75	125	2.5	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

R - RPD exceeds advisory limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 10/17/12

Project: Black Pine Mine **Work Order:** H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B										Batch: 18014
Sample ID: MB-18014	2	Method Blank				Run: ICP2-HE_120920B				09/20/12 18:16
Antimony		ND	mg/kg	1						
Silver		ND	mg/kg	0.2						
Sample ID: LFB-18014	2	Laboratory Fortified Blank				Run: ICP2-HE_120920B				09/20/12 18:20
Antimony		50.6	mg/kg	1.0	101	80	120			
Silver		23.4	mg/kg	1.0	94	80	120			
Sample ID: LCS-18014	2	Laboratory Control Sample				Run: ICP2-HE_120920B				09/20/12 18:23
Antimony		51.7	mg/kg	2.1	41	2.2	92.9			
Silver		60.0	mg/kg	1.0	88	67.8	112.8			
Sample ID: H12090110-007AMS	2	Sample Matrix Spike				Run: ICP2-HE_120920B				09/20/12 18:46
Antimony		1160	mg/kg	8.6		75	125			A
Silver		151	mg/kg	4.1	91	75	125			
Sample ID: H12090110-007AMSD	2	Sample Matrix Spike Duplicate				Run: ICP2-HE_120920B				09/20/12 18:49
Antimony		1060	mg/kg	8.6		75	125	9.4	20	A
Silver		156	mg/kg	4.1	96	75	125	3.2	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 10/17/12

Project: Black Pine Mine **Work Order:** H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6020									Analytical Run: SUB-B191707	
Sample ID: QCS	6	Initial Calibration Verification Standard							09/13/12 19:56	
Arsenic		0.0492	mg/L	0.0010	98	90	110			
Cadmium		0.0254	mg/L	0.0010	101	90	110			
Chromium		0.0493	mg/L	0.0010	99	90	110			
Lead		0.0483	mg/L	0.0010	97	90	110			
Selenium		0.0503	mg/L	0.0010	101	90	110			
Silver		0.0248	mg/L	0.0010	99	90	110			
Sample ID: ICSA	6	Interference Check Sample A							09/13/12 08:35	
Arsenic		-3.00E-05	mg/L	0.0010						
Cadmium		0.00117	mg/L	0.0010						
Chromium		0.00151	mg/L	0.0010						
Lead		0.000490	mg/L	0.0010						
Selenium		-0.000530	mg/L	0.0010						
Silver		0.000100	mg/L	0.0010						
Sample ID: ICSAB	6	Interference Check Sample AB							09/13/12 08:38	
Arsenic		0.00930	mg/L	0.0010	93	70	130			
Cadmium		0.0106	mg/L	0.0010	106	70	130			
Chromium		0.0203	mg/L	0.0010	101	70	130			
Lead		0.000490	mg/L	0.0010		0	0			
Selenium		0.00897	mg/L	0.0010	90	70	130			
Silver		0.0191	mg/L	0.0010	96	70	130			
Method: SW6020									Batch: B_65394	
Sample ID: MB-65394	7	Method Blank				Run: SUB-B191707			09/13/12 21:41	
Arsenic		ND	mg/L	0.004						
Barium		0.04	mg/L	0.0007						
Cadmium		ND	mg/L	0.002						
Chromium		0.009	mg/L	0.001						
Lead		ND	mg/L	0.001						
Selenium		ND	mg/L	0.005						
Silver		ND	mg/L	0.001						
Sample ID: H12090110-004A	7	Serial Dilution				Run: SUB-B191707			09/13/12 21:59	
Arsenic		0.0697	mg/L	0.20		0	0		10	N
Barium		0.527	mg/L	1.0		0	0		10	
Cadmium		0.0340	mg/L	0.10		0	0		10	N
Chromium		0.00950	mg/L	0.20		0	0		10	N
Lead		1.75	mg/L	0.20		0	0	2.2	10	
Selenium		ND	mg/L	0.10		0	0		10	
Silver		ND	mg/L	0.020		0	0		10	
Sample ID: LCS-65394	7	Laboratory Control Sample				Run: SUB-B191707			09/13/12 22:02	
Arsenic		0.480	mg/L	0.20	96	85	115			
Barium		5.00	mg/L	1.0	90	85	115			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

N - The analyte concentration was not sufficiently high to calculate a RPD for the serial dilution test.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 10/17/12

Project: Black Pine Mine **Work Order:** H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6020										Batch: B_65394
Sample ID: LCS-65394	7	Laboratory Control Sample				Run: SUB-B191707				09/13/12 22:02
Cadmium		0.255	mg/L	0.10	102	85	115			
Chromium		0.552	mg/L	0.20	109	85	115			
Lead		0.512	mg/L	0.20	102	85	115			
Selenium		0.494	mg/L	0.10	99	85	115			
Silver		0.0511	mg/L	0.020	102	85	115			
Sample ID: LCSD-65394	7	Laboratory Control Sample Duplicate				Run: SUB-B191707				09/13/12 22:05
Arsenic		0.479	mg/L	0.20	96	85	115	0.0	20	
Barium		4.85	mg/L	1.0	87	85	115	0.0	20	
Cadmium		0.253	mg/L	0.10	101	85	115	0.0	20	
Chromium		0.549	mg/L	0.20	108	85	115	0.0	20	
Lead		0.510	mg/L	0.20	102	85	115	0.0	20	
Selenium		0.490	mg/L	0.10	98	85	115	0.0	20	
Silver		0.0508	mg/L	0.020	101	85	115	0.0	20	
Sample ID: H12090110-002A	7	Sample Matrix Spike				Run: SUB-B191707				09/13/12 22:20
Arsenic		0.525	mg/L	0.20	96	75	125			
Barium		5.10	mg/L	1.0	88	75	125			
Cadmium		0.255	mg/L	0.10	100	75	125			
Chromium		0.556	mg/L	0.20	110	75	125			
Lead		0.783	mg/L	0.20	102	75	125			
Selenium		0.494	mg/L	0.10	99	75	125			
Silver		0.0574	mg/L	0.020	103	75	125			
Sample ID: H12090110-001A	7	Sample Matrix Spike				Run: SUB-B191707				09/13/12 22:23
Arsenic		1.51	mg/L	0.20	103	75	125			
Barium		6.53	mg/L	1.0	93	75	125			
Cadmium		0.295	mg/L	0.10	105	75	125			
Chromium		0.568	mg/L	0.20	112	75	125			
Lead		2.05	mg/L	0.20	109	75	125			
Selenium		0.499	mg/L	0.10	99	75	125			
Silver		0.0524	mg/L	0.020	105	75	125			
Sample ID: H12090110-003A	7	Sample Matrix Spike				Run: SUB-B191707				09/13/12 22:29
Arsenic		0.558	mg/L	0.20	96	75	125			
Barium		5.25	mg/L	1.0	88	75	125			
Cadmium		0.305	mg/L	0.10	100	75	125			
Chromium		0.554	mg/L	0.20	109	75	125			
Lead		1.81	mg/L	0.20	108	75	125			
Selenium		0.488	mg/L	0.10	98	75	125			
Silver		0.0504	mg/L	0.020	101	75	125			
Sample ID: H12090110-004A	7	Sample Matrix Spike				Run: SUB-B191707				09/13/12 22:32
Arsenic		0.557	mg/L	0.20	98	75	125			
Barium		5.48	mg/L	1.0	90	75	125			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 10/17/12

Project: Black Pine Mine **Work Order:** H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6020										Batch: B_65394
Sample ID: H12090110-004A	7	Sample Matrix Spike				Run: SUB-B191707				09/13/12 22:32
Cadmium		0.278	mg/L	0.10	101	75	125			
Chromium		0.556	mg/L	0.20	110	75	125			
Lead		2.20	mg/L	0.20	98	75	125			
Selenium		0.500	mg/L	0.10	100	75	125			
Silver		0.0560	mg/L	0.020	102	75	125			
Method: SW6020										Analytical Run: SUB-B191793
Sample ID: QCS		Initial Calibration Verification Standard								09/15/12 01:31
Barium		0.0475	mg/L	0.0010	95	90	110			
Sample ID: ICSA		Interference Check Sample A								09/15/12 01:37
Barium		0.000200	mg/L	0.0010						
Sample ID: ICSAB		Interference Check Sample AB								09/15/12 01:40
Barium		0.000130	mg/L	0.0010		0	0			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 10/17/12

Project: Black Pine Mine **Work Order:** H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW7470A									Analytical Run: SUB-B191584	
Sample ID: QCS		Initial Calibration Verification Standard							09/12/12 11:21	
Mercury		0.0019	mg/L	0.0020	96	90	110			
Method: SW7470A									Batch: B_65359	
Sample ID: MB-65359		Method Blank				Run: SUB-B191584			09/12/12 14:29	
Mercury		ND	mg/L	0.0002						
Sample ID: LCS-65359		Laboratory Control Sample				Run: SUB-B191584			09/12/12 14:31	
Mercury		0.0093	mg/L	0.0020	93	80	120			
Sample ID: LCSD-65359		Laboratory Control Sample Duplicate				Run: SUB-B191584			09/12/12 14:34	
Mercury		0.0090	mg/L	0.0020	89	80	120	3.8	10	
Sample ID: B12081719-004ADIL		Serial Dilution				Run: SUB-B191584			09/12/12 14:39	
Mercury		ND	mg/L	0.0020		0	0		10	
Sample ID: H12090110-001A		Sample Matrix Spike				Run: SUB-B191584			09/12/12 14:46	
Mercury		0.0092	mg/L	0.0020	93	75	125			
Sample ID: H12090110-002A		Sample Matrix Spike				Run: SUB-B191584			09/12/12 14:50	
Mercury		0.026	mg/L	0.0020	83	75	125			
Sample ID: H12090110-003A		Sample Matrix Spike				Run: SUB-B191584			09/12/12 15:21	
Mercury		0.011	mg/L	0.0020	98	75	125			
Sample ID: H12090110-004A		Sample Matrix Spike				Run: SUB-B191584			09/12/12 15:26	
Mercury		0.022	mg/L	0.0020	89	75	125			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 10/17/12

Project: Black Pine Mine **Work Order:** H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW7470A									Analytical Run: SUB-B191781	
Sample ID: QCS		Initial Calibration Verification Standard							09/14/12 13:34	
Mercury		0.0018	mg/L	0.0020	91	90	110			
Method: SW7470A									Batch: B_65404	
Sample ID: MB-65404		Method Blank				Run: SUB-B191781			09/14/12 13:42	
Mercury		ND	mg/L	0.0002						
Sample ID: LCS-65404		Laboratory Control Sample				Run: SUB-B191781			09/14/12 13:44	
Mercury		0.0094	mg/L	0.0020	94	80	120			
Sample ID: LCSD-65404		Laboratory Control Sample Duplicate				Run: SUB-B191781			09/14/12 13:47	
Mercury		0.0094	mg/L	0.0020	94	80	120	0.0	10	
Sample ID: H12090110-002A		Serial Dilution				Run: SUB-B191781			09/14/12 13:51	
Mercury		0.015	mg/L	0.0020		0	0	15	10	R
Sample ID: H12090110-002A		Sample Matrix Spike				Run: SUB-B191781			09/14/12 13:54	
Mercury		0.026	mg/L	0.0020	85	75	125			
Sample ID: H12090110-004A		Sample Matrix Spike				Run: SUB-B191781			09/14/12 13:59	
Mercury		0.021	mg/L	0.0020	86	75	125			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

R - RPD exceeds advisory limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 10/17/12

Project: Black Pine Mine **Work Order:** H12090110

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW7471A								Analytical Run: HGCV201-H_120918A		
Sample ID: ICV		Initial Calibration Verification Standard								09/18/12 11:54
Mercury		0.00098	mg/kg	0.50	98	90	110			
Sample ID: ICV		Initial Calibration Verification Standard								09/18/12 12:36
Mercury		0.00099	mg/kg	0.50	99	90	110			
New Calibration										
Sample ID: CCV		Continuing Calibration Verification Standard								09/18/12 12:38
Mercury		0.00096	mg/kg	0.50	96	90	110			
Sample ID: ICV		Initial Calibration Verification Standard								09/18/12 14:46
Mercury		0.00099	mg/kg	0.50	99	90	110			
New Calibration										
Sample ID: ICV		Initial Calibration Verification Standard								09/18/12 16:09
Mercury		0.00099	mg/kg	0.50	99	90	110			
New Calibration										
Sample ID: ICV		Initial Calibration Verification Standard								09/18/12 16:58
Mercury		0.00099	mg/kg	0.50	99	90	110			
New Calibration										
Method: SW7471A										Batch: 17928
Sample ID: MB-17928		Method Blank				Run: HGCV201-H_120918A				09/18/12 12:43
Mercury		0.024	mg/kg	0.0020						
Sample ID: LCS-17928		Laboratory Control Sample				Run: HGCV201-H_120918A				09/18/12 12:45
Mercury		5.4	mg/kg	0.50	107	80	120			
Sample ID: H12090058-002AMS		Sample Matrix Spike				Run: HGCV201-H_120918A				09/18/12 12:50
Mercury		1.2	mg/kg	0.50	111	80	120			
Sample ID: H12090058-002AMSD		Sample Matrix Spike Duplicate				Run: HGCV201-H_120918A				09/18/12 12:53
Mercury		1.1	mg/kg	0.50	110	80	120	0.5	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

Standard Reporting Procedures

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Workorder Receipt Checklist

MT DEQ-Abandoned Mines H12090110

Login completed by: Wanda Johnson
Date Received: 9/10/2012
Reviewed by: BL2000\sdull
Received by: elm
Reviewed Date: 9/17/2012
Carrier name: Hand Del

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shipping container/cooler?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received?	Yes ☐	No ☑	Not Applicable ☐
Container/Temp Blank temperature:	2.3°C On Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	Not Applicable ☑

Contact and Corrective Action Comments:

Samples left in locked entry. The chain of custody is signed when samples were relinquished & received, however they do not match due to samples were left in the locked entry. Energy Laboratories staff did not process samples until 9/10/12. Received a sample jar for CML-RCRA-07, no sample in jar but received in a plastic bag. Wj 9/10/12

ENERGY

Chain of Custody and Analytical Request Record

Page 1 of 1

PLEASE PRINT (Provide as much information as possible.)

Company Name:	Project Name, PWS, Permit, Etc.	Sample Origin	EPA/State Compliance:
TRIHYDRO	BLACK PINE MINE	State: MT	Yes ☐ No ☐
Report Mail Address:	Contact Name: / Phone/Fax:	Email:	Sampler: (Please Print)
	Thomas Smith		Brady Hanson
Invoice Address:	Invoice Contact & Phone:	Purchase Order:	Quote/Bottle Order:

Special Report/Formats:

☐ DW
☐ POTW/WWTP
☐ State: _____
☐ Other: _____
☐ EDD/EDT (Electronic Data) Format: _____
☐ LEVEL IV
☐ NELAC

ANALYSIS REQUESTED

Standard Turnaround (TAT)

R U S H

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments:

Shipped by: Hand Left in locked entry

Cooler ID(s): 4

Receipt Temp 2.3 °C

On Ice: (Y) N

Custody Seal: On Bottle Y (N); On Cooler Y (N)

Intact Y N

Signature Match Y N

	SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX (Number of Containers; Sample Type: A W S V B O DW; Air Water Soils/Solids Vegetation Bioassay Other DW - Drinking Water)	TCLP - RCRA 8 metals	Total recoverable metals + Hg	SEE ATTACHED		
1	CML-RCRA-08	09/07/12	9:45	Solid	✓			Brick	1112090110
2	CML-RCRA-07	09/07/12	10:10	Solid	✓			Wood	
3	CML-RCRA-06	09/07/12	11:35	Solid	✓			Brick	
4	CML-RCRA-05	09/07/12	11:30	Solid	✓			Wood	
5	CML-GC-04	09/07/12	10:30	Soils		✓			
6	CML-GC-05	09/07/12	11:15	Soils		✓			
7	CML-GC-06	09/07/12	12:10	Soils		✓			
8									
9									
10									

LABORATORY USE ONLY

Custody Record MUST be Signed

Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Luke Dorrell	9/6/12 1200	[signature]			
Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
			Received by Laboratory: Esther Merritt	Date/Time: 9/10/12 8:00	Signature: Esther Merritt

Sample Disposal: Return to Client: _____ Lab Disposal: _____

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report. Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

ANALYTICAL SUMMARY REPORT

September 28, 2012

MT DEQ-Abandoned Mines
PO Box 200901
Helena, MT 59620-0901

Workorder No.: H12090113 Quote ID: H765 - Black Pine Mine 2012 sampling

Project Name: Black Pine Mine

Energy Laboratories Inc Helena MT received the following 8 samples for MT DEQ-Abandoned Mines on 9/10/2012 for analysis.

Sample ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
H12090113-001	CML-GC-01B	09/07/12 15:45	09/10/12	Soil	Mercury in Solid By CVAA Digestion, Mercury by CVAA Soil Preparation
H12090113-002	CML-GC-02B	09/07/12 15:50	09/10/12	Soil	Same As Above
H12090113-003	CML-GC-03B	09/07/12 15:55	09/10/12	Soil	Same As Above
H12090113-004	CML-GC-04B	09/07/12 16:00	09/10/12	Soil	Same As Above
H12090113-005	CML-GC-05B	09/07/12 16:05	09/10/12	Soil	Same As Above
H12090113-006	CML-GC-06B	09/07/12 16:10	09/10/12	Soil	Same As Above
H12090113-007	CML-GC-07B	09/07/12 16:15	09/10/12	Soil	Same As Above
H12090113-008	CML-GC-08B	09/07/12 16:20	09/10/12	Soil	Same As Above

The analyses presented in this report were performed by Energy Laboratories, Inc., 3161 E. Lyndale Ave., Helena, MT 59604, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

Work Order Sample Summary

CLIENT: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab Order: H12090113 **Report Date:** 09/28/12

Lab Sample ID	Client Sample ID	Collection Date	Date Received
H12090113-001	CML-GC-01B	9/7/2012 3:45:00 PM	9/10/2012
H12090113-002	CML-GC-02B	9/7/2012 3:50:00 PM	9/10/2012
H12090113-003	CML-GC-03B	9/7/2012 3:55:00 PM	9/10/2012
H12090113-004	CML-GC-04B	9/7/2012 4:00:00 PM	9/10/2012
H12090113-005	CML-GC-05B	9/7/2012 4:05:00 PM	9/10/2012
H12090113-006	CML-GC-06B	9/7/2012 4:10:00 PM	9/10/2012
H12090113-007	CML-GC-07B	9/7/2012 4:15:00 PM	9/10/2012
H12090113-008	CML-GC-08B	9/7/2012 4:20:00 PM	9/10/2012

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090113-001
Client Sample ID CML-GC-01B

Report Date: 09/28/12
Collection Date: 09/07/12 15:45
DateReceived: 09/10/12
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL							
Mercury	170	mg/kg	D	50		SW7471A	09/18/12 13:22 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090113-002
Client Sample ID CML-GC-02B

Report Date: 09/28/12
Collection Date: 09/07/12 15:50
DateReceived: 09/10/12
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL							
Mercury	230	mg/kg	D	50		SW7471A	09/18/12 13:25 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090113-003
Client Sample ID CML-GC-03B

Report Date: 09/28/12
Collection Date: 09/07/12 15:55
DateReceived: 09/10/12
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL							
Mercury	59	mg/kg	D	50		SW7471A	09/18/12 13:27 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090113-004
Client Sample ID CML-GC-04B

Report Date: 09/28/12
Collection Date: 09/07/12 16:00
DateReceived: 09/10/12
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL							
Mercury	160	mg/kg	D	10		SW7471A	09/18/12 17:50 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090113-005
Client Sample ID CML-GC-05B

Report Date: 09/28/12
Collection Date: 09/07/12 16:05
DateReceived: 09/10/12
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL							
Mercury	110	mg/kg	D	50		SW7471A	09/18/12 13:40 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090113-006
Client Sample ID CML-GC-06B

Report Date: 09/28/12
Collection Date: 09/07/12 16:10
DateReceived: 09/10/12
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL							
Mercury	170	mg/kg	D	25		SW7471A	09/19/12 15:18 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090113-007
Client Sample ID CML-GC-07B

Report Date: 09/28/12
Collection Date: 09/07/12 16:15
DateReceived: 09/10/12
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL							
Mercury	78	mg/kg	D	25		SW7471A	09/19/12 15:08 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Lab ID: H12090113-008
Client Sample ID CML-GC-08B

Report Date: 09/28/12
Collection Date: 09/07/12 16:20
DateReceived: 09/10/12
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL							
Mercury	0.94	mg/kg	D	0.049		SW7471A	09/18/12 18:33 / dck

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 09/28/12

Project: Black Pine Mine **Work Order:** H12090113

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW7471A								Analytical Run: HGCV201-H_120918A		
Sample ID: ICV		Initial Calibration Verification Standard							09/18/12 11:54	
Mercury		0.00098	mg/kg	0.50	98	90	110			
Sample ID: ICV		Initial Calibration Verification Standard							09/18/12 12:36	
Mercury		0.00099	mg/kg	0.50	99	90	110			
New Calibration										
Sample ID: CCV		Continuing Calibration Verification Standard							09/18/12 13:08	
Mercury		0.0010	mg/kg	0.50	104	90	110			
Sample ID: ICV		Initial Calibration Verification Standard							09/18/12 14:46	
Mercury		0.00099	mg/kg	0.50	99	90	110			
New Calibration										
Sample ID: CCV		Continuing Calibration Verification Standard							09/18/12 14:49	
Mercury		0.00098	mg/kg	0.50	98	90	110			
Sample ID: ICV		Initial Calibration Verification Standard							09/18/12 16:09	
Mercury		0.00099	mg/kg	0.50	99	90	110			
New Calibration										
Sample ID: ICV		Initial Calibration Verification Standard							09/18/12 16:58	
Mercury		0.00099	mg/kg	0.50	99	90	110			
New Calibration										
Sample ID: CCV		Continuing Calibration Verification Standard							09/18/12 17:01	
Mercury		0.0010	mg/kg	0.50	101	90	110			
Sample ID: CCV		Continuing Calibration Verification Standard							09/18/12 18:00	
Mercury		0.0011	mg/kg	0.50	110	90	110			
Method: SW7471A										Batch: 17928
Sample ID: MB-17928		Method Blank				Run: HGCV201-H_120918A			09/18/12 12:43	
Mercury		0.024	mg/kg	0.050						
Sample ID: LCS-17928		Laboratory Control Sample				Run: HGCV201-H_120918A			09/18/12 12:45	
Mercury		5.4	mg/kg	0.50	107	80	120			
Sample ID: H12090113-004AMS		Sample Matrix Spike				Run: HGCV201-H_120918A			09/18/12 13:32	
Mercury		140	mg/kg	50		80	120			A
Sample ID: H12090113-004AMSD		Sample Matrix Spike Duplicate				Run: HGCV201-H_120918A			09/18/12 13:35	
Mercury		150	mg/kg	50		80	120	7.0	20	A
Sample ID: H12090113-004AMS		Sample Matrix Spike				Run: HGCV201-H_120918A			09/18/12 17:53	
Mercury		220	mg/kg	10.0		80	120			A
Sample ID: H12090113-004AMSD		Sample Matrix Spike Duplicate				Run: HGCV201-H_120918A			09/18/12 17:55	
Mercury		230	mg/kg	10.0		80	120	4.1	20	A
Method: SW7471A										Batch: 17929

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 09/28/12

Project: Black Pine Mine **Work Order:** H12090113

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW7471A										Batch: 17929
Sample ID: MB-17929		Method Blank				Run: HGCV201-H_120918A				09/18/12 18:05
Mercury		ND	mg/kg	0.050						
Sample ID: LCS-17929		Laboratory Control Sample				Run: HGCV201-H_120918A				09/18/12 18:07
Mercury		5.3	mg/kg	0.50	105	80	120			
Sample ID: H12090126-002AMS		Sample Matrix Spike				Run: HGCV201-H_120918A				09/18/12 18:22
Mercury		1.2	mg/kg	0.50	107	80	120			
Sample ID: H12090126-002AMSD		Sample Matrix Spike Duplicate				Run: HGCV201-H_120918A				09/18/12 18:25
Mercury		1.1	mg/kg	0.50	97	80	120	9.4	20	
Method: SW7471A										Analytical Run: HGCV201-H_120919A
Sample ID: ICV		Initial Calibration Verification Standard								09/19/12 14:35
Mercury		0.0010	mg/kg	0.50	102	90	110			
Sample ID: CCV		Continuing Calibration Verification Standard								09/19/12 14:37
Mercury		0.0010	mg/kg	0.50	103	90	110			
Sample ID: CCV		Continuing Calibration Verification Standard								09/19/12 15:01
Mercury		0.00098	mg/kg	0.50	98	90	110			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

Standard Reporting Procedures

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Workorder Receipt Checklist

MT DEQ-Abandoned Mines H12090113

Login completed by: Wanda Johnson
Date Received: 9/10/2012
Reviewed by: BL2000\kwiegand
Received by: elm
Reviewed Date: 9/13/2012
Carrier name: Hand Del

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shipping container/cooler?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received?	Yes ☑	No ☐	Not Applicable ☐
Container/Temp Blank temperature:	1.8°C On Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	Not Applicable ☑

Contact and Corrective Action Comments:

Samples left in locked entry. The chain of custody is signed when samples were relinquished & received, however they do not match due to samples were left in the locked entry. Energy Laboratories staff did not process samples until 9/10/12. Wj 9/10/12

Chain of Custody and Analytical Request Record

ENERGY LABORATORIES

Page 1 of 1

PLEASE PRINT- Provide as much information as possible.

Company Name:	Project Name, PWS, Permit, Etc.	Sample Origin	EPA/State Compliance:
Trihydro	Black Pine Mine	State: MT	Yes ☐ No ☐
Report Mail Address: 2707 Broadwater Avenue Helena, MT 59602	Contact Name: Tom Smith / Phone/Fax: 406 558 4180	Email: tsmith@trihydro.com	Sampler: (Please Print) Luke Darnell
Invoice Address:	Invoice Contact & Phone:	Purchase Order:	Quote/Bottle Order:

Special Report/Formats – ELI must be notified prior to sample submittal for the following:

- ☐ DW
- ☐ GSA
- ☐ POTW/WWTP
- ☐ State: _____
- ☐ Other: _____
- ☐ A2LA
- ☐ EDD/EDT (Electronic Data) Format: _____
- ☐ LEVEL IV
- ☐ NELAC

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX (Number of Containers; Sample Type: A W S V B O; Air Water Soils/Solids Vegetation Bioassay Other)	total recoveryable Hg									SEE ATTACHED	Normal Turnaround (TAT)	RUSH
1	CML-GC-01B	09/07/12	15:45	S	X											
2	CML-GC-02B	09/07/12	15:50	S	X											
3	CML-GC-03B	09/07/12	15:55	S	X											
4	CML-GC-04B	09/07/12	16:00	S	X											
5	CML-GC-05B	09/07/12	16:05	S	X											
6	CML-GC-06B	09/07/12	16:10	S	X											
7	CML-GC-07B	09/07/12	16:15	S	X											
8	CML-GC-08B	09/07/12	16:20	S	X											
9																
10																

Contact ELI prior to RUSH sample submittal for charges and scheduling – See Instruction Page

Comments:

LABORATORY USE ONLY

Shipped by: Hand-Left in Lab Refrigerator

Cooler ID(s): 1

Receipt Temp 1.8 °C -113

On Ice: Yes No

Custody Seal Y N

Intact Y N

Signature Match Y N

#12090113

Custody Record MUST be Signed

Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Luke Darnell	09/08/12 10:00				
Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
			Received by Laboratory:	Date/Time:	Signature:
			Esther Morrill	9/10/12 8:00	Esther Morrill

Sample Disposal: Return to Client: _____ Lab Disposal: _____

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report. Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

APPENDIX E3

GEOTECHNICAL LABORATORY REPORTS

PIONEER TECHNICAL SERVICES, INC.
P.O Box 3445, Butte, MT 59702
www.pioneer-technical.com

November 9, 2012 **Revised January 5, 2012**

Ms. Devin Clary
MT Department of Environmental Quality
PO Box 200901
Helena, MT 59620

RE: Black Pine Mine Geotechnical Testing
Pioneer Technical Services Project No. 16694

Dear Ms. Clary,
On October 10th, 12 samples from the Black Pine Mine project were delivered to our ASTM/AASHTO accredited materials testing laboratory. The samples were given Lab Nos. 13263 through 13274. The testing requests on various samples were:

- Laboratory Determination of Moisture Content (ASTM D2216);
- Sieve Analysis of Coarse and Fine Aggregate (ASTM C117, C136);
- Particle-Size Analysis of Soils (ASTM D422);
- Liquid Limit, Plastic Limit and Plasticity Index of Soils (ASTM D4318);
- Proctor Moisture/Density Relationships (AASHTO T 99 Method C);
- Permeability (ASTM D5084 – to be determined); and
- Consolidated-Undrained Triaxial Shear (ASTM 4767).

Table 1 - Sample I.D. and Testing Request

Lab No.	Boring	Depth (ft)	Sieve Analysis	PSA (Hydrometer)	Atterberg Limits	Proctor	Moisture Content	Permeability	CU Triaxial
13263	CMN-GT-01	-	x			x	x		
13264	CMN-GT-02	-	x			x*	x		
13265	CMN-GT-03	-					x		
13266	RY-SS-09	2'					x		
13267	RY-SS-10	4'					x		
13268	RY-SS-10	10'					x		
13269	RY-SS-15	2-4'					x		
13270	RY-SS-06	0-4'					x		
13271	RY-SS-06	4-7'	x[1]				x	x[1]	
13272	RY-SS-09	4-6'	x				x		
13273	RY-SS-10	14-16'	x[1]	x[1]	x[1]	x[1]	x	x[1]	x[1]
13274	RY-SS-12	15-17'	x	x	x		x		

x* Sample was too coarse (75% retained on ¾-inch sieve) for Proctor testing, no defined curve available.
x[1] Testing to be performed in our Belgrade Laboratory. A separate permeameter and triaxial report will be distributed when complete.

PIONEER TECHNICAL SERVICES, INC.
P.O Box 3445, Butte, MT 59702
www.pioneer-technical.com

Table 2: Moisture Contents

Lab No.	Sample Identification	Depth (ft)	Moisture Content (%)
13263	CMN-GT-01	-	5
13264	CMN-GT-02	-	2
13265	CMN-GT-03	-	5
13266	RY-SS-09	2	3
13267	RY-SS-10	4	14
13268	RY-SS-10	10	11
13269	RY-SS-15	2-4	12
13270	RY-SS-06	0-4	8
13271	RY-SS-06	4-7	7
13272	RY-SS-09	4-6	3
13273	RY-SS-10	14-16	8
13274	RY-SS-12	15-17	10

Four grain-size distribution curves, an Atterberg limits chart, and one of the Proctor curves are included with this report.

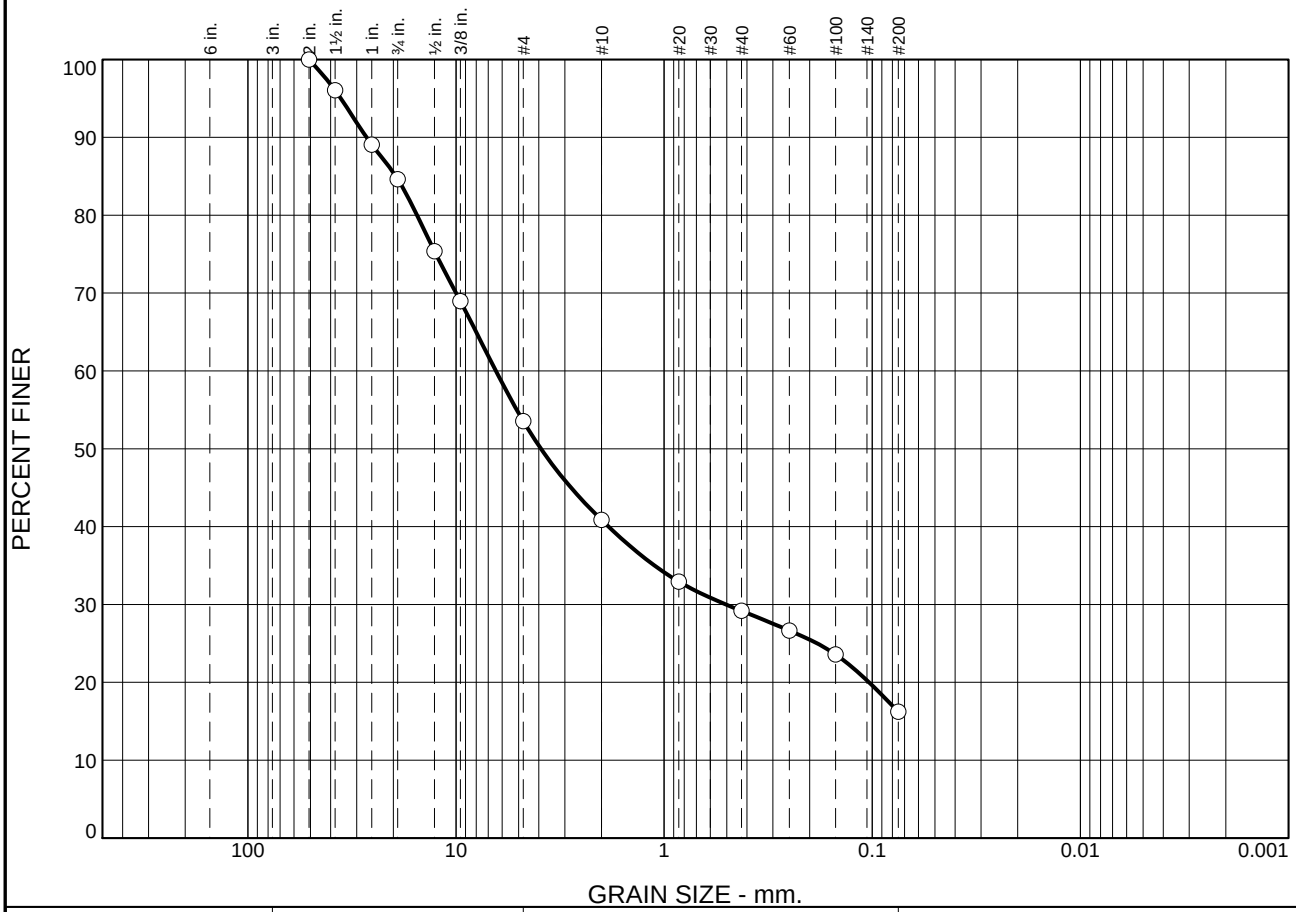
We thank you for using Pioneer Technical Services for your geotechnical and materials testing requirements. If you have any questions regarding these results, please contact Todd Lorenzen or Paul Bushnell at (406) 443-6053.

Sincerely,
PIONEER TECHNICAL SERVICES, INC.

Todd Lorenzen, P.E.
Senior Geotechnical Engineer

Paul Bushnell
Materials Testing Supervisor

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	15	31	13	12	13	16	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2	100		
1.5	96		
1	89		
.75	85		
.5	75		
.375	69		
#4	54		
#10	41		
#20	33		
#40	29		
#60	27		
#100	24		
#200	16		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 26.9091 D_{85}= 19.4485 D_{60}= 6.4291
D_{50}= 3.9058 D_{30}= 0.5050 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Location: CMN-GT-01
Sample Number: 13263

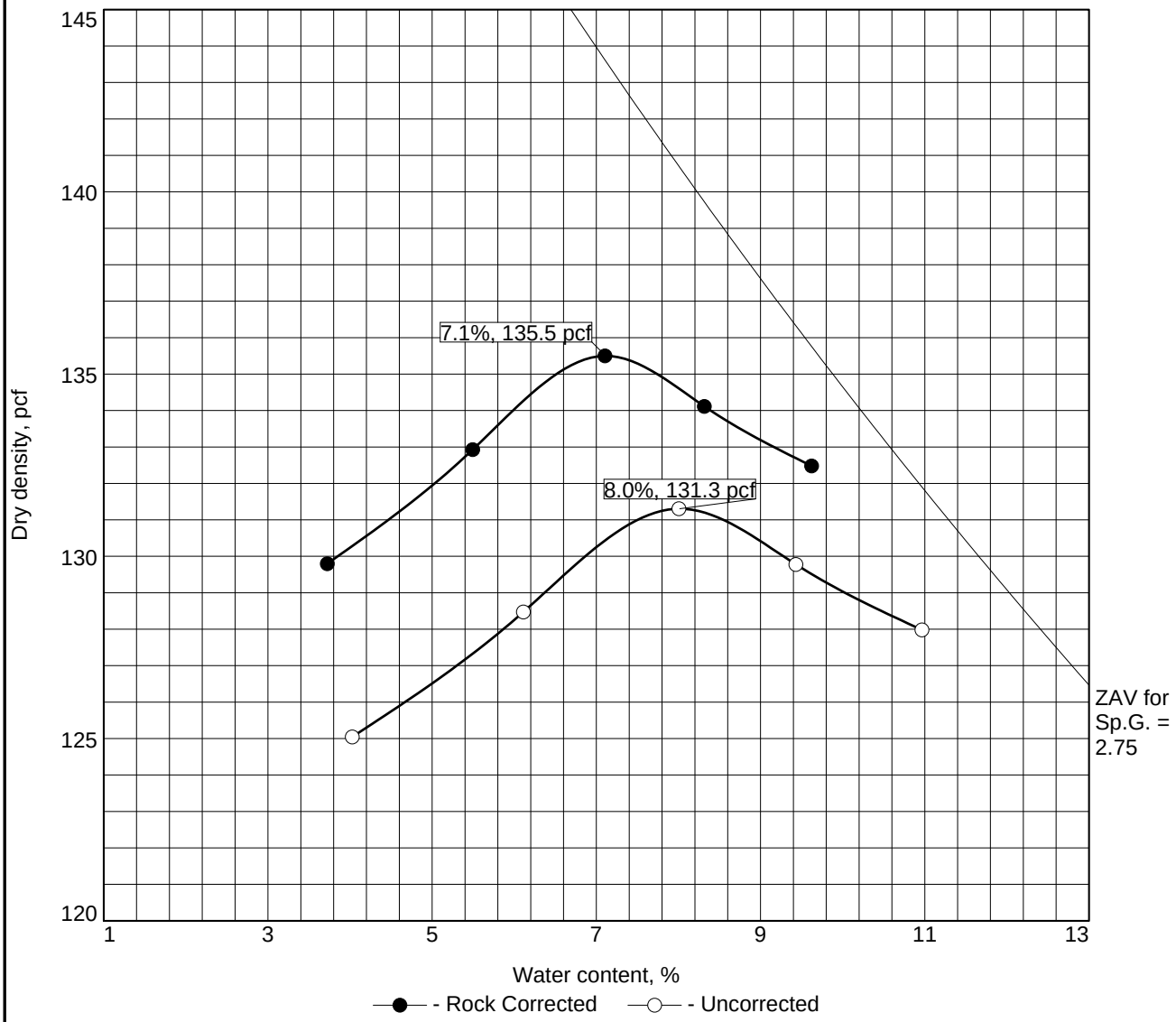
Date:

PIONEER TECHNICAL SERVICES, INC.

Client: Montana DEQ (c/o Herrera/Trihydro)
Project: Black Pine Mine Repository Investigation

Project No: 16694 **Figure**

COMPACTION TEST REPORT



Test specification: ASTM D 698-07 Method C Standard
ASTM D 4718-87 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
				2.75			15	16

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 135.5 pcf	131.3 pcf	
Optimum moisture = 7.1 %	8.0 %	

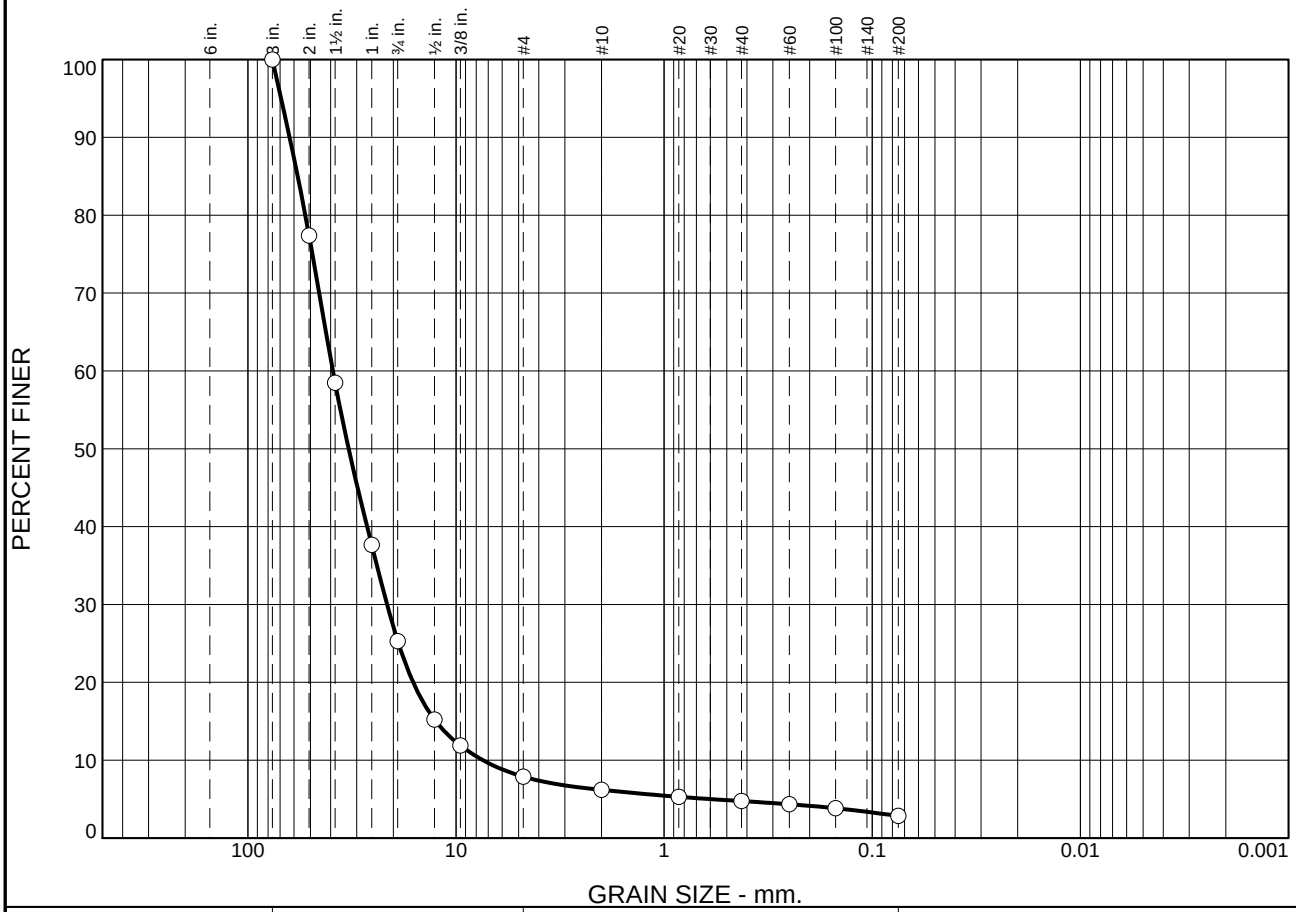
Project No. 16694 **Client:** Montana DEQ (c/o Herrera/Trihydro)
Project: Black Pine Mine Repository Investigation
Date:
○ **Location:** CMN-GT-01 **Sample Number:** 13263

Remarks:

PIONEER TECHNICAL SERVICES, INC.

