**Black Iron, LLC**

RECEIVED
NOV 0 8 2019
Utah Division of Water Quality

November 1, 2019

Mr. Dan Hall, Groundwater Protection Section Manager
Division of Water Quality
Utah Department of Environmental Quality
P.O. Box 144870
Salt Lake City, Utah 84114-4870

DWQ-2019-016801

Dear Mr. Hall,

Black Iron, LLC, is the owner of the Iron Mountain Mine, also known as the Iron Springs District mining operation, southwest of Cedar City. Iron Mountain has a long history of production of magnetite and hematite iron ore going back to pioneer days with major development occurring during World War II and afterwards. Iron ore was shipped by various mining companies to steel mills in Utah, Colorado, and California. Most recently, mining was conducted by CML Metals Corporation (CML) who shipped crushed ore and iron concentrate to the west coast for export to international customers. During the CML operations, milled ore was beneficiated with a flotation process that separated the ground magnetite from the rest of the ore using standard flotation reagents. Iron concentrate from the flotation process was dewatered and dried prior to loading into rail cars and the flotation tailings were dewatered and placed on top of former waste rock dumps. This tailings management process was permitted by the Utah Division of Water Quality (DWQ) with a Ground Water Discharge Permit by Rule issued by DWQ on January 26, 2011.

Due to adverse market conditions where iron ore prices decreased significantly, CML shut down all operations in October 2014 and placed the facilities in care and maintenance condition. The shutdown of operations was a major blow to the economy of Cedar City and Iron County.

In January 16, 2015, CML submitted an application for a Groundwater Discharge Permit to dispose of mill tailings slurry in two mined-out open pits, Blowout and Blackhawk. Tailings would be pumped from the mill to the open pits through an HDPE pipe laid on the ground surface. Reclaim water from the pits would be returned to the mill through another HDPE pipe laid next to the tailings slurry pipeline. Chemical analyses of the tailings solids and water were submitted in the permit application and showed the proposed tailings management in the open pits should not be a source of groundwater contamination. The DWQ found that permit

6249 W Gilbert Industrial Ct. Hurricane, UT 84737 435-627-1907

application to be complete in a letter dated March 11, 2015 and on March 25, 2015 provided a draft Groundwater Discharge Permit and five questions for CML to answer prior to proceeding with permitting the proposed tailings management system. CML did not complete permitting of the proposed tailings management system.

Even after all the past operations, the property is very attractive and remains the largest known iron ore deposit in the western U.S. that also has ready access to water, power, transportation and nearby urban infrastructure to support a skilled workforce. Black Iron, LLC took over the property from CML in April 2015 and is currently planning to reopen operations of the open pit mine and produce crushed ore and iron concentrate for rail shipment to international customers. Gilbert Development Corporation (GDC) has had an association with the mine that goes back decades as the contract mining company for CML and former mine owners going back to the 1980s. They will continue this association going forward.

As part of Black Iron's plans to reopen production at the mine, it proposes to revise the milling process and tailings management system compared to what was described in the previous CML permit application for a Ground Water Discharge Permit. The specific changes are:

1. Replace the previous flotation concentration circuit with a two-step magnetic separation process. This eliminates the need to condition the ground ore slurry with pH modifiers and certain reagents prior to treatment in the flotation circuit. This eliminates these chemicals from the tailings water characteristics.

2. Makeup water for the mill will be culinary water obtained from Cedar City via a 13-mile pipeline from the city to the mill that has already been installed as well as water pumped from the Mountain Lion pit. This minimizes use of local groundwater at the mine for makeup water and ensures that a component of the makeup water meets drinking water characteristics.

3. The tailings and reclaim water pipelines will have the same design as before but will be relocated compared to the previous proposed alignment allowing a shorter length for these pipelines.

4. Tailings will still be stored in the same open pits as previously proposed but instead of placing tailings slurry in both pits, tailings slurry will be deposited only in the Blowout Pit and supernatant water from that pit will be pumped to the adjacent Blackhawk Pit for further clarification and storage before being pumped back to the mill.

Due to the above described changes, Black Iron believes that the proposed tailings management system is very similar to that previously proposed by CML and reviewed by DWQ but will present even less environmental risk than the CML proposal. Because of this, Black Iron believes the previous CML application can be modified to reflect the applicable changes and resubmitted to the DWQ for completion of the permitting process that was started for the CML permit application. We are also conducting permitting actions for this tailings management system with the Cedar City Bureau of Land Management and the Utah Division of Oil, Gas and Mining.

We are hereby resubmitting the previous CML application for a Ground Water Discharge Permit, which has been updated with Black Iron information and revised to show the current proposal. We hope the prior DWQ completeness determination and drafting of a Ground Water Discharge Permit will facilitate an early completion of the permitting process started by CML because we would like to complete construction of the tailings pipelines before this coming winter.

We appreciate your timely consideration of this permitting action and request your response as to what you think the timeframe will be to complete this permitting process.

Sincerely,

Steve L. Gilbert
Manager, Managing Member

RECEIVED
NOV 08 2019
Utah Division of Water Quality

# GROUND WATER DISCHARGE PERMIT APPLICATION

## *For*

## Black Iron, LLC

## Tailings Disposal Project

November 2019

***Black Iron, LLC***
*6249 W Gilbert Industrial Court*
*Hurricane, UT 84737*

## Table of Contents

**List of Tables**



**Figures**



**Appendices**

**Acronyms and Abbreviations**

| | |
|---|---|
| CML | CML Metals Corporation |
| $CuFeS_2$ | chalcopyrite |
| DOGM | Department of Oil, Gas, and Mining |
| DWQ | Department of Water Quality |
| $FeS_2$ | pyrite |
| GWDPBR | groundwater permit-by-rule |
| HDPE | high-density polyethylene |
| LMO | large mine operation |
| MCP | magnetic concentrate plant |
| Mg/L | milligrams per liter |
| MSDS | Material Safety Data Sheet |
| NAICS | North American Industry Classification System |
| NOI | Notice of Intent |
| SAG | semi-autonomous grinding |
| SF/day | square feet per day |
| SIC | standard industrial classification |
| SITLA | School Institutional Trust Lands Administration |
| SLBM | Salt Lake Base Meridian |
| SPLP | Synthetic Precipitation Leach Procedure |
| WLIMS | Wet Low Intensity Magnetic Separation |
| UTM | Universal Transverse Mercator |

# 1.0 General Facility Information

## 1.1 Introduction

Black Iron, LLC (Black Iron) owns the Comstock/Mountain Lion open pit located in the Iron Springs District, west of Cedar City, Utah (Figure 1) and plans to begin operating it once all permits are in place. The mill grade iron ore extracted from the open pit will be processed on site via crushing and wet grinding methods, followed by magnetic separation to remove the magnetite particles from the rest of the ground ore slurry. The magnetite concentrate will be dewatered through slurry thickening followed by filtering and stockpiled near the loadout facilities, while the tailings slurry from the extraction process will be conveyed for disposal in two mined-out open pits southwest of the mill.

Black Iron is proposing to install a tailings pipeline and reclaim water pipeline that would transport tailings from the current milling facilities to two existing pits (Blackhawk and Blowout) located on the southern flank of Iron Mountain (Figure 2). The tails would initially be transported as slurry to the Blowout pit, where they would be allowed to settle and assist in backfilling the existing disturbance. The supernatant tailings water would be pumped from the Blowout pit into the adjacent Blackhawk pit for further clarification and storage and then conveyed in the reclaim water pipeline back to the mill. When the Blowout pit tailings capacity is reached, tailings slurry will be directed to the Blackhawk pit.

