REPORT

2019 Site Characterization Work Plan

Former Beatson Mine
Latouche Island, Alaska
DEC File No. 2264.38.038

Submitted to:

Rio Tinto AuM Company
Attention: Mr. Craig Stevens
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1781329.2000-620

27 June 2019

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1.0 INTRODUCTION

Golder Associates Inc. (Golder) was retained by Rio Tinto AuM Company (Rio Tinto) to prepare a work plan for additional site characterization sampling at the former Beatson Mine (the Site) on Latouche Island, Alaska.

1.1 Purpose of this Document

This work plan provides a brief overview of the current Site knowledge and describes the specific data to be collected along with details regarding the proposed sampling methodology and quality assurance/quality control measures (DEC 2017a,b). In brief, this work plan describes the sampling procedures, the applicable data quality objectives, and describes the basis for the study design, including:

- The proposed sampling locations; and
- Triggers for when additional step-out or supplemental sampling might be contemplated based on site observations (or conversely, what site observations might lead to a reduction or elimination of sampling effort).

The final sampling effort may vary based on Site observations, weather conditions and potential logistical limitations. The strategy is intended to be sufficiently flexible to be adjusted based on conditions in the field. The Site is remote and presents multiple logistical challenges. Consequently, the sampling program is intended to maximize the value of the field program by archiving samples that can be analyzed in a tiered approach. Not all samples collected will necessarily be analyzed.

1.2 Field Program Objectives

The specific objectives of the 2019 sampling program described in this document are to:

- Continue to expand the available characterization of site conditions by measuring concentrations of contaminants of potential concern in soil, groundwater and surface water at the Site;
- Inform remedial alternatives planning for the Site.

1.3 Site Description and Background

The Site history and project context have been described in previous reports (Arcadis 2018 and Golder 2019) which can be consulted for further information. The reports provide a detailed evaluation of the available Site information, including a review of historical photographs and available records, locations of current site structures, observations regarding leaks, stained soils or suspected releases, tabular and figure summaries of the chemistry data, and other topics that are typically provided in a work plan (DEC 2017a). This current work plan builds on the site characterization data collected at the Site up to August 2018 and the work methods are consistent with those presented and approved by DEC in the 2018 site characterization work plan. The key findings of the characterization work conducted to date are as follows:

- The Site comprises a group of three former copper mines, and associated facilities, located on the northwest part of Latouche Island, Alaska, in Prince William Sound. The mines were last operated by Kennecott

Copper Corporation (now part of Rio Tinto) as the Beatson Mine. Throughout the mining period, several names and various spellings were used for the mines. The three mine areas (from north to south) associated with the site are now generally referred to as: Blackbird, Chenega, and Beatson. Mining activities at the Site occurred from 1899 to 1930. Site features are shown on Figure 1.

- The Site is remote with no year-round residents on Latouche Island. The closest year-round residential area is Chenega Bay on Chenega Island located approximately 4 miles west of Latouche Island. Mine infrastructure was removed or abandoned following closure in 1930, and structures were demolished sometime in the 1960s or early 1970s.
- Following transfer of the surface rights in 1962, the patented mine claims were parceled and sold. The majority of the lots are undeveloped but a small number have cabins for recreational use. The subdivision of the original claims involved alteration of the land for road construction, and waste rock appears to have been used as construction material in some instances. An evaluation is being undertaken by Rio Tinto to confirm current lot owners and property boundaries.
- Contaminants of concern (COCs) were identified in soil, groundwater, surface water, and sediment at the Site, based on exceedances of applicable DEC clean-up levels and water quality criteria. A summary of the COCs is as follows:

Environmental Media	Contaminants of Concern
Soil	**Human Health Exposure:** metals [antimony, arsenic, copper, lead, and manganese]; PAHs [benzo(b)fluoranthene, benzo(a)pyrene, dibenz(a,h)anthracene, and benzo(a)anthracene]; DRO; RRO **Migration to Groundwater:** metals [antimony, arsenic, cadmium, copper, manganese, mercury, silver, selenium and zinc]; PAHs [pyrene, benzo(a)pyrene, benzo(a)anthracene, phenanthrene, 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene]; DRO; RRO
Groundwater	**Total and dissolved metals:** Copper, cadmium, arsenic, mercury, lead
Surface Water	**Total metals:** aluminum, cadmium, copper, iron, silver, zinc **Dissolved metals:** cadmium, copper, lead, nickel, silver, zinc
Sediment	**Freshwater**: arsenic, cadmium, chromium, copper, lead, mercury, selenium **Marine**: copper