Figure

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	75	17	2	1	2	3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100		
2	77		
1.5	58		
1	38		
.75	25		
.5	15		
.375	12		
#4	8		
#10	6		
#20	5		
#40	5		
#60	4		
#100	4		
#200	2.8		

* (no specification provided)

Material Description

well-graded gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 63.0181 D_{85}= 57.6190 D_{60}= 39.0452
D_{50}= 32.7976 D_{30}= 21.4400 D_{15}= 12.5257
D_{10}= 7.4254 C_u= 5.26 C_c= 1.59

Classification

USCS= GW AASHTO=

Remarks

Location: CMN-GT-02
Sample Number: 13264

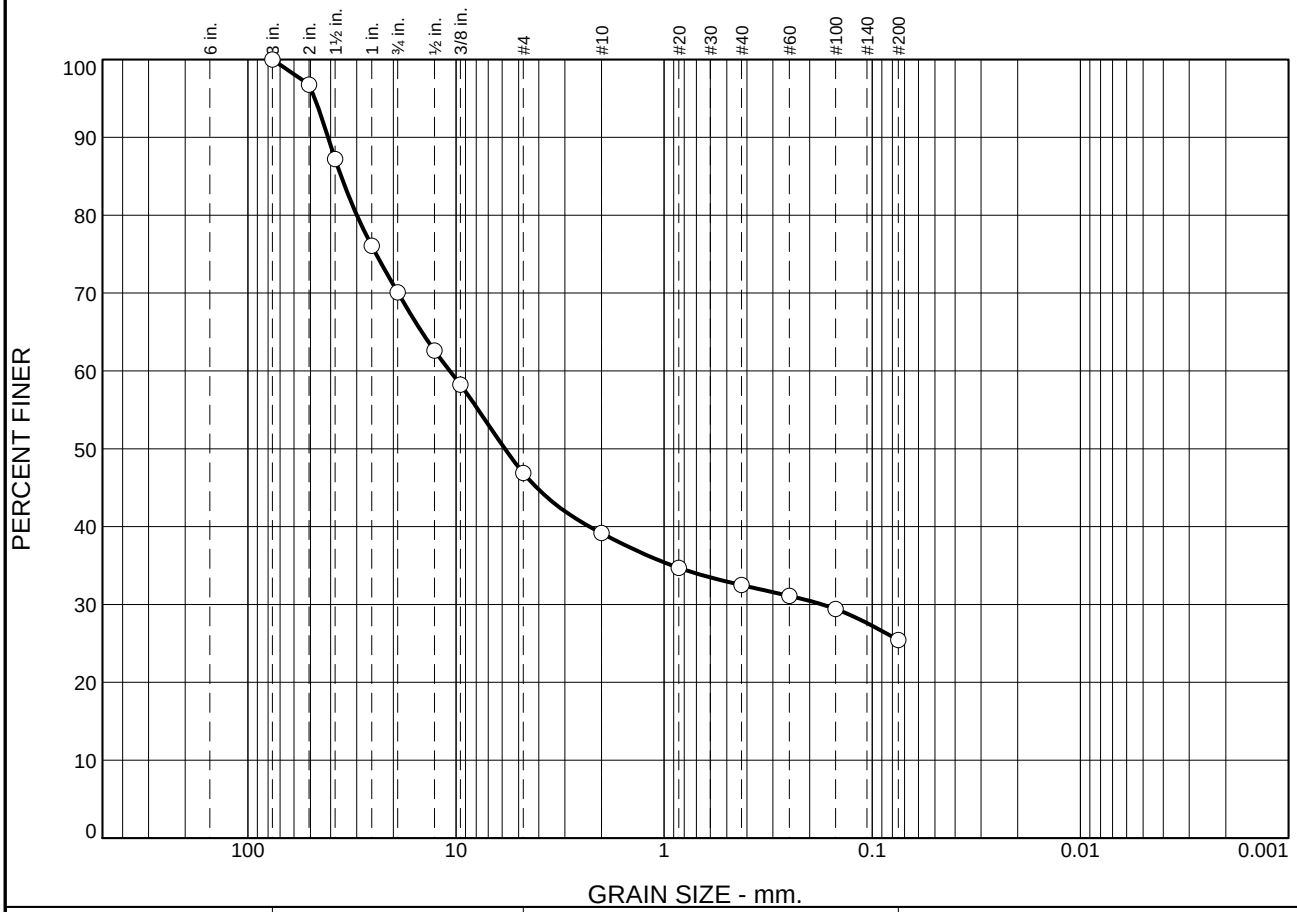
Date: 10-12-12

PIONEER TECHNICAL SERVICES, INC.

Client: Montana DEQ (c/o Herrera/Trihydro)
Project: Black Pine Mine Repository Investigation

Project No: 16694 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	30	23	8	7	7	25	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100		
2	97		
1.5	87		
1	76		
.75	70		
.5	63		
.375	58		
#4	47		
#10	39		
#20	35		
#40	32		
#60	31		
#100	29		
#200	25		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 41.1876 D_{85}= 35.6412 D_{60}= 10.7051
D_{50}= 5.8229 D_{30}= 0.1737 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

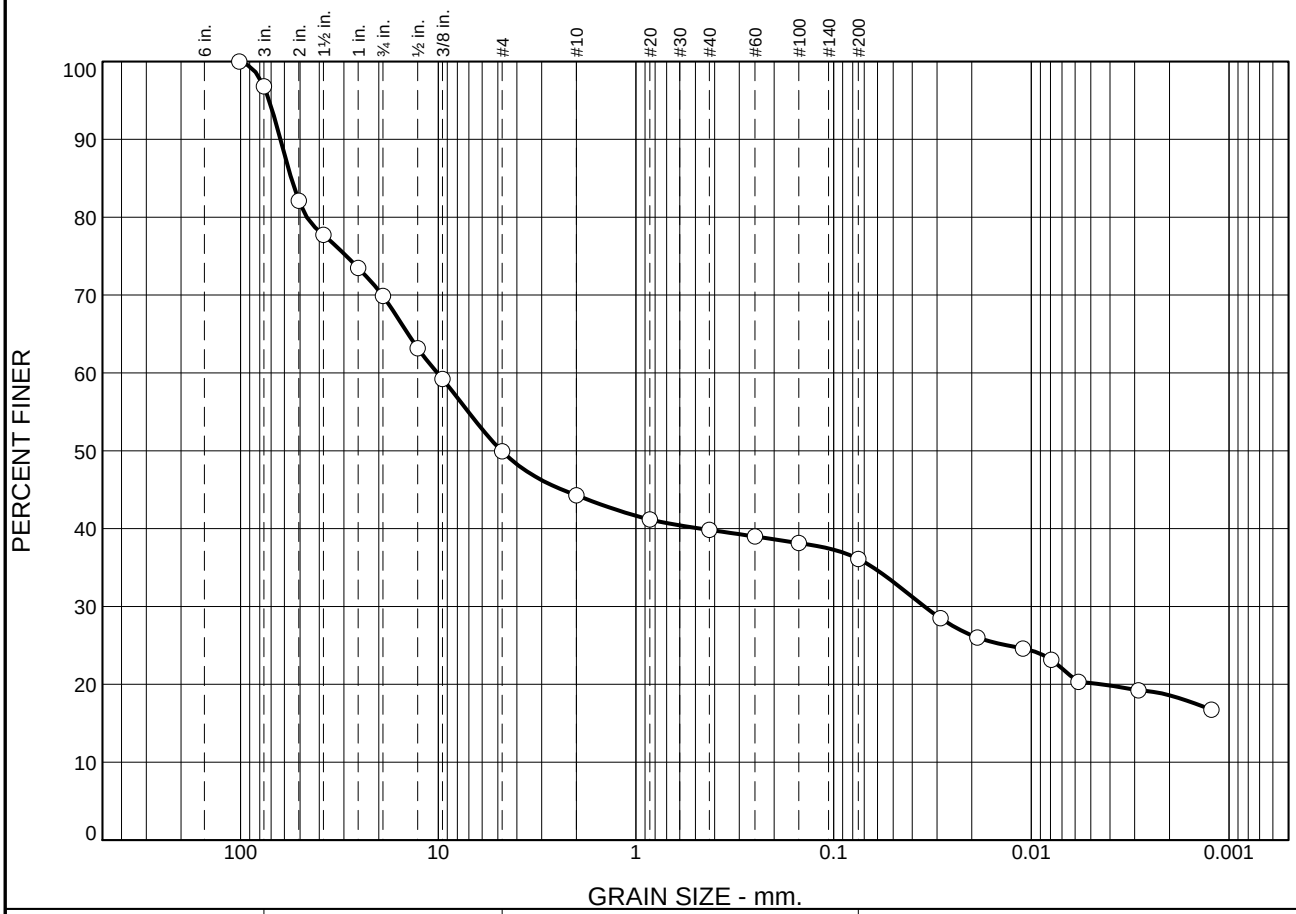
Location: RY-SS-09
Sample Number: 13272 **Depth:** 4-6' **Date:**

PIONEER TECHNICAL SERVICES, INC.

Client: Montana DEQ (c/o Herrera/Trihydro)
Project: Black Pine Mine Repository Investigation

Project No: 16694 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
3	27	20	6	4	4	16	20

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100		
3	97		
2	82		
1.5	78		
1	73		
.75	70		
.5	63		
.375	59		
#4	50		
#10	44		
#20	41		
#40	40		
#60	39		
#100	38		
#200	36		
0.0288 mm.	28		
0.0188 mm.	26		
0.0110 mm.	25		
0.0079 mm.	23		
0.0058 mm.	20		
0.0029 mm.	19		
0.0012 mm.	17		

* (no specification provided)

Soil Description

clayey gravel

Atterberg Limits

PL= 15 LL= 28 PI= 13

Coefficients

D_{90}= 62.8373 D_{85}= 55.4489 D_{60}= 10.0967
D_{50}= 4.7852 D_{30}= 0.0347 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-6(1)

Remarks

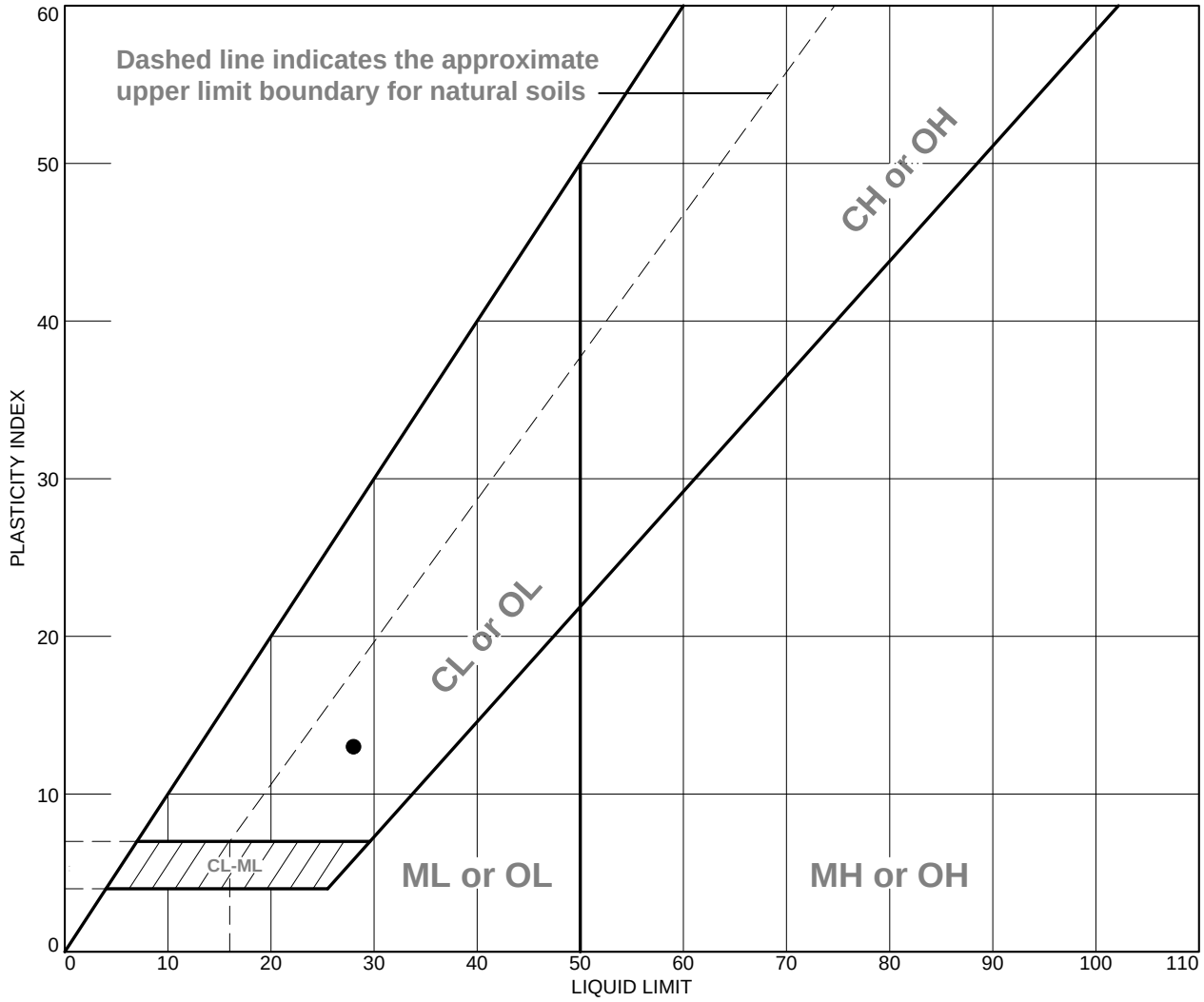
Location: RY-SS-12
Sample Number: 13274 **Date:**

PIONEER TECHNICAL SERVICES, INC.

Client: Montana DEQ (c/o Herrera/Trihydro)
Project: Black Pine Mine Repository Investigation

Project No: 16694 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	clayey gravel	28	15	13	40	36	GC

Project No. 16694 **Client:** Montana DEQ (c/o Herrera/Trihydro)

Project: Black Pine Mine Repository Investigation

● **Location:** RY-SS-12 **Sample Number:** 13274

Remarks:

PIONEER TECHNICAL SERVICES, INC.

Figure

PIONEER TECHNICAL SERVICES, INC.
P.O Box 3445, Butte, MT 59702
www.pioneer-technical.com

November 27, 2012

Ms. Devin Clary
DEQ
PO Box 200901
Helena, MT 59620

RE: Black Pine Mine Geotechnical Testing
Pioneer Technical Services Project No. 16694

Dear Ms. Clary,

On October 24th, 14 samples from the Black Pine Mine project were delivered to our ASTM/AASHTO accredited materials testing laboratory. The samples were designated as Lab Nos. 13509 through 13522. The testing request was:

- Standard Test Method for Laboratory Determination of Water Content (ASTM D2216);
- Liquid Limit, Plastic Limit and Plasticity Index of Soils (ASTM D4318);
- Particle-Size Distribution of Soils Using Sieve Analysis (ASTM D6913);
- Proctor Moisture/Density Relationships (AASHTO T 99 Method C); and
- Permeability Testing (Standard to be determined).

Table 1 - Sample I.D. and Testing Request

Lab No.	Boring	Depth (ft)	Moisture Content	Atterberg Limits	Sieve Analysis	Proctor	Permeability
13509	RY-SS-07	5'-13'	x[1]	x[1]	x[1]	x[1]	x[1]
13510	RY-SS-07	9'-13'	x	x	x		
13511	RY-SS-11	2.5'-4'	x		x	x	
13512	RY-SS-13 (VP-1)	2'-5'	x		x	x	
13513	RY-SS-14(VP-2)	2'-3'	x		x		
13514	RY-SS-15(VP-3)	12'	x	x			
13515	CML-GT-01	-	x*	x*	x*	x*	
13516	CML-GT-02	-	x*	x*	x*	x*	
13517	CML-GT-03	2'-3'	x*	x*	x*	x*	
13518	CML-GT-04	0'-1'	x*	x*	x*	x*	
13519	CML-GT-05	0'-1'	x				
13520	CML-GT-06	0'-1'	x*	x*	x*	x*	
13521	CML-GT-07	1.5'-2'	x*	x*	x*	x*	
13522	CML-GT-08	1'-2'	x*				

x[1] Testing to be performed in our Belgrade Laboratory. A separate permeability report will be distributed when complete.
x* Testing to be completed by a laboratory that works with mercury contamination.

PIONEER TECHNICAL SERVICES, INC.
P.O Box 3445, Butte, MT 59702
www.pioneer-technical.com

Table 2 – Moisture Content

Lab No.	Boring	Depth (ft)	Moisture Content (%)
13510	RY-SS-07	9'-13'	13.1
13511	RY-SS-11	2.5'-4'	13.2
13512	RY-SS-13(VP-1)	2'-5'	3.6
13513	RY-SS-14(VP-2)	2'-3'	2.5
13514	RY-SS-15(VP-3)	12'	14.2
13519	CML-GT-06	0'-1'	13.4

The Atterberg Limits Chart, and the gradation and Proctor curves are included with this report. The gradation for Lab No. 13512 had 35 percent retained on the ¾-inch sieve, which is outside the Standard's limit of 30 percent maximum for a Proctor oversize correction. Our Proctor values for Lab No. 13512 are for reference purposes only.

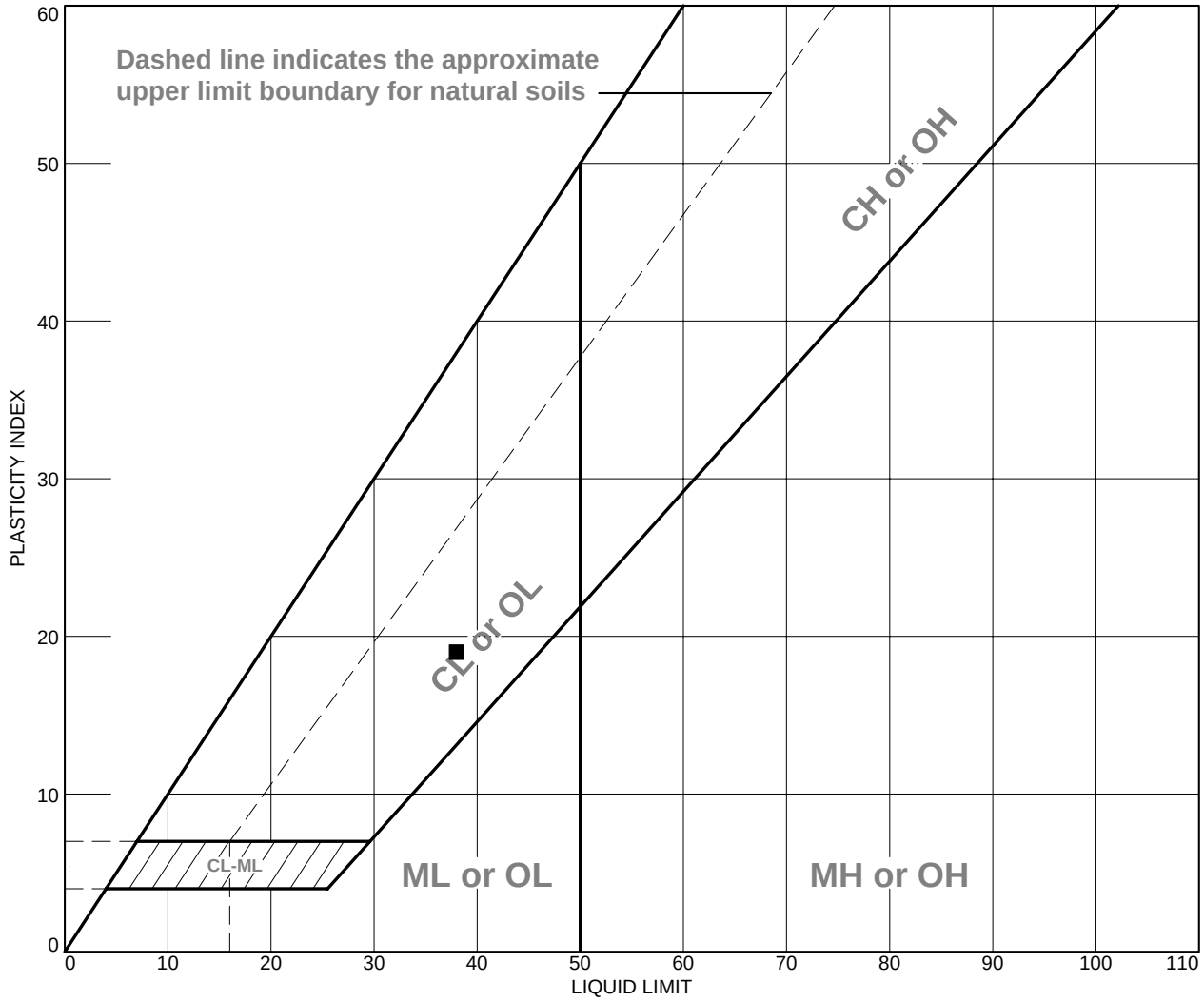
We thank you for using Pioneer Technical Services for your geotechnical and materials testing requirements. If you have any questions regarding these results, please contact Todd Lorenzen or Paul Bushnell at (406) 443-6053.

Sincerely,
PIONEER TECHNICAL SERVICES, INC.

Todd Lorenzen, P.E.
Senior Geotechnical Engineer

for
Paul Bushnell
Materials Testing Supervisor

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	silty gravel with sand	NV	NP	NP	47	37	GM
■		38	19	19			

Project No. 16694 **Client:** Montana DEQ (c/o Herrera/Trihydro)

Project: Black Pine Mine Repository Investigation

● **Location:** RY-SS-07 **Depth:** 9-13' **Sample Number:** 13510

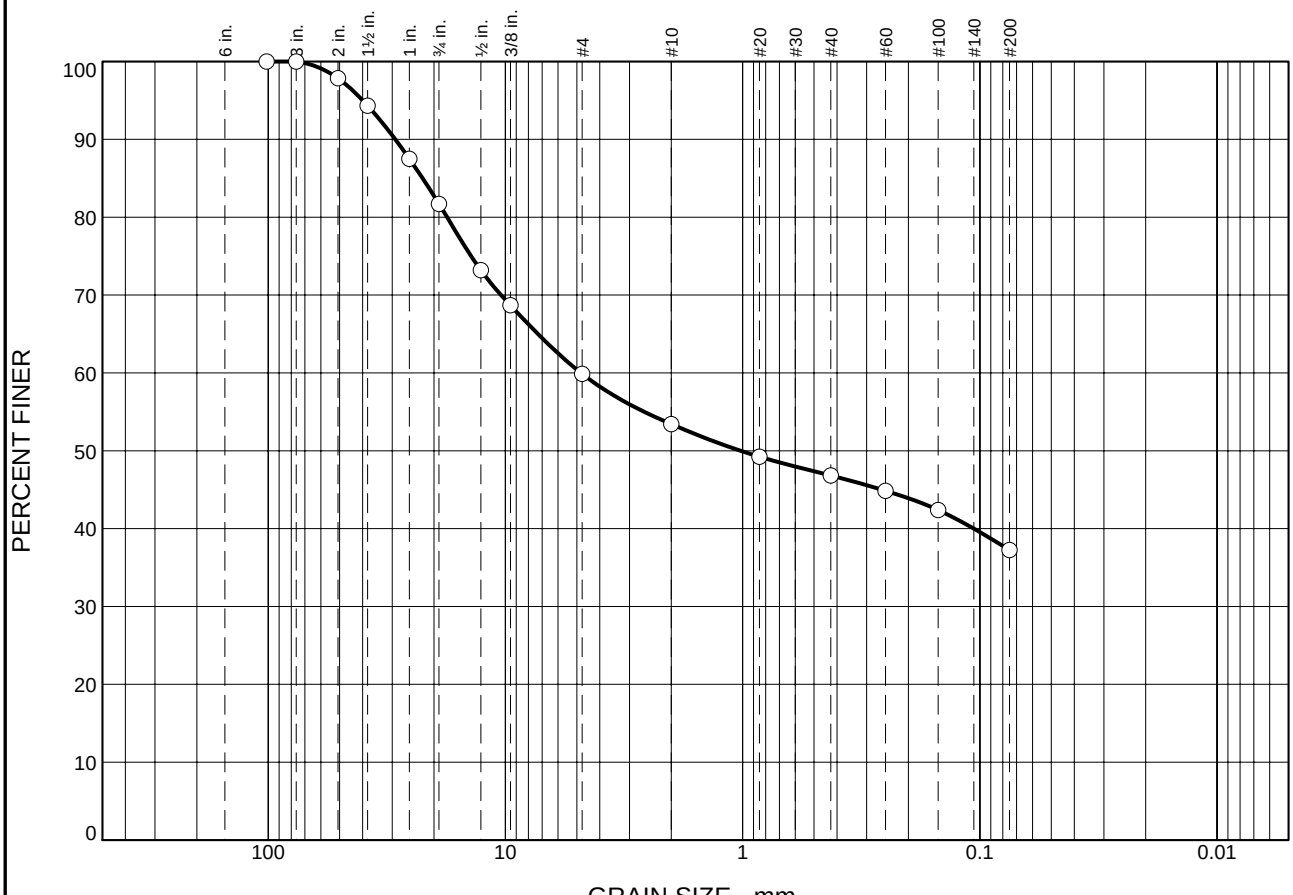
■ **Location:** RY-SS-15 (VP-3) **Depth:** 12' **Sample Number:** 13514

Remarks:

PIONEER TECHNICAL SERVICES, INC.

Figure

Particle Size Distribution Report



% Stones	% +3"	% Gravel			% Sand					% Silt	
		Coarse	Medium	Fine	V. Crs.	Crs.	Med.	Fine	V. Fine	Crs.	Fine
0	0	18	22	7	3	3	2	5	40		

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100		
3	100		
2	98		
1.5	94		
1	87		
.75	82		
.5	73		
.375	69		
#4	60		
#10	53		
#20	49		
#40	47		
#60	45		
#100	42		
#200	37		

* (no specification provided)

Material Description

silty gravel with sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 29.1394 D_{85}= 22.3457 D_{60}= 4.8039
D_{50}= 1.0211 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GM AASHTO= A-4(0)

Remarks

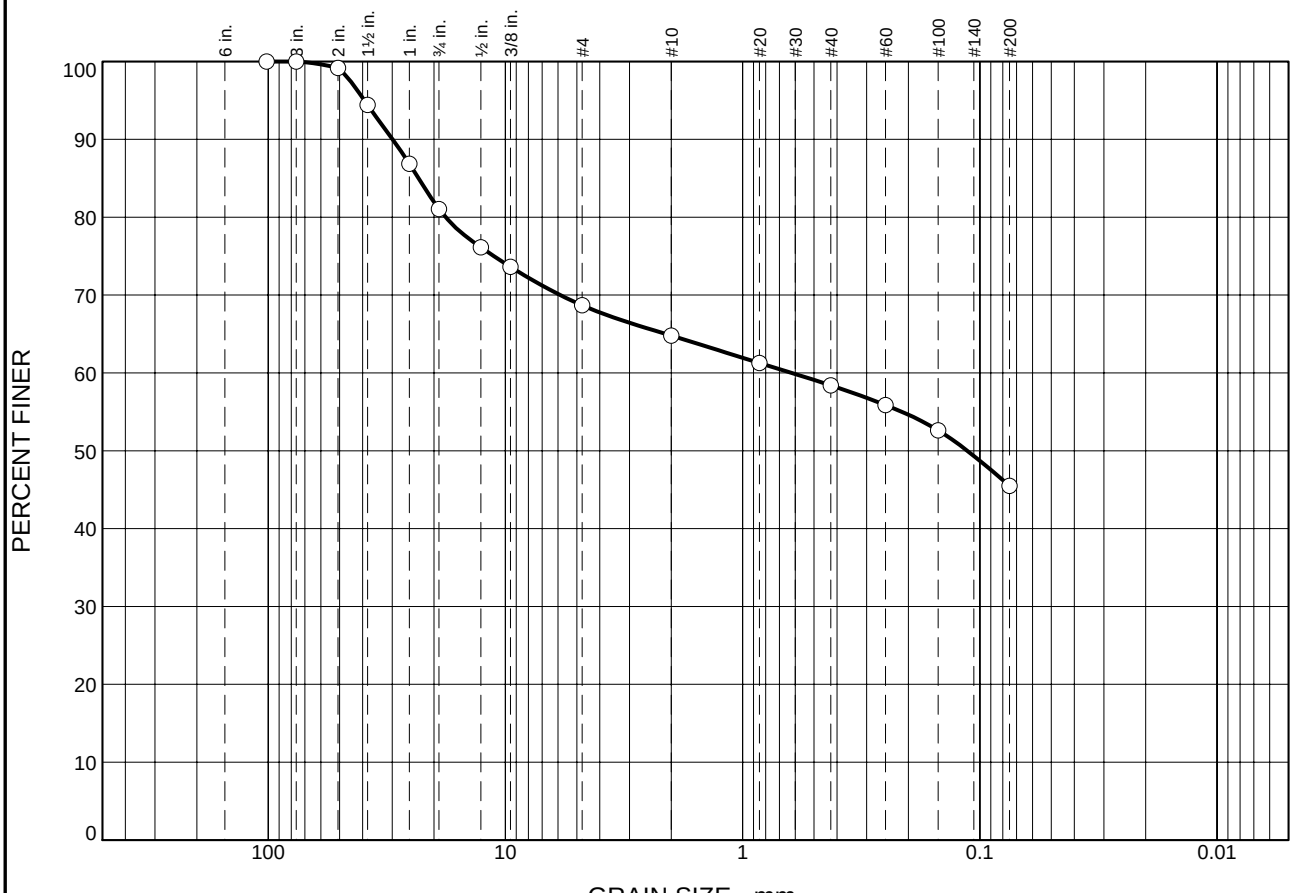
Location: RY-SS-07
Sample Number: 13510 **Depth:** 9-13' **Date:** 11/5/12

PIONEER TECHNICAL SERVICES, INC.

Client: Montana DEQ (c/o Herrera/Trihydro)
Project: Black Pine Mine Repository Investigation

Project No: 16694 **Figure**

Particle Size Distribution Report



% Stones	% +3"	% Gravel			% Sand					% Silt	
		Coarse	Medium	Fine	V. Crs.	Crs.	Med.	Fine	V. Fine	Crs.	Fine
0	0	19	12	4	3	3	3	7	49		

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4	100		
3	100		
2	99		
1.5	94		
1	87		
.75	81		
.5	76		
.375	74		
#4	69		
#10	65		
#20	61		
#40	58		
#60	56		
#100	53		
#200	45		

* (no specification provided)

Material Description

silty gravel with sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 29.9055 D_{85}= 23.2300 D_{60}= 0.6214
D_{50}= 0.1130 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GM AASHTO= A-4(0)

Remarks

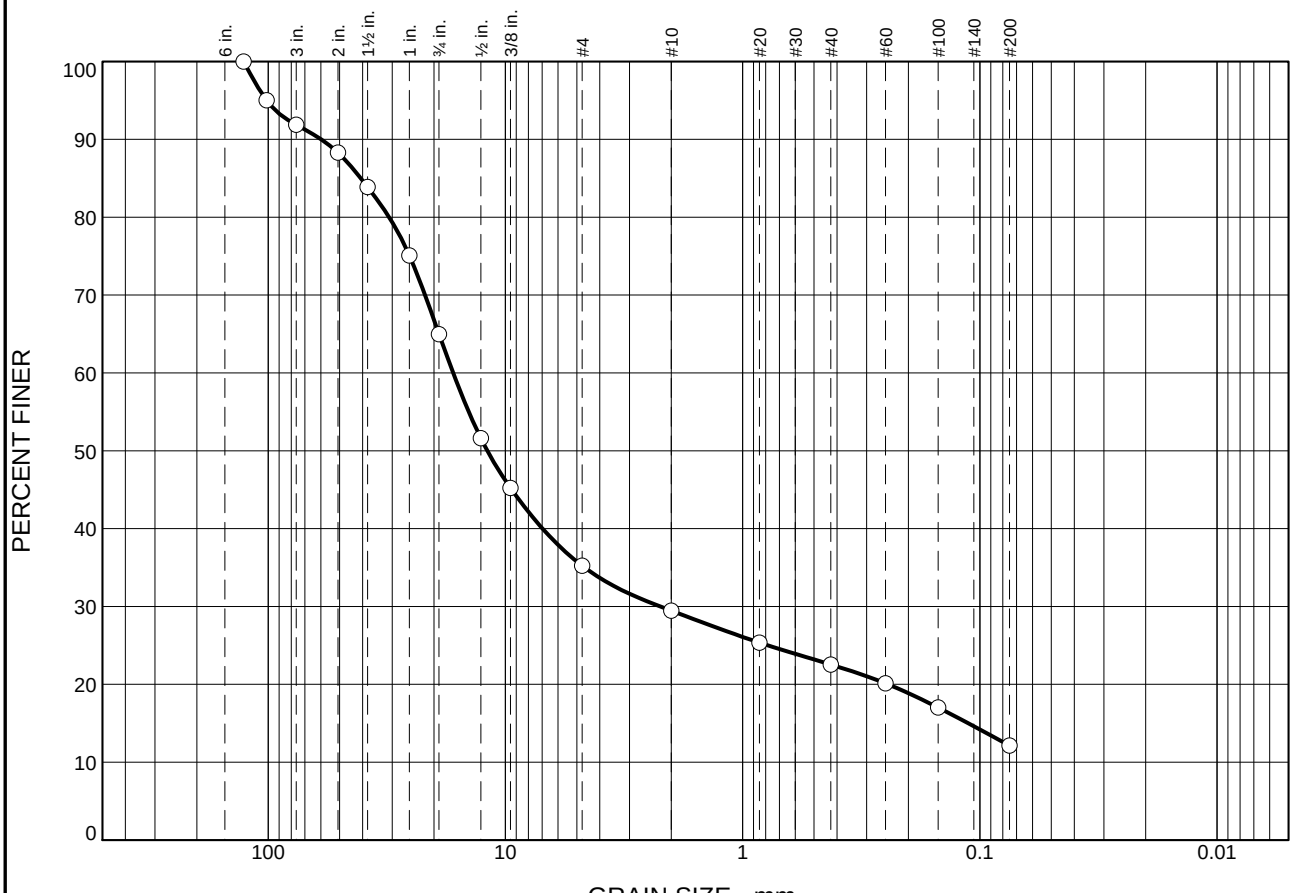
Location: RY-SS-11
Sample Number: 13511 **Depth:** 2.5-4' **Date:** 11/5/12

PIONEER TECHNICAL SERVICES, INC.

Client: Montana DEQ (c/o Herrera/Trihydro)
Project: Black Pine Mine Repository Investigation

Project No: 16694 **Figure**

Particle Size Distribution Report



% Stones	% +3"	% Gravel			% Sand					% Silt	
		Coarse	Medium	Fine	V. Crs.	Crs.	Med.	Fine	V. Fine	Crs.	Fine
0	8	27	30	6	3	3	3	6	14		

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
5	100		
4	95		
3	92		
2	88		
1.5	84		
1	75		
.75	65		
.5	52		
.375	45		
#4	35		
#10	29		
#20	25		
#40	23		
#60	20		
#100	17		
#200	12		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 59.8052 D_{85}= 40.7191 D_{60}= 16.5989
D_{50}= 11.9250 D_{30}= 2.2254 D_{15}= 0.1119
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

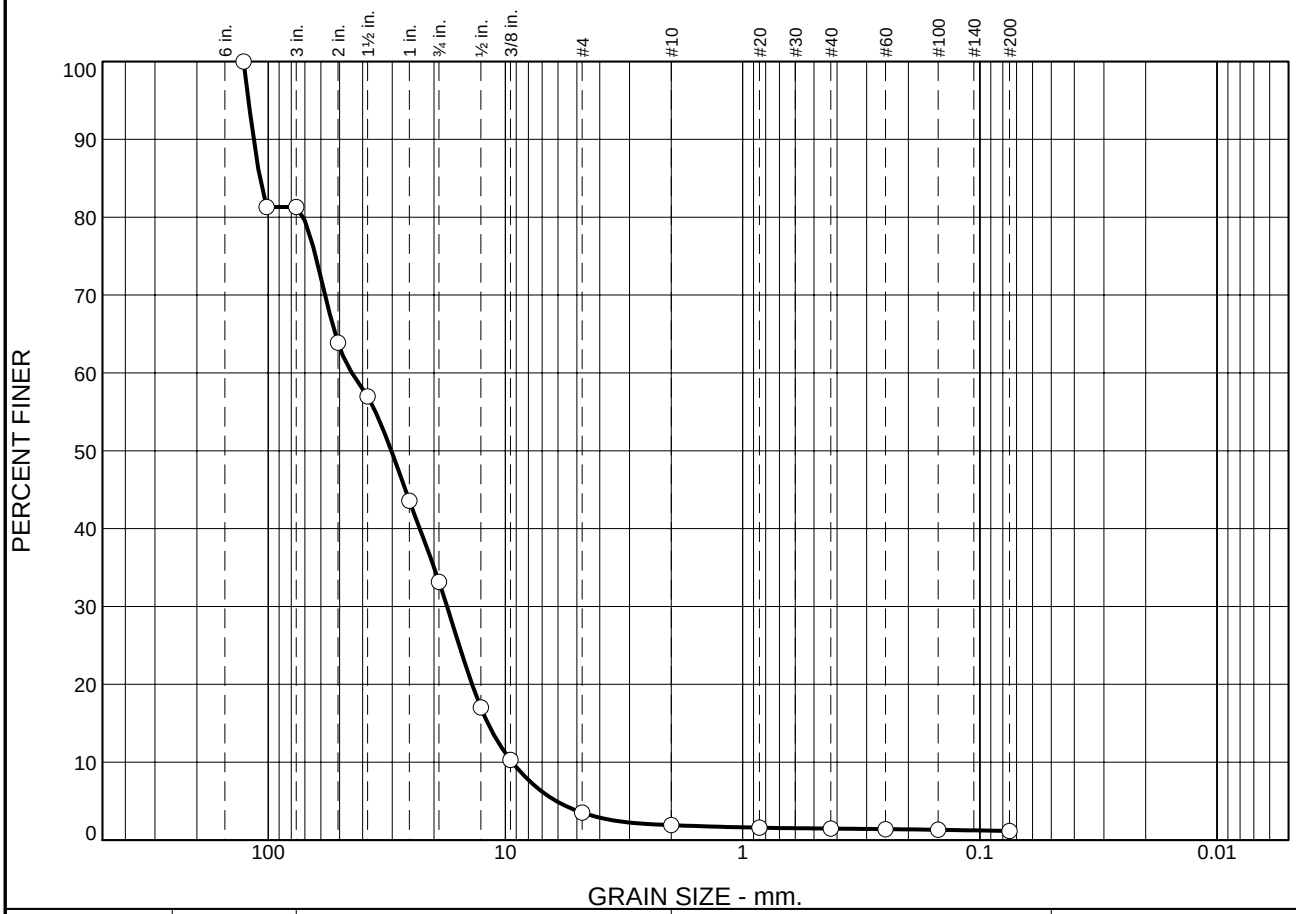
Location: RY-SS-13
Sample Number: 13512 **Depth:** 2-5' **Date:** 11/5/12

PIONEER TECHNICAL SERVICES, INC.