## 1.2 Administrative Information

**Facility Name** Iron Mountain Facilities

**Address** Black Iron, LLC
6249 W Gilbert Industrial Court
Hurricane, UT 847337

**Contact Information**

Phone: (435) 627-1907
Attn: Steve L. Gilbert, Manager and Managing Member

**Authorized Company Representative**

Steve Gilbert, Manager and Managing Member, is duly authorized to represent Black Iron with regard to this application for a ground water discharge permit for the Tailings Disposal Project.

**Facility Legal Address**

The Iron Mountain Facilities are located in the NE ¼ of the NE ¼ of Section 30, Township 36 N Range 13 W Salt Lake Base Meridian (SLBM). The Universal Transverse Mercator Geographic Coordinate System (UTM) coordinates for the Iron Mountain Facilities are: Zone 12 Northing 4169230.8, Easting 292693.5.

The proposed tailings storage points (Blackhawk and Blowout Pits) are located in the S half of Section 30, Township 36 N Range 14 W SLBM, and in the NE ¼ of Section 2 and NW ¼ of Section 1, Township 37 S Range 14 W SLBM. The UTM coordinates for the Blackhawk and Blowout Pits are: Zone 12 Northing 4166112.9, Easting 289619.7.

**Owner and Operator Information**

The owner and operator information is the same as the applicant information: Black Iron is the owner and operator for this facility.

All facilities and active mine areas are on patented mining claims owned solely by Black Iron.

## 1.4 Facility Information

Processing of the iron ore mined on site involves crushing to 6-inch minus using an impact crusher, followed by initial wet grinding in a semi-autonomous grinding (SAG) mill to $P_{80}$ 142 micron size. The ground ore slurry from the SAG mill will then be fed into a ball mill, which will wet grind the material to less than 100 micron. The final ground ore slurry will be fed into the Magnetic Concentrate Plant (MCP), which entails a rougher Wet Low Intensity Magnetic Separation (WLIMS) and a Cleaner WLIMS. The magnetic separation process is a physical process that does not require the addition of chemicals like a standard flotation process. The iron concentrate from the magnetic separation process will be dewatered via thickeners and hyperbaric filter presses and conveyed to a stockpile near the loadout facilities.

Previously, under a former owner (CML Metals Corporation (CML)), tailings from a reverse-flotation concentrate process were dewatered and dry-stacked in an area north of the existing facilities, per Ground Water Discharge Permit-by-rule dated January 26, 2011 (Appendix A). However, due to capacity of storage, Black Iron is proposing to pipe the tailings as slurry to the Blowout and Blackhawk pits, where the tailings will be discharged and allowed to settle. The water collected on the surface would be pumped back to the facilities for reuse in a closed loop process.

## 1.5 SIC/NAICS Codes

The Standard Industrial Classification (SIC) and North American Industry Classification System (NAICS) codes that describe the Black Iron facilities are 1011 (SIC) and 212210 (NAICS) for iron ore mining and/or beneficiating.

## 1.6 Project Facility Life

The expected life of the Black Iron operations is 13+ years. The approximate capacity of the Blackhawk and Blowout pits is anticipated to be great enough to hold the tails from iron ore processing for the life of the operations. If, however, this turns out to not be the case, another location for tails disposal will be located and permitted.

## 1.7 Existing Environmental Permits

The mine is currently approved for dry-stacking the tails produced during magnetite extraction through the Utah Division of Water Quality (DWQ) and the Utah Division of Oil, Gas and Mining (DOGM). Black Iron also retains or will obtain permits related to storm water discharge, air quality, and for the operations related to on site Class IIB landfill. Table 1 lists the current Federal, State, and Local environmental permits related to the Iron Mountain facilities.

**Table 1: Current Federal, State, and Local Environmental Permits for the Iron Mountain Facilities**

| Permit Name | Permit Number | Lead Agency |
|---|---|---|
| Multi-Sector General Storm Water Permit for Storm Water Discharges Associated with Industrial Activities | UTR000979[1] | Utah Department of Environmental Quality (DEQ) /EPA |
| Notice of Intent (NOI) for Large Mine Operations (LMO) | M/021/008[2] | DOGM |
| Solid Waste Permit (Class IIIB Landfill) | SW200900892[3] | Utah Division of Solid and Hazardous Waste (DSHW) |
| Air Quality Permit | DAQE-AN102900002-11 | Utah Division of Air Quality (DAQ) |
| Ground Water Discharge Permit-by-Rule for transfer of ground water (GWDPBR) | April 28, 2010 | DWQ |
| GWDPBR for tailings discharge to mine waste pile | January 26, 2011 | DWQ |

[1] The CML permit coverage will be transferred or Black Iron will obtain its own coverage under the Multi-Sector General Permit.
[2] Currently in process of transferring from CML to Black Iron
[3] Renewal application currently underway

## 1.8 Pending Permits

Black Iron is currently in the process of transferring CML's NOI for the LMO with DOGM (M/021/008) and will then amend the NOI for this tailings management system. The pending amendment will address the proposed activities described in this application document, including the proposed new tailings pipeline and reclaim water pipeline, pump stations, and tailings discharge locations in the Blackhawk and Blowout pits.

# 2.0 Process Description

Ore from the Comstock/Mountain Lion Pit will be mined via open-pit methods. The mill grade ore will be transported by truck to a raw ore stockpile where the ore will be fed into an impact crusher where the ore is then crushed to 6-inch minus and conveyed to the concentrate facilities. Within the concentrate facilities, the ore will be ground using SAG and ball mills, with water added both during and after grinding. The ore slurry will then undergo magnetic separation, which separates the magnetite from the gangue material. The clean magnetite concentrate will be sent to a concentrate thickening tank, then to a hyperbaric filter system, and then conveyed to a concentrate ore stockpile located west of the loadout facilities. Tailings slurry from the magnetic separation process will be sent to a tailings thickening tank in preparation for being pumped through a 12-inch diameter, high-density polyethylene (HDPE) slurry pipeline to the tailings disposal location at the Blowout Pit.

The tailings slurry pipeline will be laid on the ground surface in a pipeline corridor between two earth berms. These berms will constrain movement of the pipe due to expansion and contraction and provide some spill containment should an unexpected leak occur. Four booster pumps as needed will be placed within the pipeline corridor powered by a 5 kV power line built adjacent to the pipeline corridor. A 10-inch diameter, HDPE reclaim water pipeline will also be laid in this pipeline corridor. An access road will be built outside the berm next to the pipeline corridor for operation and maintenance activities. Permits for the proposed right-of-way for the pipeline corridor, power line, and access road will be obtained from the Cedar City Bureau of Land Management (BLM), the State Institutional Trust Lands Administration (SITLA), DOGM.

The mine and mill have line power with emergency backup generators to ensure continuous operation of the pumps in the tailings management system. In the event of a prolonged shutdown, the tailings slurry and reclaim water pipelines will be drained back to existing tankage at the mill.

## 2.1 Reagents Used For Processing

While CML's processing of the magnetite ore involved usage of several reagents during both the reverse-flotation process and thickening process of ore and tails, Black Iron has eliminated the reverse-flotation process and thus will reduce the number of reagents used. Table 2 lists the flocculant that will be used at the thickener facilities, as well as approximate consumption rates and specific gravity. Information for the flocculant comes from the Material Safety Data Sheet (MSDS), which is provided in Appendix B.

**Table 2: Reagents Used and Approximate Consumption During Processing of Black Iron Magnetite Ore**

| Reagent | Consumption (g/t ore)[1] | Specific Gravity |
|---|---|---|
| Flocculant (Optimer ® 83949) | 3.005 | N/A |

[1] – g/t = grams per ton

Source: Samuel Engineering. 2012. Comstock Mountain Lion Iron Project Reagent Report.