- The lateral extent of mine-affected soil is considered to be delineated, based on the results of laboratory and X-Ray Fluorescence (XRF) analyses and Site topography.
- Hydrocarbon contaminated soil is present originating from the large AST, the associated pipelines, in localized areas on the Site airstrip, and near the Beatson Mine south adit. Hydrocarbon exceedances in soil do not appear to be affecting groundwater quality, though observations of sheen and hydrocarbon-staining were noted in seepage water in test pits completed near the shoreline. Dissolved hydrocarbon concentrations have likely been naturally attenuated over time, with the heavier end hydrocarbons remaining

as residuals in soil. Concentrations of hydrocarbon parameters in groundwater were less than the default DEC cleanup levels for samples collected as part of the 2018 site characterization program.

- Concentrations of total and dissolved metals, including arsenic, cadmium, lead, mercury in groundwater exceed applicable default DEC cleanup levels in various locations. Based on Site topography, groundwater flow is generally inferred to be to the west, towards Prince William Sound. The monitoring wells that have been installed characterized the shallow groundwater located above bedrock, and based on its characteristics (shallow depth, low yield, high suspended solids, and potential for salt water intrusion) is likely to be undesirable or unusable as a drinking water source. Shallow groundwater discharges locally to surface water and porewater (within sediments) at the Site.
- Metals concentrations, total metals (including aluminum, cadmium, copper, iron, silver, zinc) and dissolved metals (including cadmium, copper, lead, nickel, silver, zinc), exceed DEC Water Quality Criteria in all surface watercourses within or crossing the Site. Flow rates in these watercourses respond rapidly (i.e., within a 24-hour period) in response to weather events, which in turn affects the overall mass loading of metals parameters into the receiving environment.

Overall, the findings of the site characterization program conducted by Golder were consistent with those identified by Arcadis with additional delineation provided. The primary receptor groups identified by Arcadis, including aquatic invertebrates, terrestrial invertebrates and plants, wildlife, and humans – remain unchanged following Golder’s 2018 investigation program. As such, the conceptual model remains the same as identified in 2016. The receptor groups at the Site may be exposed to contaminants of concern through multiple pathways, including ingestion or direct contact with soil, or ingestion of water or dietary items.

1.4 Work Plan Organization

This work plan is divided into the following sections:

- Section 2.0 provides the general requirements that govern the field sampling program.
- Section 3.0 provides specific details about site characterization sampling (e.g., collection of soil, groundwater, and surface water samples).
- Section 4.0 provides an overview of on-Site work proposed to support remedial planning.

The results of the site characterization work described herein will be detailed in a 2019 Site Characterization Report that meet the requirements outlined in DEC 2017c.

2.0 GENERAL REQUIREMENTS

2.1 Health, Safety, Security, and Environment

A site-specific Health, Safety, Security, and Environment (HSSE) plan will apply to all aspects of the proposed field program. The HSSE plan is meant to identify and mitigate the hazards associated with each element of the field program. A job safety analysis will be prepared for each of main field activities to break the work down to its component tasks and to systematically identify and mitigate the related hazards. The HSSE plan will also contain contact information for the project team and describe the emergency response procedures. A camp services provider will be contracted by Golder to provide a secure and fully outfitted base camp on Latouche Island. Some of the main HSSE controls that will be in place during the field program include (but are not limited to):

- A wildlife fence will be installed around the camp;
- A 'buddy system' will be enforced for all work on-Site and each two-person field team will have a radio for positive communication with the camp and other field crews;
- The camp will have internet capability, and a daily check-in with off-Site management will be made;
- The camp will have backup communication systems;
- An emergency medical technician (EMT) will be on-Site and an emergency evacuation procedure in case of injury will be in place;
- Field personnel will have the appropriate first aid training; and
- A daily, mandatory safety tailgate will be conducted with all staff to review the day's proposed work activities, discuss the likely hazards, and reinforce the expectation that safe work procedures will be followed.