Client: Montana DEQ (c/o Herrera/Trihydro)
Project: Black Pine Mine Repository Investigation

Project No: 16694 **Figure**

Particle Size Distribution Report



% Stones	% +3"	% Gravel			% Sand					% Silt	
		Coarse	Medium	Fine	V. Crs.	Crs.	Med.	Fine	V. Fine	Crs.	Fine
0	19	48	29	2	0	1	0	0	1		

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
5	100		
4	81		
3	81		
2	64		
1.5	57		
1	44		
.75	33		
.5	17		
.375	10		
#4	4		
#10	2		
#20	2		
#40	1		
#60	1		
#100	1		
#200	1.2		

* (no specification provided)

Material Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 115.0966 D_{85}= 108.4080 D_{60}= 44.4078
D_{50}= 30.2693 D_{30}= 17.6257 D_{15}= 11.8639
D_{10}= 9.3592 C_u= 4.74 C_c= 0.75

Classification

USCS= GP AASHTO=

Remarks

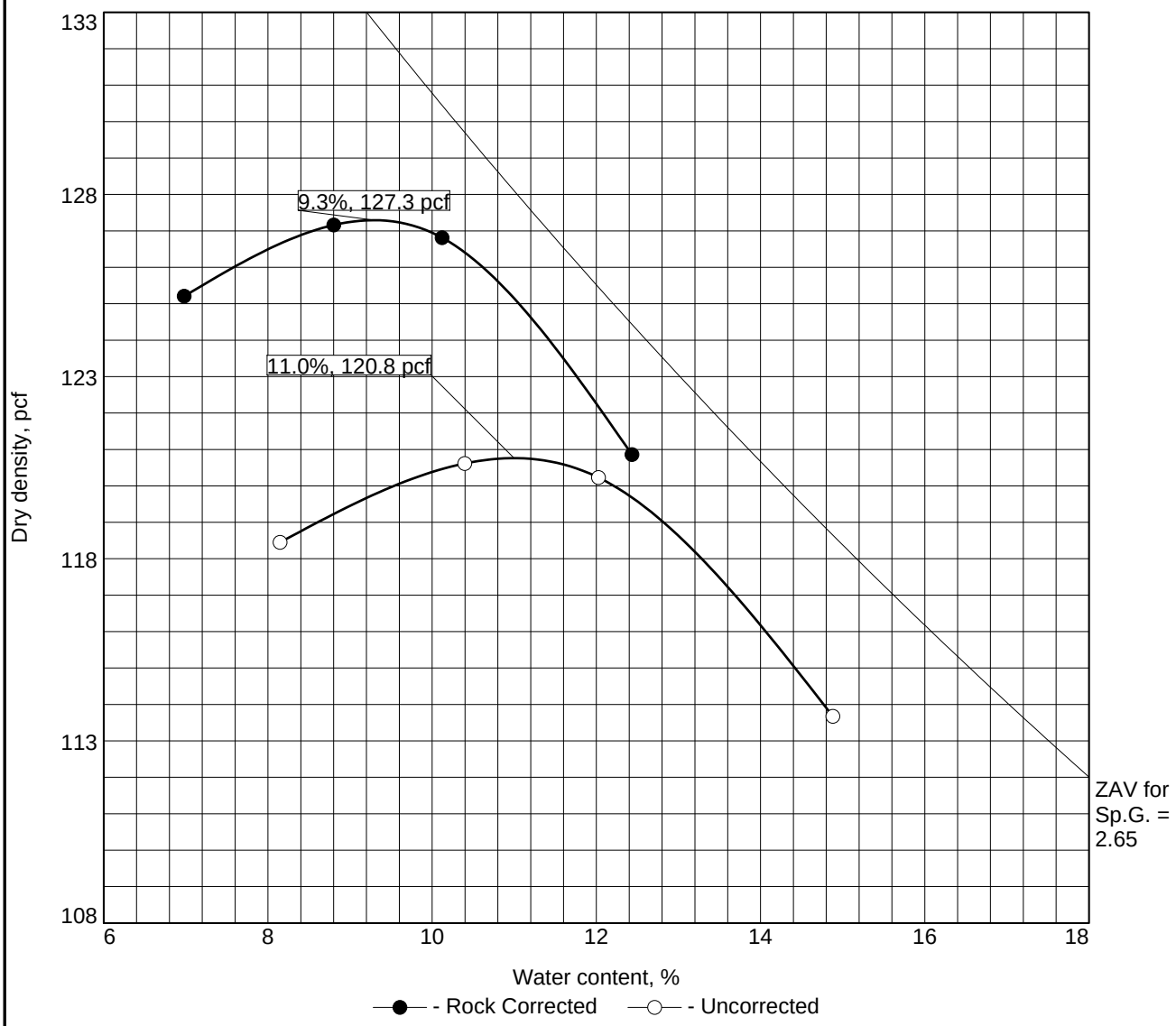
Location: RY-SS-14 (VP-2)
Sample Number: 13513 **Depth:** 2-3' **Date:** 11/5/12

PIONEER TECHNICAL SERVICES, INC.

Client: Montana DEQ (c/o Herrera/Trihydro)
Project: Black Pine Mine Repository Investigation

Project No: 16694 **Figure**

COMPACTION TEST REPORT



Test specification: AASHTO T 99 Method C Standard
AASHTO T 224-01 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
2.5-4'	GM	A-4(0)		2.65	NV	NP	19	45

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 127.3 pcf	120.8 pcf	silty gravel with sand
Optimum moisture = 9.3 %	11.0 %	

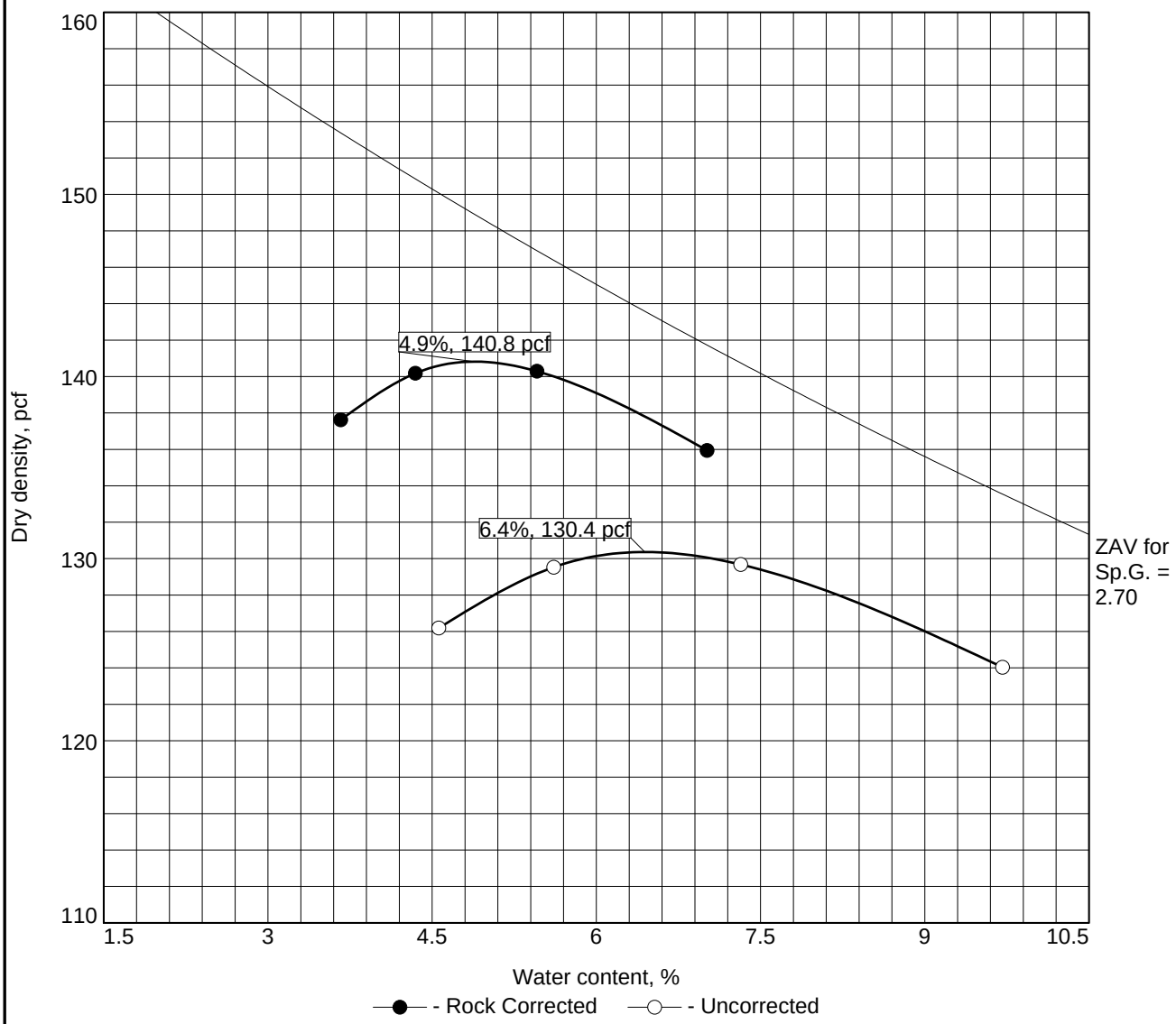
Project No. 16694 **Client:** Montana DEQ (c/o Herrera/Trihydro)
Project: Black Pine Mine Repository Investigation
Date:
○ **Location:** RY-SS-11 **Sample Number:** 13511

Remarks:

PIONEER TECHNICAL SERVICES, INC.

Figure

COMPACTION TEST REPORT



Test specification: AASHTO T 99 Method C Standard
AASHTO T 224-01 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
2-5'				2.70			35	12

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 140.8 pcf	130.4 pcf	
Optimum moisture = 4.9 %	6.4 %	

Project No. 16694 **Client:** Montana DEQ (c/o Herrera/Trihydro)

Project: Black Pine Mine Repository Investigation

Date:

○ **Location:** RY-SS-13 **Sample Number:** 13512

Remarks:

PIONEER TECHNICAL SERVICES, INC.

Figure

PIONEER
TECHNICAL SERVICES, INC.

May 31, 2013

Mr. Tom Smith
Trihydro Corporation
2707 Broadwater Avenue
Helena, MT 59601

RE: Black Pine Mine Geotechnical Testing Adjusted Final Report

Dear Mr. Smith:

Between October 8 and December 5, 2013 samples listed in the table below were delivered to our soils laboratory in Belgrade, Montana.

Requested Testing included:

- Standard Test Method for Laboratory Determination of Water Content (ASTM D2216)
- Liquid Limit, Plastic Limit and Plasticity Index of Soils (ASTM D4318)
- Particle Size Distribution of Soils Using Sieve Analysis (ASTM D6913)
- Proctor Moisture Density Relationships (ASTM D698)
- Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter (ASTM D5084)
- Standard Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils (ASTM D4767)

Lab No.	Boring	Depth (ft)	Sieve Analysis	Hydrometer	Atterberg Limits	Proctor	Moisture Content	Hydraulic Conductivity	CU Triaxial
13273	RY-SS-10	14-16	X	X	X	X	X	X	X
13271	RY-SS-06	4-7	X	X					
13509	RY-SS-07	5-13	X		X	X	X		
13777	RY-SS-11	6-8	X	X	X		X	X	X

Unit Weight and compaction, and moisture content parameters for triaxial testing and hydraulic conductivity testing were determined by Mr. Vincent Perrone of Perrone Consulting, Inc.

Sample RY-SS-10 (14-16') was recompacted to 95% of the maximum dry density (ASTM D698) value and at a target moisture of 1% over optimum moisture content. Confining pressures were 1500 psf, 3000 psf, and 6000 psf. We were able to run the hydraulic conductivity tests in conjunction with the triaxial tests at the requested confining pressures of 1500 psf and 6000 psf. Specimens were then consolidated at the requested confining pressures prior to the hydraulic conductivity testing. At the request of Mr. Vincent Perrone a fourth point was

performed. This point was performed at the same parameters as the previous points and at a confining pressure of 2500 psf. Hydraulic Conductivity testing was not performed for this point.

Sample RY-SS-11 was recompacted to 95% of the maximum dry unit weight (ASTM D698) based on values from sample RY-SS-11 (2.5-4.0'). Target moisture was between optimum and 2% over optimum. Requested confining pressures were 1000psf, 2500psf and 5000 psf.

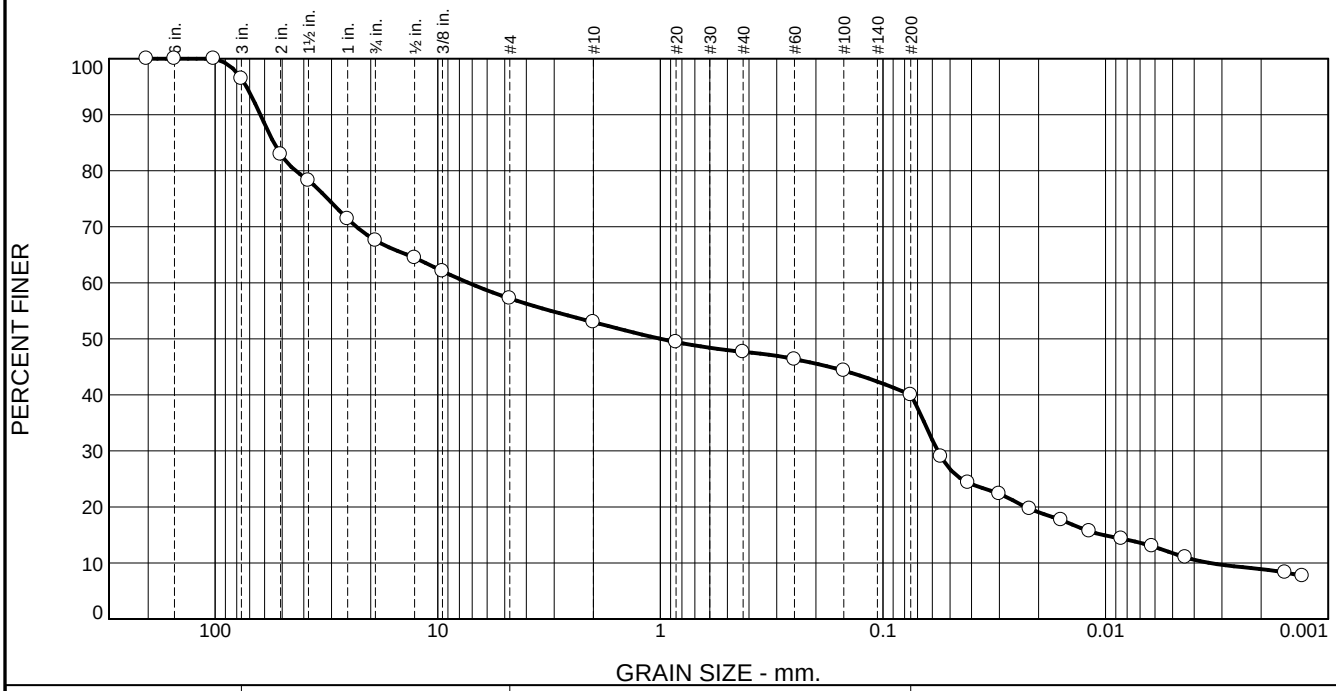
Hydraulic conductivity testing was also performed at the conclusion of the consolidation stage at each of these confining pressures in conjunction with triaxial testing.

The results of the testing are attached, please call if you have any questions or need additional information.

Sincerely,

Niki Griffis

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
4	28	11	4	5	8	28	12

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
8	100		
6	100		
4	100		
3	96		
2	83		
1.5	78		
1	71		
.75	68		
.5	64		
.375	62		
#4	57		
#10	53		
#20	49		
#40	48		
#60	46		
#100	44		
#200	40		
0.0550 mm.	29		
0.0414 mm.	24		
0.0300 mm.	22		
0.0219 mm.	20		
0.0159 mm.	18		
0.0118 mm.	16		
0.0085 mm.	14		
0.0062 mm.	13		
0.0044 mm.	11		
0.0016 mm.	8.3		
0.0013 mm.	7.7		

* (no specification provided)

Material Description

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= **AASHTO (M 145)=**

Coefficients

D_{90}= 62.6576 D_{85}= 54.4842 D_{60}= 7.2872
D_{50}= 0.9964 D_{30}= 0.0568 D_{15}= 0.0103
D_{10}= 0.0034 C_u= 2143.38 C_c= 0.13

Remarks

Date Received: **Date Tested:** 10-8-12

Tested By: LS

Checked By: NG

Title:

Source of Sample: RY-SS-06 **Depth:** 4-7' **Date Sampled:**

Pioneer Technical Services, Inc.

1215 Apple's Way - Belgrade, MT 59714

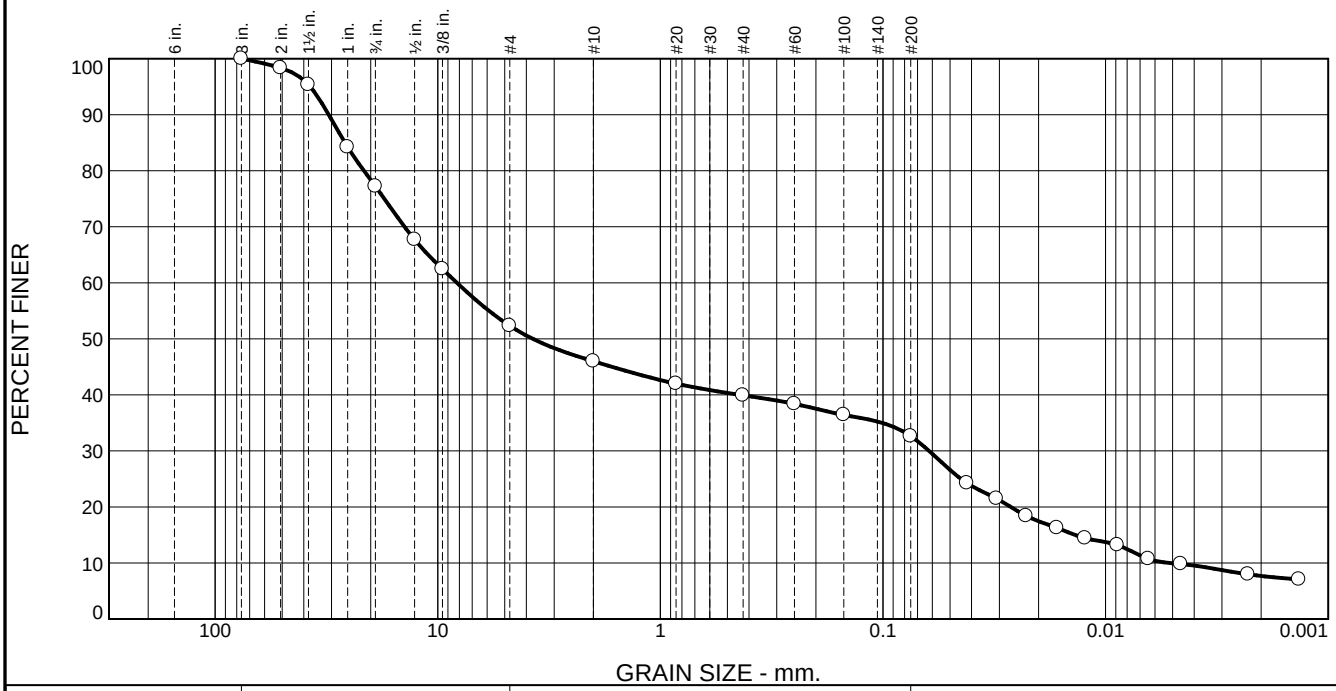
Ph. 406-388-8578 - Fax 406-388-8579

Client: Montana DEQ (c/o Herrera/Trihydro)

Project: Black Pine Mine

Project No: 16694 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	23	25	6	6	7	23	10

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3	100		
2	98		
1.5	95		
1	84		
.75	77		
.5	68		
.375	62		
#4	52		
#10	46		
#20	42		
#40	40		
#60	38		
#100	36		
#200	33		
0.0419 mm.	24		
0.0309 mm.	21		
0.0228 mm.	18		
0.0165 mm.	16		
0.0123 mm.	14		
0.0089 mm.	13		
0.0064 mm.	11		
0.0046 mm.	9.8		
0.0023 mm.	8.0		
0.0014 mm.	7.1		

* (no specification provided)

Material Description

silty clayey gravel with sand

Atterberg Limits (ASTM D 4318)

PL= 18 **LL=** 25 **PI=** 7

Classification

USCS (D 2487)= GC-GM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 30.8616 D_{85}= 26.1088 D_{60}= 8.2035
D_{50}= 3.7390 D_{30}= 0.0620 D_{15}= 0.0137
D_{10}= 0.0052 C_u= 1591.47 C_c= 0.09

Remarks

Date Received: **Date Tested:**

Tested By: LS/NG

Checked By:

Title:

Source of Sample: RY-SS-07 **Depth:** 5-13 composite **Date Sampled:**

Pioneer Technical Services, Inc.

1215 Apple's Way - Belgrade, MT 59714

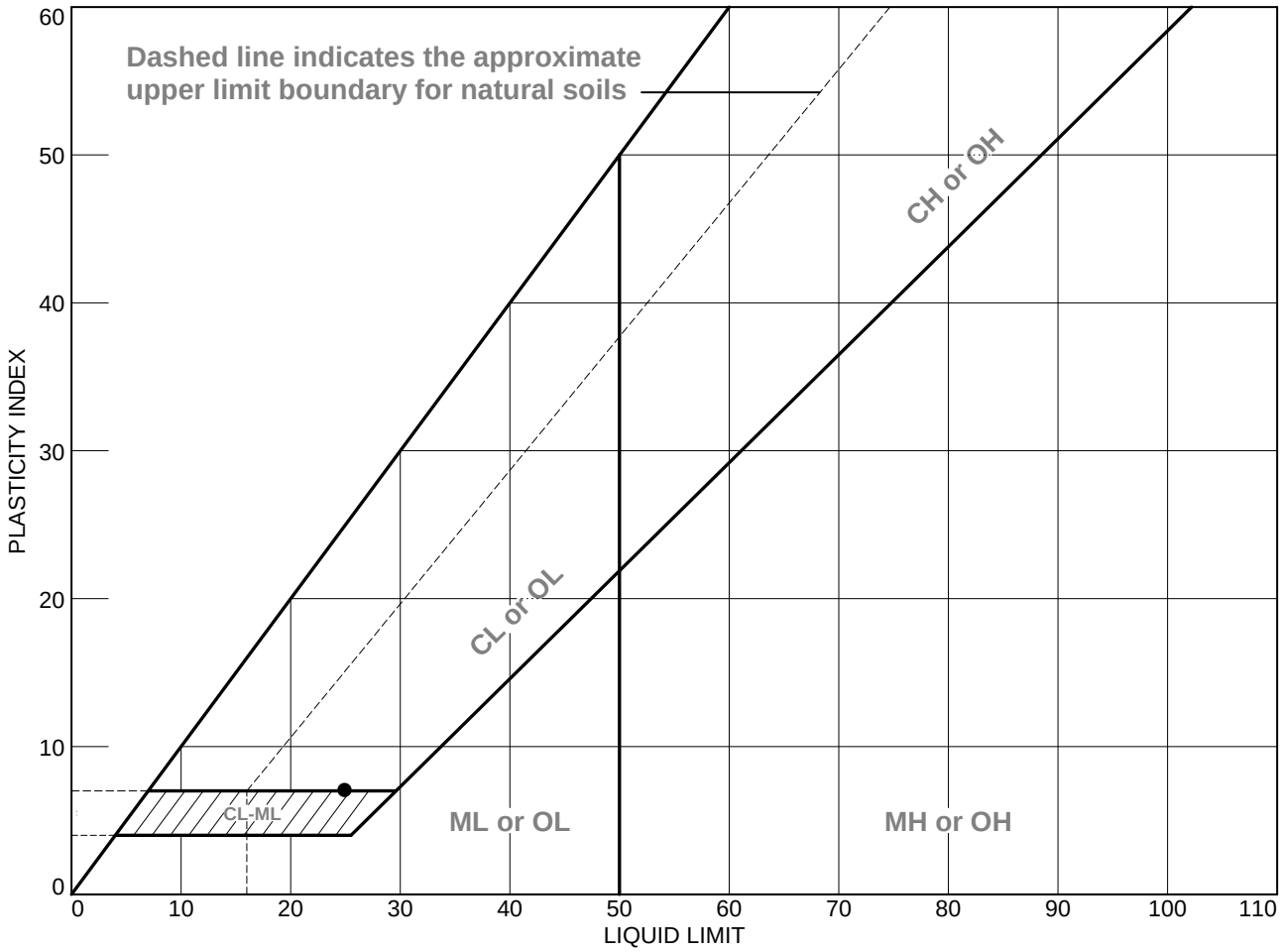
Ph. 406-388-8578 - Fax 406-388-8579

Client: Montana DEQ (c/o Herrera/Trihydro)

Project: Black Pine Mine

Project No: 16694 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	RY-SS-07		5-13 composite	8.15	18	25	7	GC-GM

Pioneer Technical Services, Inc.

1215 Apple's Way - Belgrade, MT 59714

Ph. 406-388-8578 - Fax 406-388-8579

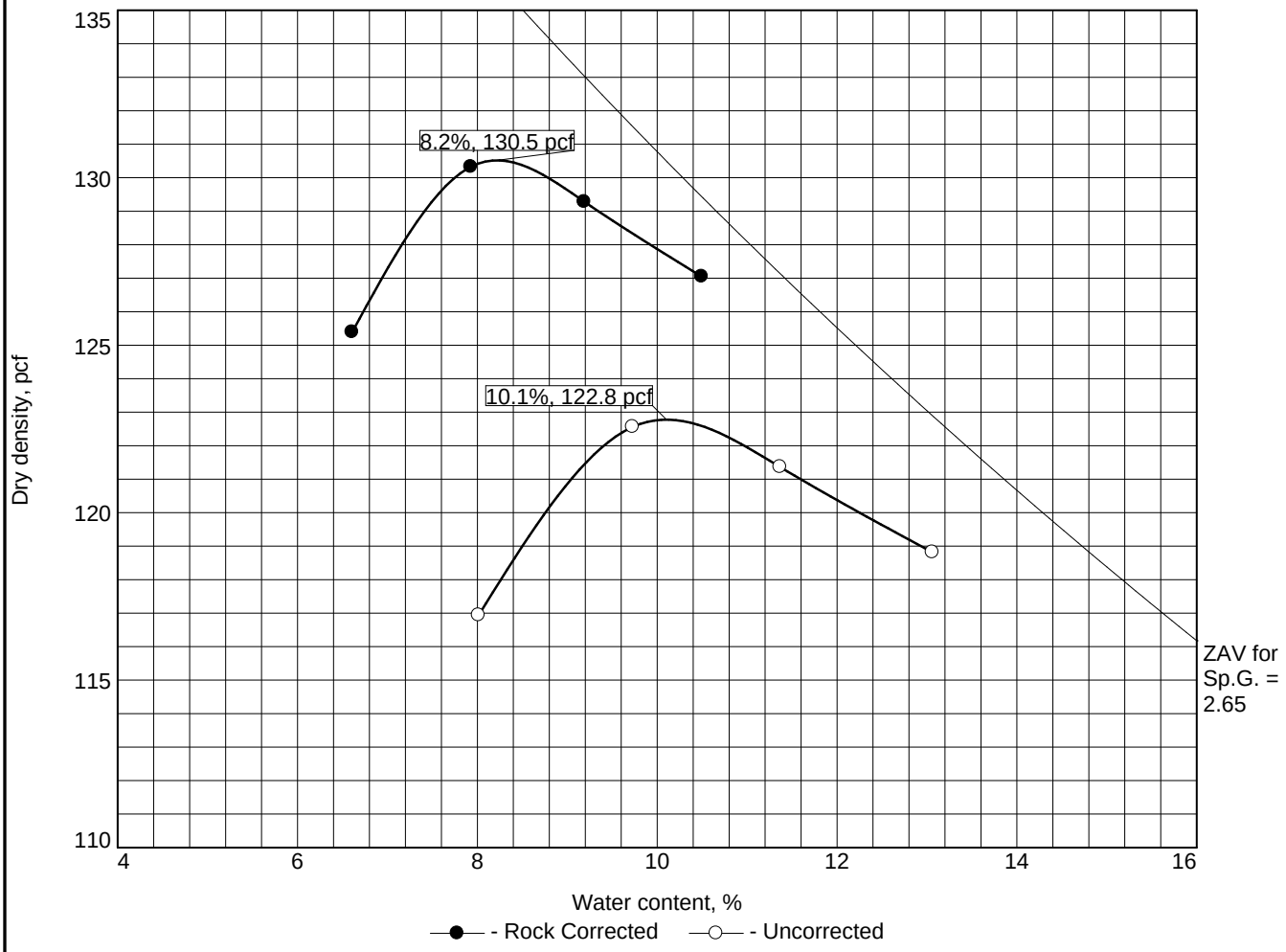
Client: Montana DEQ (c/o Herrera/Trihydro)

Project: Black Pine Mine

Project No.: 16694 **Figure**

Tested By: LS

COMPACTION TEST REPORT



Test specification: ASTM D 698-07 Method C Standard
ASTM D 4718-87 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
5-13 composite	GC-GM	A-2-4(0)	8.15	2.65	25	7	23	33

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 130.5 pcf	122.8 pcf	silty clayey gravel with sand
Optimum moisture = 8.2 %	10.1 %	

Project No. 16694 **Client:** Montana DEQ (c/o Herrera/Trihydro)
Project: Black Pine Mine

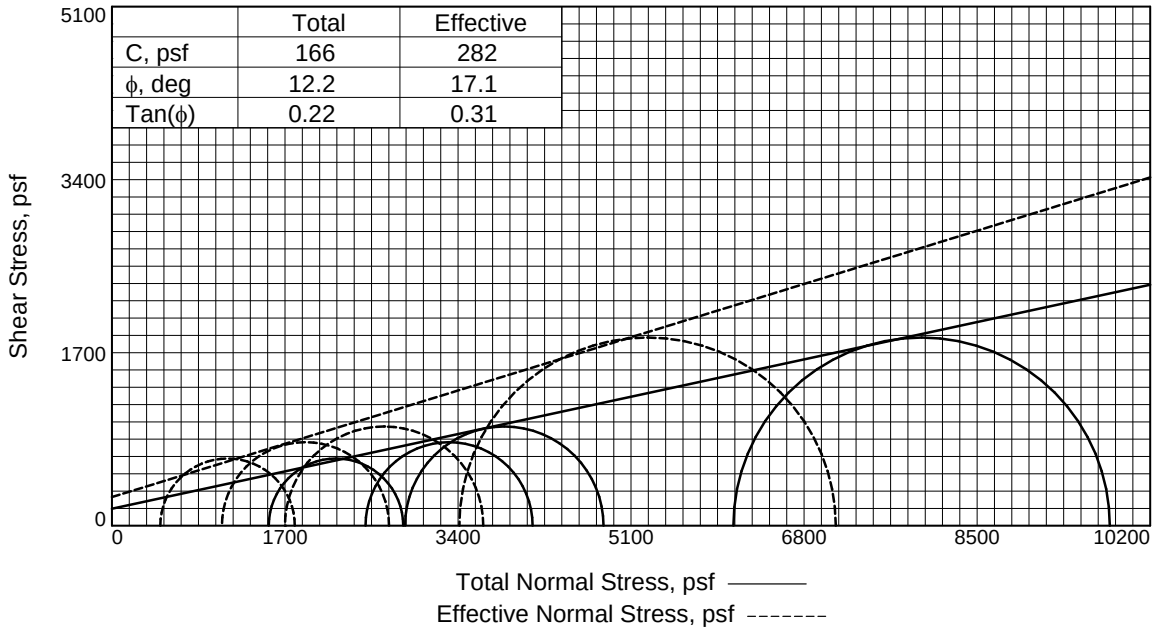
○**Source of Sample:** RY-SS-07

Remarks:

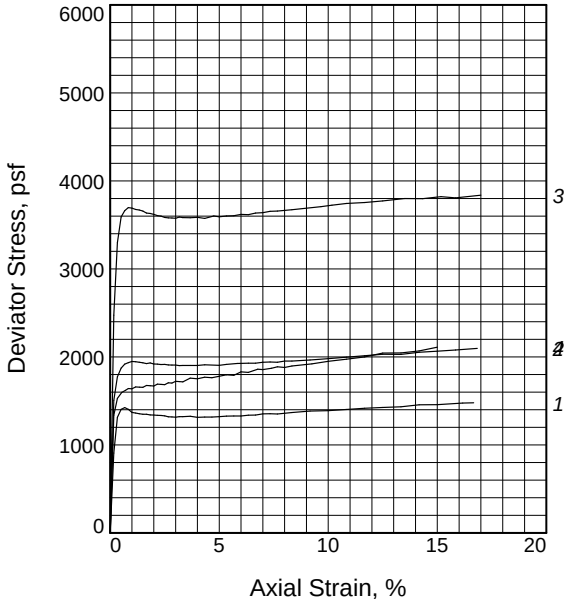
Pioneer Technical Services, Inc.
1215 Apple's Way - Belgrade, MT 59714
Ph. 406-388-8578 - Fax 406-388-8579

Figure

Tested By: LS



	Total	Effective
C, psf	166	282
ϕ, deg	12.2	17.1
Tan(ϕ)	0.22	0.31



Sample No.		1	2	3	4
Initial	Water Content, %	11.0	11.4	11.4	10.9
	Dry Density, pcf	113.4	113.4	112.8	113.6
	Saturation, %	64.9	67.3	66.1	64.8
	Void Ratio	0.4424	0.4422	0.4501	0.4399
	Diameter, in.	2.80	2.80	2.80	2.80
	Height, in.	6.00	6.00	6.00	6.00
At Test	Water Content, %	15.6	14.4	13.6	14.6
	Dry Density, pcf	116.1	118.8	120.5	118.2
	Saturation, %	100.0	99.8	99.9	99.9
	Void Ratio	0.4094	0.3773	0.3568	0.3833
	Diameter, in.	2.77	2.74	2.71	2.74
	Height, in.	6.00	6.00	6.00	6.00
Strain rate, in./min.		0.01	0.01	0.01	0.00
Back Pressure, psi		73.60	75.60	74.50	84.50
Cell Pressure, psi		84.30	95.60	116.90	101.80
Fail. Stress, psf		1321	1949	3698	1642
Total Pore Pr., psf		11664	12067	13421	13579
Ult. Stress, psf		1389	1981	3725	1950
Total Pore Pr., psf		11693	13046	15494	14069
$\bar{\sigma}_1$ Failure, psf		1796	3648	7111	2722
$\bar{\sigma}_3$ Failure, psf		475	1699	3413	1080

Type of Test:
CU with Pore Pressures

Sample Type:

Description: sandy lean clay with gravel

LL= 35 **PL=** 15 **PI=** 20

Specific Gravity= 2.62

Remarks: Classification is based on 3/4" minus material that was used to remold the sample for testing

Figure _____

Client: Montana DEQ (c/o Herrera/Trihydro)

Project: Black Pine Mine

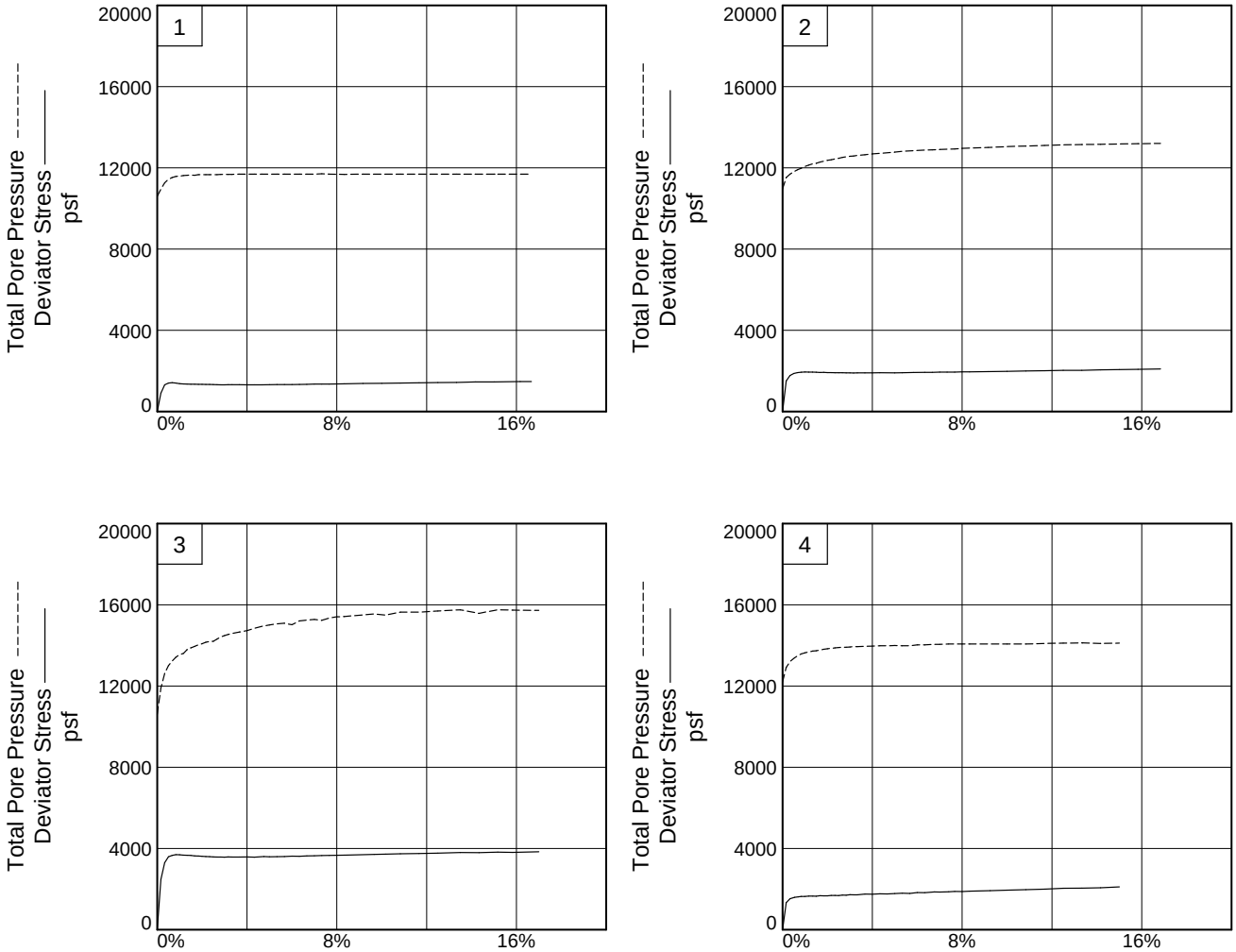
Source of Sample: RY-SS-10 **Depth:** 14-16'

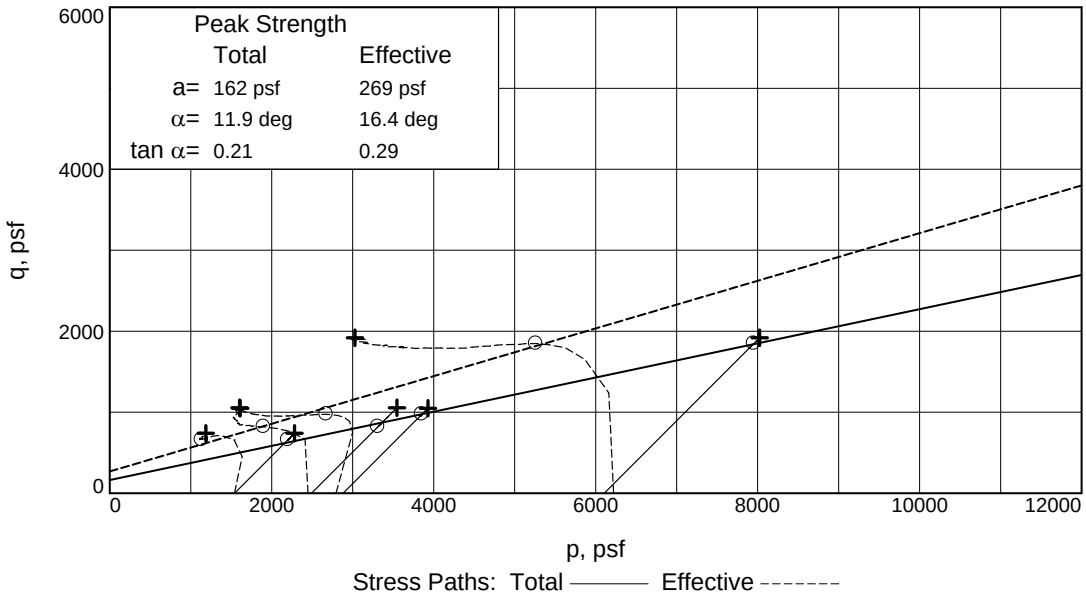
Sample Number: S-3 (#13273)

Proj. No.: 16694 **Date Sampled:**

TRIAXIAL SHEAR TEST REPORT
Pioneer Technical Services, Inc.
106 Pronghorn Trail, Suite A - Bozeman, MT 59718

Tested By: NKG





Client: Montana DEQ (c/o Herrera/Trihydro)
Project: Black Pine Mine
Source of Sample: RY-SS-10 **Depth:** 14-16' **Sample Number:** S-3 (#13273)
Project No.: 16694 **Figure** _____

Pioneer Technical Services, Inc.