The flocculant used will be the Optimer ® 83949. This is an anionic, water-soluble polymer floc that is supplied as a granular powder. Small concentrations of floc are used in both the concentrate and tailings thickeners. In the case of the concentrate thickener, the quantity exiting would go with the concentrate. There is also a small amount of floc that will exit the tailings thickener with the tailings slurry.

Flocculant toxicity varies with charge type. Anionic (such as used here) and neutral flocculants typically exhibit low toxicity, as opposed to cationic flocculants which can be more toxic. Additionally, according to the MSDS data sheet for Optimer ® 83949, the material contains no ingredients which are known to be hazardous (Appendix B).

Tailings pH levels are expected to be in a neutral range. This provides alkaline protection against any acidic leaching of metals from minor residual sulfide content that comes from very small amounts of gangue minerals, including minute quantities of chalcopyrite ($CuFeS_2$) and very minor pyrite ($FeS_2$) contained in the tails.

## 2.2 Magnetite Concentrate and Tails Characteristics

Upon completion of the concentrate process, the final product will range between 65-67 percent total iron, with an approximate moisture content of 7 to 10 percent, and weight of approximately 215 lb/CY. Remaining gangue material within the magnetite concentrate consists primarily of quartz monzonite, as well as very minimal (<1%) amounts of mica and pyrite (FLSmidth 2011).

The tailings produced during the concentrate process will be composed of a slurry consisting of approximately 20-50 percent solids, which have a specific gravity of 2.9. Based on a study performed by Samuel Engineering in 2011, the material contained within the tails is primarily quartz monzonite, dolomite, and micas. The tailings will also retain approximately 5 to 10 percent magnetite, and minimal amounts (<1%) of apatite and pyrite

Small amounts of flocculant reagent will remain in the tails and are contained within the aqueous component of the slurry. Due to the mineral solids having a specific gravity of 2.9, it is postulated that the organic components of the waste stream will tend to separate toward the top of the tailings mass, or on top of the water surface. However, due to the minute amount of organics that will remain in the tails upon discharge, and the characteristics of the organics

(Section 2.1), any organic material that collects on the water surface of the proposed tailings discharge points will have minimal to no environmental effects. The low specific gravity of the organic and aqueous constituents will also act as a deterrent for any potential commingling with ground water in the Blackhawk and Blowout pits.

# 3.0 General Discharge Information

## 3.1 Description and Location of Proposed Discharge Points

Black Iron is proposing to discharge the tailings produced during the magnetite concentrate process in two existing pits located on the southern flank of Iron Mountain (Figure 2). The pits, named Blackhawk and Blowout, each have an overall capacity of approximately 3 million and 5 million cubic yards, respectively. The pits currently retain water that is a combination of precipitation, surface water runoff, and intercepted ground water.

## 3.2 Discharge Characteristics

The Black Iron concentrate facilities are currently designed to process approximately 3.1 million metric tons of ore per year. The process will produce approximately 2 million metric tons of concentrate per year, and 1.1 million metric tons of tailings solids. After processing, the tailings will be approximately 20-50 percent solids and the rest liquid. Upon initial discharge in the Blowout Pit, the solids will be allowed to settle, and the supernatant water will collect on top of the tailings solids. This water will be pumped to the nearby Blackhawk Pit for temporary storage and further clarification before being pumped back to the concentrate facilities in a reclaim water pipeline for use in further processing. When the Blowout Pit reaches capacity for tailings solids, the tailings slurry will be discharged to the Blackhawk Pit and the reclaim water will continue to be pumped back to the mill from this location.

### *3.2.1 Potential Discharge Volumes*

Table 3 provides a breakdown of process volumes that are produced during concentrate activities.

**Table 3: Water Consumption and Process Characteristics for the Black Iron Concentrate Facilities (Based on 1yr Average)**

| VOLUME | UNITS |
|---:|---|
| 3,100,000 | Metric Tons Ore Mill Feed per Year |
| 2,000,000 | Metric Tons Concentrate Produced per Year |
| 1,100,000 | Metric Tons Tailings Solids per Year |

As stated in Section 2.0 above, water is added during the concentration process in the mill. Figure 3 provides a schematic flow chart of the concentration process. Process steps are in solid boxes, additions to the process are in dashed boxes. No treatment technologies are included in the diagram because water released from the tailings is of high enough quality, based on testing results discussed in Section 3.2.2 below, that it will not degrade ground water, should this water comingle with ground water.

### *3.2.2 Process Water Characteristics*

Process water for the beneficiation of magnetite concentrate will come from a combination of sources, including on-site Mountain Lion Pit Lake, culinary water from Cedar City, and reclaim water from the proposed tailings disposal facility. These sources would commingle in a process water tank adjacent to the mill.

Table 4 below provides a comparison of the water quality of fresh process water from the Mountain Lion pit lake and water taken from the tailings thickener tank under the prior CML mill operations.

**Table 4: Comparison of Water Quality Between Fresh Process Water and Tailings Thickener Tank Water**

| Constituent | Drinking Water Standard (Mg/L) | Mountain Lion Pit Lake<br>Water Sample (mg/L)<br>12/22/2014 | Tailings Thickener Tank Water<br>Water Sample (mg/L)<br>4/24/2012 |
|---|---|---|---|
| Alkalinity (as CaCO3) | NA | 117 | 112 |
| Bicarbonate (as CaCO3) | NA | 117 | 112 |
| Carbonate (as CaCO3) | NA | <10.0 | <10.0 |
| Chloride | 250 | 374 | 187 |
| Conductivity - lab | NA | 1640 | 1390 |
| Conductivity - field | NA | Not tested | 1350 |
| Fluoride | 2 | Not tested | 1.26 |
| Hardness (as CaCO3) | NA | Not tested | 479 |
| Nitrate/Nitrite (as N) | 10 | 0.0118 | 3.69 |

| Constituent | Drinking Water Standard (Mg/L) | Mountain Lion Pit Lake | Tailings Thickener Tank Water |
|---|---|---|---|
| | | Water Sample (mg/L) 12/22/2014 | Water Sample (mg/L) 4/24/2012 |
| pH @ 25° - lab (S.U.) | 6.5-8.5 | 8.11 | 8.05 |
| pH in field/temp (S.U.) | 6.5-8.5 | Not tested | 8.04 / 24°C |
| Sulfate | 250 | 108 | 202 |
| TDS | 500 | Not tested | 792 |
| **Total Metals** | | | |
| Aluminum | 0.05-0.2 | <0.100 | <0.100 |
| Antimony | 0.006 | Not tested | <0.00100 |
| Arsenic | 0.01 | <0.00200 | 0.00188 |
| Barium | 2 | Not tested | 0.0353 |
| Cadmium | 0.005 | <0.000500 | <0.000180 |
| Calcium | NA | 97.7 | 99.9 |
| Chromium | 0.1 | Not tested | <0.0100 |
| Copper | 1 | <0.00200 | <0.00160 |
| Iron | 0.3 | <0.100 | <0.100 |
| Lead | 0.015 | <0.00200 | <0.0004 |
| Magnesium | NA | 96.5 | 55.7 |
| Mercury | 0.002 | Not tested | <0.000150 |
| Nickel | NA | Not tested | 0.00153 |
| Potassium | NA | 3.22 | 16.4 |
| Selenium | 0.05 | 0.00388 | 0.0109 |

| Constituent | Drinking Water Standard (Mg/L) | Mountain Lion Pit Lake | Tailings Thickener Tank Water |
|---|---|---|---|
| | | Water Sample (mg/L) 12/22/2014 | Water Sample (mg/L) 4/24/2012 |
| Silver | 0.1 | Not tested | <0.000400 |
| Sodium | NA | 48.8 | 46.9 |
| Thallium | 0.002 | Not tested | <0.000400 |
| Zinc | 5 | 0.0140 | 0.00511 |
| **SVOA** | | | |
| Benzo(a) pyrene | 0.0002 | Not tested | <0.01 |
| Bis(2-ethylhexyl)phthalate | NA | Not tested | <0.01 |
| bis(2-ethylhexyl)adipate | NA | Not tested | <0.01 |
| Hexachlorobenzene | 0.001 | Not tested | <0.01 |
| Hexachlorocyclopentadiene | 0.05 | Not tested | <0.01 |
| **VOA** | | | All Non-detect |

All water analyses were performed by America West Analytical Laboratories.