2.2 Site Access

The Site consists of privately-owned separate lots and access permission will be requested from individual property owners where sampling activities and other intrusive actions are proposed. The access permission request will be submitted by Alaska Earth Sciences. Sampling will not be conducted on properties where the owner has declined to allow access. Although the Site itself is not owned by any Alaska Native Corporations, most of Latouche Island is owned by Chugach Alaska Corporation. Therefore, Chugach Alaska Corporation will be contacted prior to field implementation.

Questions or comments from landowners or the Chugach Alaska Corporation in the field will be captured in a record of contact and relayed to the Golder project manager and Rio Tinto for information and follow-up action.

2.3 General Quality Assurance/Quality Control Procedures

Quality assurance and quality control (QC/QC) procedures govern all aspects of the sampling process, including maintenance and operation of equipment and instrumentation, sampling methods, sample handling, and shipping. The general requirements that will apply to all sampling methods include:

- All sampling described in this work plan will be conducted in accordance with the Alaska regulatory guidance *"Field Sampling Guidance"* (DEC 2017a) or appropriate technical guidance as described in the following sections. Samples will be collected by personnel who meet the criteria for a "qualified sampler" or "qualified environmental professional", as defined by 18 Alaska Administrative Code [AAC] 75.333.
- Specific work instructions will be prepared for each activity and approved by the Golder project manager. This work plan and the supporting technical documents will be available for on-Site reference. Each part of the project team will conduct a daily tailgate prior to the start of work to review the work plan and supporting technical documents as they apply to their proposed sampling activities for the day.

- All sampling and field screening methods will be performed using tools and instruments that are either single-use (disposable) or properly decontaminated following manufacturer recommendations to avoid contributing to false readings in the field or in the laboratory.
- All field instruments will be calibrated according to manufacturer's specifications on a daily basis. Calibration standards, dates, times and all calibration results will be recorded in the field record or log book. A reference copy of manufacturer's operating instructions will be kept in the field. All instrument users will be trained in routine maintenance and operation.
- Sample containers for soil and water will be provided by the laboratory performing the analyses. The containers will be opened only immediately before collecting the samples. Lab-supplied pre-measured chemical preservatives will be added to sample containers in the field where appropriate. Samples will also be preserved in the field by maintaining the required temperature range by either placing the samples in an insulated cooler containing frozen "gel ice" or ice or placing the samples in a refrigerator after sample collection, protecting them from light.
- Field duplicate samples (where applicable) will be collected concurrently with field samples at a ratio of one blind duplicate sample for every 10 field samples. Field duplicates will be collected throughout the sampling process from a range of environmental concentrations. Field duplicates for soil will be collected from a sample with sufficient volume that has been homogenized in the field. Field duplicates for water samples will consist of two separate samples taken from the same location at the same time.
- Equipment blanks will be collected concurrently with field samples at a ratio of one per set of 20 similar samples. Equipment blanks are samples of analyte-free water poured over or through decontaminated field sampling equipment (e.g., low-flow peristaltic pumps for groundwater sampling). Some sampling types do not involve sampling equipment (e.g., surface water collection) and therefore, equipment blanks would not be applicable.
- Trip blanks will be taken from the laboratory to the Site and then transported back to the laboratory without having been exposed to sampling procedures. One bottle set per sample cooler filled with laboratory-prepared deionized water will accompany the bottles and samples throughout the duration of the field program (up to a maximum of 10 trip blanks). Trip blanks will be included when samples are being collected for petroleum hydrocarbons.
- Sample coolers will be labeled for shipment. A temperature blank will be placed in the cooler prior to shipment. Coolers will be checked at designated intervals en-route to Anchorage to confirm that sample temperature is being maintained. Evidence of collection, shipment, laboratory receipt, and laboratory custody until completion of analyses will be documented via a chain-of-custody form containing the signature of the individuals collecting, shipping, and receiving each sample. All samples will be transported to TestAmerica (Anchorage, Alaska). All routine analyses (soil and water) will be completed by TestAmerica who are DEC-approved. TestAmerica will be responsible for trans-shipment of samples to specialist laboratories where required.
- All laboratory analyses will be conducted with matrix spike, laboratory duplicate, and certified reference materials as required by the applicable analytical protocols. All certificates of analyses will be reviewed by Golder as part of a data quality review process to verify that data are representative of site conditions and appropriate for use in a site characterization assessment. This data quality review process includes a review of field duplicate relative percent differences, equipment and trip blank analyses, reportable detection limits

and laboratory QA/QC findings (including all data qualifiers). The data quality review will be documented through completion of a DEC data quality checklist for each individual laboratory report; the data review checklists will be included in the site characterization report