Tested By: NKG

HYDRAULIC CONDUCTIVITY FOR FLEXIBLE-WALLED TEST SAMPLES
FALLING HEAD APPARATUS, ASTM D5084

Client:	TriHydro						**Project:**	Black Pine Mine			
Sample Description:	RY-SS-10 S-3 14-16'		At 1500 psf								
		Panel #	2								
Test Specimen											
Dry Density (pcf):		115.9									
% Max. ASTM D-698:		95%									
Specimen Length (cm):		15.24									
Specimen Diameter (cm):		7.112									
				Testing Equipment							
				Height Inlet Above Floor (cm):							
				Height Outlet Above Bench (cm):		21.9					
				Area of Standpipe (cm^2):		0.912					

Increment Number	Initial Reading Influent (cm^3)	Inital Reading Effluent (cm^3)	Final Reading Influent (cm^3)	Final Reading Effluent (cm^3)	Time Increment (min.)	Applied Pressure Differential (psi)	Initial Head (cm)	Final Head (cm)	Average Hydraulic Gradient (cm/cm)	Hydraulic Conductivity (cm/sec)	Hydraulic Conductivity at 20 C (cm/sec)
1	0.5	46.4	41	5.8	412	3.1	268.24	179.35	14.68	2.8E-06	2.7E-06
2	0.3	46.2	28.3	18.2	282	3.0	261.21	199.83	15.13	2.8E-06	2.7E-06
3	0.4	46.2	29.7	16.7	296	3.1	268.13	203.68	15.48	2.7E-06	2.6E-06
4	0.3	47.2	31.1	15.7	332	3.0	262.30	194.02	14.97	2.6E-06	2.5E-06
12	0.2	46.8	20.4	26.5	198	3.5	297.12	252.74	18.04	2.4E-06	2.3E-06
13	0.4	45.3	20.8	24.8	201	3.1	267.14	222.31	16.06	2.7E-06	2.5E-06
14											
15											
16											
17											
18											
19											
20	**Average Hydraulic Conductivity of Last Four Test Increments =**							**2.5E-06**	**cm/sec**		
21											
22											
23											
24											
25											

k = (aL/At) ln (h1/h2)

Water Content Before Test		Water Content After Test	
Tare #		Tare #	
Wet Soil + Tare (grams)	1220.30	Wet Soil + Tare (grams)	1381.70
Dry Soil + Tare (grams)	1099.73	Dry Soil + Tare (grams)	1209.80
Tare Weight (grams)	0.00	Tare Weight (grams)	110.07
Water Content (%)	10.96	Water Content (%)	15.63
Source	Specimen	Source	Specimen

HYDRAULIC CONDUCTIVITY FOR FLEXIBLE-WALLED TEST SAMPLES
FALLING HEAD APPARATUS, ASTM D5084

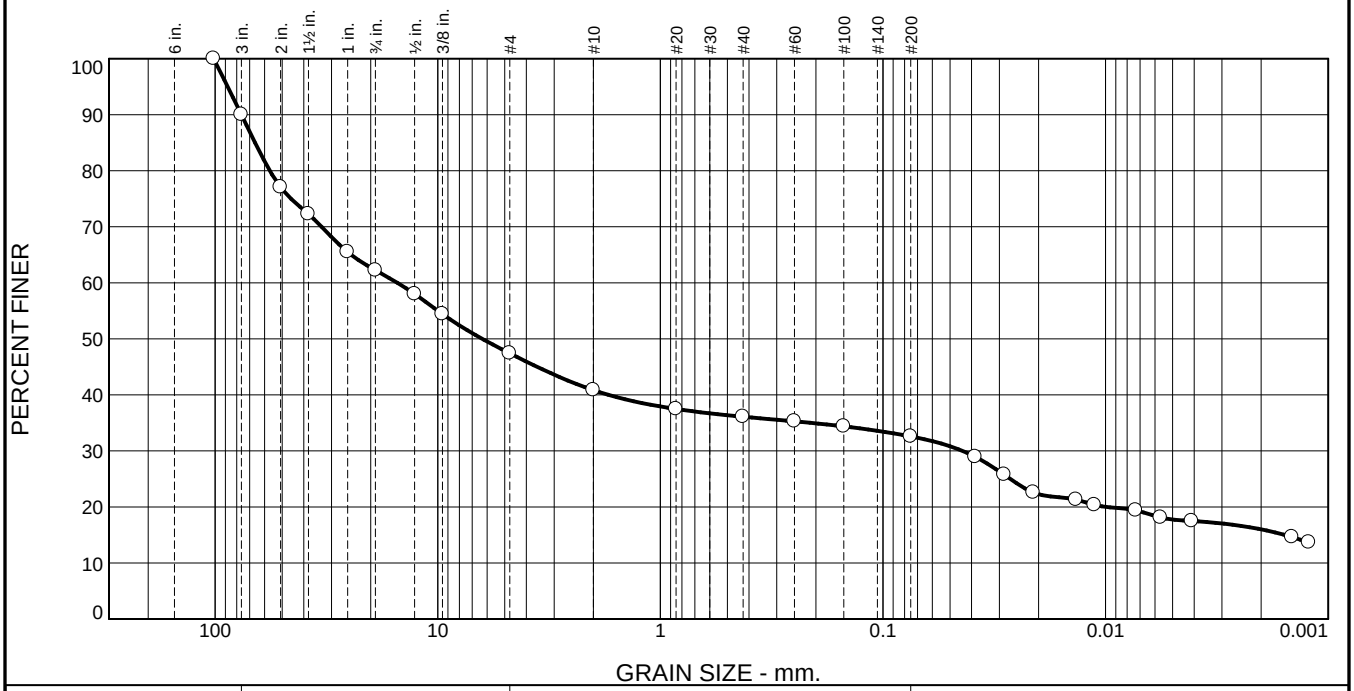
Client:	TriHydro						**Project:**	Black Pine Mine			
Sample Description:	RY-SS-10 S-3 14-16' at 6000psf										
		Panel #	5								
Test Specimen											
Dry Density (pcf):		115.1									
% Max. ASTM D-698:		95%									
Specimen Length (cm):		15.24									
Specimen Diameter (cm):		7.112									
				Testing Equipment							
				Height Inlet Above Floor (cm):							
				Height Outlet Above Bench (cm):		21.9					
				Area of Standpipe (cm^2):		0.912					

Increment Number	Initial Reading Influent (cm^3)	Inital Reading Effluent (cm^3)	Final Reading Influent (cm^3)	Final Reading Effluent (cm^3)	Time Increment (min.)	Applied Pressure Differential (psi)	Initial Head (cm)	Final Head (cm)	Average Hydraulic Gradient (cm/cm)	Hydraulic Conductivity (cm/sec)	Hydraulic Conductivity at 20 C (cm/sec)
1	0.1	42	0.7	41.9	327	2.5	221.67	220.91	14.52	3.1E-08	2.9E-08
2	0.7	41.9	3	41.6	1487	3.0	256.06	253.21	16.71	2.2E-08	2.2E-08
3	3	41.6	6.6	41.5	2400	3.0	253.21	249.15	16.48	2.0E-08	2.0E-08
4	6.6	41.5	13.1	41.1	4316	3.2	263.21	255.65	17.02	2.0E-08	2.0E-08
12	13.1	41.1	15	40.95	1380	3.2	255.65	253.40	16.70	1.9E-08	1.9E-08
13											
14											
15											
16											
17											
18											
19											
20	**Average Hydraulic Conductivity of Last Four Test Increments =**							**2.0E-08**	**cm/sec**		
21											
22											
23											
24											
25											

k = (aL/At) ln (h1/h2)

Water Content Before Test		Water Content After Test	
Tare #		Tare #	
Wet Soil + Tare (grams)	1218.10	Wet Soil + Tare (grams)	1353.40
Dry Soil + Tare (grams)	1093.73	Dry Soil + Tare (grams)	1204.60
Tare Weight (grams)	0.00	Tare Weight (grams)	110.87
Water Content (%)	11.37	Water Content (%)	13.60
Source	Specimen	Source	Specimen

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
10	28	15	6	5	3	15	18

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
4"	100		
3"	90		
2"	77		
1.5"	72		
1"	65		
3/4"	62		
1/2"	58		
3/8"	54		
#4	47		
#10	41		
#20	37		
#40	36		
#60	35		
#100	34		
#200	33		
0.0385 mm.	29		
0.0285 mm.	26		
0.0211 mm.	23		
0.0136 mm.	21		
0.0112 mm.	20		
0.0073 mm.	19		
0.0057 mm.	18		
0.0041 mm.	17		
0.0015 mm.	15		
0.0012 mm.	14		

* (no specification provided)

Material Description

clayey gravel with sand

Atterberg Limits (ASTM D 4318)

PL= 15 **LL=** 35 **PI=** 20

Classification

USCS (D 2487)= GC **AASHTO (M 145)=** A-6(3)

Coefficients

D_{90}= 76.1710 D_{85}= 66.1929 D_{60}= 15.2049
D_{50}= 6.3088 D_{30}= 0.0439 D_{15}= 0.0016
D_{10}= C_u= C_c=

Remarks

Date Received: **Date Tested:** 10-08-12

Tested By: NKG/LS

Checked By: NKG

Title:

Source of Sample: RY-SS-10 **Depth:** 14-16' **Date Sampled:**
Sample Number: S-3 (#13273)

Pioneer Technical Services, Inc.

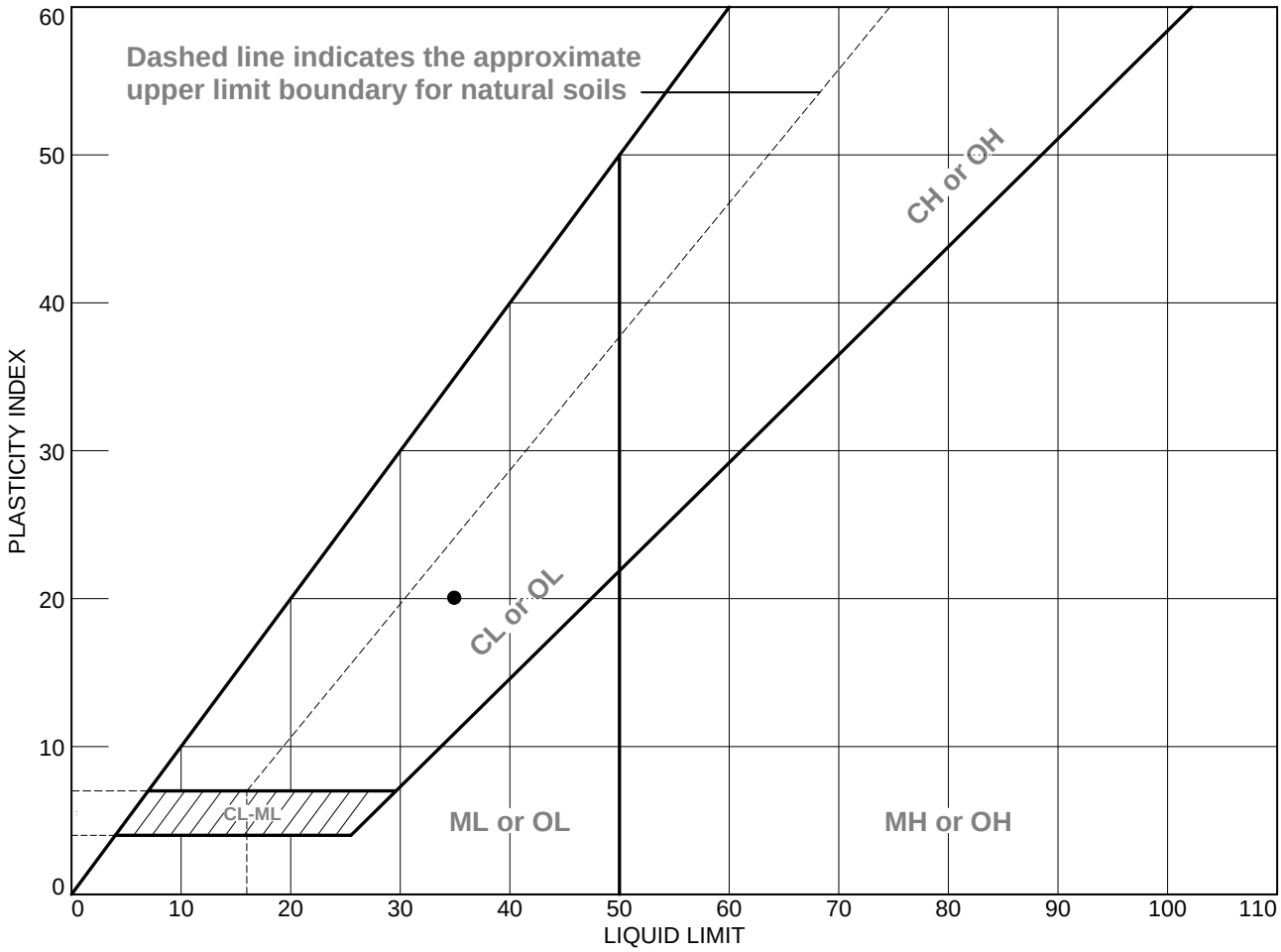
1215 Apple's Way - Belgrade, MT 59714

Ph. 406-388-8578 - Fax 406-388-8579

Client: Montana DEQ (c/o Herrera/Trihydro)
Project: Black Pine Mine

Project No: 16694 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	RY-SS-10	S-3 (#13273)	14-16'		15	35	20	GC

Pioneer Technical Services, Inc.

1215 Apple's Way - Belgrade, MT 59714

Ph. 406-388-8578 - Fax 406-388-8579

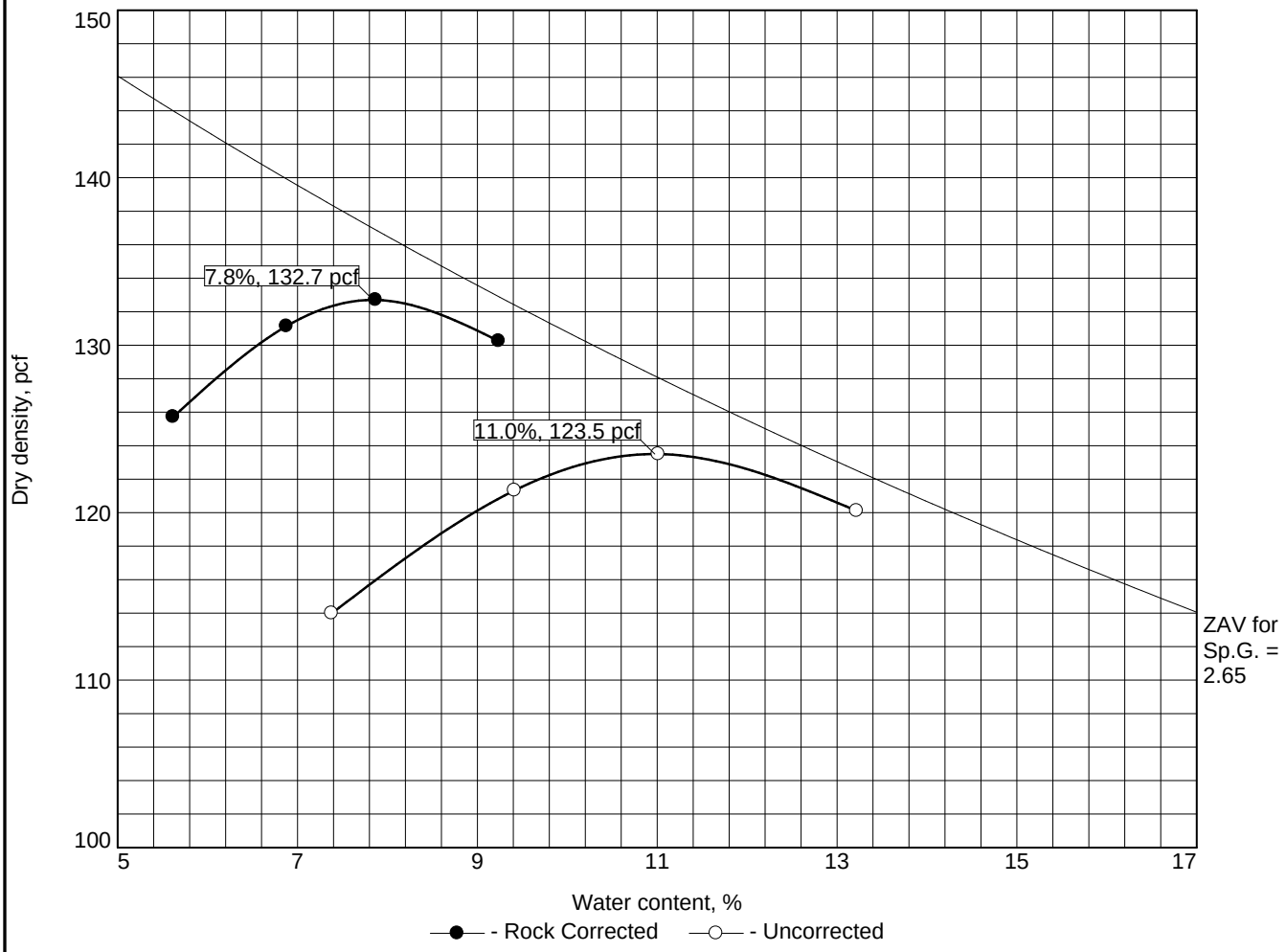
Client: Montana DEQ (c/o Herrera/Trihydro)

Project: Black Pine Mine

Project No.: 16694 **Figure**

Tested By: LS **Checked By:** NG

COMPACTION TEST REPORT



Test specification: ASTM D 698-07 Method C Standard
ASTM D 4718-87 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
14-16'	GC	A-6(3)		2.42	35	20	38	33

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 132.7 pcf	123.5 pcf	clayey gravel with sand
Optimum moisture = 7.8 %	11.0 %	

Project No. 16694 **Client:** Montana DEQ (c/o Herrera/Trihydro)
Project: Black Pine Mine

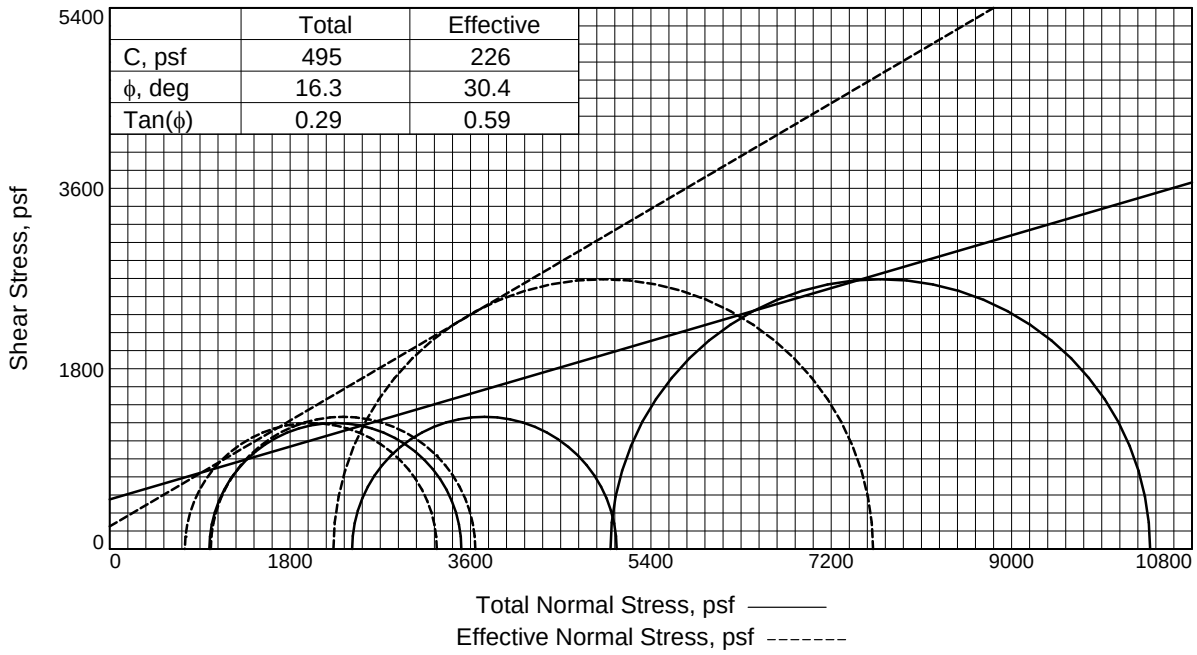
○**Source of Sample:** RY-SS-10 **Sample Number:** S-3 (#13273)

Remarks:

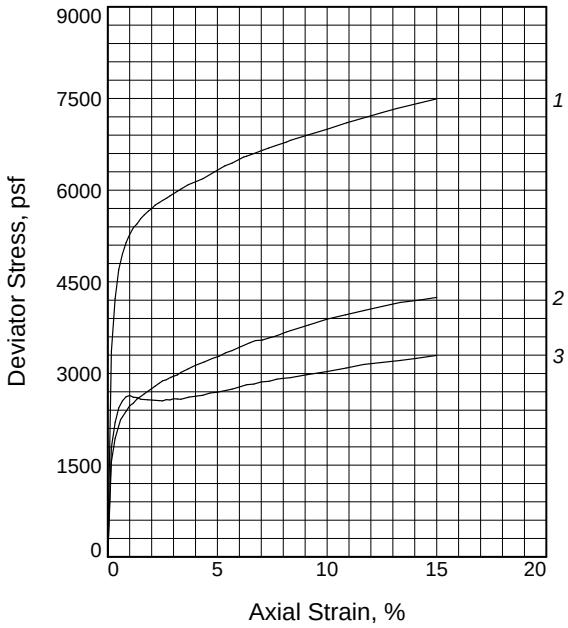
Pioneer Technical Services, Inc.
1215 Apple's Way - Belgrade, MT 59714
Ph. 406-388-8578 - Fax 406-388-8579

Figure

Tested By: NKG



	Total	Effective
C, psf	495	226
ϕ, deg	16.3	30.4
Tan(ϕ)	0.29	0.59



Sample No.		1	2	3
Initial	Water Content, %	12.7	12.7	12.8
	Dry Density, pcf	110.7	110.9	110.0
	Saturation, %	65.6	65.8	65.0
	Void Ratio	0.5223	0.5198	0.5329
	Diameter, in.	2.80	2.80	2.80
	Height, in.	6.00	6.00	6.00
At Test	Water Content, %	16.5	17.1	17.9
	Dry Density, pcf	114.7	113.9	114.0
	Saturation, %	95.1	96.4	100.7
	Void Ratio	0.4700	0.4804	0.4789
	Diameter, in.	2.75	2.76	2.75
	Height, in.	6.00	6.00	6.00
Strain rate, in./min.		0.00	0.00	0.00
Eff. Cell Pressure, psi		34.70	6.90	16.80
Fail. Stress, psf		5385	2515	2640
Total Pore Pr., psf		13248	11419	11966
Strain, %		1.2	1.2	1.0
Ult. Stress, psf		7493	4245	3296
Total Pore Pr., psf		12586	10627	11779
Strain, %		15.0	15.0	15.0
$\bar{\sigma}_1$ Failure, psf		7617	3264	3648
$\bar{\sigma}_3$ Failure, psf		2232	749	1008

Type of Test:
CU with Pore Pressures

Sample Type:

Description: clayey sand with gravel

LL= 28 **PL=** 17 **PI=** 11

Assumed Specific Gravity= 2.7

Remarks: Classification is based on 3/4" minus material that was used for remolding the sample

Figure _____

Client: Montana DEQ (c/o Herrera/Trihydro)

Project: Black Pine Mine

Source of Sample: RY-SS-11 **Depth:** 6-8'

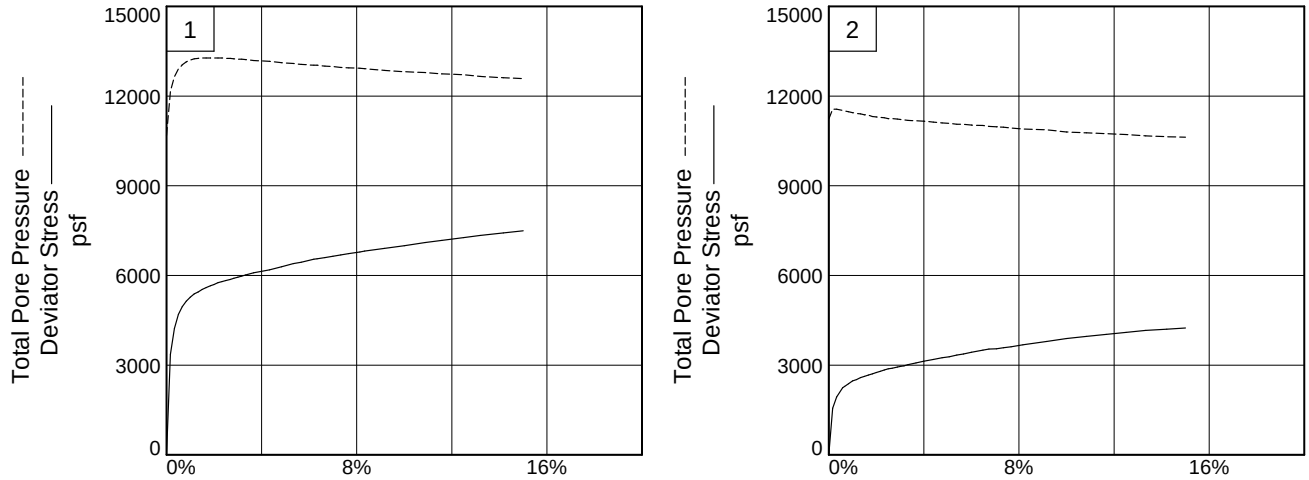
Sample Number: 13777

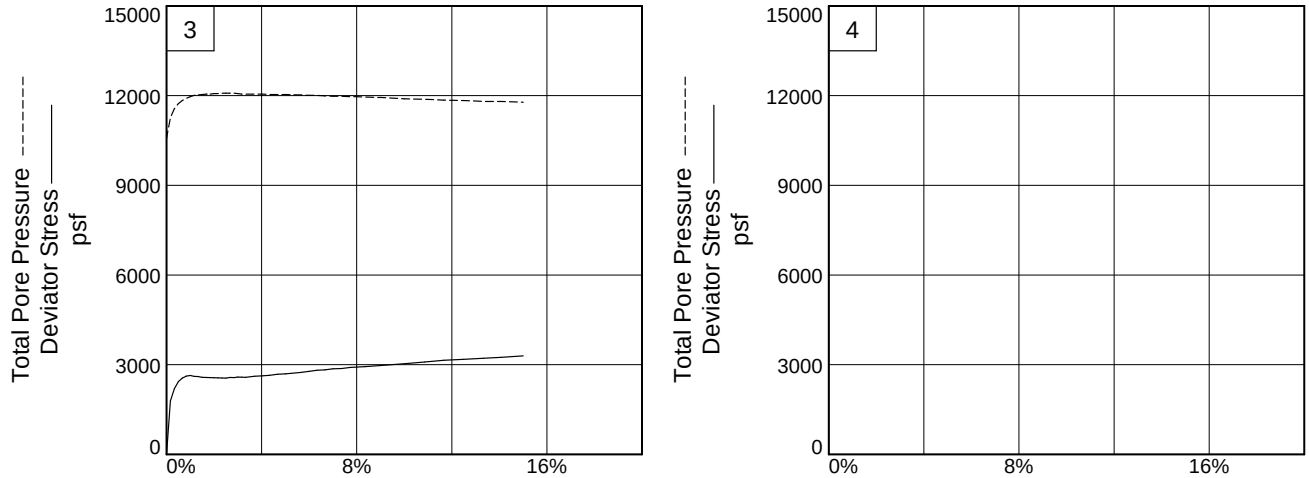
Proj. No.: 16694 **Date Sampled:**

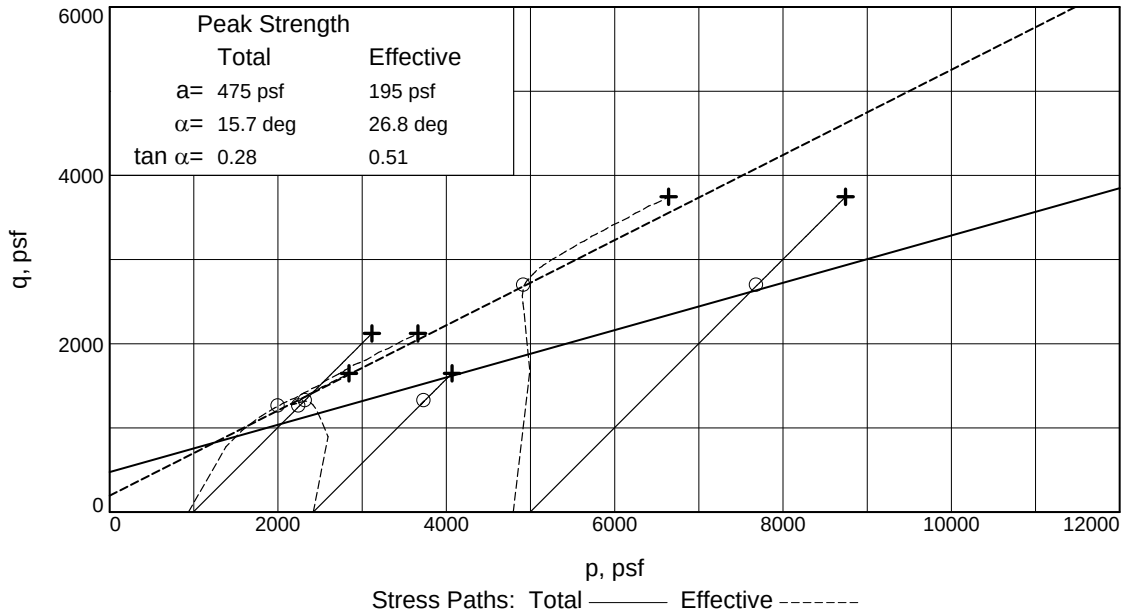
TRIAXIAL SHEAR TEST REPORT

Pioneer Technical Services, Inc.

106 Pronghorn Trail, Suite A - Bozeman, MT 59718







Client: Montana DEQ (c/o Herrera/Trihydro)

Project: Black Pine Mine

Source of Sample: RY-SS-11 **Depth:** 6-8' **Sample Number:** 13777

Project No.: 16694 **Figure** _____

Pioneer Technical Services, Inc.

HYDRAULIC CONDUCTIVITY FOR FLEXIBLE-WALLED TEST SAMPLES
FALLING HEAD APPARATUS, ASTM D5084

Client:	TriHydro						**Project:**	Black Pine Mine			
Sample Description:	RY-SS-11 (6-8')		At 1000 psf								
		Panel #	5								
Test Specimen											
Dry Density (pcf):		110.9									
% Max. ASTM D-698:		95%									
Specimen Length (cm):		15.24									
Specimen Diameter (cm):		7.112									
				Testing Equipment							
				Height Inlet Above Floor (cm):							
				Height Outlet Above Bench (cm):		21.9					
				Area of Standpipe (cm^2):		0.912					

Increment Number	Initial Reading Influent (cm^3)	Inital Reading Effluent (cm^3)	Final Reading Influent (cm^3)	Final Reading Effluent (cm^3)	Time Increment (min.)	Applied Pressure Differential (psi)	Initial Head (cm)	Final Head (cm)	Average Hydraulic Gradient (cm/cm)	Hydraulic Conductivity (cm/sec)	Hydraulic Conductivity at 20 C (cm/sec)
1	0.9	48.8	30.8	19.1	1312	3.0	263.40	198.08	15.14	6.3E-07	6.3E-07
2	30.8	19.1	46.2	3.8	1195	3.0	198.08	164.43	11.89	4.5E-07	4.5E-07
3	0.2	48.9	25.4	23.5	1415	3.0	264.28	208.82	15.52	4.9E-07	4.9E-07
4	25.4	23.5	32.5	16.5	501	2.9	201.79	186.33	12.73	4.6E-07	4.5E-07
12	0.1	49.1	16.5	32.6	993	2.9	257.57	221.52	15.72	4.4E-07	4.4E-07
13											
14											
15											
16											
17											
18											
19											
20	**Average Hydraulic Conductivity of Last Four Test Increments =**							**4.6E-07**	**cm/sec**		
21											
22											
23											
24											
25											

k = (aL/At) ln (h1/h2)

Water Content Before Test		Water Content After Test	
Tare #		Tare #	
Wet Soil + Tare (grams)	1211.70	Wet Soil + Tare (grams)	1371.50
Dry Soil + Tare (grams)	1075.53	Dry Soil + Tare (grams)	1187.10
Tare Weight (grams)	0.00	Tare Weight (grams)	111.57
Water Content (%)	12.66	Water Content (%)	17.15
Source	Specimen	Source	Specimen

HYDRAULIC CONDUCTIVITY FOR FLEXIBLE-WALLED TEST SAMPLES
FALLING HEAD APPARATUS, ASTM D5084

Client:	TriHydro						**Project:**	Black Pine Mine			
Sample Description:	RY-SS-11 (6-8')		At 2500 psf								
		Panel #	2								
Test Specimen											
Dry Density (pcf):		110									
% Max. ASTM D-698:		95%									
Specimen Length (cm):		15.24									
Specimen Diameter (cm):		7.112									
				Testing Equipment							
				Height Inlet Above Floor (cm):							
				Height Outlet Above Bench (cm):		21.9					
				Area of Standpipe (cm^2):		0.912					

Increment Number	Initial Reading Influent (cm^3)	Inital Reading Effluent (cm^3)	Final Reading Influent (cm^3)	Final Reading Effluent (cm^3)	Time Increment (min.)	Applied Pressure Differential (psi)	Initial Head (cm)	Final Head (cm)	Average Hydraulic Gradient (cm/cm)	Hydraulic Conductivity (cm/sec)	Hydraulic Conductivity at 20 C (cm/sec)
1	1	43.8	45.3	0	1306	3.1	264.84	168.28	14.21	1.0E-06	9.9E-07
2	0	49	27.1	21.8	710	3.0	264.60	205.09	15.41	1.0E-06	1.0E-06
3	27.2	22.1	36.6	12.5	298	2.9	198.28	177.46	12.33	1.1E-06	1.1E-06
4	0.2	49.4	38.5	10.9	1120	3.0	264.82	180.65	14.62	1.0E-06	1.0E-06

Average Hydraulic Conductivity of Last Four Test Increments = 1.0E-06 cm/sec

k = (aL/At) ln (h1/h2)

Water Content Before Test		Water Content After Test	
Tare #		Tare #	
Wet Soil + Tare (grams)	1203.20	Wet Soil + Tare (grams)	1368.60
Dry Soil + Tare (grams)	1066.38	Dry Soil + Tare (grams)	1178.10
Tare Weight (grams)	0.00	Tare Weight (grams)	111.72
Water Content (%)	12.83	Water Content (%)	17.86
Source	Specimen	Source	Specimen

HYDRAULIC CONDUCTIVITY FOR FLEXIBLE-WALLED TEST SAMPLES
FALLING HEAD APPARATUS, ASTM D5084

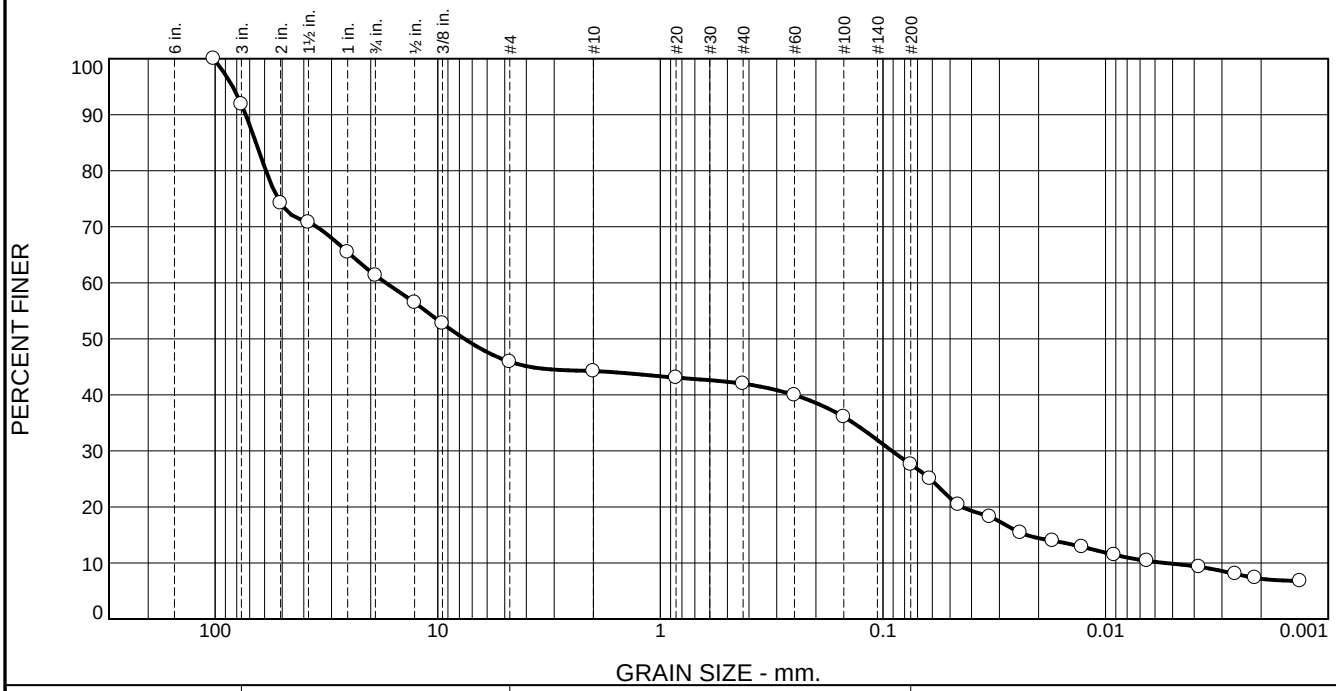
Client:	TriHydro						**Project:**	Black Pine Mine			
Sample Description:	RY-SS-11 (6-8')		At 5000 psf								
		Panel #	2								
Test Specimen											
Dry Density (pcf):		110.7									
% Max. ASTM D-698:		95%									
Specimen Length (cm):		15.24									
Specimen Diameter (cm):		7.112									
				Testing Equipment							
				Height Inlet Above Floor (cm):							
				Height Outlet Above Bench (cm):		21.9					
				Area of Standpipe (cm^2):		0.912					

Increment Number	Initial Reading Influent (cm^3)	Inital Reading Effluent (cm^3)	Final Reading Influent (cm^3)	Final Reading Effluent (cm^3)	Time Increment (min.)	Applied Pressure Differential (psi)	Initial Head (cm)	Final Head (cm)	Average Hydraulic Gradient (cm/cm)	Hydraulic Conductivity (cm/sec)	Hydraulic Conductivity at 20 C (cm/sec)
1	0.4	41.95	11	31.4	1309	2.7	235.35	212.17	14.68	2.3E-07	2.3E-07
2	11	31.4	21.9	20.6	1658	2.8	219.20	195.42	13.60	2.0E-07	2.0E-07
3	21.9	20.6	28	13.8	1197	2.8	195.42	181.28	12.36	1.8E-07	1.8E-07
4	28	36.6	13.8	6.1	1432	2.9	213.30	195.43	13.41	1.8E-07	1.8E-07
12	0.2	48.9	11.1	37.7	1406	2.8	250.22	225.99	15.62	2.1E-07	2.1E-07
13	0.4										
14											
15											
16											
17											
18											
19											
20	**Average Hydraulic Conductivity of Last Four Test Increments =**							**1.9E-07**	**cm/sec**		
21											
22											
23											
24											
25											

k = (aL/At) ln (h1/h2)

Water Content Before Test		Water Content After Test	
Tare #		Tare #	
Wet Soil + Tare (grams)	1210.10	Wet Soil + Tare (grams)	1362.80
Dry Soil + Tare (grams)	1073.82	Dry Soil + Tare (grams)	1185.10
Tare Weight (grams)	0.00	Tare Weight (grams)	111.28
Water Content (%)	12.69	Water Content (%)	16.55
Source	Specimen	Source	Specimen

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
8	31	15	2	2	14	18	10

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
4	100		
3	92		
2	74		
1.5	71		
1	65		
.75	61		
.5	56		
.375	53		
#4	46		
#10	44		
#20	43		
#40	42		
#60	40		
#100	36		
#200	28		
0.0616 mm.	25		
0.0459 mm.	20		
0.0332 mm.	18		
0.0241 mm.	15		
0.0173 mm.	14		
0.0128 mm.	13		
0.0091 mm.	11		
0.0065 mm.	10		
0.0038 mm.	9.3		
0.0026 mm.	8.1		
0.0021 mm.	7.3		
0.0013 mm.	6.8		

* (no specification provided)

Material Description

clayey gravel with sand

Atterberg Limits (ASTM D 4318)

PL= 17 **LL=** 28 **PI=** 11

Classification

USCS (D 2487)= GC **AASHTO (M 145)=** A-2-6(0)

Coefficients

D_{90}= 72.8571 D_{85}= 65.5700 D_{60}= 17.1205
D_{50}= 7.5867 D_{30}= 0.0911 D_{15}= 0.0227
D_{10}= 0.0054 C_u= 3186.58 C_c= 0.09

Remarks

Date Received: **Date Tested:**

Tested By: LS/NG

Checked By: NG

Title:

Source of Sample: RY-SS-11 **Depth:** 6-8' **Date Sampled:**
Sample Number: 13777

Pioneer Technical Services, Inc.