As noted, the water quality for the Mountain Lion pit and water from the tailings thickener tank are comparable. In fact, the only divergence to be noted is the slightly elevated levels of potassium in the tailings tank water, which could be contributed to the higher concentrations of K-spar present.

Tailings would be collected from the thickener tank continuously, via a slurry pipeline, and transported to the Blowout pit in the tailings slurry pipeline. The water quality information in Table 5 represents the tailings water that would comingle with the water in the Blackhawk and Blowout pit lakes. All analyses for volatiles, semi-volatiles, and metals were below the detection limit for this sample, and the sample met primary drinking water standards for metals and Class II ground water quality standards.

Water quality information for the Blackhawk and Blowout pit lakes were taken in 2007 and analyzed by Southern Utah University's water laboratory (Table 5). Due to the proposal of discharging tailings directly into the Blackhawk and Blowout pits, a worst-case, long-term analysis of water quality of the tails was performed in the form of a Synthetic Precipitation Leach Procedure (SPLP). According to the EPA Solid Waste Manual 846, the SPLP (Method 1312) was a lab test developed by the US EPA "to determine the mobility of both organic and inorganic analytes present in liquids, solids, and wastes."

Table 5 compares the water quality of the Blackhawk and Blowout pit lakes with the SPLP analyses for proposed discharged tails.

**Table 5: Comparison of Blackhawk and Blowout Pit Lake Water Quality with Long-Term Prediction of Water Quality of Discharged Tails (mg/L)**

| Parameter and Drinking Water Standards | | Blowout Pit Water (2007)[1] | Blackhawk Pit Water (2007)[1] | Tailings Analysis (SPLP Method 2014)[2] |
|---|---|---|---|---|
| **Parameter** | **Standards** | **Sample Results** | **Sample Results** | **Sample Results** |
| pH (S.U.) | 6.5-8.5 | 8.15 | 8.34 | 9.83 |
| Total Dissolved Solids | 500 | 785 | 715 | 106 |
| Nitrate | 10 | <0.1 | <0.1 | 0.778 |
| Nitrate/Nitrite | 10 | Not tested | Not tested | 0.798 |
| Nitrite | 1 | <0.1 | <0.1 | 0.0208 |
| Fluoride | 2 | <0.4 | <0.4 | 0.299 |
| Cyanide, Free | NA | Not tested | Not tested | <0.00500 |
| Antimony | 0.006 | <0.005 | <0.005 | <0.0100 |
| Arsenic | 0.01 | <0.010 | <0.010 | <0.0100 |
| Barium | 2 | 0.186 | 0.231 | <0.0500 |
| Beryllium | 0.004 | ND | ND | <0.00250 |
| Cadmium | 0.005 | <0.001 | <0.001 | <0.0100 |
| Chromium | 0.01 | <0.025 | <0.025 | <0.0100 |
| Copper | 1 | <0.050 | <0.050 | <0.0500 |
| Lead | 0.015 | <0.005 | <0.005 | <0.00100 |
| Mercury | 0.002 | Not tested | Not tested | <0.0100 |
| Selenium | 0.05 | <0.005 | <0.005 | <0.0100 |

| Parameter and Drinking Water Standards | | Blowout Pit Water (2007)[1] | Blackhawk Pit Water (2007)[1] | Tailings Analysis (SPLP Method 2014)[2] |
|---|---|---|---|---|
| Silver | 0.1 | Not tested | Not tested | <0.0100 |
| Sulfate | 250 | 160 | 94.3 | Not tested |
| Thallium | 0.002 | <0.002 | <0.002 | <0.0100 |
| Zinc | 5 | Not tested | Not tested | <0.0500 |

[1]Water Quality analysis performed by Southern Utah University on June 7, 2007

[2]SPLP analysis performed on process tails by American West Analytical Laboratories on December 11, 2014

[3]Chlorine and chlorite analyses performed on process tails by Chemtech-Ford Laboratories on December 12, 2014

Using the water quality information in Tables 4 and 5, the ground water for the Iron Mountain area generally meets Primary Drinking Water standards (with the exception of total dissolved solids) and other analytes were below Utah Ground Water Quality Standards (CML 2011). Evaluation of sample data from the tailings thickener tank indicates that free tailings water is very similar to groundwater in the pits. Thus, there will not be a decrease in water quality should tailings water mix with ground water.

### *3.2.3 Means of Discharge*

The tails from the magnetite concentrate operations will be transported in an HDPE pipeline designed to meet specifications applicable to the task. The pipeline will run from the tailings thickener tank at the mill, for a length of approximately 3.1 miles to the southwest side of Iron Mountain with an initial discharge point along the Blowout high wall. A barge pump will be installed in the pit to pump supernatant water into the Blackhawk Pit, and another barge pump in that pit will return water back to the concentrate facilities along a reclaim water pipeline that will parallel the tails pipeline. When the Blowout pit reaches maximum capacity for tailings, the tailings slurry will be discharged in the Blackhawk pit and reclaim water will continue to be pumped back to the mill from that pit.

# 4.0 Geologic and Hydrologic Information

## 4.1 Description of Geologic Setting

The area is characterized by a pluton intrusive with ore deposits situated along the flanks in sedimentary rocks. A complex series of fractures also exists in the flanks as parallel and cross faults. The Iron Mountain area is underlain by unconsolidated Quaternary alluvial sediments (sands, silts, and clays) in the valley floors and semi-consolidated to consolidated Jurassic/Cretaceous rock sediments in the mountains and hills. The Quaternary and Cretaceous sediments comprise the principal ground water reservoir. Ground water exists in the shallow Cretaceous Iron Springs Formation, which consists of continental sandstone with subordinate shale and other rock types. According to pump testing in the area, the aquifer in the Iron Springs Formation is shallow and has very low re-charge, indicating the aquifer is fed primarily by rainfall and other means of infiltration.

Another ground water aquifer occurs in the deeper Jurassic rock and along the iron ore contacts primarily in fracture planes (joints/faults) and along bedding planes. Flow is controlled by the fracture pattern systems, fault trends, and attitude (strike and dip) of the bedrock. Permeability of the bedrock combined with fracture pattern flows controls the transmissivity (flow rate) of the aquifers (CML 2011).

The Blackhawk and Blowout pit walls consist of quartz monzonite, the Homestake Limestone member of the Carmel Formation, and Navajo sandstone (field observations; Appendix C). Historic observations by CML employees indicated that the pit floors still contain sparse amounts of magnetite ore.

Transmissivity data is not available in the study area but values can be expected to range from 1,000 to 20,000 square feet/day (SF/day) in valley fill to from 200 to 120,000 SF/day in the bedrock areas. Hydraulic conductivity of the respective aquifer system and specific yield values are also unknown due to lack of pumping test data but can be expected to be in the 50 to 500 SF/day range due to the complex structure and stratigraphic relationships in the area. Further complicating the flow systems are the intrusive bodies with associated faulting and fracturing (CML 2011).