2.4 Field Records

Field staff will maintain detailed documentation of field activities on field record sheets or in a logbook per DEC (2017a). Field records will be included as an appendix to the Site Characterization Report and will include:

- General descriptions regarding the daily objective, weather and site conditions and the time, location and observations with respect to each sample collected.
- The location of each sample (established using a hand-held GPS), along with a representative photograph that places the sample location in the context of its surroundings. Temporary sample markers will be placed where needed so that field staff can readily locate the sample location for follow-up sampling as needed during the August field program.
- A unique sample identification code will be assigned to each sample following a coding system that builds on the approach used by Golder (2019). Previous sample IDs will generally not be re-used unless a sample is being collected from a fixed sample location (e.g., groundwater wells or surface water monitoring locations). To prevent misidentification of samples, legible labels will be affixed to each sample container including project name, sample type, sample identification, initials of collector, data and time of data collected, analysis required and preservative (as applicable). A master list of all samples collected will be maintained.
- Calibration records will be maintained in the field logbooks or equipment-specific log sheets as appropriate.

3.0 SITE CHARACTERIZATION SAMPLING

This section describes how site characterization samples (*i.e.*, soil, groundwater, and surface water chemistry data) will be collected during the 2019 field program. There may be minor modifications to this proposed scope of work to account for field conditions which will be discussed with the appropriate Golder technical lead and Rio Tinto project manager. If the modification requires deviation from the overall study plan, we will communicate the proposed deviation and the rationale to DEC prior to modifying the approved plan.

3.1 Soil Sampling

3.1.1 Purpose of Sampling

Golder will conduct additional, targeted sampling of soil and waste rock in order to support remedial alternatives planning for the Site. Soil and/or waste rock samples will be collected from the following areas of the Site:

- <u>Along existing roadways across the Site</u>. Previous investigations indicated that waste rock was used as road construction material in some instances. Although the gravel roads in the southern area of the Site, along South Blackbird creek past the large AST and nearby Mr. Mann's property do not appear to have been constructed with waste rock, additional samples are recommended in order to increase the sampling density and support remedial planning for this material. Samples for metals analysis will be collected at approximately 500 feet intervals along the roadways; 15 samples have been budgeted to address this data gap. An XRF analyzer will be available on-Site to delineate metals-contaminated soil and assess whether additional step-out samples may be required.

- Delineation samples to refine the results of principal component analysis (PCA). PCA is a statistical analysis that measures the variance in a data set (e.g., soil chemistry), and was conducted to support the risk assessment for the Site. The results of the PCA were interpolated and plotted to generate an approximate extent of metals-contaminated soil. Additional samples are recommended to refine the areas of high metals contamination. Samples collected as part of this task will be analyzed by the laboratory and in the field using the XRF. Approximately 20 samples have been estimated to support this task.
- Storage tanks and associated piping. Additional, opportunistic soil samples will be collected to further delineate the extent of hydrocarbon contamination to the north, east and south of the historic infrastructure at the Site. The purpose of this sampling effort is to refine the volume of contaminated soil that may require remediation. Approximately 15 samples have been estimated to support this task.
- Mineralized Soil Samples. Samples will be opportunistically collected outside the mined area (e.g. to the east of Mine Lake) to represent background samples of soil from potentially mineralized geologic units in the area. Approximately 10 samples have been estimated to support this task.

3.1.2 Methodology

Soil samples will be collected in accordance with DEC (2017a):

- Test pits will be excavated using an excavator, shovel, pickaxe, trowel, or stainless-steel hand auger, depending on accessibility. The maximum depth investigated will range between 3 to 15 feet below ground surface, depending on the excavation method and suspected contamination.
- Soil samples will be collected by hand from soil material in the test pit or from the hand auger using single-use disposable nitrile gloves. While using an excavator, soil samples will be collected from the test pit or the center of the excavator bucket.
- The soil samples will be classified using the Unified Soil Classification System (USCS). GPS coordinates, sample interval depths, lithology descriptions, soil classifications, and other pertinent geologic data and observations on disturbance area will be recorded on field forms.
- Hand tools will be decontaminated between sample locations.
- Upon completion, the test pit and hand-dug sampling locations will be backfilled with excavated material, in the reverse order that the material was excavated.