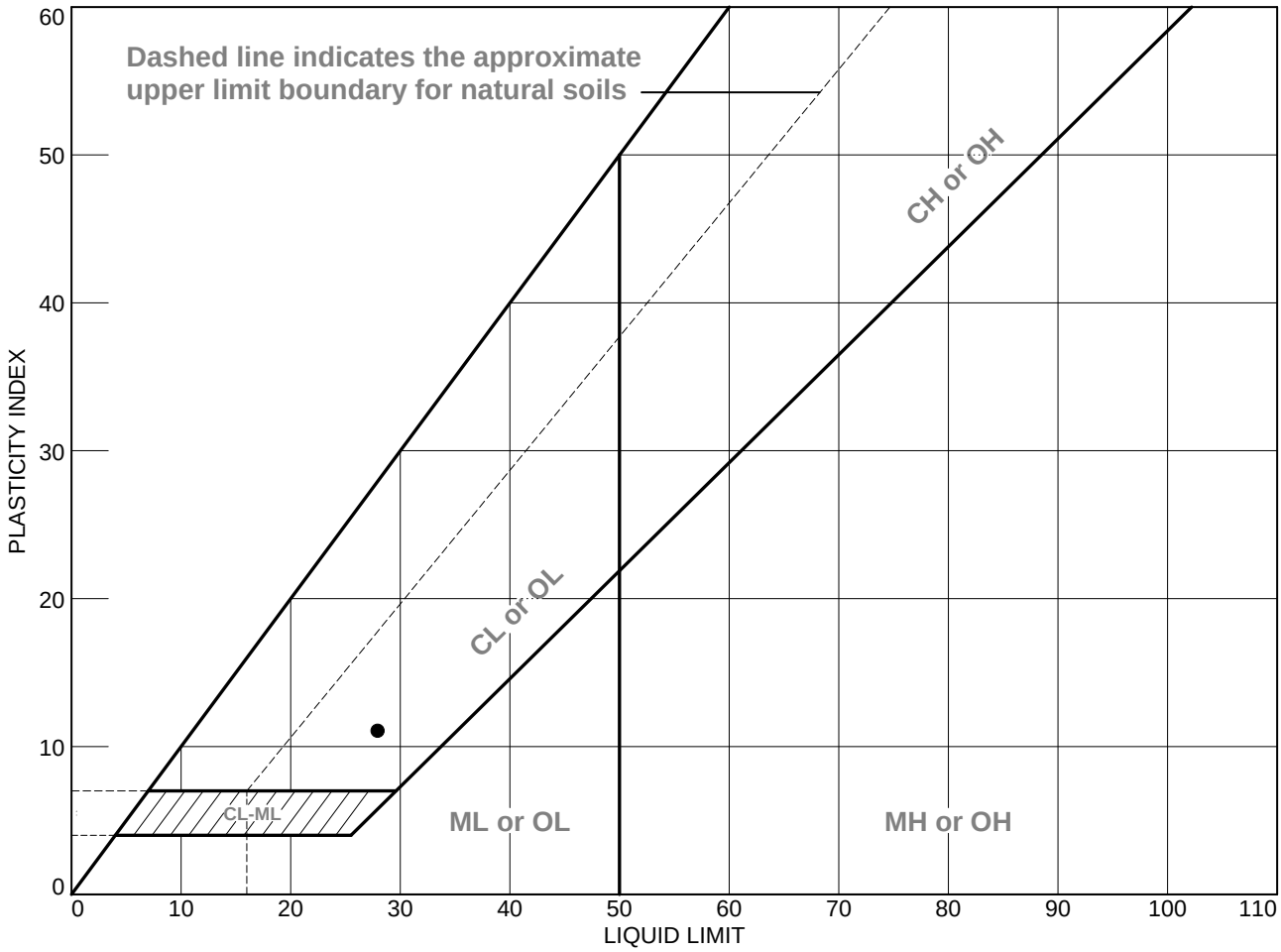
1215 Apple's Way - Belgrade, MT 59714

Ph. 406-388-8578 - Fax 406-388-8579

Client: Montana DEQ (c/o Herrera/Trihydro)
Project: Black Pine Mine

Project No: 16694 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	RY-SS-11	13777	6-8'		17	28	11	GC

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1215 Apple's Way - Belgrade, MT 59714

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Client: Montana DEQ (c/o Herrera/Trihydro)

Project: Black Pine Mine

Project No.: 16694

Figure

Tested By: LS

Specific Gravity of Soils

Specific Gravity of (-) #10 Fraction

Project: Black Pine Mine
Client: Montana DEQ (c/o Herrera/Trihydro)
Date: 10/11/2012
Tested By: LS

Sample I.D.	Depth (ft)	Specific Gravity
RY-SS-10	14.0-16.0	2.62

Moisture Analysis-AASHTO T265; ASTM D2216

Project Black Pine Mine
Client: Montana DEQ (c/o Herrera/Trihydro)
Date: 10/8/12 - 1/15/13
Tested By: LS/NG

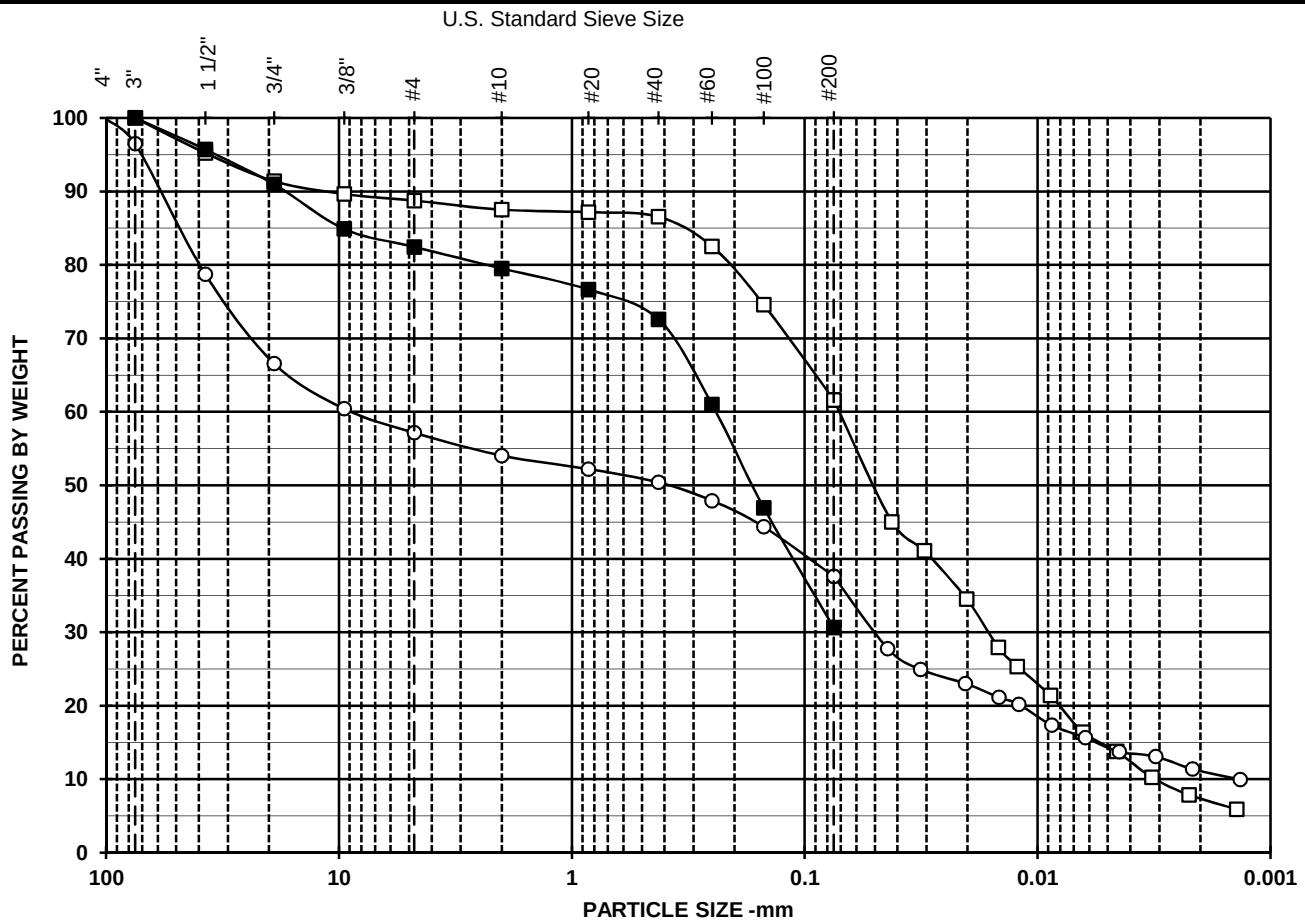
Sample I.D.	Depth (ft)	Moisture Content (%)
RY-SS-07	5.0-13.0	**8**
RY-SS-10	14.0-16.0	**7**
RY-SS-06	4.0-7.0	**9**
RY-SS-11	6.0-8.0	**11**

Pioneer Technical Services
Black Pine Mine
LABORATORY TESTING DATA SUMMARY

BORING NO.	SAMPLE NO.	DEPTH (ft)	IDENTIFICATION TESTS							COMPACTION							REMARKS
			WATER CONTENT (-3/4") (%)	LIQUID LIMIT (-)	PLASTIC LIMIT (-)	PLAS. INDEX (-)	USCS SYMB. (1)	SIEVE MINUS NO. 200 (%)	HYDROMETER % MINUS 2 μm (%)	AASHTO STD.	PREPARATION				AS-COMPACTED		
											wet	dry	-#4	- 3/4	OPT. WATER CONTENT (%)	MAX . DRY UNIT WGT. (pcf)	
CML-GT	01		4.0	23	18	5	CL-ML	61.6	7	T99C	X			X	16.8	107.1	
CML-GT	02	0.5-2.0	5.5				SM	30.6		T99C	X			X	21.4	98.9	
CML-GT	03	2-3	7.1	45	20	25	GC	37.6	11	T99C	X			X	17.6	103.1	excess oversize
CML-GT	04	01	5.1			NP	ML	57.2	8	T99C	X			X	24.4	91.6	
CML-GT	05		15.9														
CML-GT	06	01	5.5			NP	SM	20.2		T99C	X			X	18.0	100.2	
CML-GT	07	2-3	5.9	27	15	12	CL	70.0	11	T99C	X			X	15.6	107.1	
CML-GT	08		60.5														

Note: (1) USCS symbol based on visual observation, Sieve results, and Atterberg limits reported.

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



Symbol	□	■	○
Boring	CML-GT	CML-GT-	CML-GT
Sample	01	02	03
Depth		0.5-2.0	2-3
% +3"	0.0	0.0	3.5
% Gravel	11.3	17.6	39.3
% SAND	27.1	51.8	19.6
%C SAND	1.2	2.9	3.1
%M SAND	1.0	6.9	3.6
%F SAND	24.9	42.0	12.8
% FINES	61.6	30.6	37.6
% -2μ	7		11
D_{100} (mm)	75.00	75.00	101.60
D_{60} (mm)	0.07	0.24	8.88
D_{30} (mm)	0.02		0.05
D_{10} (mm)			
Cc			
Cu			

Particle Size	PERCENT FINER		
(Sieve #)	□	■	○
4"			100.0
3"	100.0	100.0	96.5
1 1/2"	95.2	95.7	78.7
3/4"	91.4	91.0	66.6
3/8"	89.6	84.9	60.4
4	88.7	82.4	57.1
10	87.5	79.5	54.0
20	87.2	76.7	52.2
40	86.5	72.6	50.4
60	82.5	61.0	47.9
100	74.6	46.9	44.3
200	61.6	30.6	37.6

SYMBOL	w (%)	LL	PL	PI	USCS	DESCRIPTION AND REMARKS	Date Tested
□		23	18	5	CL-ML	Yellowish-brown, Sandy silty clay	2/6/2013
■					SM	Brown, Silty sand with gravel	2/6/2013
○		45	20	25	GC	Gray, Clayey gravel with sand	2/6/2013

TerraSense, LLC

8054-13001

Pioneer Technical Services

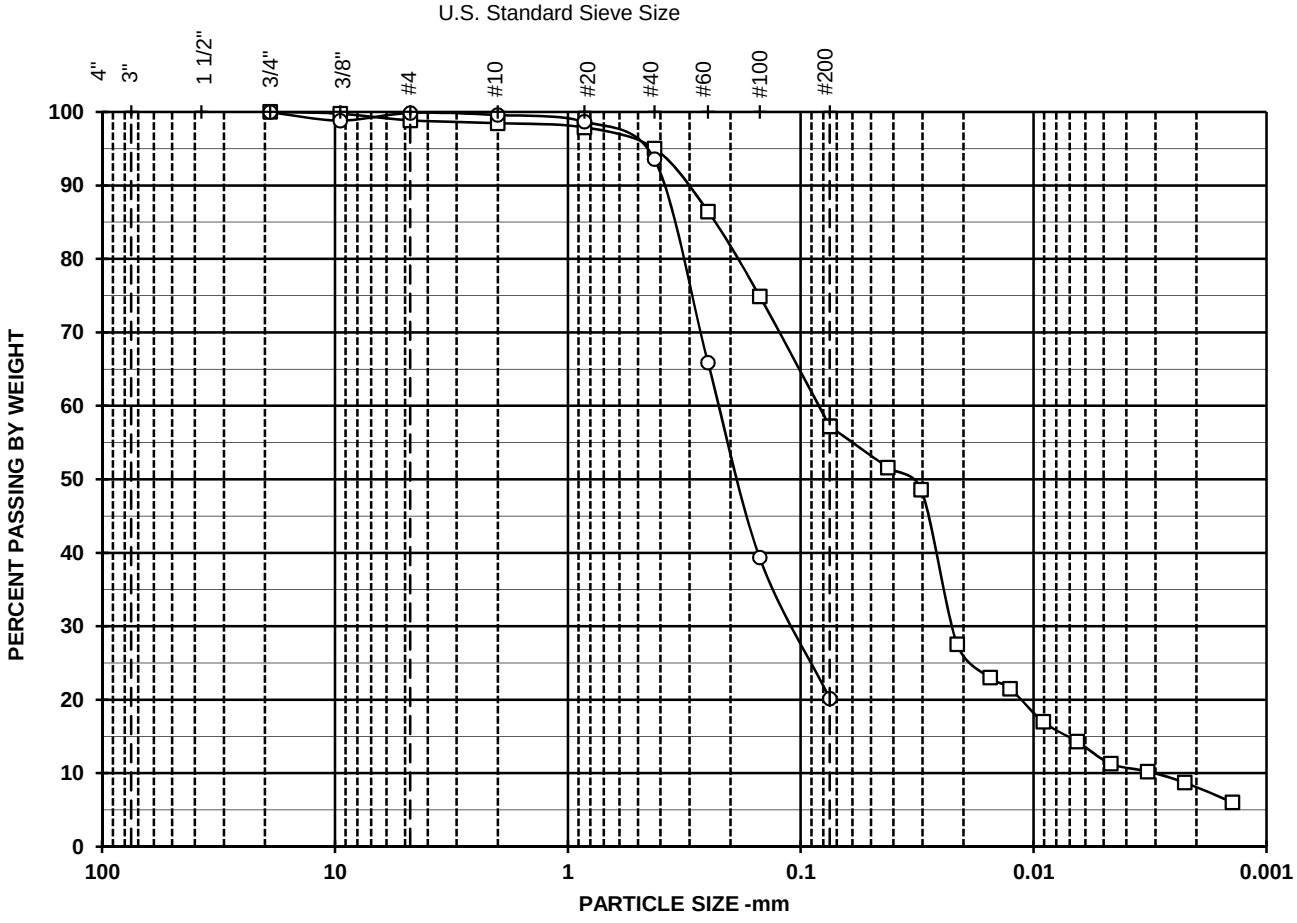
PARTICLE SIZE DISTRIBUTION

Black Pine Mine

Analysis File: 3SV-MasterRev3

siev1a.xls 8/29/2013

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



Symbol	□	■	○
Boring	CML-GT		CML-GT-
Sample	04		06
Depth	0-1		0-1
% +3"	0.0		0.0
% Gravel	1.1		0.1
% SAND	41.7		79.7
%C SAND	0.4		0.3
%M SAND	3.5		6.0
%F SAND	37.8		73.4
% FINES	57.2		20.2
% -2μ	8		
D_{100} (mm)	19.00		37.50
D_{60} (mm)	0.09		0.23
D_{30} (mm)	0.02		0.11
D_{10} (mm)			
Cc			
Cu			

Particle Size	PERCENT FINER		
(Sieve #)	□	■	○
4"			
3"			
1 1/2"			
3/4"	100.0		100.0
3/8"	99.8		98.8
4	98.9		99.9
10	98.5		99.6
20	97.9		98.7
40	95.0		93.6
60	86.4		65.9
100	74.9		39.3
200	57.2		20.2

SYMBOL	w (%)	LL	PL	PI	USCS	DESCRIPTION AND REMARKS	Date Tested
□	5.1	np	np	np	ML	Gray, Sandy silt	2/6/2013
■							
○	5.5	np	np	np	SM	Brown, Silty sand wood chips noted	2/6/2013

TerraSense, LLC | **Pioneer Technical Services**

8054-13001

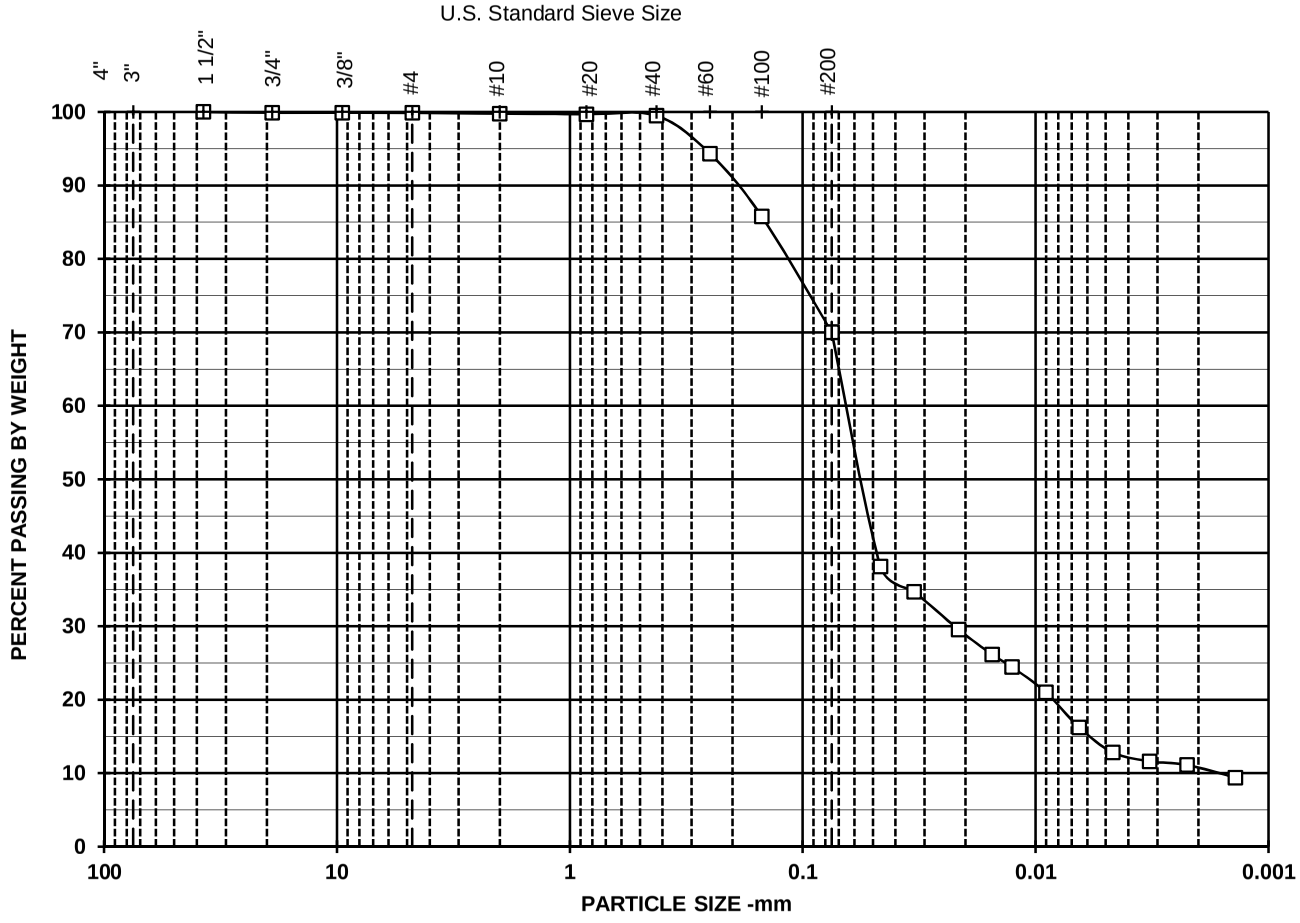
PARTICLE SIZE DISTRIBUTION

Black Pine Mine

Analysis File: 3SV-MasterRev3

siev1b.xls 2/26/2013

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



SYMBOL	w (%)	LL	PL	PI	USCS	DESCRIPTION AND REMARKS	Date Tested
□		27	15	12	CL	Gray, Lean clay with sand	2/6/2013
■							
○							

Symbol	□	■	○
Boring	CML-GT		
Sample	07		
Depth	1.5-2		
% +3"	0.0		
% Gravel	0.1		
% SAND	29.9		
%C SAND	0.1		
%M SAND	0.3		
%F SAND	29.5		
% FINES	70.0		
% -2μ	11		
D_{100} (mm)	37.50		
D_{60} (mm)	0.07		
D_{30} (mm)	0.02		
D_{10} (mm)			
Cc			
Cu			

Particle Size	PERCENT FINER		
(Sieve #)	□	■	○
4"			
3"			
1 1/2"	100.0		
3/4"	99.9		
3/8"	99.9		
4	99.9		
10	99.8		
20	99.7		
40	99.5		
60	94.3		
100	85.8		
200	70.0		

TerraSense, LLC

8054-13001

Pioneer Technical Services

PARTICLE SIZE DISTRIBUTION

Black Pine Mine

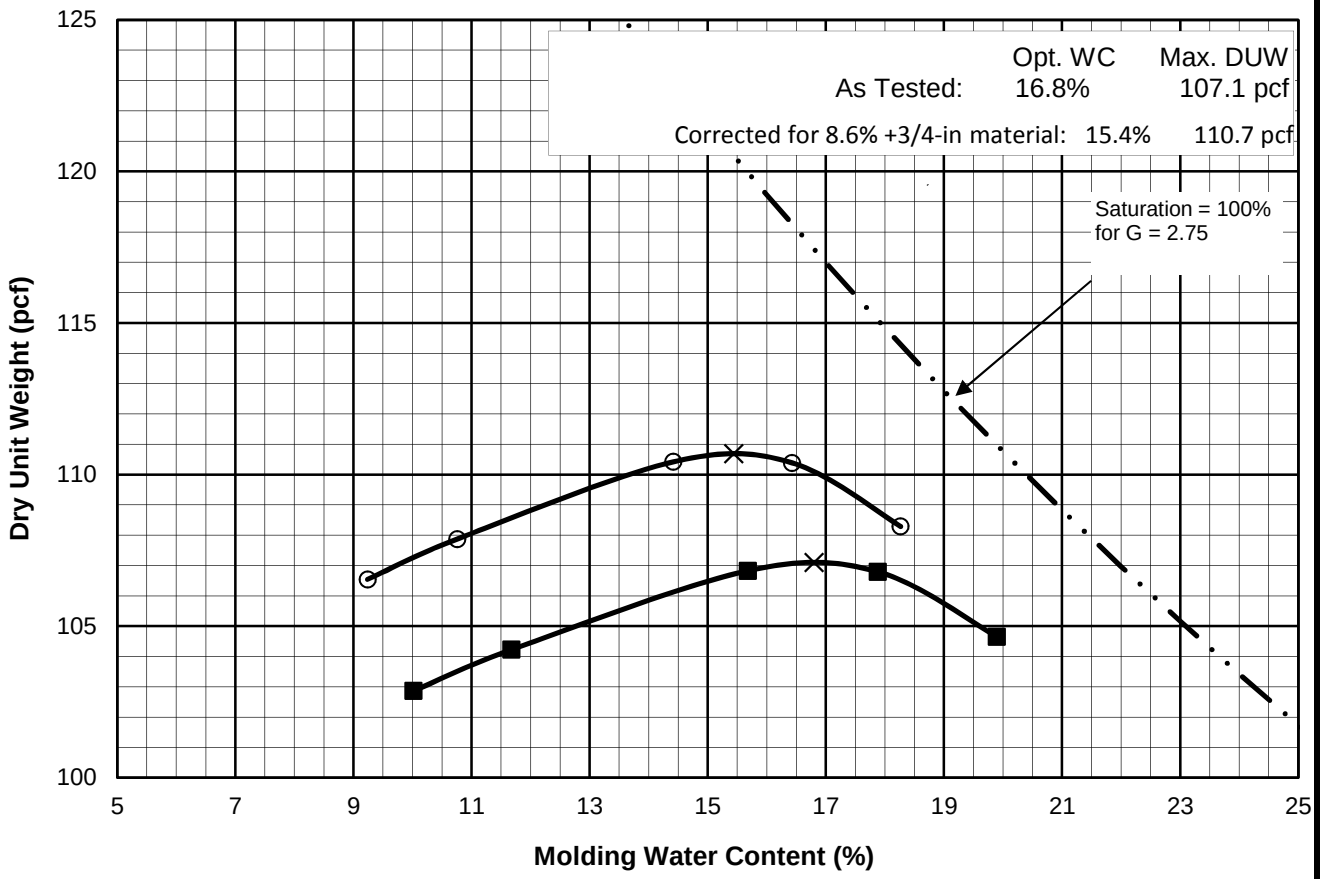
Analysis File: 3SV-MasterRev3

siev1c.xls 2/26/2013

COMPACTION CURVE

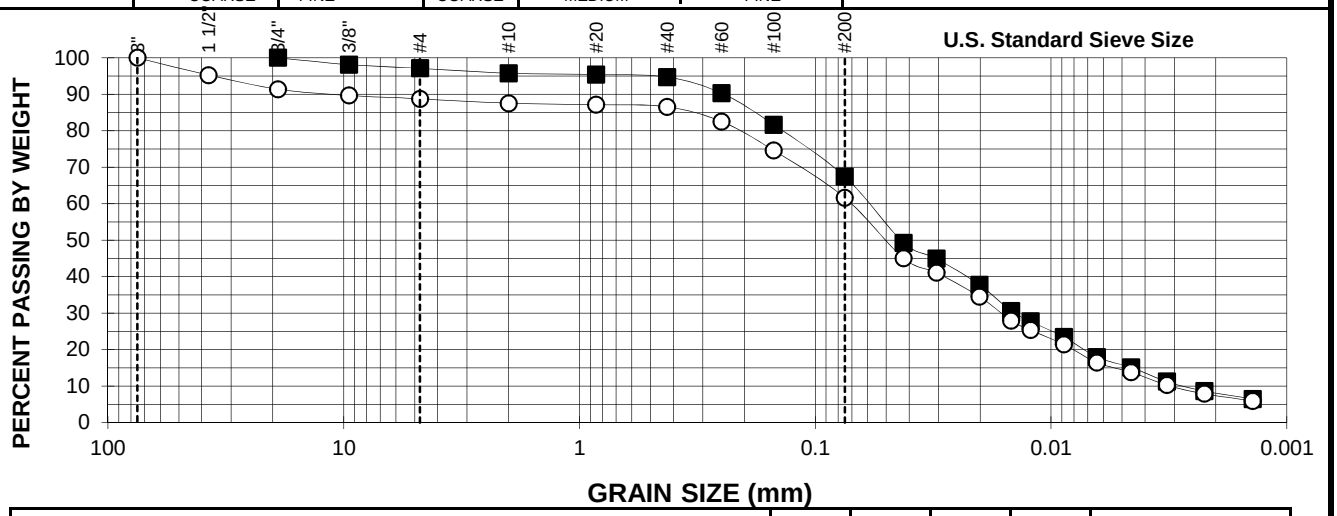
Test Method: AASHTO T99 Compaction Procedure: **C** Specimen Preparation Method: **Moist**

NOTATION: ○ Representative of entire sample ■ Compaction Test specimen X Selected Optimum Point



PARTICLE-SIZE DISTRIBUTION CURVE

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



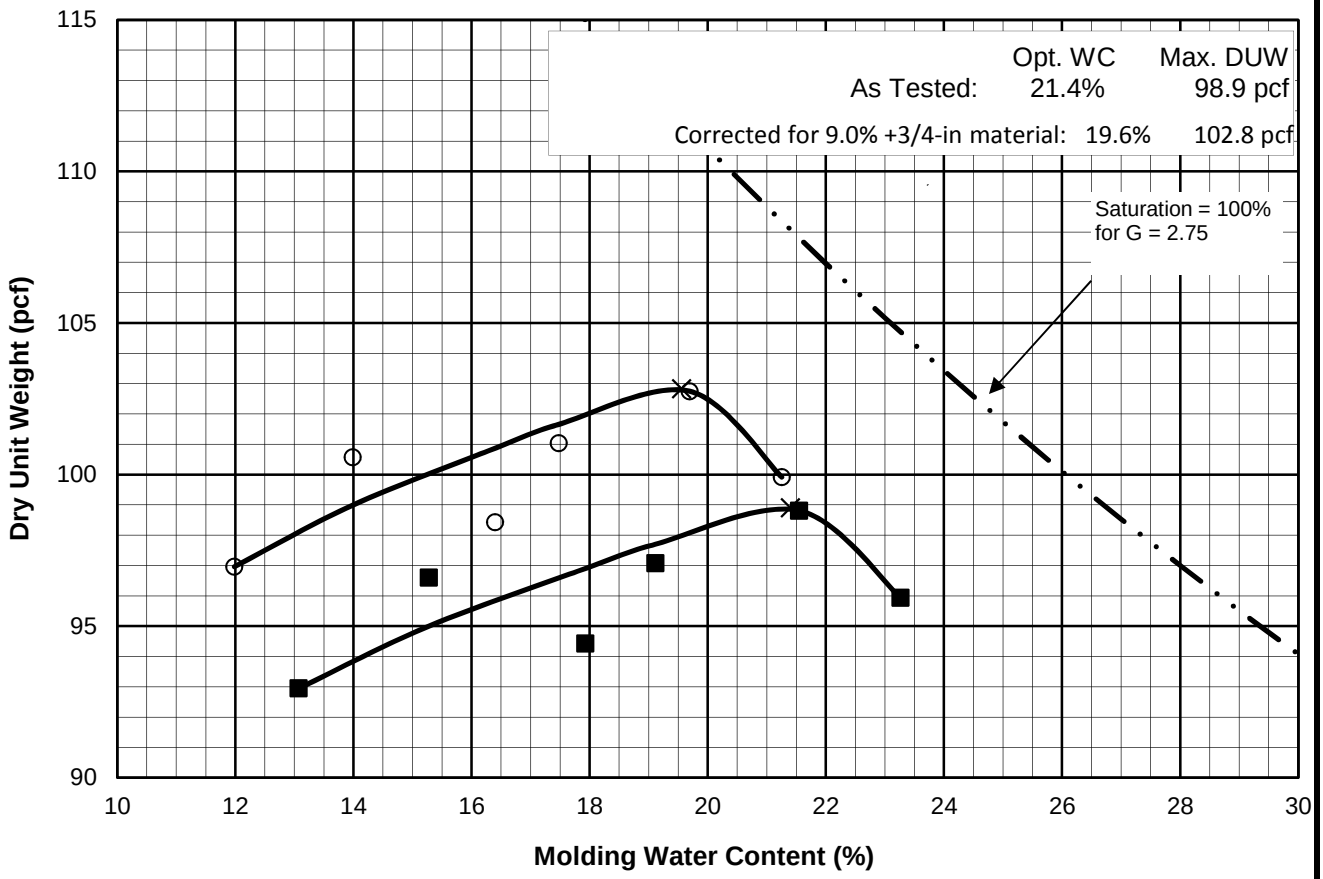
Description and/or Classification	LL	PL	PI	% Fines	Specific Gravity
CL-ML, yellowish-brown, Sandy silty clay	23	18	5	61.6	2.75 (Assumed)

Black Pine Mine		**CML-GT** **SAMPLE: 01**
Pioneer Technical Services		**COMPACTION AND INDEX PROPERTY DATA**
TerraSense, LLC	Project No. 8054-13001	

COMPACTION CURVE

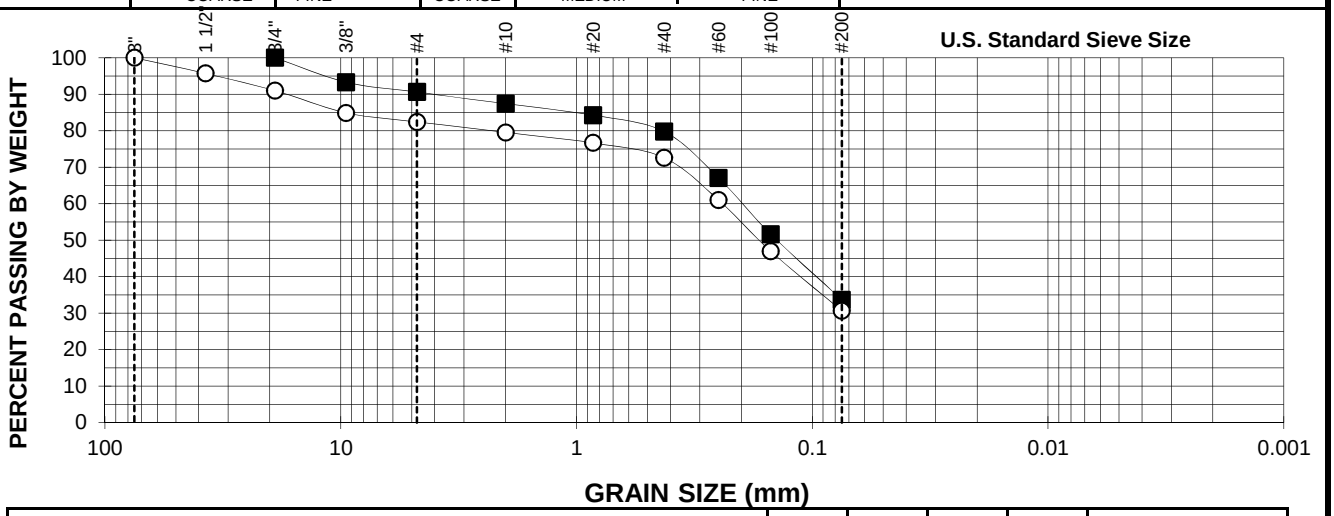
Test Method: AASHTO T99 Compaction Procedure: **C** Specimen Preparation Method: **Moist**

NOTATION: ○ Representative of entire sample ■ Compaction Test specimen X Selected Optimum Point



PARTICLE-SIZE DISTRIBUTION CURVE

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



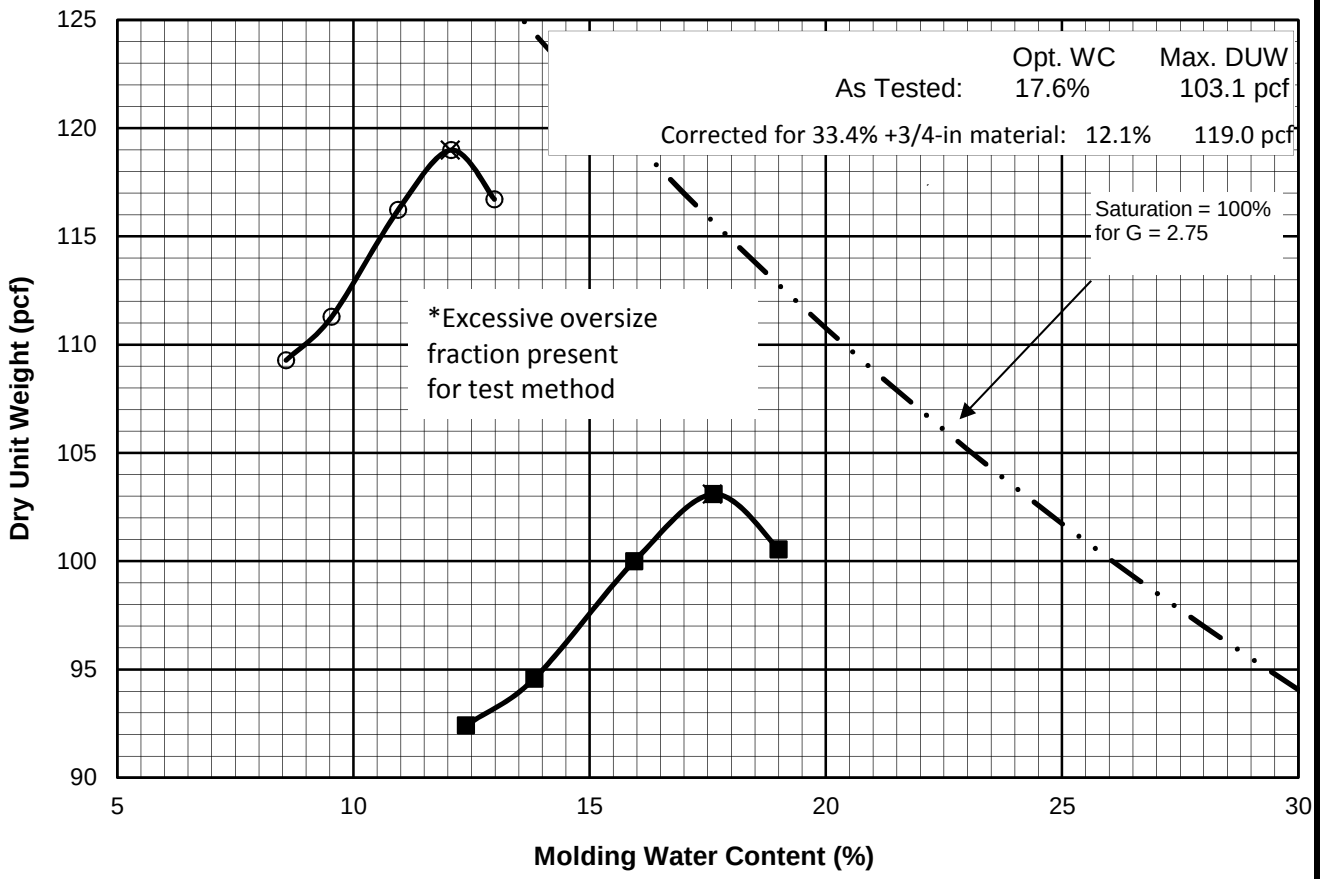
Description and/or Classification	LL	PL	PI	% Fines	Specific Gravity
SM, brown, Silty sand with gravel				30.6	2.75 (Assumed)

Black Pine Mine		**CML-GT** **SAMPLE: 02**
Pioneer Technical Services		**COMPACTION AND INDEX PROPERTY DATA**
TerraSense, LLC	Project No. 8054-13001	

COMPACTION CURVE

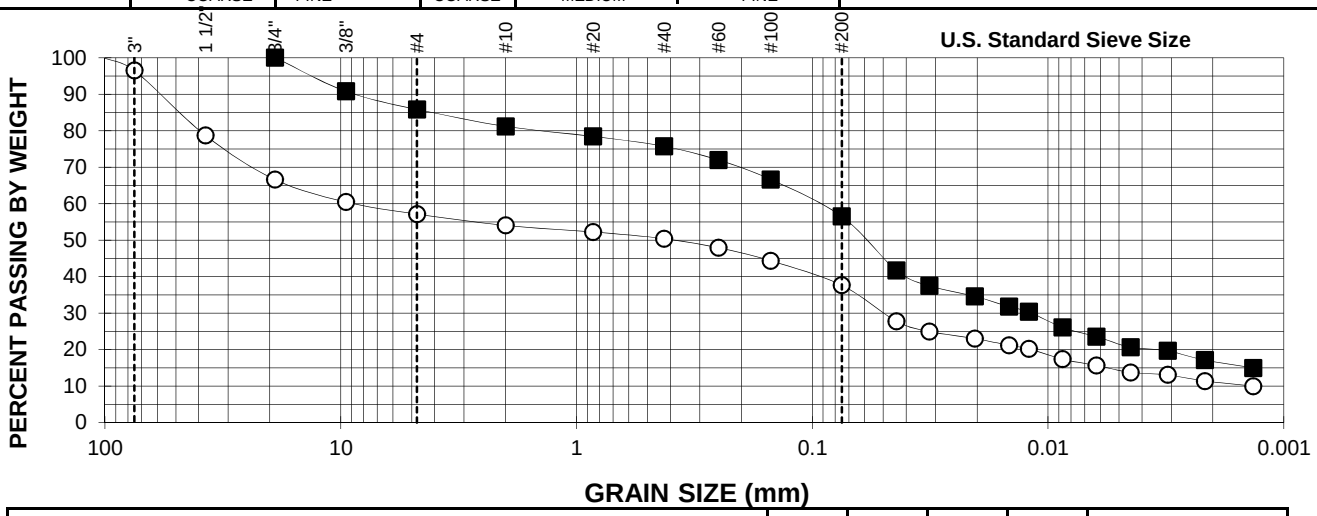
Test Method: AASHTO T99* Compaction Procedure: **C*** Specimen Preparation Method: **Moist**

NOTATION: ○ Representative of entire sample ■ Compaction Test specimen X Selected Optimum Point