## 4.3 Water Resources

Water resources in the area are used to support grazing, farming, residences, mining, and wildlife. Other than Newcastle Reservoir located about 6 miles to the west, no recreational facilities, i.e., fishing or boating, exist in the area (CML 2011).

### *4.3.1 Ground Water Resources*

The State of Utah defines an aquifer as "a geologic formation, group of geologic formations or part of a geologic formation that contains sufficiently saturated permeable material to yield usable quantities of water to wells and springs" (R317-6-1). The Iron Mountain area is underlain by unconsolidated Quaternary alluvial sediments (sands, silts, and clays) in the valley floors and semi-consolidated to consolidated Jurassic/Cretaceous rock sediments in the mountains and hills. The Quaternary and Cretaceous sediments comprise the principle ground water reservoir. Ground water exists in the deeper Jurassic rock and along the iron ore contacts primarily in fracture planes (joints/faults) and along bedding planes. Flow is controlled by the fracture pattern systems, fault trends, and attitude (strike and dip) of the bedrock. Permeability of the bedrock combined with fracture pattern flows controls the transmissivity (flow rate) of the aquifers (CML 2011).

Regionally, the direction of ground water movement in this part of the Basin and Range is toward the west. Evaluation of the data indicates that the water in the area can be classified as Class II Drinking Water Quality Ground Water with total dissolved solids being less than 900 mg/L, a pH of around 8, and other analytes well below Utah Ground Water Quality Standards (CML 2011).

In terms of ground water resources, a comparison of 2009 water table elevation readings in the open pits versus historic water levels in the mine area (Geneva Steel 1996) suggest that the overall water table level in the Iron Mountain area has dropped between 12 and 100 feet between 1996 and 2009, depending on pit locations. This small but general decrease in ground water elevation is mirrored by a similar, if not stronger, decrease in ground water levels throughout the Escalante Desert basin, of which Iron Mountain is a part. Data extending back to 1945 show a clear decline in water table elevations of agricultural lands located in this basin to the north and west of Iron Mountain due to water-well pumping for irrigation in the Enterprise-Beryl-Lund area. Records show that discharge exceeds recharge in this area, resulting in a declining water table; in some areas ground water levels have decreased by 70 or more feet (Thomas and Lowe 2007). Because agriculture is ongoing in the Escalante Desert, it can be assumed that water table elevations will decline further, rather than increase, over time.

According to 2009 aerial survey data, water level was last measured to be at the 6320 elevation in the Blackhawk Pit, and 6340 elevation in the Blowout Pit. Historic pit floors are indicated to be at the 6305-foot elevation level for Blackhawk, and 5925 elevation level for Blowout. The average depth to ground water for the Iron Mountain area ranges between 120 feet in the valley floor to 300+ feet along the slopes of Iron Mountain (Figure 4). The Blackhawk and Blowout pits are situated partially along the southwest slope of Iron Mountain, and as mining commenced, the pit floor intercepted the ground water table.

### *4.3.2 Surface Water Resources*

The area occurs within the Dry Wash watershed (HUC12 – 16030061401) of the Escalante Desert sub-basin (HUC8 – 1603006), which is part of the Escalante Desert-Sevier Lake Basin. Recharge into the area comes partly by infiltration from losing stream channels and precipitation. The closest surface water body is the Lamb Reservoir which is approximately 3 miles southwest of the Blackhawk and Blowout pits (JBR 2014).

Annual rainfall is generally low for this region, averaging 10.74 inches per year (WRCC 2013). The 10-year 24-hour storm event for Iron Mountain is 1.33 inches (NOAA 2013).

There are five springs within an approximate 1-mile radius of the Blackhawk and Blowout pits. These springs, Dry Hollow, Crystal, Dry Wash, and two unnamed springs, are all located upgradient of the current water levels in the Blackhawk and Blowout pits. In 2014, JBR Environmental Consultants, Inc. (now Stantec) performed a seep and spring inventory of the area surrounding the Blackhawk and Blowout pits. The findings of the inventory indicate that the springs within the vicinity of the Blackhawk and Blowout pits are fed by the ground water aquifer within the Iron Springs Formation, with surface percolation occurring as a result of fractures or faulting in the area (JBR 2014, Appendix D).

### *4.3.3 Water Rights Information*

According to the Utah Division of Water Rights online database (UDWR 2015), there are nine points of diversion within a 1-mile radius of the Blackhawk and Blowout pits. Water Rights information for the points of diversion is listed in Table 6.

**Table 6: Water Rights Information for Points of Diversion within a one-mile Radius of the Blackhawk and Blowout Pits**

| Number | Owner | Sctn | Twnshp | Rng | Well Log | Source Type | Flow (af) | Flow (cfs) | Period of Use | Usage Designation |
|---|---|---|---|---|---|---|---|---|---|---|
| 71-584 | Black Iron, LLC | 02 | 37S | 14W | | Underground Water Well | 36.2 | 0.05 | 01/01-12/31 | Mining, Domestic |
| 71-2101 | SITLA | 36 | 36S | 14W | No | Crystal Spring | 4.82 | 0.011 | 10/01 to 05/01 | Livestock |
| 71-2403 | Black Iron, LLC | 02 | 37S | 14W | No | Underground Water Well | 64.29 | 0.112 | 01/01 to 12/31 | Mining, Domestic |
| 71-2806 | Maree Higbee Gardner Trust | 36 | 36S | 14W | No | Crystal Spring | | 0.00666 | 01/01 to 12/31 | Mining |
| 71-2856 | US Forest Service – Dixie National Forest | 14[1] | 37S | 14W | No | Multiple Surface Sources in West Pinto Allotment | | Unevaluated | | Livestock |
| 71-3017 | US BLM | 36 | 36S | 14W | No | Crystal Spring | | 0.022 | 01/01 to 12/31 | Livestock |
| 71-3830 | William A. Horn | 01 | 37S | 14W | No | Underground Water Well | 2.00 | | 01/01 to 12/31 (domestic); 04/01 to 12/31 (irrigation) | Irrigation, Domestic |

| Number | Owner | Sctn | Twnshp | Rng | Well Log | Source Type | Flow (af) | Flow (cfs) | Period of Use | Usage Designation |
|---|---|---|---|---|---|---|---|---|---|---|
| 71-4023 | Kevin and Lisa Price Wilkerson | 01 | 37S | 14W | No | Underground Water Well | 0.5 | | 01/01 to 12/31 (domestic); 04/01 to 10/31 (irrigation) | Irrigation, Domestic |
| 71-4139 | Joshua Black | 01 | 37S | 14W | Yes | Underground Water Well | 1.0 | | 01/01 to 12/31 (domestic); 04/01 to 12/31 (irrigation) | Irrigation, Livestock, Domestic |

Notes: [1] Multiple points of diversion associated with this water right; section shown is within radius.

# 5.0 Ground Water Discharge Control Plan

Black Iron's ground water discharge control plan will consist of monitor wells both up-gradient and down-gradient of the Blackhawk and Blowout pits. Well locations will be chosen based upon the 1996 ground water contour data that was compiled by Geneva Steel for the area. The down-gradient monitor well will be installed prior to initiation of tailings discharge into the Blackhawk or Blowout Pit.

The tailings and reclaim water pipelines will also have engineered protocols to monitor transmission of the slurry/water through the pipes. If there is a rupture, valves will be closed and pumping will cease to ensure minimum spillage occurs. The pipelines will also be visibly checked regularly for signs of wear, and repairs will be made accordingly. Flows will be metered at the beginning and end of the pipelines. This will enable immediate detection of any loss along the line. Year-round access along the 3-mile pipeline will be maintained and crews can be sent immediately to investigate/contain any leakage or spill.The closure plan for these facilities will be covered in the DOGM permit.