Metals

Consistent with site characterization work conducted in 2016 and 2018, soil characterization work undertaken in 2019 will include the use of a Niton XRF analyzer to delineate metals-contaminated soils. The purpose of the XRF is to allow field staff to get same day results to assess whether additional step-out samples will add value for Site management decisions. The XRF analyzer uses x-ray emissions to provide real-time measurements of metals concentrations within the soil matrix. Golder field staff are trained in the proper use of a portable XRF. Field screening for metals will be conducted in accordance with USEPA Method 6200 (2007), as follows:

- Golder will collect bulk soil samples and fill laboratory-provided containers at each sample location. Soil material will be homogenized on-site and will be free of roots, leaves, and rocks. Bulk soil samples will be stored in disposable polyethylene bags until analysis using a Niton XRF analyzer is completed.
- Soil samples for laboratory analysis will be placed directly into clean laboratory-provided containers and preserved specific to the analysis to be performed. Sample containers will be properly labeled to include the date, time, location, depth of the samples collected, and accompanied by the chain-of-custody form through delivery to the laboratory.
- A target of 10 percent of soil samples analyzed with the XRF in the field will be submitted to the laboratory for metals analysis. Samples will be selected from the lower, middle and upper range of metals concentrations. The remaining samples will be transported to Anchorage and archived. The results of these analyses will be used to generate control pairs with the corresponding XRF results. If the correlation coefficient is low, additional samples may be selected for laboratory analysis.
- The soil samples submitted to a state-certified laboratory (TestAmerica) will be analyzed for the following metals parameters:
  - Aluminum, calcium, iron, magnesium, potassium, and sodium by USEPA Method 6010C
  - Antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, nickel, selenium, silver, strontium, thallium, vanadium and zinc by USEPA Method 6020B; and
  - Mercury by USEPA Method 7471B.

This is the same set of metals analytes that was analyzed as part of the 2018 site characterization program.

Petroleum Hydrocarbons

Golder's Site assessment work will include the use of a photoionization detector (PID) to help delineate hydrocarbon contaminated soils. Golder is aware of the limitations of the PID when faced with weathered heavy end oils and probable heavy rainfall, and therefore, field staff will also use physical screening methods, such as visual and olfactory screening, to obtain basic information related to the presence or absence of petroleum hydrocarbons. Soil samples will be collected in accordance with DEC (2017a):

- Three soil samples would be collected from each sample location. The first sub-sample would be for XRF analysis as described above. The second sub-sample would be field screened for organic vapor concentration, and the third sub-sample will be collected for possible laboratory analysis.
- The field screening for organic vapor concentration involves:
  - Bag will be filled approximately one-half to one-third full (no less than 250 mL or eight ounces);
  - Prior to the PID reading, the bag will be agitated for approximately 15 seconds;
  - Bag will be placed in a warm location (approximately 10 minutes but no longer than an hour);
  - Bag temperature should be at least 5°C (40F);

  - Bag will be agitated again for approximately 15 seconds; and
  - The PID will be inserted into the bag for three seconds and the highest reading recorded in the field forms.
- Soil samples for laboratory analysis will be placed directly into clean laboratory-provided glass containers and preserved specific to the analysis to be performed. Sample containers will be properly labeled to include the date, time, location, depth of the samples collected, and accompanied by the chain-of-custody form through delivery to the laboratory.
- Hand tools will be decontaminated with Alconox soap and subsequently rinsed with water prior to retrieving another sample to prevent cross-contamination.
- The soil samples will be submitted to a state-certified laboratory (TestAmerica) for possible metals analysis as outlined above, as well as petroleum hydrocarbon parameter analysis including:
  - Percent moisture;
  - PAHs by USEPA Method 8270B;
  - DRO by DEC Method AK102; and
  - RRO by DEC Method AK103.