PARTICLE-SIZE DISTRIBUTION CURVE

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



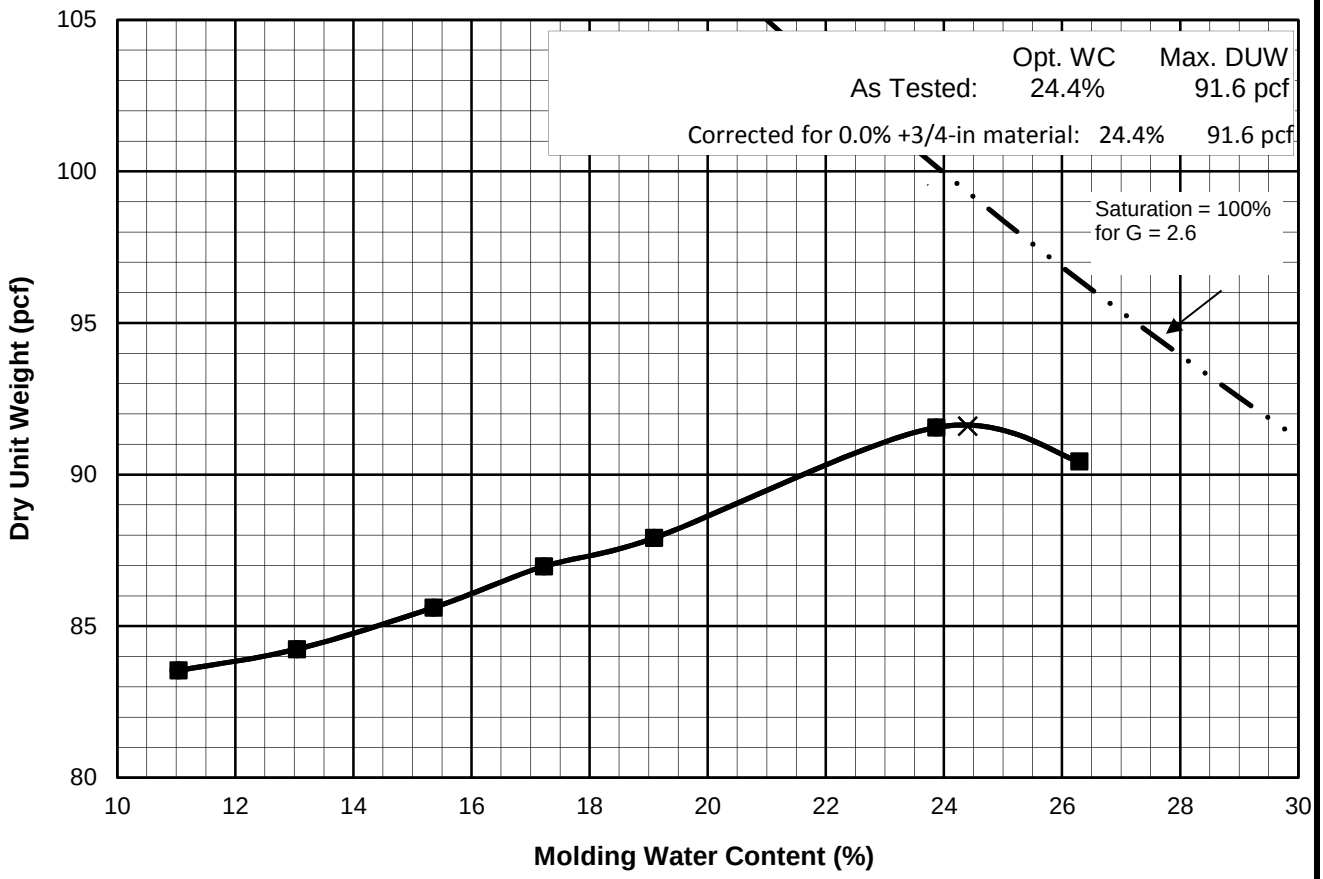
Description and/or Classification	LL	PL	PI	% Fines	Specific Gravity
GC, gray, Clayey gravel with sand	45	20	25	37.6	2.75 (Assumed)

Black Pine Mine	**CML-GT** **SAMPLE: 03 DEPTH: 2-3 ft**
Pioneer Technical Services	**COMPACTION AND INDEX PROPERTY DATA**
TerraSense, LLC Project No. 8054-13001	

COMPACTION CURVE

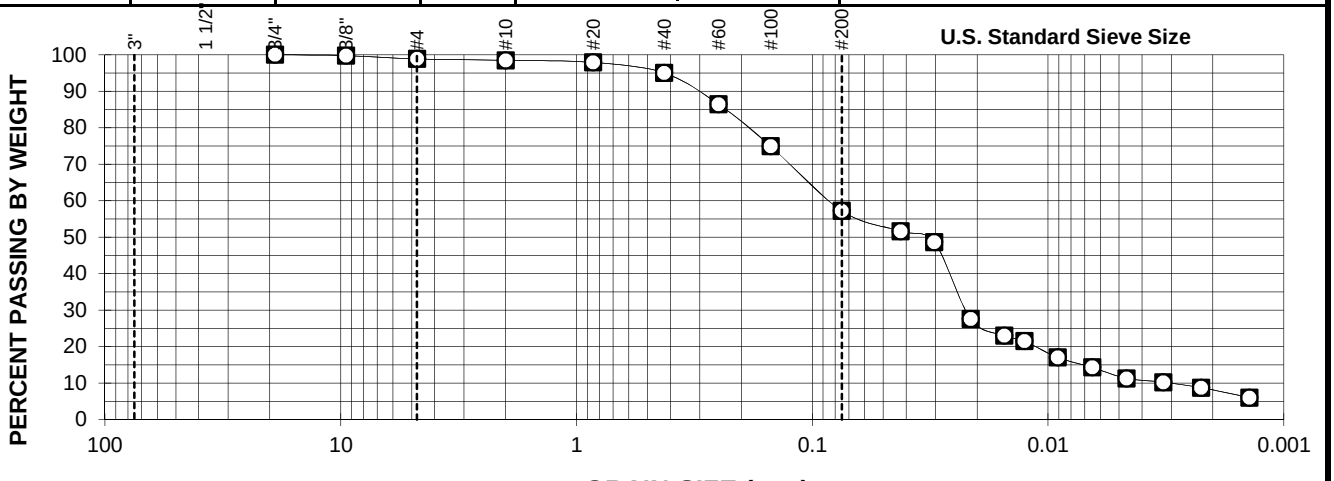
Test Method: AASHTO T99 Compaction Procedure: **C** Specimen Preparation Method: **Moist**

NOTATION: ○ Representative of entire sample ■ Compaction Test specimen X Selected Optimum Point



PARTICLE-SIZE DISTRIBUTION CURVE

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



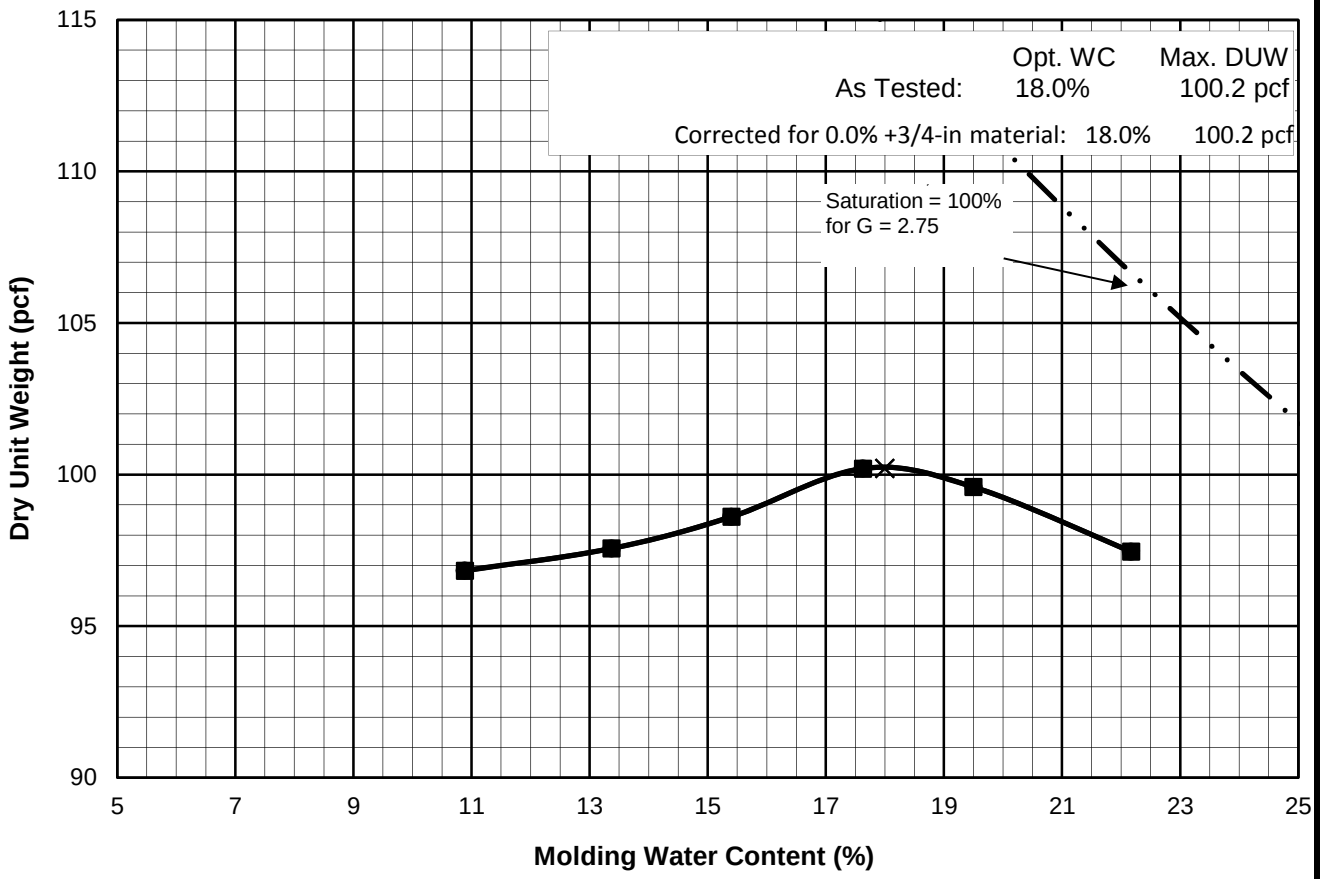
Description and/or Classification	LL	PL	PI	% Fines	Specific Gravity
ML, gray, Sandy silt	np	np	np	57.2	2.6 (Assumed)

Black Pine Mine	**CML-GT** **SAMPLE: 04 DEPTH: 0-1 ft**
Pioneer Technical Services	**COMPACTION AND INDEX PROPERTY DATA**
TerraSense, LLC Project No. 8054-13001	

COMPACTION CURVE

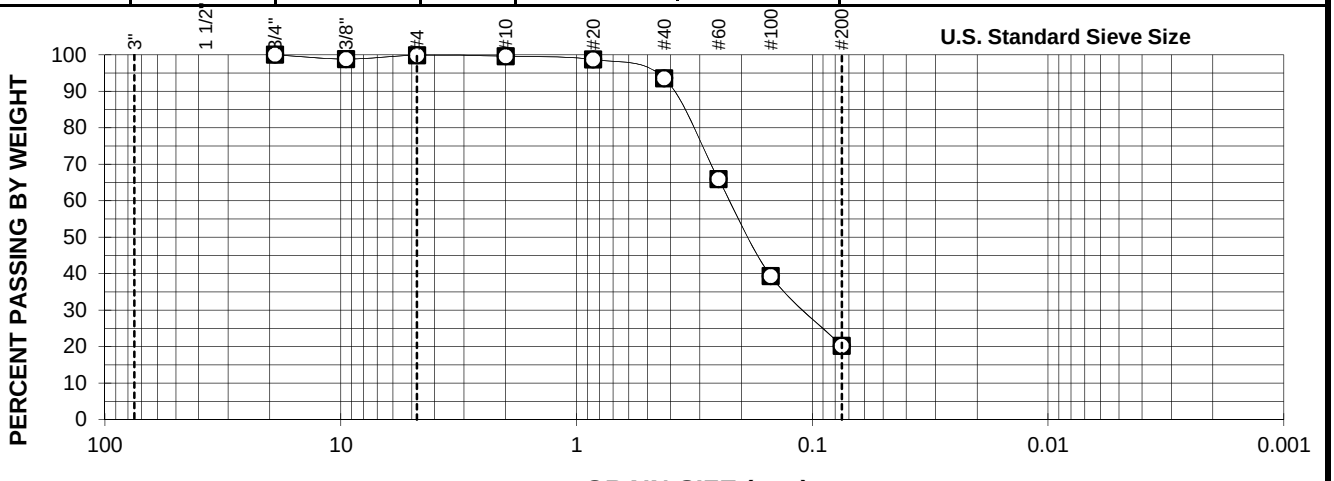
Test Method: AASHTO T99 Compaction Procedure: **C** Specimen Preparation Method: **Moist**

NOTATION: ○ Representative of entire sample ■ Compaction Test specimen X Selected Optimum Point



PARTICLE-SIZE DISTRIBUTION CURVE

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



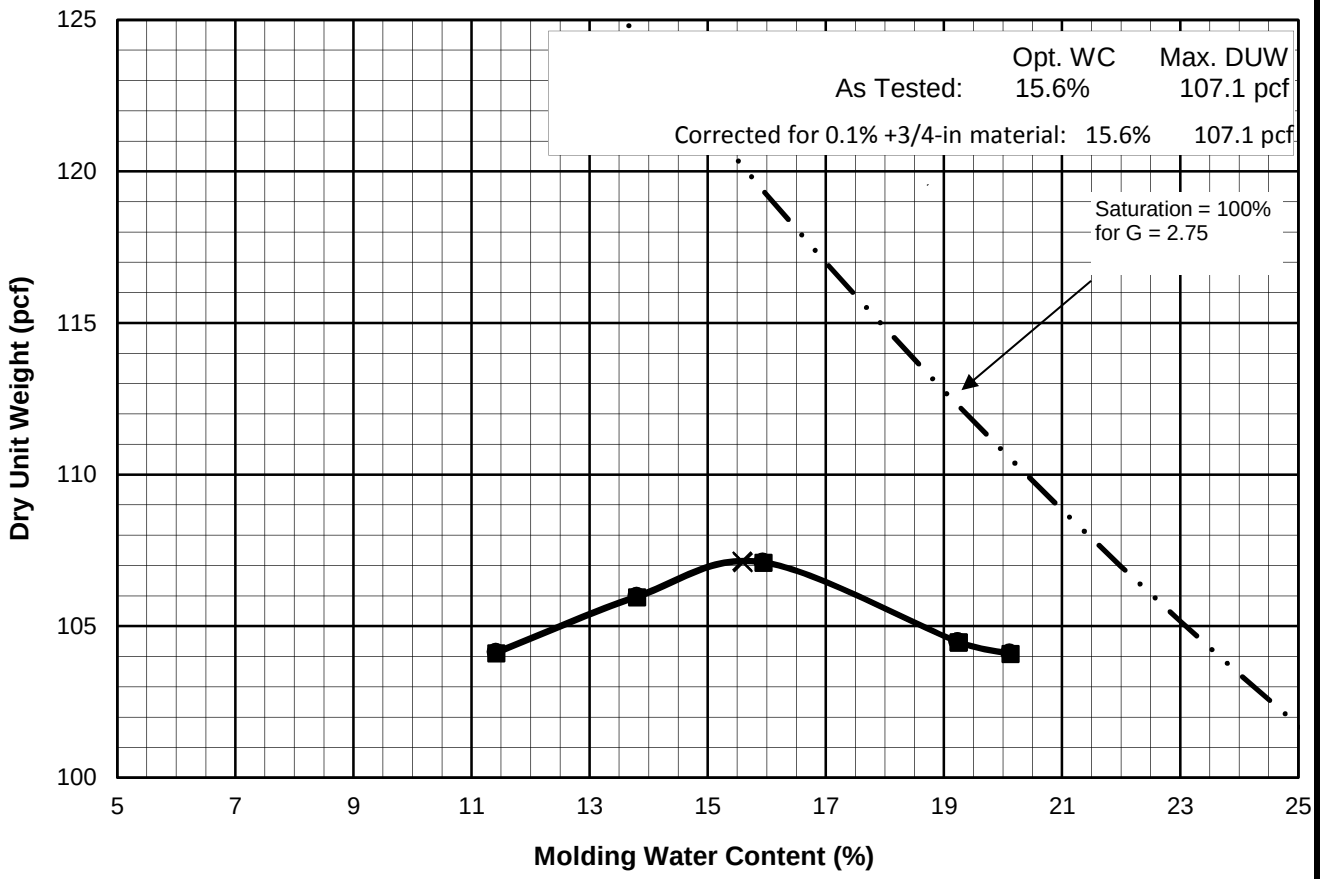
Description and/or Classification	LL	PL	PI	% Fines	Specific Gravity
SM, brown, Silty sand			NP	20.2	2.75 (Assumed)

Black Pine Mine		**CML-GT** **SAMPLE: 06 DEPTH: 0-1 ft**
Pioneer Technical Services		**COMPACTION AND INDEX PROPERTY DATA**
TerraSense, LLC	Project No. 8054-13001	

COMPACTION CURVE

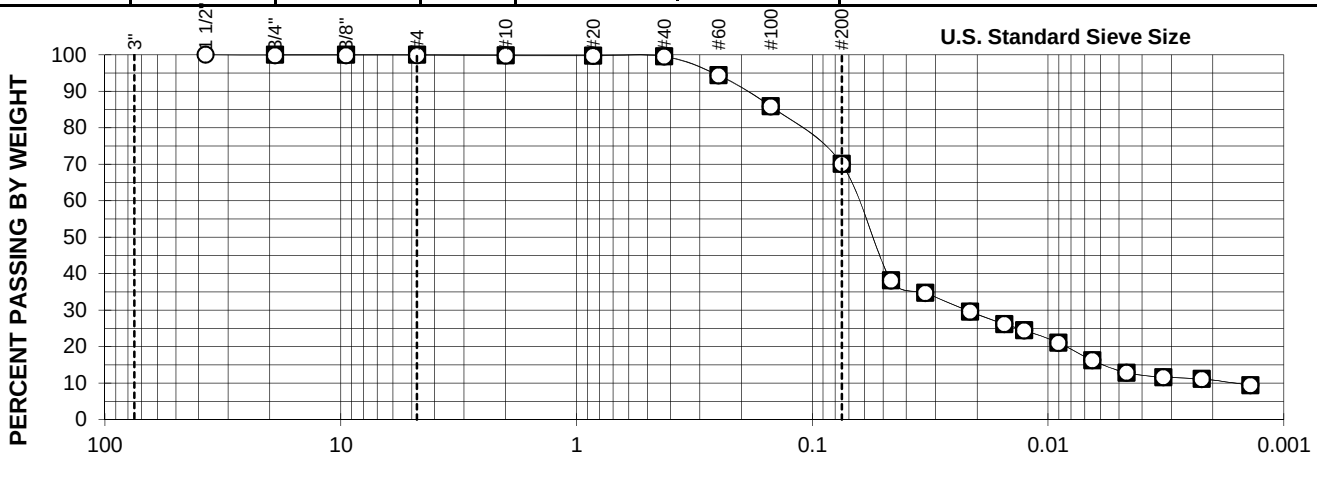
Test Method: AASHTO T99 Compaction Procedure: **C** Specimen Preparation Method: **Moist**

NOTATION: ○ Representative of entire sample ■ Compaction Test specimen X Selected Optimum Point



PARTICLE-SIZE DISTRIBUTION CURVE

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



Description and/or Classification	LL	PL	PI	% Fines	Specific Gravity
CL, gray, Lean clay with sand	27	15	12	70.0	2.75 (Assumed)

Black Pine Mine	**CML-GT** **SAMPLE: 07 DEPTH: 1.5-2 ft**
Pioneer Technical Services	**COMPACTION AND INDEX PROPERTY DATA**
TerraSense, LLC Project No. 8054-13001	

APPENDIX E4

AGRONOMIC LABORATORY ANALYTICAL REPORTS APPENDIX

ANALYTICAL SUMMARY REPORT

September 27, 2012

MT DEQ-Abandoned Mines
PO Box 200901
Helena, MT 59620-0901

Workorder No.: H12090018 Quote ID: H765 - Black Pine Mine 2012 sampling

Project Name: Black Pine Mine

Energy Laboratories Inc Helena MT received the following 17 samples for MT DEQ-Abandoned Mines on 9/4/2012 for analysis.

Sample ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
H12090018-001	BPB7A-GC-03	08/31/12 10:00	09/04/12	Soil	Cation Exchange Capacity Cations, NHO4Ac Extractable Conductivity, Saturated Paste Extract Lime Requirement, SMP Buffer Moisture Nitrate as N, KCL Extract Organic Matter-Walkley/Black pH, Saturated Paste Phosphorus-Olsen CEC NH4AC Soil Extraction KCL Soil Extract NaHCO3 Soil Extract NH4AC Soil Extraction Particle Size Analysis / Texture Prep Saturated Paste Extraction Total Organic Matter Prep Particle Size Analysis / Texture
H12090018-002	BPB7A-GC-02	08/31/12 10:45	09/04/12	Soil	Cation Exchange Capacity Cations, NHO4Ac Extractable Acid/Base Potential Conductivity, Saturated Paste Extract Lime Requirement, SMP Buffer Moisture Nitrate as N, KCL Extract Organic Matter-Walkley/Black pH, Saturated Paste Phosphorus-Olsen CEC NH4AC Soil Extraction KCL Soil Extract Lime Percentage NaHCO3 Soil Extract NH4AC Soil Extraction Particle Size Analysis / Texture Prep Saturated Paste Extraction Total Organic Matter Prep Particle Size Analysis / Texture Sulfur Forms

ANALYTICAL SUMMARY REPORT

H12090018-003	BPB7A-GC-04	08/31/12 12:45	09/04/12	Soil	Cation Exchange Capacity Cations, NHO4Ac Extractable Conductivity, Saturated Paste Extract Lime Requirement, SMP Buffer Moisture Nitrate as N, KCL Extract Organic Matter-Walkley/Black pH, Saturated Paste Phosphorus-Olsen CEC NH4AC Soil Extraction KCL Soil Extract NaHCO3 Soil Extract NH4AC Soil Extraction Particle Size Analysis / Texture Prep Saturated Paste Extraction Total Organic Matter Prep Particle Size Analysis / Texture
H12090018-004	BPB2/3-GC-02	08/29/12 12:10	09/04/12	Soil	Same As Above
H12090018-005	BPB2/3-GC-05	08/29/12 11:00	09/04/12	Soil	Same As Above
H12090018-006	BPB2/3-GC-01	08/29/12 12:30	09/04/12	Soil	Same As Above
H12090018-007	BPB2/3-GC-03	08/29/12 10:10	09/04/12	Soil	Same As Above
H12090018-008	BPB2/3-GC-06	08/29/12 9:00	09/04/12	Soil	Same As Above
H12090018-009	BPB2/3-GC-04	08/29/12 9:30	09/04/12	Soil	Cation Exchange Capacity Cations, NHO4Ac Extractable Acid/Base Potential Conductivity, Saturated Paste Extract Lime Requirement, SMP Buffer Moisture Nitrate as N, KCL Extract Organic Matter-Walkley/Black pH, Saturated Paste Phosphorus-Olsen CEC NH4AC Soil Extraction KCL Soil Extract Lime Percentage NaHCO3 Soil Extract NH4AC Soil Extraction Particle Size Analysis / Texture Prep Saturated Paste Extraction Total Organic Matter Prep Particle Size Analysis / Texture Sulfur Forms

ANALYTICAL SUMMARY REPORT

H12090018-010	BPB1A-GC-01	08/31/12 8:45	09/04/12	Soil	Cation Exchange Capacity Cations, NHO4Ac Extractable Conductivity, Saturated Paste Extract Lime Requirement, SMP Buffer Moisture Nitrate as N, KCL Extract Organic Matter-Walkley/Black pH, Saturated Paste Phosphorus-Olsen CEC NH4AC Soil Extraction KCL Soil Extract NaHCO3 Soil Extract NH4AC Soil Extraction Particle Size Analysis / Texture Prep Saturated Paste Extraction Total Organic Matter Prep Particle Size Analysis / Texture
H12090018-011	BPB1A-GC-02	08/29/12 7:15	09/04/12	Soil	Cation Exchange Capacity Cations, NHO4Ac Extractable Acid/Base Potential Conductivity, Saturated Paste Extract Lime Requirement, SMP Buffer Moisture Nitrate as N, KCL Extract Organic Matter-Walkley/Black pH, Saturated Paste Phosphorus-Olsen CEC NH4AC Soil Extraction KCL Soil Extract Lime Percentage NaHCO3 Soil Extract NH4AC Soil Extraction Particle Size Analysis / Texture Prep Saturated Paste Extraction Total Organic Matter Prep Particle Size Analysis / Texture Sulfur Forms
H12090018-012	BPB1A-GC-03	08/28/12 15:45	09/04/12	Soil	Cation Exchange Capacity Cations, NHO4Ac Extractable Conductivity, Saturated Paste Extract Lime Requirement, SMP Buffer Moisture Nitrate as N, KCL Extract Organic Matter-Walkley/Black pH, Saturated Paste Phosphorus-Olsen CEC NH4AC Soil Extraction KCL Soil Extract NaHCO3 Soil Extract NH4AC Soil Extraction Particle Size Analysis / Texture Prep Saturated Paste Extraction Total Organic Matter Prep Particle Size Analysis / Texture
H12090018-013	BPB1A-GC-04	08/28/12 16:30	09/04/12	Soil	Same As Above

ANALYTICAL SUMMARY REPORT

H12090018-014	BPB13-GC-01	08/30/12 11:00 09/04/12	Soil	Cation Exchange Capacity Cations, NHO4Ac Extractable Acid/Base Potential Conductivity, Saturated Paste Extract Lime Requirement, SMP Buffer Moisture Nitrate as N, KCL Extract Organic Matter-Walkley/Black pH, Saturated Paste Phosphorus-Olsen CEC NH4AC Soil Extraction KCL Soil Extract Lime Percentage NaHCO3 Soil Extract NH4AC Soil Extraction Particle Size Analysis / Texture Prep Saturated Paste Extraction Total Organic Matter Prep Particle Size Analysis / Texture Sulfur Forms
H12090018-015	BPB13-GC-02	08/30/12 12:00 09/04/12	Soil	Cation Exchange Capacity Cations, NHO4Ac Extractable Conductivity, Saturated Paste Extract Lime Requirement, SMP Buffer Moisture Nitrate as N, KCL Extract Organic Matter-Walkley/Black pH, Saturated Paste Phosphorus-Olsen CEC NH4AC Soil Extraction KCL Soil Extract NaHCO3 Soil Extract NH4AC Soil Extraction Particle Size Analysis / Texture Prep Saturated Paste Extraction Total Organic Matter Prep Particle Size Analysis / Texture
H12090018-016	BPB13-GC-03	08/30/12 12:40 09/04/12	Soil	Same As Above
H12090018-017	BPB13-GC-04	08/30/12 13:30 09/04/12	Soil	Same As Above

The analyses presented in this report were performed by Energy Laboratories, Inc., 3161 E. Lyndale Ave., Helena, MT 59604, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these test results, please call.

Report Approved By:

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Workorder: H12090018

Report Date: 09/27/12
Date Received: 09/04/12

		Analysis		pH, SMP Buffer	Lime Requireme	Moisture (As	Sand	Silt	Clay	Texture	pH-SatPst	COND	K, available	CEC
		Units		Tons/1000T	Tons/1000T	wt%	%	%	%	%	s_u_	mmhos/cm	mg/kg	meq/100g
Sample ID	**Client Sample ID**	**Up**	**Low**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
H12090018-001	BPB7A-GC-03	0	0	6.8	1	2.5	34	56	10	SiL	4.8	0.3	206	6.68
H12090018-002	BPB7A-GC-02	0	0	5.4	11	7.0	30	56	14	SiL	5.1	0.1	219	18.7
H12090018-003	BPB7A-GC-04	0	0	6.6	3	4.2	32	54	14	SiL	5.4	0.1	137	11.5
H12090018-004	BPB2/3-GC-02	0	0	6.9	< 1	4.6	50	40	10	L	5.9	0.5	129	9.90
H12090018-005	BPB2/3-GC-05	0	0	6.2	6	5.3	52	36	12	L	5.4	0.3	224	13.1
H12090018-006	BPB2/3-GC-01	0	0	6.9	< 1	3.1	56	36	8	SL	5.6	0.5	127	7.16
H12090018-007	BPB2/3-GC-03	0	0	6.2	5	4.7	46	42	12	L	6.0	0.4	292	23.1
H12090018-008	BPB2/3-GC-06	0	0	6.1	6	3.4	44	40	16	L	5.6	0.2	217	17.7
H12090018-009	BPB2/3-GC-04	0	0	5.7	9	10.8	32	56	12	SiL	5.8	0.1	289	34.9
H12090018-010	BPB1A-GC-01	0	0	5.6	10	7.4	32	54	14	SiL	5.3	0.2	246	23.4
H12090018-011	BPB1A-GC-02	0	0	6.2	5	3.6	42	42	16	L	5.6	0.1	262	15.1
H12090018-012	BPB1A-GC-03	0	0	5.9	7	6.1	34	50	16	SiL	5.4	0.2	118	16.7
H12090018-013	BPB1A-GC-04	0	0	6.0	7	12.2	36	50	14	SiL	5.0	0.1	480	14.7
H12090018-014	BPB13-GC-01	0	0	6.7	2	6.8	26	54	20	SiL	5.6	0.2	217	14.2
H12090018-015	BPB13-GC-02	0	0	7.1	< 1	4.0	32	54	14	SiL	5.5	0.1	139	8.60
H12090018-016	BPB13-GC-03	0	0	5.9	8	7.8	30	56	14	SiL	5.0	0.2	367	21.2
H12090018-017	BPB13-GC-04	0	0	6.9	< 1	6.3	32	50	18	SiL	5.5	0.1	269	14.1

LABORATORY ANALYTICAL REPORT

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Project: Black Pine Mine
Workorder: H12090018

Report Date: 09/27/12
Date Received: 09/04/12

		Analysis		OM-WB	Neut Potential	Acid Potential	Acid/Base Potential	Sulfur, Total	Sulfur, Hot Water	Sulfur, HCl Extractable	Sulfur, HNO3	Sulfur, Residual	Olsen Phos-Olsen	NO3
		Units		%	t/kt	t/kt	t/kt	%	%	%	%	%	mg/kg	mg/kg Dry
Sample ID	**Client Sample ID**	**Up**	**Low**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**	**Results**
H12090018-001	BPB7A-GC-03	0	0	1.11									3	< 1.0
H12090018-002	BPB7A-GC-02	0	0	4.40	2	< 0.3	2	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	44	< 1.0
H12090018-003	BPB7A-GC-04	0	0	1.91									7	< 1.0
H12090018-004	BPB2/3-GC-02	0	0	1.95									29	< 1.0
H12090018-005	BPB2/3-GC-05	0	0	4.22									30	< 1.0
H12090018-006	BPB2/3-GC-01	0	0	2.29									20	< 1.0
H12090018-007	BPB2/3-GC-03	0	0	9.51									30	< 1.0
H12090018-008	BPB2/3-GC-06	0	0	4.65									16	1.1
H12090018-009	BPB2/3-GC-04	0	0	9.06	8	< 0.3	8	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	15	< 1.0
H12090018-010	BPB1A-GC-01	0	0	9.06									20	< 1.0
H12090018-011	BPB1A-GC-02	0	0	2.51	5	< 0.3	5	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	49	< 1.0
H12090018-012	BPB1A-GC-03	0	0	9.51									13	< 1.0
H12090018-013	BPB1A-GC-04	0	0	3.75									5	< 1.0
H12090018-014	BPB13-GC-01	0	0	2.01	6	< 0.3	6	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	1	< 1.0
H12090018-015	BPB13-GC-02	0	0	0.76									4	< 1.0
H12090018-016	BPB13-GC-03	0	0	4.47									30	< 1.0
H12090018-017	BPB13-GC-04	0	0	0.82									8	< 1.0

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 09/27/12

Project: Black Pine Mine **Work Order:** H12090018

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA12-3								Analytical Run: SOIL PH METER_120912A		
Sample ID: CCV1		Continuing Calibration Verification Standard							09/12/12 16:00	
pH, SMP Buffer		3.98	Tons/1000T	0.10	100	90	110			
Method: ASA12-3									Batch: R82887	
Sample ID: ICV1		Initial Calibration Verification Standard				Run: SOIL PH METER_120912A			09/12/12 16:00	
pH, SMP Buffer		9.98	Tons/1000T	0.10	100	90	110			
Sample ID: LCS-1011		Laboratory Control Sample				Run: SOIL PH METER_120912A			09/12/12 16:00	
pH, SMP Buffer		7.55	Tons/1000T	0.10	100	70	130			
Sample ID: H12090018-010ADUP	2	Sample Duplicate				Run: SOIL PH METER_120912A			09/12/12 16:00	
pH, SMP Buffer		5.54	Tons/1000T	0.10						
Lime Requirement, SMP buffer		10.2	Tons/1000T	1.0				0.7	30	
Sample ID: H12090018-017ADUP	2	Sample Duplicate				Run: SOIL PH METER_120912A			09/12/12 16:00	
pH, SMP Buffer		6.96	Tons/1000T	0.10						
Lime Requirement, SMP buffer		ND	Tons/1000T	1.0					30	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Report Date: 09/27/12
Project: Black Pine Mine
Work Order: H12090018

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA15-5										Batch: R82970
Sample ID: H12090018-010ADUP	3	Sample Duplicate				Run: SOIL HYDROMETER_120917			09/14/12 10:38	
Sand		30.0	%	1.0				6.5	20	
Silt		56.0	%	1.0				3.6	20	
Clay		14.0	%	1.0				0.0	20	
Sample ID: H12090018-017ADUP	3	Sample Duplicate				Run: SOIL HYDROMETER_120917			09/14/12 10:38	
Sand		32.0	%	1.0				0.0	20	
Silt		52.0	%	1.0				3.9	20	
Clay		16.0	%	1.0				12	20	
Sample ID: LCS-17957	3	Laboratory Control Sample				Run: SOIL HYDROMETER_120917			09/14/12 10:38	
Sand		30.0	%	1.0	107	70	130			
Silt		40.0	%	1.0	105	70	130			
Clay		30.0	%	1.0	88	70	130			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 09/27/12

Project: Black Pine Mine **Work Order:** H12090018

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA24-5									Analytical Run: FIA202-HE_120912A	
Sample ID: ICV		Initial Calibration Verification Standard							09/12/12 13:05	
Phosphorus, Olsen		5.3	mg/kg	1.0	106	90	110			
Sample ID: ICB		Initial Calibration Blank, Instrument Blank							09/12/12 13:09	
Phosphorus, Olsen		0.025	mg/kg	1.0		0	0			
Method: ASA24-5									Batch: 17889	
Sample ID: MB-17889		Method Blank				Run: FIA202-HE_120912A			09/12/12 13:11	
Phosphorus, Olsen		0.8	mg/kg	0.08						
Sample ID: LCS-17889		Laboratory Control Sample				Run: FIA202-HE_120912A			09/12/12 13:12	
Phosphorus, Olsen		44	mg/kg	1.0	99	70	130			
Sample ID: H12090018-001AMS		Sample Matrix Spike				Run: FIA202-HE_120912A			09/12/12 13:14	
Phosphorus, Olsen		65	mg/kg	1.0	125	80	120			S
Sample ID: H12090018-001AMSD		Sample Matrix Spike Duplicate				Run: FIA202-HE_120912A			09/12/12 13:15	
Phosphorus, Olsen		62	mg/kg	1.0	117	80	120	5.9	20	
Sample ID: H12090018-010Adup		Sample Duplicate				Run: FIA202-HE_120912A			09/12/12 13:28	
Phosphorus, Olsen		21	mg/kg	1.0				6.5	30	
Sample ID: H12090018-015AMS		Sample Matrix Spike				Run: FIA202-HE_120912A			09/12/12 13:34	
Phosphorus, Olsen		93	mg/kg	1.0	117	80	120			
Sample ID: H12090018-015AMSD		Sample Matrix Spike Duplicate				Run: FIA202-HE_120912A			09/12/12 13:35	
Phosphorus, Olsen		75	mg/kg	1.0	94	80	120	21	20	R
Sample ID: H12090018-017Adup		Sample Duplicate				Run: FIA202-HE_120912A			09/12/12 13:40	
Phosphorus, Olsen		8.0	mg/kg	1.0				3.4	30	

Qualifiers:

RL - Analyte reporting limit.

R - RPD exceeds advisory limit.

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Report Date: 09/27/12
Project: Black Pine Mine
Work Order: H12090018

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA29-3										Batch: 17875
Sample ID: LCS-178751209100822		Laboratory Control Sample				Run: MISC SOILS_120910C				09/10/12 08:22
Organic Matter		1.29	%	0.020	103	70	130			
Sample ID: MBLK-1787512091008		Method Blank				Run: MISC SOILS_120910C				09/10/12 08:22
Organic Matter		0.02	%	0.009						
Sample ID: H12090018-010ADUP		Sample Duplicate				Run: MISC SOILS_120910C				09/10/12 08:24
Organic Matter		9.13	%	0.020				0.7	30	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 09/27/12

Project: Black Pine Mine **Work Order:** H12090018

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA33-8									Analytical Run: FIA203-HE_120913B	
Sample ID: ICV		Initial Calibration Verification Standard							09/13/12 10:20	
Nitrate as N, KCL Extract		1.0	mg/kg	1.0	101	90	110			
Sample ID: CCV		Continuing Calibration Verification Standard							09/13/12 10:22	
Nitrate as N, KCL Extract		0.51	mg/kg	1.0	102	90	110			
Sample ID: ICB		Initial Calibration Blank, Instrument Blank							09/13/12 10:25	
Nitrate as N, KCL Extract		-0.0072	mg/kg	1.0		0	0			
Sample ID: CCV		Continuing Calibration Verification Standard							09/13/12 11:33	
Nitrate as N, KCL Extract		0.52	mg/kg	1.0	103	90	110			
Method: ASA33-8									Batch: 17888	
Sample ID: MB-17888		Method Blank				Run: FIA203-HE_120913B			09/13/12 11:19	
Nitrate as N, KCL Extract		0.6	mg/kg Dry	0.1						
Sample ID: LCS-17888		Laboratory Control Sample				Run: FIA203-HE_120913B			09/13/12 11:20	
Nitrate as N, KCL Extract		6.4	mg/kg Dry	1.0	89	70	130			
Sample ID: H12090018-009AMS		Sample Matrix Spike				Run: FIA203-HE_120913B			09/13/12 11:36	
Nitrate as N, KCL Extract		5.2	mg/kg Dry	1.0	97	80	120			
Sample ID: H12090018-009AMSD		Sample Matrix Spike Duplicate				Run: FIA203-HE_120913B			09/13/12 11:37	
Nitrate as N, KCL Extract		5.1	mg/kg Dry	1.0	95	80	120	1.8	30	
Sample ID: H12090018-010ADUP		Sample Duplicate				Run: FIA203-HE_120913B			09/13/12 11:40	
Nitrate as N, KCL Extract		0.18	mg/kg Dry	1.0					30	
Sample ID: H12090018-017ADUP		Sample Duplicate				Run: FIA203-HE_120913B			09/13/12 11:50	
Nitrate as N, KCL Extract		0.81	mg/kg Dry	1.0					30	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 09/27/12

Project: Black Pine Mine **Work Order:** H12090018

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASAM10-3									Analytical Run: SOIL EC_120910A	
Sample ID: ICV_1_120905_1		Initial Calibration Verification Standard							09/06/12 07:30	
Conductivity, sat. paste		12.2	mmhos/cm	0.10	94	90	110			
Sample ID: CCV_1_120906_1		Continuing Calibration Verification Standard							09/07/12 08:09	
Conductivity, sat. paste		1.46	mmhos/cm	0.10	103	90	110			
Sample ID: CCV1_1_120906_1		Continuing Calibration Verification Standard							09/07/12 08:10	
Conductivity, sat. paste		6.69	mmhos/cm	0.10	100	90	110			
Sample ID: ICV_1_120906_1		Initial Calibration Verification Standard							09/07/12 08:10	
Conductivity, sat. paste		12.0	mmhos/cm	0.10	93	90	110			
Sample ID: CCV_3_120906_1		Continuing Calibration Verification Standard							09/07/12 08:19	
Conductivity, sat. paste		1.44	mmhos/cm	0.10	102	90	110			
Sample ID: ICV_1_120904_1		Initial Calibration Verification Standard							09/05/12 11:53	
Conductivity, sat. paste		12.3	mmhos/cm	0.10	95	90	110			
Method: ASAM10-3									Batch: 120906_1_COND-S-PASTE	
Sample ID: LCS-17874		Laboratory Control Sample				Run: SOIL EC_120910A			09/07/12 08:11	
Conductivity, sat. paste		5.01	mmhos/cm	0.10	106	80	120			
Sample ID: H12090018-010ADUP		Sample Duplicate				Run: SOIL EC_120910A			09/07/12 08:18	
Conductivity, sat. paste		0.220	mmhos/cm	0.10				0.9	20	
Sample ID: H12090018-017ADUP		Sample Duplicate				Run: SOIL EC_120910A			09/07/12 08:24	
Conductivity, sat. paste		0.104	mmhos/cm	0.10				0.5	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 09/27/12

Project: Black Pine Mine **Work Order:** H12090018

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASAM10-3.2								Analytical Run: SOIL PH METER_120910A		
Sample ID: CCV_1_120906_1		Continuing Calibration Verification Standard							09/07/12 06:44	
pH, sat. paste		7.00	s.u.	0.10	100	95	105			
Sample ID: CCV1_1_120906_1		Continuing Calibration Verification Standard							09/07/12 06:44	
pH, sat. paste		4.02	s.u.	0.10	100	95	105			
Sample ID: ICV_1_120906_1		Initial Calibration Verification Standard							09/07/12 06:45	
pH, sat. paste		9.96	s.u.	0.10	100	98	102			
Sample ID: CCV_3_120906_1		Continuing Calibration Verification Standard							09/07/12 06:55	
pH, sat. paste		6.99	s.u.	0.10	100	95	105			
Sample ID: ICV_1_120905_1		Initial Calibration Verification Standard							09/06/12 06:51	
pH, sat. paste		9.95	s.u.	0.10	99	98	102			
Method: ASAM10-3.2										Batch: 17874
Sample ID: LCS-17874		Laboratory Control Sample				Run: SOIL PH METER_120910A			09/07/12 06:46	
pH, sat. paste		7.55	s.u.	0.10	100	90	110			
Sample ID: H12090018-010ADUP		Sample Duplicate				Run: SOIL PH METER_120910A			09/07/12 06:55	
pH, sat. paste		5.30	s.u.	0.10				0.2	30	
Sample ID: H12090018-017ADUP		Sample Duplicate				Run: SOIL PH METER_120910A			09/07/12 07:01	
pH, sat. paste		5.48	s.u.	0.10				0.2	30	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Report Date: 09/27/12
Project: Black Pine Mine
Work Order: H12090018

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: D2974										Batch: R82740
Sample ID: H12090018-010ADUP		Sample Duplicate				Run: MISC SOILS_120905A			09/06/12 10:23	
Moisture (As Received)		5.73	wt%	0.20				25	20	R
Sample ID: H12090018-017ADUP		Sample Duplicate				Run: MISC SOILS_120905A			09/06/12 10:23	
Moisture (As Received)		5.80	wt%	0.20				8.8	20	

Qualifiers:

RL - Analyte reporting limit.
ND - Not detected at the reporting limit.
R - RPD exceeds advisory limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Report Date: 09/27/12
Project: Black Pine Mine
Work Order: H12090018

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E200.7									Analytical Run: ICP1-HE_120911A	
Sample ID: ICV		Initial Calibration Verification Standard							09/11/12 13:59	
Sodium		39.3	mg/L	1.0	98	90	110			
Sample ID: ICSA		Interference Check Sample A							09/11/12 14:25	
Sodium		0.0106	mg/L	1.0		0	0			
Sample ID: ICSAB		Interference Check Sample AB							09/11/12 14:28	
Sodium		21.0	mg/L	1.0	105	80	120			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 09/27/12

Project: Black Pine Mine **Work Order:** H12090018

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: Sobek Modified									Batch: R82831	
Sample ID: LCS1209111113	4	Laboratory Control Sample				Run: LECO632_120911A			09/11/12 11:13	
Sulfur, Total		0.67	%	0.010	91	90	110			
Sulfur, HCl Extractable		0.082	%	0.010	92	52	148			
Sulfur, HNO3 Extractable		0.23	%	0.010	96	69	131			
Sulfur, Residual		0.23	%	0.010	106	82	118			
Sample ID: H12090018-009A	5	Sample Duplicate				Run: LECO632_120911A			09/11/12 12:23	
Sulfur, Total		ND	%	0.010					30	
Sulfur, Hot Water Extractable		ND	%	0.010					30	
Sulfur, HCl Extractable		ND	%	0.010					30	
Sulfur, HNO3 Extractable		ND	%	0.010					30	
Sulfur, Residual		ND	%	0.010					30	
Method: Sobek Modified									Batch: 17885	
Sample ID: LCS-17885		Laboratory Control Sample				Run: MAN-TECH_120907A			09/07/12 07:32	
Neutralization Potential		69	t/kt		97	70	130			
Sample ID: H12090018-009ADUP		Sample Duplicate				Run: MAN-TECH_120907A			09/07/12 07:50	
Neutralization Potential		7.6	t/kt					5.1	20	
Method: Sobek Modified									Batch: 17885	
Sample ID: H12090018-009ADUP	2	Sample Duplicate				Run: MISC SOILS_120911C			09/07/12 11:46	
Acid Potential		ND	t/kt	0.31					20	
Acid/Base Potential		7.6	t/kt					5.1	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines **Report Date:** 09/27/12
Project: Black Pine Mine **Work Order:** H12090018

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B										Batch: 17887
Sample ID: MB-17887	2	Method Blank				Run: ICP1-HE_120911A				09/11/12 18:43
Sodium		0.4	mg/kg	0.06						
Cation Exchange Capacity		0.04	meq/100g	0.006						
Sample ID: LCS-17887	2	Laboratory Control Sample				Run: ICP1-HE_120911A				09/11/12 18:47
Sodium		224	mg/kg	2.0	93	70	130			
Cation Exchange Capacity		19.4	meq/100g	0.17	93	70	130			
Sample ID: H12090018-001AMS2	2	Sample Matrix Spike				Run: ICP1-HE_120911A				09/11/12 19:08
Sodium		301	mg/kg	2.1	90	75	125			
Cation Exchange Capacity		26.2	meq/100g	0.18	90	75	125			
Sample ID: H12090018-001AMSD2	2	Sample Matrix Spike Duplicate				Run: ICP1-HE_120911A				09/11/12 19:11
Sodium		303	mg/kg	2.1	91	75	125	0.7	20	
Cation Exchange Capacity		26.4	meq/100g	0.18	91	75	125	0.7	20	
Sample ID: H12090018-015AMS2	2	Sample Matrix Spike				Run: ICP1-HE_120911A				09/11/12 20:10
Sodium		321	mg/kg	2.1	89	75	125			
Cation Exchange Capacity		27.9	meq/100g	0.18	89	75	125			
Sample ID: H12090018-015AMSD2	2	Sample Matrix Spike Duplicate				Run: ICP1-HE_120911A				09/11/12 20:20
Sodium		328	mg/kg	2.1	91	75	125	2.1	20	
Cation Exchange Capacity		28.5	meq/100g	0.18	91	75	125	2.1	20	
Method: SW6010B										Batch: 17890
Sample ID: MB-17890	2	Method Blank				Run: ICP1-HE_120911A				09/11/12 16:02
Potassium, Available		5	mg/kg	0.009						
Potassium, Extractable		0.01	meq/100g	2E-05						
Sample ID: LCS-17890	2	Laboratory Control Sample				Run: ICP1-HE_120911A				09/11/12 16:05
Potassium, Available		170	mg/kg	1.00	92	70	130			
Potassium, Extractable		0.44	meq/100g		93	70	130			
Sample ID: H12080533-011Adup	2	Sample Duplicate				Run: ICP1-HE_120911A				09/11/12 16:11
Potassium, Available		41.6	mg/kg	1.00				0.3	30	
Potassium, Extractable		0.11	meq/100g					0.3	30	
Sample ID: H12090018-002AMS2	2	Sample Matrix Spike				Run: ICP1-HE_120911A				09/11/12 16:37
Potassium, Available		688	mg/kg	1.4	94	75	125			
Potassium, Extractable		1.76	meq/100g		94	75	125			
Sample ID: H12090018-002AMSD2	2	Sample Matrix Spike Duplicate				Run: ICP1-HE_120911A				09/11/12 16:40
Potassium, Available		691	mg/kg	1.4	94	75	125	0.4	20	
Potassium, Extractable		1.77	meq/100g		95	75	125	0.4	20	
Sample ID: H12090018-015AMS2	2	Sample Matrix Spike				Run: ICP1-HE_120911A				09/11/12 17:36
Potassium, Available		602	mg/kg	1.4	93	75	125			
Potassium, Extractable		1.54	meq/100g		93	75	125			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Helena, MT Branch

Client: MT DEQ-Abandoned Mines
Report Date: 09/27/12
Project: Black Pine Mine
Work Order: H12090018

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B										Batch: 17890
Sample ID: H12090018-015AMSD2	2	Sample Matrix Spike Duplicate				Run: ICP1-HE_120911A			09/11/12 17:39	
Potassium, Available		614	mg/kg	1.4	95	75	125	2.0	20	
Potassium, Extractable		1.57	meq/100g		95	75	125	2.0	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

Standard Reporting Procedures

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Workorder Receipt Checklist

MT DEQ-Abandoned Mines H12090018

Login completed by: Tracy L. Lorash
Date Received: 9/4/2012
Reviewed by: BL2000\jhager
Received by: elm
Reviewed Date: 9/10/2012
Carrier name: Hand Del

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shipping container/cooler?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☐	No ☑	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received?	Yes ☐	No ☑	Not Applicable ☐
Container/Temp Blank temperature:	26.9°C No Ice		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	Not Applicable ☑

Contact and Corrective Action Comments:

Sample ID on COC is BPB1A-GC-03 - ID on bag is BPB1A-GC/GT-03. Logged in with ID from COC per Mark. TI 9/5/12.

Chain of Custody and Analytical Request Record

PLEASE PRINT (Provide as much information as possible.)

Company Name:	Project Name, PWS, Permit, Etc.	Sample Origin	EPA/State Compliance:
TRI HYDRO	BLACK PINE MINE	State: MT	Yes ☐ No ☐
Report Mail Address:	**Contact Name:** / **Phone/Fax:**	**Email:**	**Sampler: (Please Print)**
1252 COMMERCE DR. LARAMIE WY 82070	MARK DONNER 307-745-7474	MDONNER@TRIHYDRO.COM	J. MOUGOUEN
Invoice Address:	**Invoice Contact & Phone:**	**Purchase Order:**	**Quote/Bottle Order:**
	DEVIN CLARY 406-841-5029		

Special Report/Formats:

☐ DW
☐ POTW/WWTP
☐ State: _____
☐ Other: _____
☒ EDD/EDT (Electronic Data) Format: EXCELL
☐ LEVEL IV
☐ NELAC

ANALYSIS REQUESTED

RUSH: Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Standard Turnaround (TAT)

Comments:

Shipped by: Hand
Cooler ID(s): Totes
Receipt Temp: 26.9c
On Ice: Y (N)
Custody Seal: On Bottle Y (N); On Cooler Y (N)
Intact: Y N
Signature Match: Y N

LABORATORY USE ONLY: H12090018

	SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX	~~Water~~ Particle Size	Moisture Content ~~Aqueous Total Dissolved Solids~~	Cation/Anion Exchange Capacity	pH	Conductivity	Nitrate as Nitrogen	Total Phosphorus	Lime Requirements	Organic Matter	SEE ATTACHED	Total Potassium	Comments
1	BPB 7A-GC-03	8-31-12	1000	1												
2	BPB 7A-GC-02	8-31-12	1045	1												ABA
3	BPB 7A-GC-04	8-31-12	1245	1												
4	BPB 2/3-GC-02	8-29-12	1210	1												
5	BPB 2/3-GC-05	8-29-12	1100	1												
6	BPB 2/3-GC-01	8-29-12	1230	1												
7	BPB 2/3-GC-03	8-29-12	~~1030~~ 1010	1												
8	BPB 2/3-GC-06	8-29-12	0900	1										X		
9	BPB 2/3-GC-04	8-29-12	0930	1												ABA
10																

Custody Record MUST be Signed

Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Jamie Mougouen	8/31/12 1845		Sarah Seitz	8/31/12 18:45	
S. Seitz	9/4/12 13:09				

Received by Laboratory: Date/Time: 9/4/12 13:09 Signature:

Sample Disposal: Return to Client: _____ Lab Disposal: _____

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report. Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

Chain of Custody and Analytical Request Record

PLEASE PRINT (Provide as much information as possible.)

Company Name:	Project Name, PWS, Permit, Etc.	Sample Origin	EPA/State Compliance:
TRI HYDRO	BLACK PINE MINE	State: MT	Yes ☐ No ☐
Report Mail Address:	**Contact Name:** / **Phone/Fax:**	**Email:**	**Sampler: (Please Print)**
1252 COMMERCE DR LARAMIE WY 82070	MARK DONNER 307-745-7474	MDONNER@TRIHYDRO.COM	J MONGOLDEN
Invoice Address:	**Invoice Contact & Phone:**	**Purchase Order:**	**Quote/Bottle Order:**
	DEVIN CLARY 406-841-5029		

Special Report/Formats:

☐ DW
☐ POTW/WWTP
☐ State: _____
☐ Other: _____
☒ EDD/EDT (Electronic Data) Format: EXCEL
☐ LEVEL IV
☐ NELAC

ANALYSIS REQUESTED

SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	MATRIX (Number of Containers; Sample Type: A W S V B O DW; Air Water Soils/Solids Vegetation Bioassay Other DW - Drinking Water)	PARTICLE SIZE	NATURAL MOISTURE CONTENT	CATION EXCHANGE CAPACITY	pH	CONDUCTIVITY	NITRATE AS NITROGEN	TOTAL PHOSPHORUS	LIME REQUIREMENTS	ORGANIC MATTER	SEE ATTACHED	Standard Turnaround (TAT)	TOTAL POTASSIUM
1 BPB1A - GC-01	8-31-12	0845	1												
2 BPB1A - GC-02	8-29-12	0715	1												
3 BPB1A - GC-03	8-28-12	1545	1												
4 BPB1A - GC-04	8-28-12	1630	1												
5 BPB13 - GC-01	8-30-12	1100	1												
6 BPB13 - GC-02	8-30-12	1200	1												
7 BPB13 - GC-03	8-30-12	1240	1												
8 BPB13 - GC-04	8-30-12	1330	1												
9															
10															

RUSH — Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments:
✓ ABA
✓ ABA

Shipped by: third
Cooler ID(s): Totes
Receipt Temp: 26.9 °C
On Ice: Y (N)
Custody Seal: On Bottle Y N; On Cooler Y N
Intact: Y N
Signature Match: Y N

LABORATORY USE ONLY H12690018

Custody Record MUST be Signed

Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Janie Mongolden	8-31-12 / 1845		Sarah Seitz	8/31/12 1845	
S. SEITZ	9-4-12 / 13:09				

Received by Laboratory: Esther Merrill 9-4-12 13:19

Sample Disposal: Return to Client: _____ Lab Disposal: _____

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report.
Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

APPENDIX E5

RECLAMATION INVESTIGATION GEOTECHNICAL TESTING RESULTS

TABLE E5-1. RECLAMATION INVESTIGATION GEOTECHNICAL TESTING RESULTS - INDEX TESTS
BLACK PINE MINE

Location	Field Sample ID	Lab Sample ID	Date Sampled	Sample Location Description	Sample Depth (ft) [e]	ASTM D2487 General Material Description [a]	ASTM D2487 USCS Classification Based on Lab Testing	ASTM D2216 Moisture Content as Received (%)	ASTM D4318 Liquid Limit	ASTM D4318 Plastic Limit	ASTM D4318 Plasticity Index	OVERSIZE CORRECTED ASTM D4318 Atterberg Classification of Fines [b]	OVERSIZE CORRECTED AASHTO T99 C Maximum Dry Unit Weight (pcf)	OVERSIZE CORRECTED AASHTO T99 C Optimum Water Content (%)	Oversized Material (%)	AASHTO T85 Specific Gravity (-2 mm)	Percent of Total Fines (%)	Percent of Total Coarse (%)	AASHTO T100-03 Specific Gravity Weight Average	ASTM D5084 C Permeability (cm/sec)
RY-SS-01	BP-RY-SS-01-00	11182	7/12/2011	Repository 1	0 - 1.3	SILTY GRAVEL w/ SAND	GM	4.0	34	29	5	ML	128.0	10.7	18.4	2.559	25.43	74.57	2.670	
RY-SS-01	BP-RY-SS-01-02	11174	7/12/2011	Repository 1	1.3 - 2.7	Well graded GRAVEL w/ SILT & SAND	GW-GM	2.7	23	20	3	ML	132.6	6.4	21	2.659	11.62	88.38	2.703	
RY-SS-02	BP-RY-02-00	11180	7/12/2011	Repository 1	0 - 0.5	Well graded GRAVEL w/ SILT	GW-GM	4.3	62	52	10	MH	139.4	5.9	61.4	2.477	10.12	89.88	2.690	
RY-SS-02	BP-RY-02-01	11183	7/12/2011	Repository 1	0.5 - 2.7	SILTY GRAVEL	GM	6.8	34	28	6	ML	too coarse for Proctor test		---	2.635	18.04	81.96	2.661	
RY-SS-03	BP-RY-SS-03-00	11176	7/12/2011	Repository 2	0 - 1.5	SILTY GRAVEL	GM	3.8	22	21	1	ML	131.0	7.9	24.0	2.638	34.96	65.04	2.694	
RY-SS-03	BP-RY-SS-03-01	11178	7/12/2011	Repository 2	13	SILTY, CLAYEY COBBLES & GRAVEL	GC-GM	10.1	23	18	5	CL-ML	131.1	9.6	55.3	2.678	34.81	65.19	2.610	
RY-SS-04	BP-RY-SS-04-00	11181	7/12/2011	Repository 2	0 - 1.5	Well graded GRAVEL w/ SILT	GW-GM	7.5	22	20	2	ML	135.5 [d]	6.0 [d]	38.9	2.640	11.51	88.49	2.668	
RY-SS-04	BP-RY-SS-04-01	11175	7/12/2011	Repository 2	8	SILTY, CLAYEY COBBLES & GRAVEL, w/ SAND	GC-GM	5.5	19	15	4	ML	138.4	5.9	32.1	2.641	54.51	45.49	2.649	
RY-SS-05	BP-RY-SS-05-00	11177	7/12/2011	Repository 3	0.5 - 1.5	SILTY GRAVEL	GM	4.2	50	43	7	MH	115.8	9.5	40.9	2.426	22.76	77.24	2.634	
RY-SS-05	BP-RY-SS-05-01	11179	7/12/2011	Repository 3	5	Well graded GRAVEL	GW	4.1	21	20	1	ML	too coarse for Proctor test		---	2.650	2.91	97.09	2.701	
CML-TS-11 [f]	BP-CML-TS-11-08	11197	7/15/2011	Combination Mill Repository	8-10	CLAYEY GRAVEL w/ SAND	GC	not tested, missed by lab	35	14	21	CL	120.2 [d]	14.1 [d]	20.7	2.731	41.46	58.54	2.670	
MW-RY-06	BP-RY-06	11503	8/16/2011	Repository 2	3 - 12	GRAVELLY LEAN CLAY, w/ SAND	CL	14.5	46	16	30	CL	116.6 [c]	14.4 [c]	21	2.716	79.01	20.99	2.704	6.3E-07
MW-RY-07	BP-RY-07	11505	8/17/2011	Repository 2	0.5 - 3	SILTY GRAVEL w/ SAND	GM	6.4	31	30	1	ML	Sample volume too small for Proctor test		---	2.580	60.5	39.5	2.615	
MW-RY-08	BP-RY-08	11504	8/17/2011	Repository 2	8 - 10	SILTY GRAVEL w/ SAND	GM	4.0	19	17	2	ML	139.7 [d]	7.9 [d]	13.3	2.668	38.53	61.47	2.662	
HM-RS-06	BP-HM-RS-06	11184	7/13/2011	Harper Shaft waste rock	1 - 3	SILTY GRAVEL w/ SAND	GM	10.5	20	18	2	ML	134.9	7.8	43.3	2.628 [g]	36.84	63.16	2.619	
HM-RS-01	BP-HM-RS-01-05	11185	7/13/2011	Harrison Shaft waste rock	5	CLAYEY COBBLES & GRAVEL w/ SAND	GC	16.1	36	15	21	CL	121.9	12.8	23.7	2.631 [g]	58.99	41.01	2.650	
TS-RS-01	BP-TS-RS-01	11186	7/12/2011	Tim Smith No. 1 Adit waste rock	4 - 6	Well graded GRAVEL w/ SILT & SAND	GW-GM	not tested, missed by lab	NP	NP	NP	NP	135.5	7.6	23.6	2.637 [g]	43.59	56.41	2.650	
CMN-SS-09	BP-CMN-SS-09-00	11195	7/14/2011	Combination Mine N Soils Removal Area	0 - 1	SILTY, CLAYEY GRAVEL, w/ SAND	GC-GM	16.4	26	21	5	CL-ML	118.0	12.3	16.7	2.575 [g]	50.76	49.24	2.613	
CMN-SS-11	BP-CMN-SS-11-00	11196	7/14/2011	Combination Mine S Soils Removal Area	0 - 1	SILTY SAND w/ GRAVEL	SM	not tested, missed by lab	16	15	1	ML	128.5	9.1	19.4	2.632 [g]	70.05	29.95	2.635	

[a] General Material Descriptions generally do not include the oversized (cobbles) in the descriptions.
[b] Atterberg Limits performed on soil passing the #40 sieve.
[c] Proctor test performed using ASTM D698 Method A
[d] Proctor test performed using AASHTO T180 Method C
[e] Sample depths from HM-RS-06, HM-RS-01, TS-RS-01, CMN-SS-09, CMN-SS-11, and CML-SS-11 were listed as 0 in the lab reports. The correct depths are shown in Tables H-1 and H-2.
[f] Field sample CML-TS-11-08 was incorrectly listed in the lab reports as CMN-TS-11-08.
[g] Fine grained portion of samples screened to material passing the 4.75 mm screen, rather than the 2 mm screen.
cm/sec: centimeters per second
ft: feet
pcf: pounds per cubic foot
USCS: Unified Soil Classification System

TABLE E5-2. RECLAMATION INVESTIGATION GEOTECHNICAL TESTING RESULTS - PARTICLE SIZE DISTRIBUTION SUMMARY
BLACK PINE MINE

Location	Field Sample ID	Lab Sample ID	Date Sampled	Sample Location Description	Sample Depth (ft) [d]	ASTM D2487 General Material Description [a]	ASTM D2487 USCS Classification Based on Lab Testing	Particle Size Distribution ASTM D422 % Cobbles [b] Passing 3" sieve [c]	% Gravel	% Sand	% Silt	% Clay	Curvature Coefficient C_c $D_{30}^2/(D_{10}D_{60})$	Uniformity Coefficient C_u D_{60}/D_{10}
RY-SS-01	BP-RY-SS-01-00	11182	7/12/2011	Repository 1	0 - 1.3	SILTY GRAVEL w/ SAND	GM	100	62.2	20.3	14.2	3.3	40.98	491.95
RY-SS-01	BP-RY-SS-01-02	11174	7/12/2011	Repository 1	1.3- 2.7	Well graded GRAVEL w/ SILT & SAND	GW-GM	100	72.7	22.0	4.5	0.7	1.59	7.72
RY-SS-02	BP-RY-SS-02-00	11180	7/12/2011	Repository 1	0 - 0.5	Well graded GRAVEL w/ SILT	GW-GM	100	85.9	6.7	6.7	0.7	2.84	19.70
RY-SS-02	BP-RY-SS-02-01	11183	7/12/2011	Repository 1	0.5 - 2.7	SILTY GRAVEL	GM	~86	61.7	10.8	12.3	1.8	59.87	1142.05
RY-SS-03	BP-RY-SS-03-00	11176	7/12/2011	Repository 2	0 - 1.5	SILTY GRAVEL	GM	100	57.0	13.4	26.3	3.3	0.06	847.06
RY-SS-03	BP-RY-SS-03-01	11178	7/12/2011	Repository 2	13	SILTY, CLAYEY COBBLES & GRAVEL	GC-GM	~76	41.8	10.5	20.1	3.3	0.35	1082.36
RY-SS-04	BP-RY-SS-04-00	11181	7/12/2011	Repository 2	0 - 1.5	Well graded GRAVEL w/ SILT	GW-GM	100	80.9	12.6	5.6	0.9	2.53	14.61
RY-SS-04	BP-RY-SS-04-01	11175	7/12/2011	Repository 2	8	SILTY, CLAYEY COBBLES & GRAVEL, w/ SAND	GC-GM	100	43.5	17.9	30.5	8.0	0.08	1802.54
RY-SS-05	BP-RY-SS-05-00	11177	7/12/2011	Repository 3	0.5 - 1.5	SILTY GRAVEL	GM	100	70.9	12.1	15.7	1.2	39.73	613.41
RY-SS-05	BP-RY-SS-05-01	11179	7/12/2011	Repository 3	5	Well graded GRAVEL	GW	~87	78.3	6.6	2.0	0.2	1.39	6.05
CML-TS-11 [e]	BP-CML-TS-11-08	11197	7/15/2011	Combination Mill Repository	8-10	CLAYEY GRAVEL w/ SAND	GC	100	37.8	26.9	23.0	12.3	---	---
MW-RY-06	BP-RY-06	11503	8/16/2011	Repository 2	3 - 12	GRAVELLY LEAN CLAY, w/ SAND	CL	100	21.0	19.8	35.8	23.3	---	---
MW-RY-07	BP-RY-07	11505	8/17/2011	Repository 2	0.5 - 3	SILTY GRAVEL w/ SAND	GM	100	39.9	25.5	30.5	4.2	0.08	548.73
MW-RY-08	BP-RY-08	11504	8/17/2011	Repository 2	8 - 10	SILTY GRAVEL w/ SAND	GM	100	61.6	16.4	19.6	2.4	16.29	262.39
HM-RS-06	BP-HM-RS-06	11184	7/13/2011	Harper Shaft waste rock	1 - 3	SILTY GRAVEL w/ SAND	GM	100	63.2	16.9	16.2	3.7	0.50	671.46
HM-RS-01	BP-HM-RS-01-05	11185	7/13/2011	Harrison Shaft waste rock	5	CLAYEY COBBLES & GRAVEL w/ SAND	GC	100	41.0	17.6	27.3	14.1	---	---
TS-RS-01	BP-TS-RS-01	11186	7/12/2011	Tim Smith No. 1 Adit waste rock	4 - 6	Well graded GRAVEL w/ SILT & SAND	GW-GM	100	56.4	32.6	8.9	2.0	1.27	149.97
CMN-SS-09	BP-CMN-SS-09-00	11195	7/14/2011	Combination Mine N Soils Removal Area	0 - 1	SILTY, CLAYEY GRAVEL, w/ SAND	GC-GM	100	49.2	24.2	21.5	5.0	0.12	597.39
CMN-SS-11	BP-CMN-SS-11-00	11196	7/14/2011	Combination Mine S Soils Removal Area	0 - 1	SILTY SAND w/ GRAVEL	SM	100	30.0	30.9	30.6	8.5	2.2	106.31

[a] General Material Descriptions generally do not include the oversized (cobbles) in the descriptions.
[b] Boulders and large cobbles removed before placing samples in 5-gallon buckets.
[c] Percentages estimated from the Grain Size Distribution Charts.
[d] Sample depths for HM-RS-06, HM-RS-01, TS-RS-01, CMN-SS-09, CMN-SS-11, and CML-SS-11 were listed as 0 in the lab reports. The correct depths are shown in Tables H-1 and H-2.
[e] Field sample CML-TS-11-08 was incorrectly listed in the lab reports as CMN-TS-11-08.
ft: feet
USCS: Unified Soil Classification System

APPENDIX E6

RECLAMATION INVESTIGATION SOIL MOISTURE RESULTS

TABLE E6-1. RECLAMATION INVESTIGATION SOIL MOISTURE RESULTS
COMBINATION MILL AOC
BLACK PINE MINE

Sample ID	Location	Date Sampled	Sample Start Depth (ft)	Sample End Depth (ft)	Soil Moisutre (%)	Matrix	X	Y
CML-SD-37 (0-0.5 ft)	CML-SD-37	7/12/2011	0	0.5	3.8	Soil	988274.13	829339.22
CML-SD-29 (0-0.5 ft)	CML-SD-29	7/12/2011	0	0.5	6	Soil	988274.13	830339.22
CML-SD-27 (0-0.5 ft)	CML-SD-27	7/12/2011	0	0.5	7.3	Soil	988474.13	830339.22
CML-TS-07 (2-4 ft)	CML-TS-07	7/15/2011	2	4	8.2	Soil/Tailings	988722.44	829153.27
CML-SD-25 (0-0.5 ft)	CML-SD-25	7/12/2011	0	0.5	8.6	Soil	988374.13	830539.22
CML-SD-19 (0-0.5 ft)	CML-SD-19	7/13/2011	0	0.5	9.2	Soil	988574.13	830739.22
CML-SD-41 (0-0.5 ft)	CML-SD-41	7/12/2011	0	0.5	9.3	Soil	988174.13	829139.22
CML-SD-24 (0-0.5 ft)	CML-SD-24	7/12/2011	0	0.5	9.6	Soil	988474.13	830539.22
CML-SS-11 (1-3 ft)	CML-SS-11	7/15/2011	1	3	9.7	Soil/Tailings	988056.31	829211.96
CML-SD-33 (1-2 ft)	CML-SD-33	7/12/2011	1	2	10.1	Soil	988274.13	829739.22
CML-TS-01 (0-1 ft)	CML-TS-01	7/15/2011	0	1	10.7	Soil/Tailings	988616.41	830303.97
CML-TS-10 (0-1 ft)	CML-TS-10	7/15/2011	0	1	12	Soil/Tailings	988249.08	829777.32
CML-SS-11 (8-10 ft)	CML-SS-11	7/15/2011	8	10	12.5	Soil/Tailings	988056.31	829211.96
CML-SS-07 (5-7 ft)	CML-SS-07	7/15/2011	5	7	13.1	Soil	988722.44	829153.27
CML-SD-31 (0-0.5 ft)	CML-SD-31	7/12/2011	0	0.5	14.2	Soil	988274.13	830139.22
CML-TS-02 (0-1 ft)	CML-TS-02	7/15/2011	0	1	14.3	Soil/Tailings	988486.50	830048.85
CML-SD-42 (0-0.5 ft)	CML-SD-42	7/13/2011	0	0.5	15	Soil	988374.13	828939.22
CML-SD-01 (0-0.5 ft)	CML-SD-01	6/14/2011	0	0.5	15.2	Sediment	989313.06	838754.65
CML-SD-38 (0-0.5 ft)	CML-SD-38	7/12/2011	0	0.5	15.8	Soil	988174.13	829337.61
CML-SD-33 (0-0.5 ft)	CML-SD-33	7/12/2011	0	0.5	15.9	Soil	988274.13	829739.22
CML-TS-09 (4-6 ft)	CML-TS-09	7/15/2011	4	6	16.2	Soil/Tailings	988657.50	828897.92
CML-TS-06 (2-4 ft)	CML-TS-06	7/15/2011	2	4	16.4	Soil/Tailings	988459.01	829346.48
CML-SD-42 (2-3 ft)	CML-SD-42	7/13/2011	2	3	16.6	Soil	988374.13	828939.22
CML-SS-10 (6-7 ft)	CML-SS-10	7/15/2011	6	7	17.2	Soil	988236.27	829715.05
CML-SS-02 (6-7 ft)	CML-SS-02	7/15/2011	6	7	17.9	Soil	988486.50	830048.85
CML-SD-28 (0-0.5 ft)	CML-SD-28	7/12/2011	0	0.5	18	Soil	988374.13	830339.22
CML-SD-39 (0-0.5 ft)	CML-SD-39	7/13/2011	0	0.5	18.1	Soil	988374.13	829139.22
CML-SD-23 (2-3 ft)	CML-SD-23	7/13/2011	2	3	18.4	Soil	988574.13	830539.22
CML-TS-09 (2-4 ft)	CML-TS-09	7/15/2011	2	4	18.6	Soil/Tailings	988657.50	828897.92
CML-TS-06 (0-1 ft)	CML-TS-06	7/15/2011	0	1	19.8	Soil/Tailings	988459.01	829346.48
CML-TS-07 (0-1 ft)	CML-TS-07	7/15/2011	0	1	20.4	Soil/Tailings	988722.44	829153.27
CML-SD-36 (0-0.5 ft)	CML-SD-36	7/12/2011	0	0.5	20.5	Soil	988374.13	829339.22
CML-SD-26 (0-0.5 ft)	CML-SD-26	7/12/2011	0	0.5	20.7	Soil	988274.13	830539.22
CML-TS-04 (2-4 ft)	CML-TS-04	7/15/2011	2	4	20.8	Soil/Tailings	988406.32	829694.92
CML-SD-11 (0-0.5 ft)	CML-SD-11	6/14/2011	0	0.5	21	Sediment	989035.55	832376.49
CML-TS-04 (0-1 ft)	CML-TS-04	7/15/2011	0	1	21.2	Soil/Tailings	988406.32	829694.92
CML-SD-23 (0-0.5 ft)	CML-SD-23	7/13/2011	0	0.5	21.5	Soil	988574.13	830539.22
CML-SD-22 (0-0.5 ft)	CML-SD-22	7/13/2011	0	0.5	21.9	Soil	988647.45	830538.21
CML-SD-31 (2-3 ft)	CML-SD-31	7/12/2011	2	3	22.2	Soil	988274.13	830139.22
CML-SD-24 (1-2 ft)	CML-SD-24	7/12/2011	1	2	22.6	Soil	988474.13	830539.22
CML-TS-09 (6-8 ft)	CML-TS-09	7/15/2011	6	8	22.6	Soil/Tailings	988657.50	828897.92
CML-TS-05 (0-1 ft)	CML-TS-05	7/15/2011	0	1	23.3	Soil/Tailings	988516.20	829612.88
CML-TS-05 (2-4 ft)	CML-TS-05	7/15/2011	2	4	23.3	Soil/Tailings	988516.20	829612.88
CML-SD-30 (0-0.5 ft)	CML-SD-30	7/13/2011	0	0.5	23.7	Soil	988415.52	830223.41
CML-SS-08 (7-9 ft)	CML-SS-08	7/15/2011	7	9	23.7	Soil	988475.16	828988.49
CML-SD-21 (0-0.5 ft)	CML-SD-21	7/12/2011	0	0.5	24.3	Soil	988374.13	830739.22
CML-SS-04 (6-8 ft)	CML-SS-04	7/15/2011	6	8	24.6	Soil	988406.32	829694.92
CML-TS-10 (2-4 ft)	CML-TS-10	7/15/2011	2	4	25	Soil/Tailings	988249.08	829777.32
CML-SD-45 (0-0.5 ft)	CML-SD-45	7/12/2011	0	0.5	25.4	Soil	988274.13	828739.22
CML-SD-19 (2-3 ft)	CML-SD-19	7/13/2011	2	3	25.4	Soil	988574.13	830739.22
CML-TS-08 (0-1 ft)	CML-TS-08	7/15/2011	0	1	25.4	Soil/Tailings	988475.16	828988.49
CML-TS-03 (2-4 ft)	CML-TS-03	7/15/2011	2	4	25.5	Soil/Tailings	988666.65	829989.19

TABLE E6-1. RECLAMATION INVESTIGATION SOIL MOISTURE RESULTS
COMBINATION MILL AOC
BLACK PINE MINE

Sample ID	Location	Date Sampled	Sample Start Depth (ft)	Sample End Depth (ft)	Soil Moisutre (%)	Matrix	X	Y
CML-SD-09 (0-0.5 ft)	CML-SD-09	6/14/2011	0	0.5	26.1	Sediment	987927.78	836610.15
CML-SD-35 (0-0.5 ft)	CML-SD-35	7/12/2011	0	0.5	27	Soil	988174.13	829538.22
CML-SD-20 (2-3 ft)	CML-SD-20	7/12/2011	2	3	27.5	Soil	988474.13	830739.22
CML-SS-03 (6-7 ft)	CML-SS-03	7/15/2011	6	7	28.9	Soil	988666.65	829989.19
CML-SD-02 (0-0.5 ft)	CML-SD-02	6/15/2011	0	0.5	29.6	Sediment	988686.08	831557.87
CML-SD-32 (0-0.5 ft)	CML-SD-32	7/12/2011	0	0.5	29.7	Soil	988274.13	829939.22
CML-SD-10 (0-0.5 ft)	CML-SD-10	6/14/2011	0	0.5	30.1	Sediment	988519.66	834758.14
CML-SD-43 (0-0.5 ft)	CML-SD-43	7/12/2011	0	0.5	30.5	Soil	988274.13	828939.22
CML-SD-16 (0-0.5 ft)	CML-SD-16	6/16/2011	0	0.5	31	Sediment	988876.52	831915.39
CML-TS-08 (5-7 ft)	CML-TS-08	7/15/2011	5	7	34.5	Soil/Tailings	988475.16	828988.49
CML-TS-09 (0-1 ft)	CML-TS-09	7/15/2011	0	1	34.5	Soil/Tailings	988657.50	828897.92
CML-SD-15 (0-0.5 ft)	CML-SD-15	6/16/2011	0	0.5	35.1	Sediment	988585.66	834660.72
CML-SD-07 (0-0.5 ft)	CML-SD-07	6/14/2011	0	0.5	35.8	Sediment	988475.47	830441.94
CML-SD-20 (0-0.5 ft)	CML-SD-20	7/12/2011	0	0.5	36.4	Soil	988474.13	830739.22
CML-SD-08 (0-0.5 ft)	CML-SD-08	6/14/2011	0	0.5	36.5	Sediment	987914.93	836670.88
CML-SS-05 (4-6 ft)	CML-SS-05	7/15/2011	4	6	36.7	Soil	988516.20	829612.88
CML-SS-01 (6-7 ft)	CML-SS-01	7/15/2011	6	7	37.2	Soil	988616.41	830303.97
CML-SD-14 (0-0.5 ft)	CML-SD-14	6/16/2011	0	0.5	37.8	Sediment	988683.60	836351.89
CML-SD-13 (0-0.5 ft)	CML-SD-13	6/16/2011	0	0.5	38.2	Sediment	987973.86	836622.85
CML-TS-03 (0-1 ft)	CML-TS-03	7/15/2011	0	1	38.2	Soil/Tailings	988666.65	829989.19
CML-SD-44 (0-0.5 ft)	CML-SD-44	7/12/2011	0	0.5	38.4	Soil	988174.13	828939.22
CML-TS-02 (2-4 ft)	CML-TS-02	7/15/2011	2	4	38.4	Soil/Tailings	988486.50	830048.85
CML-SD-17 (0-0.5 ft)	CML-SD-17	6/16/2011	0	0.5	38.6	Sediment	988659.81	831282.58
CML-TS-01 (2-4 ft)	CML-TS-01	7/15/2011	2	4	40.1	Soil/Tailings	988616.41	830303.97
CML-SS-06 (5-7 ft)	CML-SS-06	7/15/2011	5	7	42.4	Soil	988459.01	829346.48
CML-SD-05 (0-0.5 ft)	CML-SD-05	6/14/2011	0	0.5	43.7	Sediment	987789.32	825202.77
CML-SD-03 (0-0.5 ft)	CML-SD-03	6/15/2011	0	0.5	43.8	Sediment	988786.48	829207.60
CML-SD-40 (0-0.5 ft)	CML-SD-40	7/12/2011	0	0.5	44.3	Soil	988274.13	829139.22
CML-SD-18 (0-0.5 ft)	CML-SD-18	7/13/2011	0	0.5	53.2	Soil	988624.20	830688.17
CML-SD-06 (0-0.5 ft)	CML-SD-06	6/13/2011	0	0.5	55.8	Sediment	988475.47	829216.35
CML-SD-46 (0-0.5 ft)	CML-SD-46	7/12/2011	0	0.5	60.7	Soil	988174.13	828739.22
CML-SD-34 (0-0.5 ft)	CML-SD-34	7/12/2011	0	0.5	62.7	Soil	988274.13	829539.22
CML-SD-04 (0-0.5 ft)	CML-SD-04	6/14/2011	0	0.5	67.7	Sediment	988269.43	828557.35

ft: feet

APPENDIX F

HISTORICAL SURFACE WATER METALS ANALYTICAL RESULTS – HISTORIC MINE AOC

TABLE F-1. HISTORICAL SURFACE WATER ANALYTICAL RESULTS - METALS
HISTORIC MINE AOC
BLACK PINE MINE

Location	Date Sampled	Metals Analysis[c]	Units	Antimony	Arsenic	Cadmium	Copper	Iron	Lead	Manganese	Mercury	Silver	Zinc
BPM-Seep	5/6/1998	Total	ug/L	4	**2**	ND(0.2)	11	250	ND(1)	ND(5)	NA*	ND(1)	ND(5)
MCSP-1	6/7/2001	Dissolved	ug/L	ND(50)	**ND(3)**	0.1	3	170	ND(3)	ND(10)	NA*	ND(3)	10
MCSP-1	7/18/2001	Dissolved	ug/L	ND(50)	**ND(3)**	2	3	80	ND(3)	ND(10)	NA*	ND(3)	ND(10)
MCSP-1	4/23/2004	Dissolved	ug/L	NA*	**ND(3)**	ND(0.1)	ND(1)	ND(30)	ND(3)	ND(10)	NA*	NA*	ND(10)
MCSP-1	5/31/2005	Dissolved	ug/L	NA*	**ND(3)**	ND(0.1)	4	ND(30)	ND(3)	ND(10)	NA*	NA*	ND(10)
MCSP-1	6/13/2011	Total Recoverable	ug/L	1.4	**1.6**	0.26	107	1080	2.9	15.4	0.045	ND(0.5)	**31.4**
Road cut	5/19/2011	Total Recoverable	ug/L	NA*	**3.3**	ND(0.08)	16.8	1810	5.3	16	NA*	NA*	9.2

[a] MT DEQ Risk Based Cleanup Guidelines (RBCG) Composite, Conservative Water Cleanup Guidelines for Recreational Visitors Table 7-11 (DEQ 1996)

[b] Carcinogenic risk of 5E-07

[c] For samples where both dissolved and total metals analysis were performed, the result shown is for the total metals analysis.

Bold values exceed DEQ RBCG values

Shading indicates relative concentrations values, dark represents higher relative concentrations

J and JB qualifiers not shown, refer to Table 3-19 for qualifiers on 2011 data

ug/L = micrograms per liter

NA* - Not Applicable or not analyzed

ND() - Analyte was not detected (reporting limit)

NS - A standard has not been adopted

APPENDIX G

SOIL AND ROCK CLASSIFICATION SYSTEMS AND METHODS

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]					Soil Classification	
					Group Symbol	Group Name[B]
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No.4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]		GW	Well-graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]		GP	Poorly graded gravel[F]
		Gravels with Fines More than 12% Fines[C]	Fines classify as ML or MH		GM	Silty gravel[F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel[F, G, H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[E]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]		SW	Well-graded sand[I]
			$Cu < 6$ and/or $1 > Cc > 3$[E]		SP	Poorly graded sand[I]
		Sands with Fines More than 12% Fines[D]	Fines classify as ML or MH		SM	Silty sand[G, H, I]
			Fines classify as CL or CH		SC	Clayey sand[G, H, I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	inorganic	PI >7 and plots on or above "A" line[J]		CL	Lean clay[K, L, M]
			PI < 4 or plots below "A" line[J]		ML	Silt[K, L, M]
		organic	Liquid limit - oven dried	< 0.75%	OL	Organic Clay[K, L, M, N]
			Liquid limit - not dried			Organic silt[K, L, M, O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line		CH	Fat clay[K, L, M]
			PI plots below "A" line		MH	Elastic silt[K, L, M]
		organic	Liquid limit - oven dried	< 0.75%	OH	Organic clay[K, L, M, P]
			Liquid limit - not dried			Organic silt[K, L, M, O]
Highly organic soils	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve.
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols:
- GW-GM well graded gravel with silt
- GW-GC well graded gravel with clay
- GP-GM poorly graded gravel with silt
- GP-GC poorly graded gravel with clay

[D] Sands with 5 to 12% fines require dual symbols:
- SW-GM well graded sand with silt
- SW-GC well graded sand with clay
- SP-GM poorly graded sand with silt
- SP-GC poorly graded sand with clay

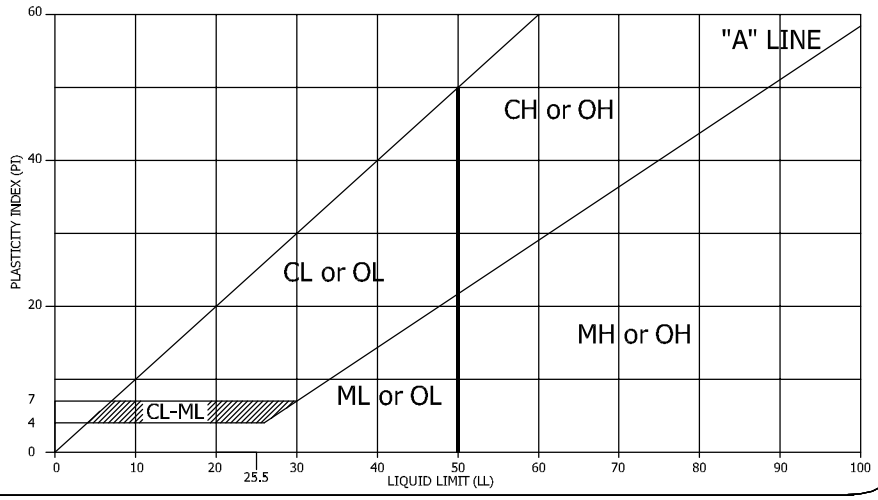
[E]
$$Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

[F] If soil contains ≥ 15% sand , add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with Gravel", whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] if soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.