# 6.0 Ground Water and Source Monitoring

## 6.1 Ground Water Monitoring

Black Iron proposes to take annual ground water samples from an up-gradient monitor well, as well as collect a sample of Blackhawk and Blowout pit water prior to commencement of tails discharge. Once the down-gradient monitor well has been installed, water quality analyses will be performed quarterly from this well.

A proposed suite of analytes includes major ions, metals listed in Table 5, nitrate, TDS, and organic constituents diagnostic of the flocculant used in the tailings thickener.

## 6.2 Source Monitoring

Along with annual analyses of water from the up-gradient monitor well, and quarterly analyses of water from the proposed down-gradient monitor well, Black Iron will collect quarterly water samples directly from the tails pipeline and the reclaim water pipeline. The sample results for all sources (up-gradient monitor well, down-gradient monitor well, tails pipeline, and reclaim water pipeline) will be compiled into an annual report to be submitted to the DWQ for their records.

# 7.0 Reclamation and Closure Evaluation

Upon completion of tailings discharge into the Blowout Pit, the remaining water will be removed and the tails solids will be allowed to dry and stabilize for a period of time adequate for moisture content of the surface of the now backfilled pit to be minimal. The surface of the dried tailings solids will be stabilized with perennial vegetation. Testing conducted with the involvement of DOGM will determine if vegetation can be grown in the tailings solids without applying topsoil. If topsoil is found to be required, prior to placement of growth media, the backfilled surface maybe covered with a geo-fabric to help stabilize the surface. This will be followed by placement of growth media either from surrounding historic stockpiles or trucked in from offsite. The depth of topsoil placement will be determined by the above-mentioned testing program. The tailings surface, or growth media if required, will be scarified to relieve compaction and a DOGM-approved seed mixture will be broadcast over the backfilled surfaces.

Upon closure and following reclamation activities, ground water monitoring will occur annually both from the up-gradient and down-gradient water wells. This will continue for a period of 5 years following closure of the backfilled pits, or as deemed necessary by DWQ.

# 8.0 References

CML Metals Corporation. 2011. Notice of Intent for Large Mining Operations with the Division of Oil, Gas and Mining. Approved January 2012.

FLSmidth. 2011. CML Metals Corp. Report of Metallurgical Test Work Conducted on Samples from CML Metals' Property near Cedar City, Utah. April 26, 2011.

Geneva Steel. 1996. Internal Report for the Ground water Contour Map for the Iron Mountain Mining District.

JBR Environmental Consultants, Inc. 2014. CML Metals Corporation Rex Ore Body Mine – Seep and Spring Inventory Report.

National Oceanic and Atmospheric Administration (NOAA). 2013. Accessed online at http://hdsc.nws.noaa.gov/hdsc/pfds/

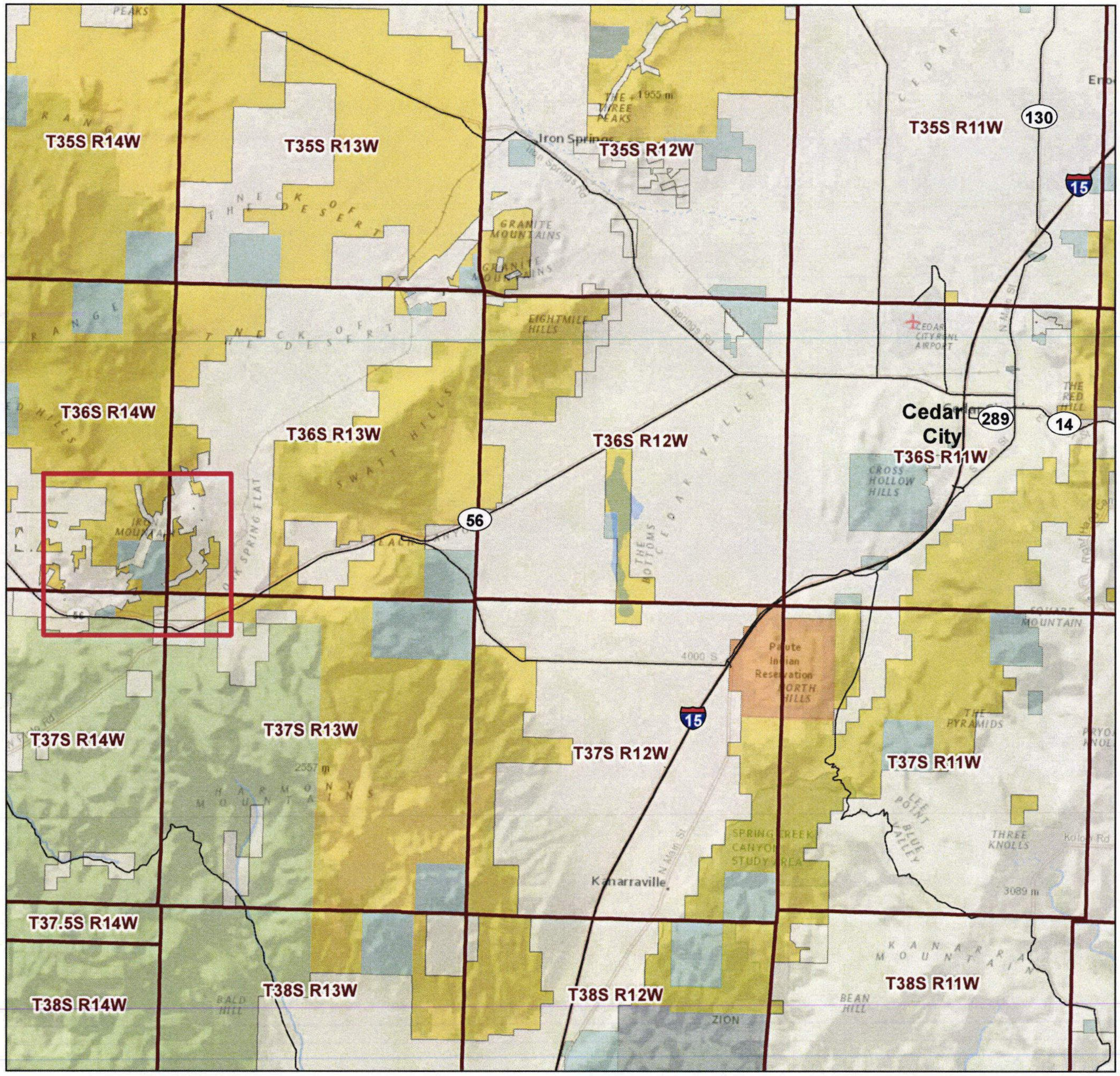
Samuel Engineering. 2012. Comstock Mountain Lion Iron Project Reagent Report. May, 2012.

Samuel Engineering. 2011. Process Chemistry Results, Project 10090-01 Report, "Full Balance, Tailings Filter Feed." March 4, 2011.

Thomas, Kevin, and Mike Lowe. 2007. Recharge and Discharge Areas for the Principla Basin-Fill Aquifer, Beryl-Enterprise Area, Iron, Washington, and Beaver Counties, Utah. Utah Geological Survey, Map 225. Utah Department of Natural Resources. ISBN 1-55791-770-1.