3.1.3 Data Quality Objectives

The primary data quality objective for soil sampling data relates to laboratory QA/QC practices (e.g., matrix spike recovery; performance of certified reference materials, blanks). Data may be rejected if the laboratory fails to achieve the desired detection limits (i.e., DEC [2017b] Cleanup Levels), or if the matrix spike falls outside the limits specified by the analytical method. Field duplicate samples will be collected concurrently with field soil samples at a ratio of one blind duplicate sample for every 10 field samples. An RPD of >50% indicates that data may not have sufficient precision and that further evaluation to confirm that sampling methods were properly executed is needed (DEC 2017a).

As the majority of the metals contamination will be delineated in the field using an XRF, the second data quality objective for soil sampling relates to the correlation coefficient between the confirmatory laboratory analysis and XRF results. This coefficient should be 0.7 at a minimum for the XRF data to be used as screening data (USEPA 2007).

3.2 Waste Rock Sampling

The objective of the waste rock sampling and analysis is to provide information on constituent leaching to evaluate the possibility of waste rock backfill into Mine Lake as a remedy component.

Sample collection will target waste rock piles where subsurface investigations for other purposes (i.e. test pitting or coring) are already planned (or in proximity to planned activities).

The primary waste rock sample locations will be from:

- Blackbird Waste Rock Pile. The excavator will be used to collect near-surface samples to the depth of the reach of the excavator. This area likely contains waste rock with the highest acid rock drainage (ARD) and metal leaching (ML) potential.
- Tram Dump. Samples will be taken from the entire depth of the borehole.
- Mine Lake. If drilling is conducted in the vicinity of a waste rock pile, samples will be collected along the depth of each hole otherwise surface samples will be collected with an excavator.

Up to 30 samples will be collected from these waste rock areas along with other areas as appropriate. Additional confirmatory sampling will be conducted at a future date if backfill into Mine Lake is selected as the preferred alternative to confirm that waste rock from other areas has similar ARD and ML potential.

The following laboratory analysis of the waste rock samples will be conducted:

- Static Leach Testing
- Acid Base Accounting (ABA)
- Elemental Analysis
- Particle Size Distribution
- Quality Assurance and Quality Control

3.3 Borehole Drilling and Monitoring Well Installation

Golder will subcontract Discovery Drilling to provide a drill rig capable of drilling through overburden and bedrock. Borehole drilling and monitoring well installation will be undertaken in accordance with Alaska DEC document "*Monitoring Well Guidance*" (DEC 2013). A summary of the proposed monitoring wells is shown in Table 1 with locations shown on Figure 1.

Table 1: Proposed Borehole and Monitoring Well Locations

Objective	Approximate Location	Depth	Type of installation	Rationale
Assess shallow/deep groundwater properties	Block 4, Lot 37 (PW-01) and Block 4 Lot 36 (O-02)	~15' (PW-01), 70' (O-02)	Nested Bedrock/overburden for 2" PVC Obs well. 4" PVC pumping well will be installed in overburden or bedrock.	To assess aquifer thickness and conduct a 48-hr. pumping test to evaluate aquifer properties and potential for saltwater intrusion. The obs. well will be drilled first to assess groundwater in bedrock. A 4" well will be installed in overburden if aquifer thickness is sufficient to conduct a pumping test,

Objective	Approximate Location	Depth	Type of installation	Rationale
				and/or in bedrock if groundwater is encountered.
Assess background concentrations	Block 7, Lot 1 (B-01), Block 7, Lot 9 (B-02) and Block 8, Lot 33 (B-03)	~80’	2” PVC monitoring wells with 5’ screens. Nested in overburden and bedrock.	Assess arsenic and copper concentrations in groundwater in background locations. B-02 is to assess metals concentrations up-gradient of waste rock pile.
Delineate potential metals impacts in groundwater associated with Blackbird waste rock pile	Block 4, Lot 14 (O-01)	~ 80’	2” PVC monitoring well with 5’ screens. Nested overburden and bedrock	Determine metals concentrations down-gradient of waste rock
Groundwater-surface water interaction	Block 7, Lot 1 or 2 (I-01), Block 4, Lot 8 (I-02), Block 4, Lot 31 (I-03), Block 8, Lot 3 (I-04)	~20’	2” PVC monitoring wells with 5’ screens. Installed in overburden	Determine influence of groundwater on North Blackbird Ck, South Blackbird Ck, Upper Copper Ck, Lower Copper Ck
Groundwater influence to Mine Lake	Block 4, Lot 25 (ML-01), Block 4, Lot 33 (ML-02), Block 8, Lot 28 (ML-03)	80’	Nested overburden and Bedrock	GW flow direction, confirmation of drainage divide, aquifer properties, water quality B-03 can also be used for Mine Lake influence.
Geotechnical	Block 4, Lot 32 (G-01), Block 8, Lot 42 (G-02), Block 4, Lot 31 (G-03)	30’	2” PVC monitoring wells with 5’ or 10’ screens in overburden	Geologic mapping and groundwater elevation