For classification of fine-grained soils and fine-grained fraction of coarse-grained soils.

Equation of "A" Line
Horizontal at PI = 4 to LL + 25.5.
then PI = 0.73 (LL -20)



DRAWN BY: SB 04/24/2001 REVIEWED BY: TS

Table 6: Classification of individual parameters used in the Tunnelling Quality Index *Q*

DESCRIPTION	VALUE	NOTES
1. ROCK QUALITY DESIGNATION	***RQD***	
A. Very poor	0 - 25	1. Where *RQD* is reported or measured as ≤ 10 (including 0),
B. Poor	25 - 50	a nominal value of 10 is used to evaluate *Q*.
C. Fair	50 - 75	
D. Good	75 - 90	2. *RQD* intervals of 5, i.e. 100, 95, 90 etc. are sufficiently
E. Excellent	90 - 100	accurate.
2. JOINT SET NUMBER	J_n	
A. Massive, no or few joints	0.5 - 1.0	
B. One joint set	2	
C. One joint set plus random	3	
D. Two joint sets	4	
E. Two joint sets plus random	6	
F. Three joint sets	9	1. For intersections use ($3.0 \times J_n$)
G. Three joint sets plus random	12	
H. Four or more joint sets, random,	15	2. For portals use ($2.0 \times J_n$)
heavily jointed, 'sugar cube', etc.		
J. Crushed rock, earthlike	20	
3. JOINT ROUGHNESS NUMBER	J_r	
a. Rock wall contact		
b. Rock wall contact before 10 cm shear		
A. Discontinuous joints	4	
B. Rough and irregular, undulating	3	
C. Smooth undulating	2	
D. Slickensided undulating	1.5	1. Add 1.0 if the mean spacing of the relevant joint set is
E. Rough or irregular, planar	1.5	greater than 3 m.
F. Smooth, planar	1.0	
G. Slickensided, planar	0.5	2. J_r = 0.5 can be used for planar, slickensided joints having
c. No rock wall contact when sheared		lineations, provided that the lineations are oriented for
H. Zones containing clay minerals thick	1.0	minimum strength.
enough to prevent rock wall contact	(nominal)	
J. Sandy, gravely or crushed zone thick	1.0	
enough to prevent rock wall contact	(nominal)	
4. JOINT ALTERATION NUMBER	J_a	ϕr degrees (approx.)
a. Rock wall contact		
A. Tightly healed, hard, non-softening,	0.75	1. Values of ϕr, the residual friction angle,
impermeable filling		are intended as an approximate guide
B. Unaltered joint walls, surface staining only	1.0	25 - 35 to the mineralogical properties of the
C. Slightly altered joint walls, non-softening	2.0	25 - 30 alteration products, if present.
mineral coatings, sandy particles, clay-free		
disintegrated rock, etc.		
D. Silty-, or sandy-clay coatings, small clay-	3.0	20 - 25
fraction (non-softening)		
E. Softening or low-friction clay mineral coatings,	4.0	8 - 16
i.e. kaolinite, mica. Also chlorite, talc, gypsum		
and graphite etc., and small quantities of swelling		
clays. (Discontinuous coatings, 1 - 2 mm or less)		

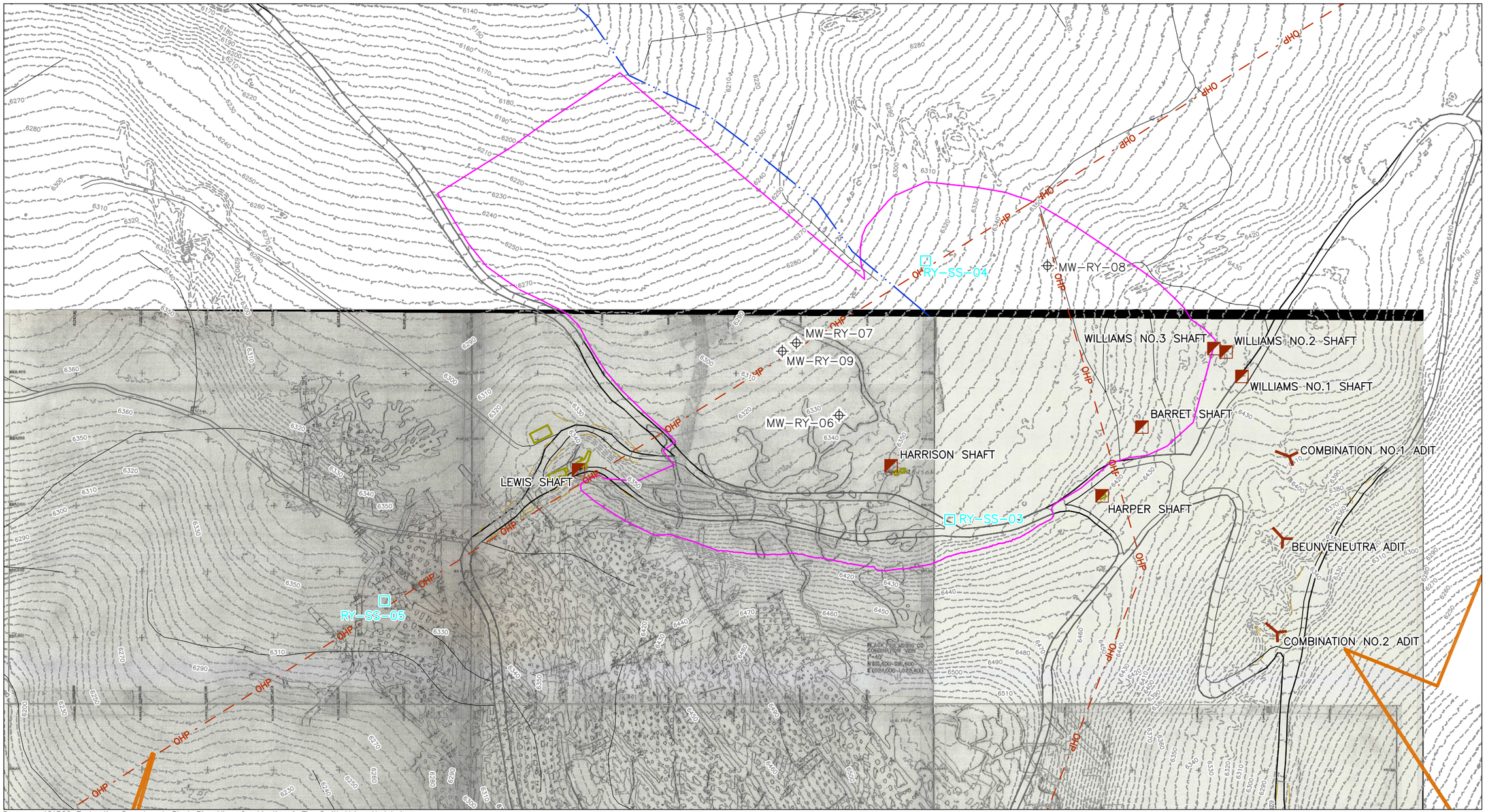
Table 6: (cont'd.) Classification of individual parameters used in the Tunnelling Quality Index *Q* (After Barton et al 1974).

4, JOINT ALTERATION NUMBER	J_a	ϕr degrees (approx.)	
b. Rock wall contact before 10 cm shear			
F. Sandy particles, clay-free, disintegrating rock etc.	4.0	25 - 30	
G. Strongly over-consolidated, non-softening clay mineral fillings (continuous < 5 mm thick)	6.0	16 - 24	
H. Medium or low over-consolidation, softening clay mineral fillings (continuous < 5 mm thick)	8.0	12 - 16	
J. Swelling clay fillings, i.e. montmorillonite, (continuous < 5 mm thick). Values of J_a depend on percent of swelling clay-size particles, and access to water.	8.0 - 12.0	6 - 12	
c. No rock wall contact when sheared			
K. Zones or bands of disintegrated or crushed	6.0		
L. rock and clay (see G, H and J for clay	8.0		
M. conditions)	8.0 - 12.0	6 - 24	
N. Zones or bands of silty- or sandy-clay, small clay fraction, non-softening	5.0		
O. Thick continuous zones or bands of clay	10.0 - 13.0		
P. & R. (see G.H and J for clay conditions)	6.0 - 24.0		
5. JOINT WATER REDUCTION	J_w	approx. water pressure (kgf/cm^2)	
A. Dry excavation or minor inflow i.e. < 5 l/m locally	1.0	< 1.0	
B. Medium inflow or pressure, occasional outwash of joint fillings	0.66	1.0 - 2.5	
C. Large inflow or high pressure in competent rock with unfilled joints	0.5	2.5 - 10.0	1. Factors C to F are crude estimates; increase J_w if drainage installed.
D. Large inflow or high pressure	0.33	2.5 - 10.0	
E. Exceptionally high inflow or pressure at blasting, decaying with time	0.2 - 0.1	> 10	2. Special problems caused by ice formation are not considered.
F. Exceptionally high inflow or pressure	0.1 - 0.05	> 10	
6. STRESS REDUCTION FACTOR		***SRF***	
a. Weakness zones intersecting excavation, which may cause loosening of rock mass when tunnel is excavated			
A. Multiple occurrences of weakness zones containing clay or chemically disintegrated rock, very loose surrounding rock any depth)		10.0	1. Reduce these values of *SRF* by 25 - 50% but only if the relevant shear zones influence do not intersect the excavation
B. Single weakness zones containing clay, or chemically disintegrated rock (excavation depth < 50 m)		5.0	
C. Single weakness zones containing clay, or chemically disintegrated rock (excavation depth > 50 m)		2.5	
D. Multiple shear zones in competent rock (clay free), loose surrounding rock (any depth)		7.5	
E. Single shear zone in competent rock (clay free). (depth of excavation < 50 m)		5.0	
F. Single shear zone in competent rock (clay free). (depth of excavation > 50 m)		2.5	
G. Loose open joints, heavily jointed or 'sugar cube', (any depth)		5.0	

Reference: Hoek, E. 2007. Practical Rock Engineering.
http://www.rocscience.com/hoek/corner/Practical_Rock_Engineering.pdf. 237 p.

APPENDIX H

GEOREFERENCED MAPS IN PROPOSED REPOSITORY AREA



Basemap: ASARCO Exploration Department, Black Pine Mine, Combination & Tim Smith Veins, Undated.

EXPLANATION

- EXISTING GROUND SURFACE CONTOURS (5' INTERVALS)
- PROPERTY BOUNDARY
- EDGE OF ROAD
- OHP — OVERHEAD POWER
- STREAMS
- BUILDING
- PROPOSED REPOSITORY AREA
- SHAFT
- ADIT
- MW-RY-06 — BORING LOCATION AND DESIGNATION
- RY-SS-05 — TEST PIT LOCATION AND DESIGNATION
- RY — REPOSITORY
- SS — SOIL
- MW — MONITORING WELL

N

0 300'

NOTE

UNDERGROUND MINE MAPS HAVE BEEN GEOREFERENCED BASED ON COORDINATE SYSTEM AND SURFACE FEATURES, LOCATIONS ARE APPROXIMATE.

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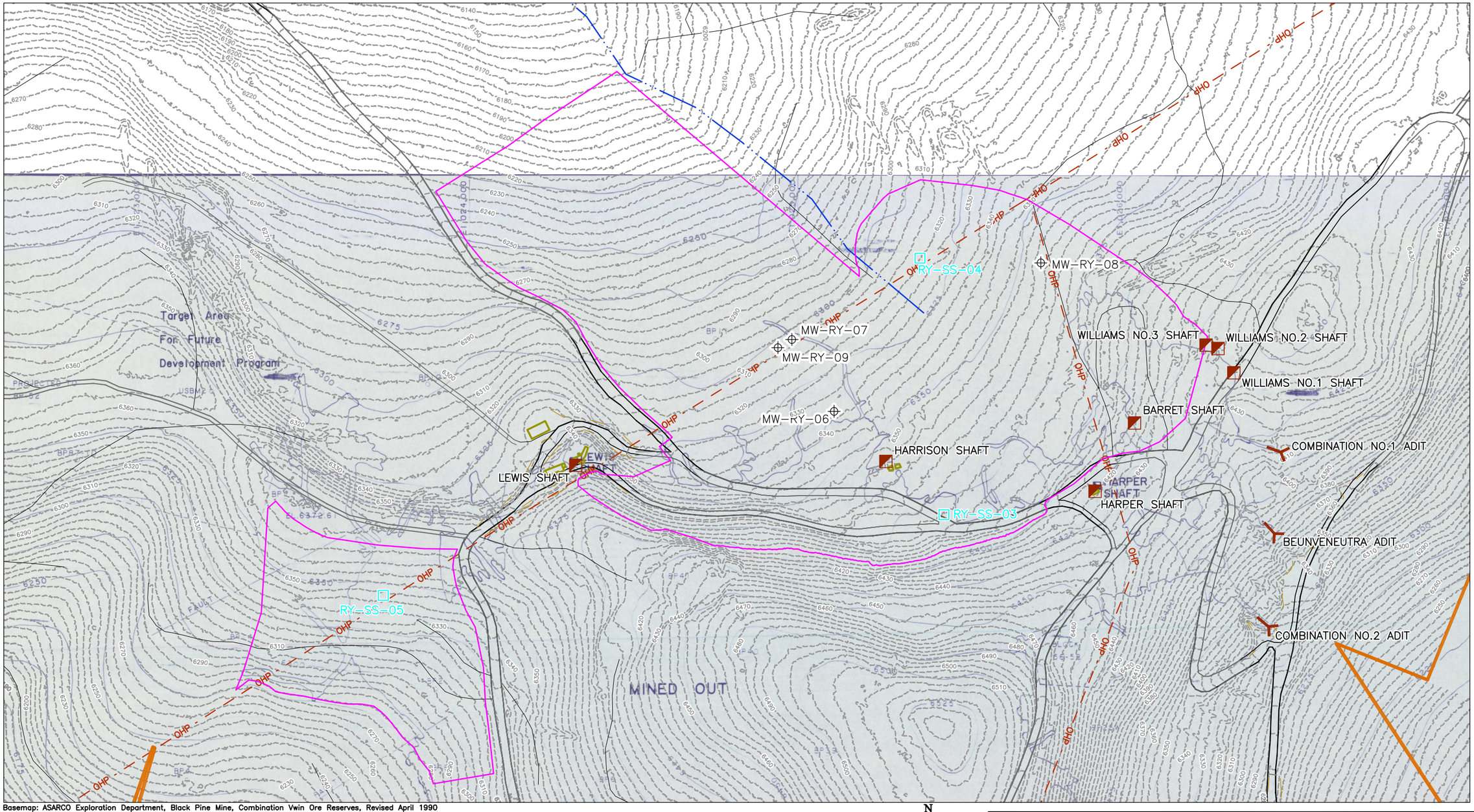
FIGURE 1

UNDATED HISTORIC COMBINATION VEINS MINE MAP

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
ABANDONED MINE LANDS BUREAU

Drawn By: DRT	Checked By: MRD	Scale: 1"=300'	Date: 4/10/12	File: 776_UNDATED_COMB_VEIN



Basemap: ASARCO Exploration Department, Black Pine Mine, Combination Vwin Ore Reserves, Revised April 1990

EXPLANATION

- EXISTING GROUND SURFACE CONTOURS (5' INTERVALS)
- PROPERTY BOUNDARY
- EDGE OF ROAD
- OHP — OVERHEAD POWER
- STREAMS
- BUILDING
- PROPOSED REPOSITORY AREA
- SHAFT
- ADIT
- MW-RY-06 — PROPOSED BORING LOCATION AND DESIGNATION
- RY-SS-05 — PROPOSED TEST PIT LOCATION AND DESIGNATION
- RY — REPOSITORY
- SS — SOIL
- MW — MONITORING WELL

N

0 300'

NOTE

UNDERGROUND MINE MAPS HAVE BEEN GEOREFERENCED BASED ON COORDINATE SYSTEM AND SURFACE FEATURES, LOCATIONS ARE APPROXIMATE.

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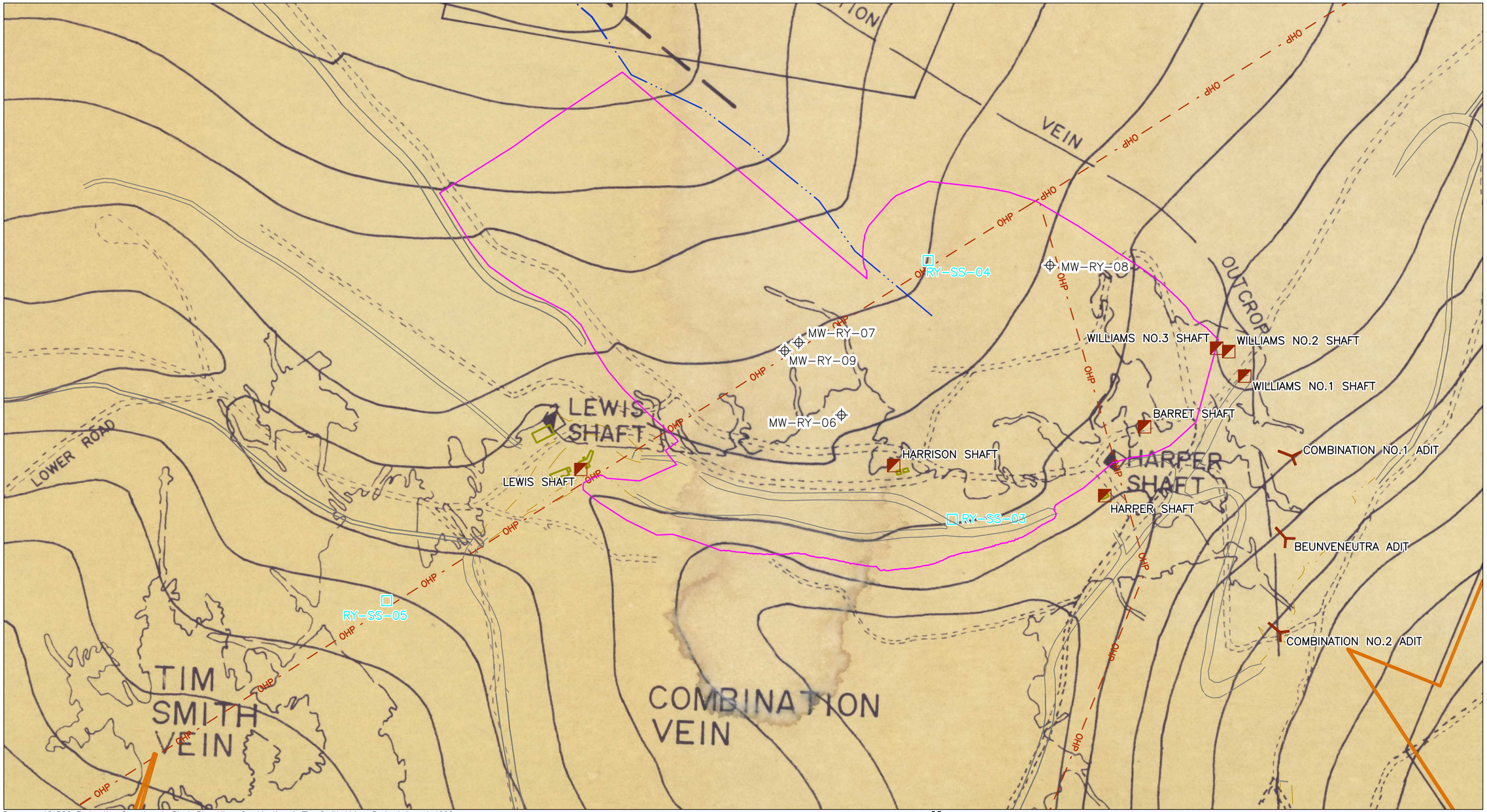
FIGURE 2

1990 COMBINATION VEIN ORE RESERVES MAP

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
ABANDONED MINE LANDS BUREAU

Drawn By: DRT	Checked By: MRD	Scale: 1"=300'	Date: 4/10/12	File: 776_1990_COMB_VEIN



Basemap: ASARCO Exploration Department, Black Pine Mine, Combination & Tim Smith Veins, Revised August 1990.

EXPLANATION

- EXISTING GROUND SURFACE CONTOURS (5' INTERVALS) (6250)
- PROPERTY BOUNDARY
- EDGE OF ROAD
- OVERHEAD POWER (OHP)
- STREAMS
- BUILDING
- PROPOSED REPOSITORY AREA
- SHAFT
- ADIT
- MW-RY-06 BORING LOCATION AND DESIGNATION
- RY-SS-05 TEST PIT LOCATION AND DESIGNATION
- RY REPOSITORY
- SS SOIL
- MW MONITORING WELL

N

0 300'

NOTE

UNDERGROUND MINE MAPS HAVE BEEN GEOREFERENCED BASED ON COORDINATE SYSTEM AND SURFACE FEATURES, LOCATIONS ARE APPROXIMATE.

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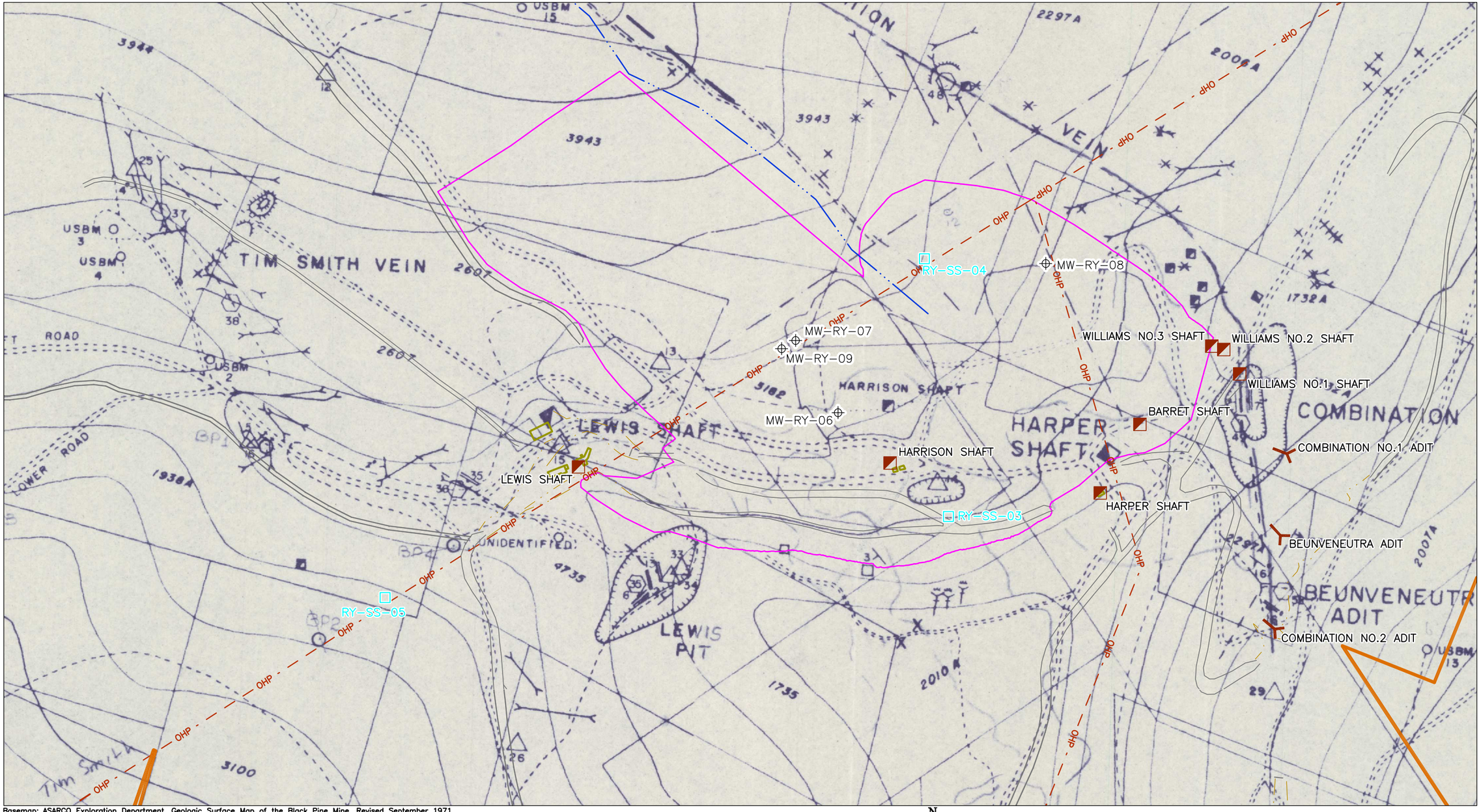
FIGURE 3

1990 COMBINATION & TIM SMITH VEINS MINE MAP

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
ABANDONED MINE LANDS BUREAU

Drawn By: DRT	Checked By: MRD	Scale: 1"=300'	Date: 4/10/12	File: 776_MINE_MAP_1990_ZOOM



Basemap: ASARCO Exploration Department, Geologic Surface Map of the Black Pine Mine, Revised September 1971

EXPLANATION

- EXISTING GROUND SURFACE CONTOURS (5' INTERVALS)
- PROPERTY BOUNDARY
- EDGE OF ROAD
- OHP — OVERHEAD POWER
- STREAMS
- BUILDING
- PROPOSED REPOSITORY AREA
- SHAFT
- ADIT
- MW-RY-06 — BORING LOCATION AND DESIGNATION
- RY-SS-05 — TEST PIT LOCATION AND DESIGNATION
- RY — REPOSITORY
- SS — SOIL
- MW — MONITORING WELL

N

0 300'

NOTE

UNDERGROUND MINE MAPS HAVE BEEN GEOREFERENCED BASED ON COORDINATE SYSTEM AND SURFACE FEATURES, LOCATIONS ARE APPROXIMATE.

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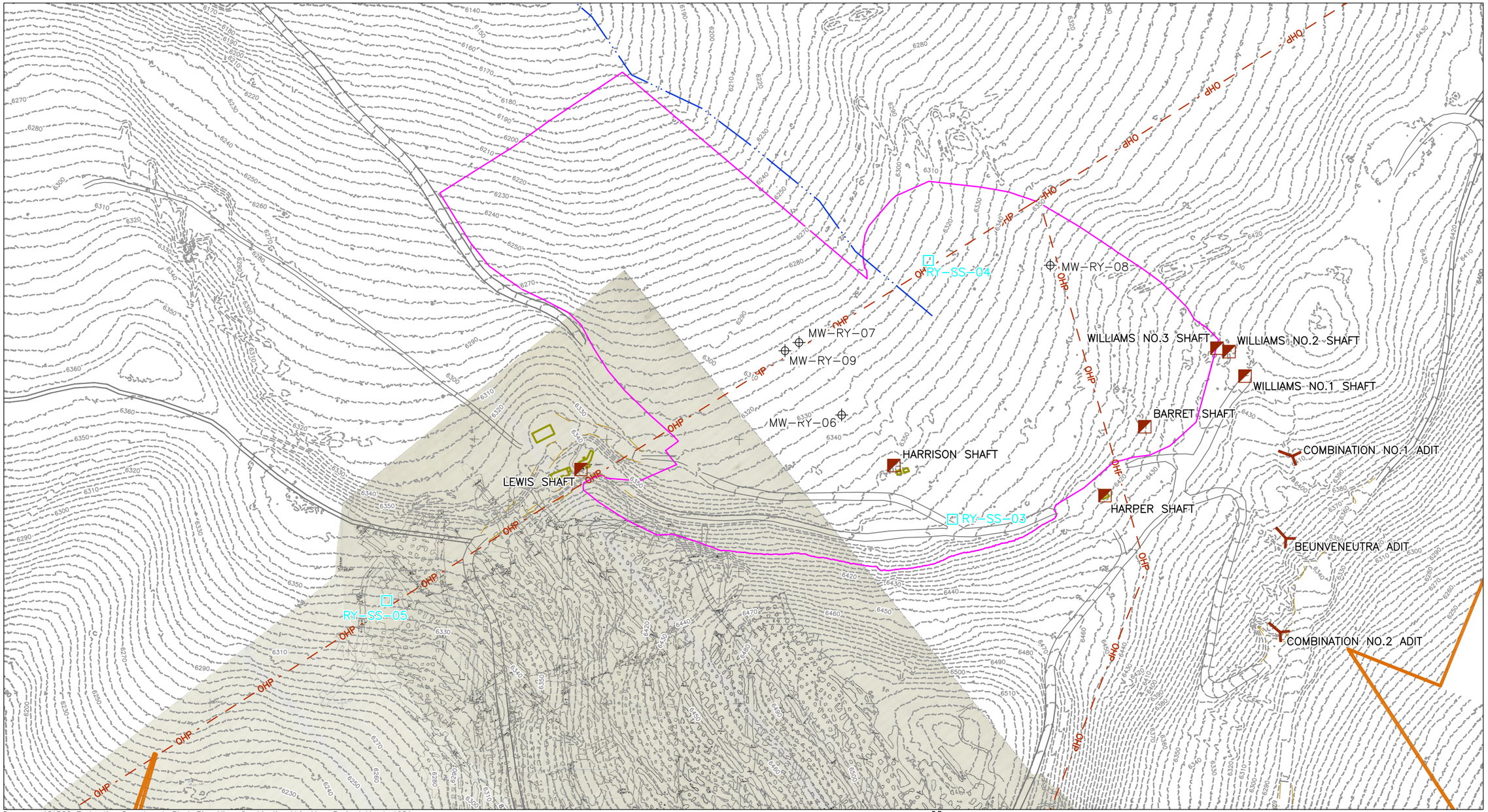
FIGURE 4

1971 GEOLOGICAL SURFACE MAP

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
ABANDONED MINE LANDS BUREAU

Drawn By: DRT	Checked By: MRD	Scale: 1"=300'	Date: 4/10/12	File: 776_1971_GEOLOGICAL



Basemap: ASARCO Exploration Department, Black Pine Mine, Combination Vein Map, Revised March 1981.

EXPLANATION

- EXISTING GROUND SURFACE CONTOURS (5' INTERVALS)
- PROPERTY BOUNDARY
- EDGE OF ROAD
- OVERHEAD POWER
- STREAMS
- BUILDING
- PROPOSED REPOSITORY AREA
- SHAFT
- ADIT
- MW-RY-06 BORING LOCATION AND DESIGNATION
- RY-SS-05 TEST PIT LOCATION AND DESIGNATION
- RY REPOSITORY
- SS SOIL
- MW MONITORING WELL

N

0 300'

NOTE

UNDERGROUND MINE MAPS HAVE BEEN GEOREFERENCED BASED ON COORDINATE SYSTEM AND SURFACE FEATURES, LOCATIONS ARE APPROXIMATE.

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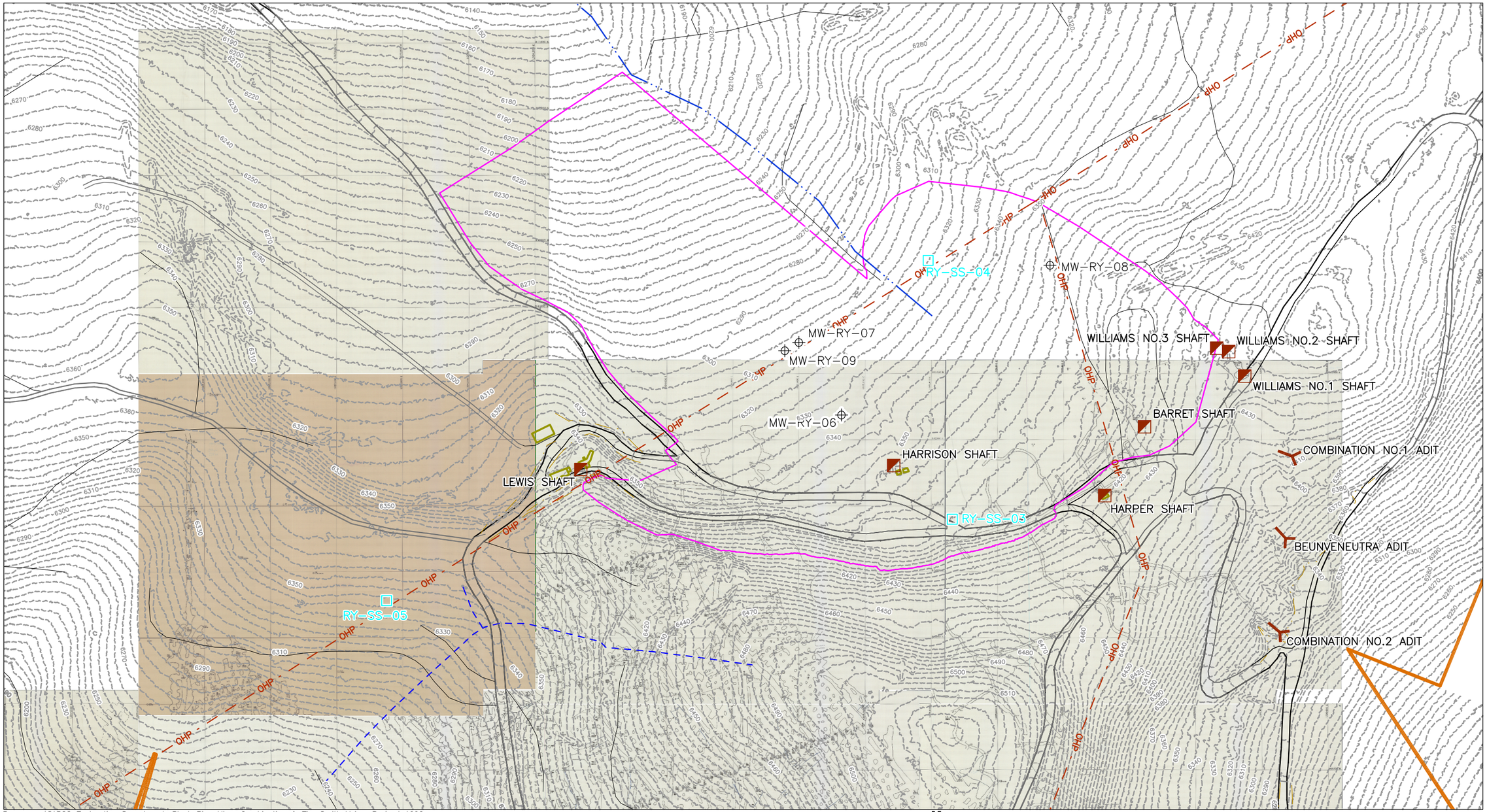
FIGURE 5

1981 COMBINATION VEIN MINE MAP

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
ABANDONED MINE LANDS BUREAU

Drawn By: DRT	Checked By: MRD	Scale: 1"=300'	Date: 4/10/12	File: 776_1981_COMB_VEIN



Basemap: ASARCO Exploration Department, Black Pine Mine, Combination & Tim Smith Veins, Revised 1990.

EXPLANATION

- EXISTING GROUND SURFACE CONTOURS (5' INTERVALS)
- PROPERTY BOUNDARY
- EDGE OF ROAD
- OHP — OVERHEAD POWER
- STREAMS
- BUILDING
- PROPOSED REPOSITORY AREA
- SHAFT
- ADIT
- MW-RY-06 — BORING LOCATION AND DESIGNATION
- RY-SS-05 — TEST PIT LOCATION AND DESIGNATION
- RY — REPOSITORY
- SS — SOIL
- MW — MONITORING WELL

N

0 300'

NOTE

UNDERGROUND MINE MAPS HAVE BEEN GEOREFERENCED BASED ON COORDINATE SYSTEM AND SURFACE FEATURES, LOCATIONS ARE APPROXIMATE.

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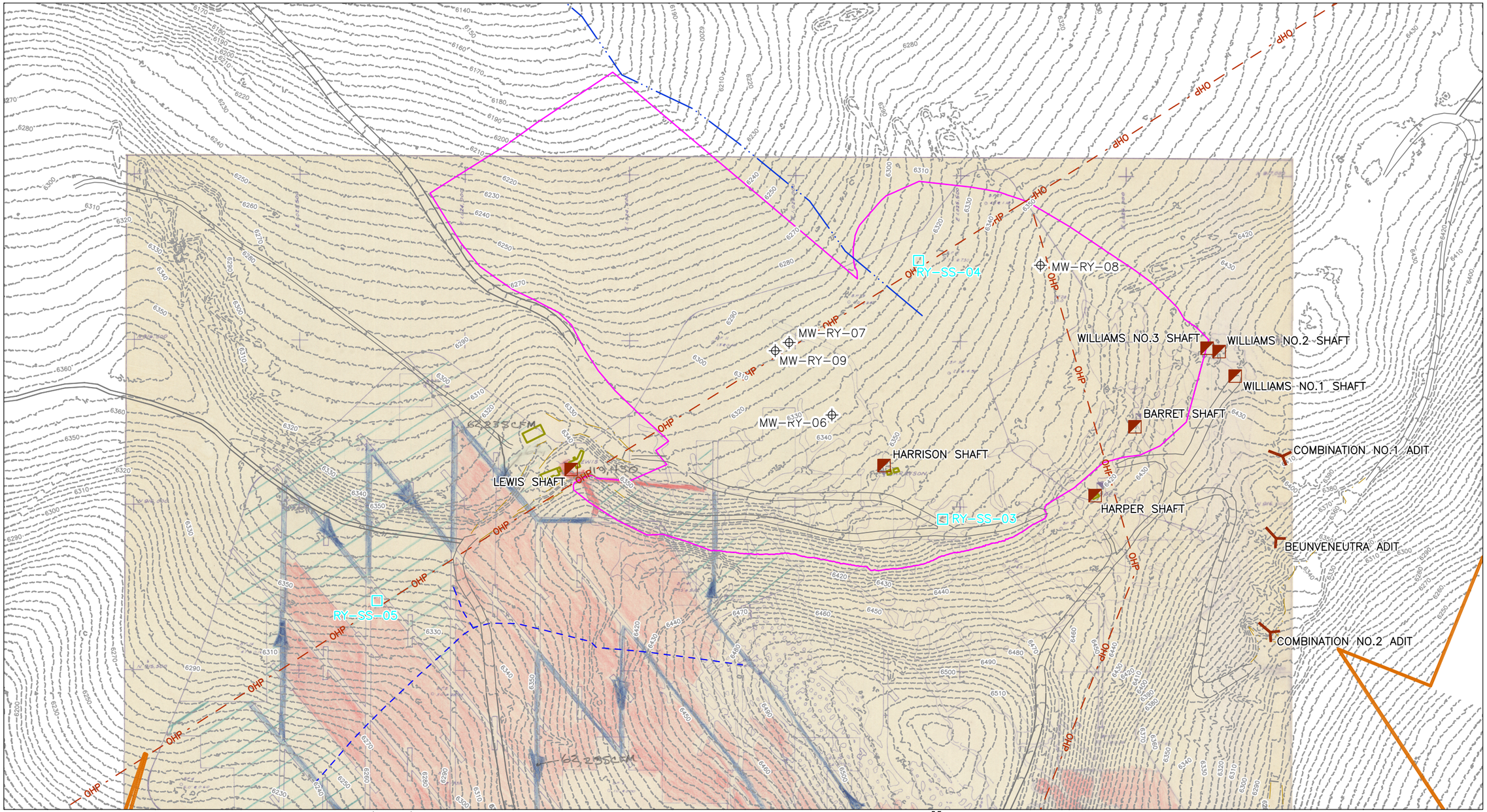
FIGURE 6

COMBINATION VEINS MINE MAP

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
ABANDONED MINE LANDS BUREAU

Drawn By: DRT	Checked By: MRD	Scale: 1"=300'	Date: 4/10/12	File: 776_COMB_VEIN



Basemap: ASARCO Exploration Department, Black Pine Mine, Development Map, Revised 1984 (Estimated).

EXPLANATION

- EXISTING GROUND SURFACE CONTOURS (5' INTERVALS)
- PROPERTY BOUNDARY
- EDGE OF ROAD
- OVERHEAD POWER
- STREAMS
- BUILDING
- PROPOSED REPOSITORY AREA
- SHAFT
- ADIT
- MW-RY-06 BORING LOCATION AND DESIGNATION
- RY-SS-05 TEST PIT LOCATION AND DESIGNATION
- RY REPOSITORY
- SS SOIL
- MW MONITORING WELL

N

0 300'

NOTE

UNDERGROUND MINE MAPS HAVE BEEN GEOREFERENCED BASED ON COORDINATE SYSTEM AND SURFACE FEATURES, LOCATIONS ARE APPROXIMATE.

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FIGURE 7

1984 DEVELOPMENT MINE MAP

BLACK PINE MINE RECLAMATION PROJECT
MONTANA DEQ
ABANDONED MINE LANDS BUREAU

Drawn By: DRT	Checked By: MRD	Scale: 1"=300'	Date: 4/10/12	File: 776_1984_DEVELOPMENT