Utah Division of Water Rights. 2019. Online Water Rights Data Search. Accessed online at http://www.waterrights.utah.gov/cgi-bin/wrindex.exe?Startup

Western Regional Climate Center (WRCC). 2013. Accessed online at http://wrcc.dri.edu/




**Stantec**

**Legend**

Approximate Project Area

**Land Status**

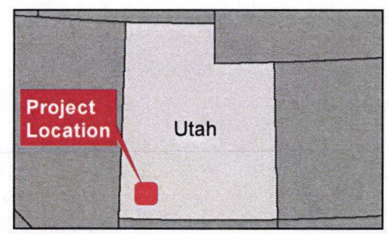
- Bureau of Land Management (BLM)
- Indian Reservation (IR)
- National Park Service (NPS)
- Private
- State
- State Parks and Recreation
- State Wildlife Reserve/Management Area
- US Forest Service (USFS)

N

0 1.5 3 Miles
(At original document size of 8.5x11)
1:190,080

**Notes**

1. Coordinate System: NAD 1983 UTM Zone 12N
2. Data Sources: Utah BLM, Utah AGRC, Black Iron
3. Background: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.




*Project Location*
near Cedar City
Iron County, Utah

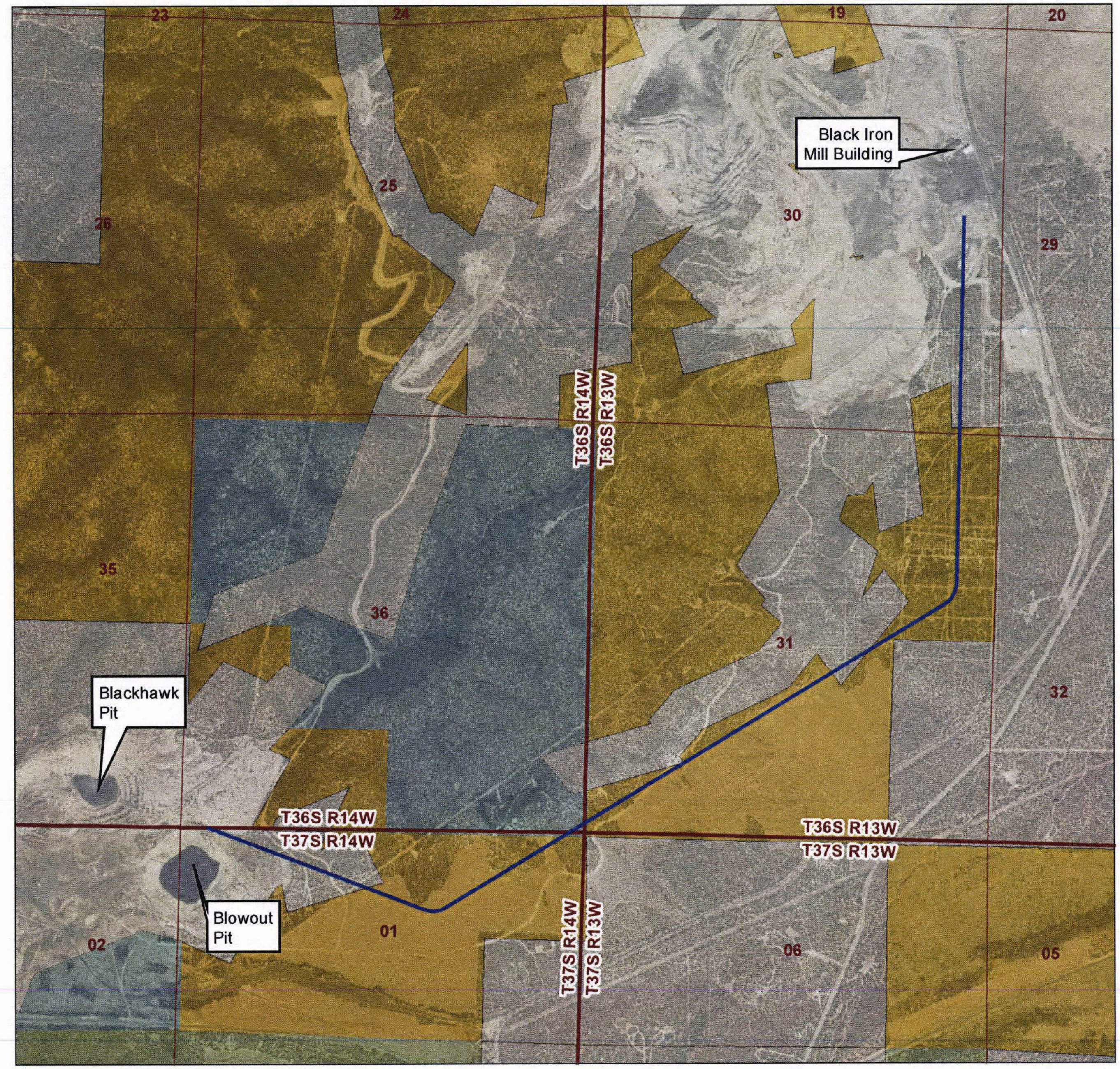
Prepared by NF on 2019-10-02
TR by JT on 2019-10-02
IR Review by KK on 2019-10-02

*Client/Project*
203721532
Black Iron, LLC
Black Iron Tailings Disposal Project
Ground Water Discharge Permit Application

*Figure No.*
**1**

*Title*
**General Location Map**

Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. Stantec has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. Stantec assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.




Stantec

**Legend**

Proposed Pipeline Corridor

**Land Status**

Bureau of Land Management (BLM)

Private

State

US Forest Service (USFS)

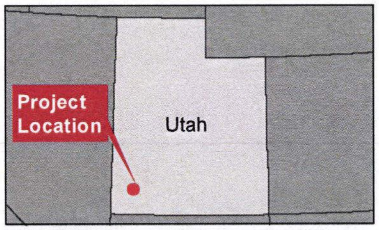
N

0 1,000 2,000 Feet

(At original document size of 8.5x11)
1:24,000

***Notes***

1. Coordinate System: NAD 1983 UTM Zone 12N
2. Data Sources: Utah BLM, Utah AGRC, Black Iron
3. Background: August 2018 NAIP Imagery



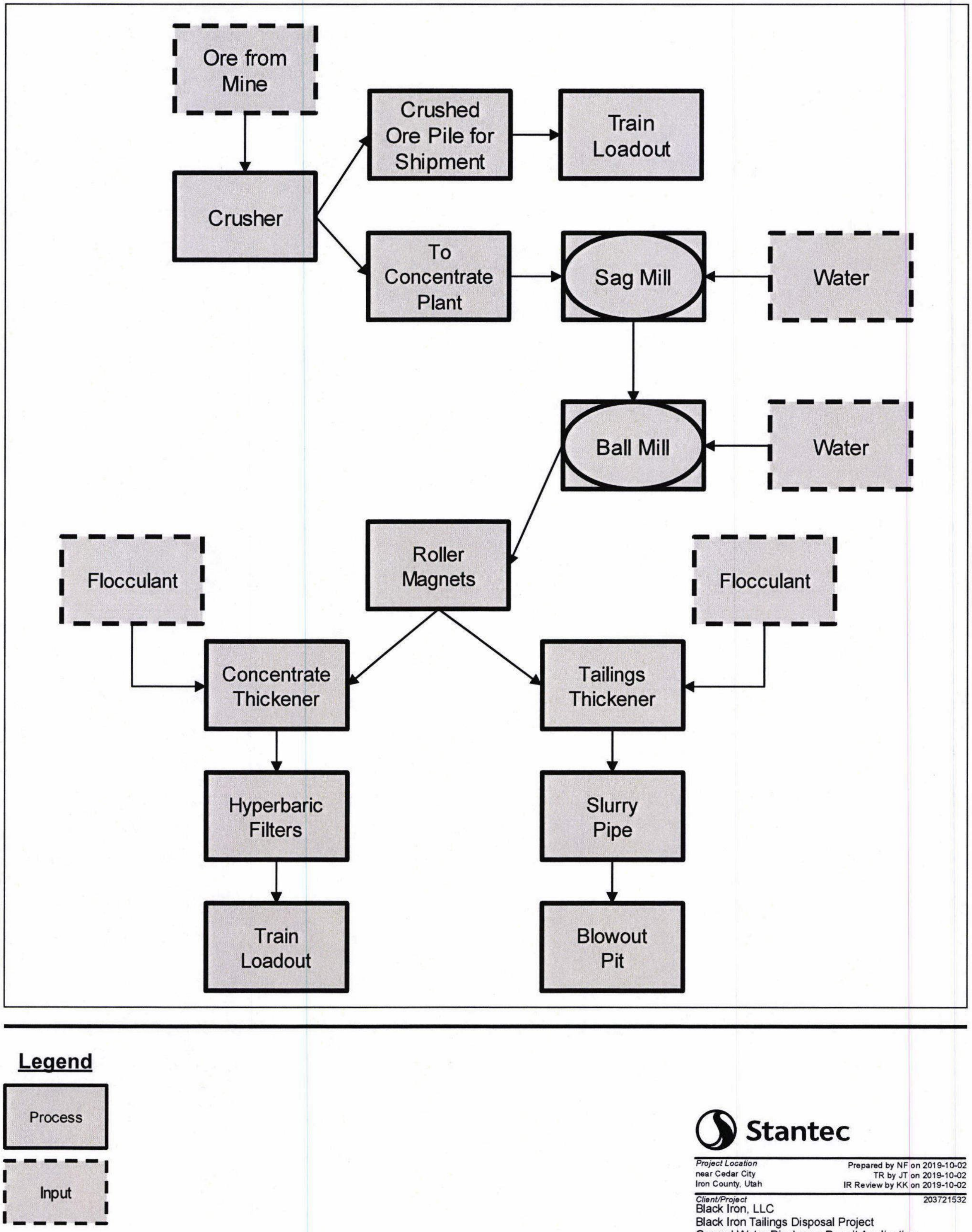

*Project Location*
near Cedar City
Iron County, Utah

Prepared by NF on 2019-10-18
TR by JT on 2019-10-18
IR Review by KK on 2019-10-18

*Client/Project*
203721532
Black Iron, LLC
Black Iron Tailings Disposal Project
Ground Water Discharge Permit Application

*Figure No.*
**2**

*Title*
**Tailings Pipeline and Storage Facilities**




***Notes***
1. Data Sources: Black Iron

**Stantec**

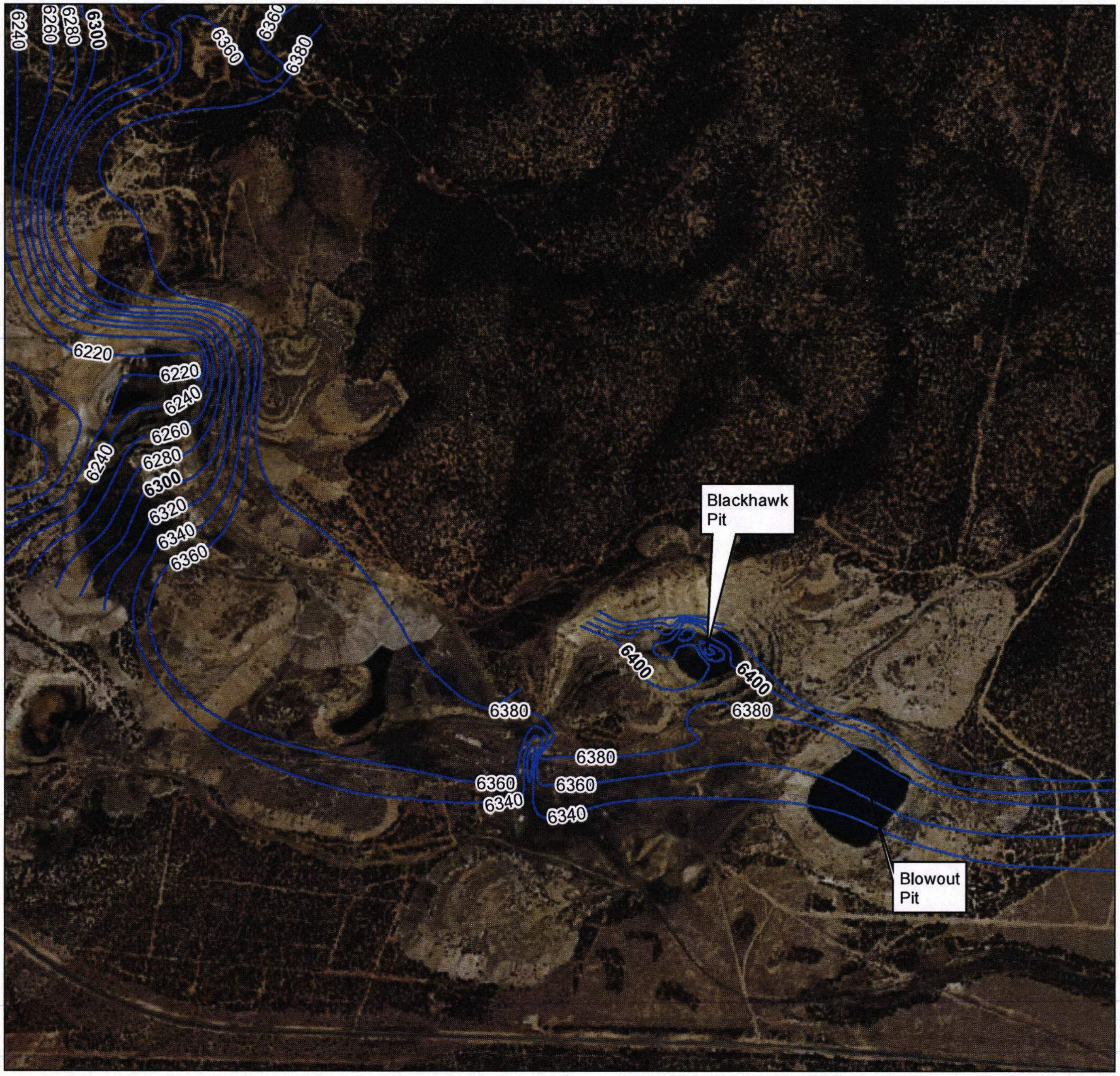
*Project Location*
near Cedar City
Iron County, Utah

Prepared by NF on 2019-10-02
TR by JT on 2019-10-02
IR Review by KK on 2019-10-02

*Client/Project*
203721532
Black Iron, LLC
Black Iron Tailings Disposal Project
Ground Water Discharge Permit Application

*Figure No.*
**3**

*Title*
**Mining Process Diagram**




Stantec

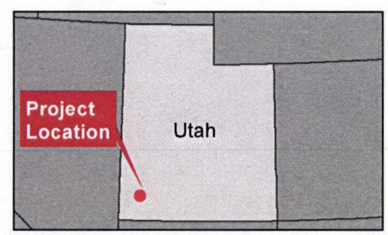
**Legend**

Groundwater Contour

N

0 600 1,200 Feet
(At original document size of 8.5x11)
1:14,400

***Notes***
1. Coordinate System: NAD 1983 UTM Zone 12N
2. Data Sources: Black Iron
3. Background: August 2018 NAIP Imagery




*Project Location*
near Cedar City
Iron County, Utah

Prepared by NF on 2019-10-02
TR by JT on 2019-10-02
IR Review by KK on 2019-10-02
203721532

*Client/Project*
Black Iron, LLC
Black Iron Tailings Disposal Project
Ground Water Discharge Permit Application

*Figure No.*
**4**

*Title*
**Groundwater Contour Map**