The monitoring wells will be constructed as per the Alaska DEC monitoring well guidance document. This includes installing the piping without the use of glues or solvents; the well risers will be constructed of 2-inch or 4-inch diameter, pre-washed, wrapped and threaded Schedule 40, threaded polyvinyl chloride (PVC) pipe and the well screens will be constructed with sections of No. 10 size slotted PVC pipe. The length of the well screen will be based on observations made in the field. A clean 10/20 size filter sand pack will be placed around the screened portion of the wells to approximately 1 foot above the top of the screen and 1 foot below the bottom of the screen. A bentonite seal will be used to fill the annular space between the sand pack and ground surface. Cuttings generated during the drilling program will be returned to the ground following completion of the monitoring well. The monitoring wells will be completed with stick-up protective casings, set in concrete.

The investigation will be carried out under the supervision of a Golder Environmental Field Supervisor. The soil conditions encountered during the drilling program will be logged on field borehole logs. The anticipated depths of the monitoring well installations are outlined in Table 2 but will be confirmed in the field based on observations made during the drilling program. Where possible, soil cuttings that are generated during the drilling program will be re-used to backfill the boreholes, in combination with a bentonite seal. Soil cuttings not used as backfill will be spread on the ground surface in the vicinity of the borehole locations.

3.4 Groundwater Sampling

3.4.1 Purpose of Sampling

Additional groundwater sampling is included as part of the 2019 site characterization program to further evaluate the potential future use of groundwater as a source of drinking water, and to evaluate the interaction between groundwater and surface water at the Site. The seven existing groundwater monitoring wells at the Site, in addition to the up to 20 newly installed monitoring wells (refer to Section 3.2), will be sampled as part of the 2019 site characterization program. Existing and proposed monitoring well locations are shown on Figure 1.

3.4.2 Methodology

Groundwater samples will be collected in accordance with DEC (2017a):

- At each well location, depth to water and depth to bottom will be measured as feet below top of pipe (btop) using a decontaminated water level tape, and well stickup will be measured as feet above ground surface (ags). Well coordinates will be recorded at each location and a photograph taken to document conditions at the time of sampling.
- Monitoring wells will be purged and sampled using either a GeoPump peristaltic pump and dedicated tubing or a single use/dedicated bailer. The purging and sampling method will depend on the depth to water and well water volume. The well may be considered purged when three well volumes are removed, when water quality parameters stabilize or, for low yield wells, when the well casing is evacuated. The plan for purge water disposal is to return to the ground at each well location through infiltration, as was previously done on the site.
- A pumping test up of at least 48 hours in length is planned to occur at one or two locations depending on the geology encountered. A downhole submersible pump would pump groundwater at a constant rate during the test. The water would be directed through hoses to an area away from the pumping well and allowed to discharge back to ground through infiltration. The water level in the pumping wells and other nearby wells will be monitored during the pumping test and for 24 hours following the end of pumping through the use of a pressure transducer. Manual water level measurements and field water quality parameters will also be conducted throughout the test and recovery period. Groundwater samples will also be collected throughout the test.
- Field water quality parameters, including pH, temperature, dissolved oxygen, specific conductance, and oxidation reduction potential will be recorded during and after purging. Groundwater turbidity will be recorded after purging is complete.
- Groundwater samples will be collected using the same method as purging at each well. Samples will be collected directly from the dedicated tubing into the pre-cleaned laboratory-supplied containers. Samples for

dissolved metals, dissolved organic carbon and chromium and arsenic speciation will be filtered in the field using a 0.45 micrometer (µm) in-line or syringe tip filter. Laboratory supplied, pre-measured preservatives will added to the applicable samples in the field.

- Groundwater samples will be submitted to a state-certified laboratory (TestAmerica) and analyzed for the same parameters as in the previous sampling event, namely:
  - Dissolved and total arsenic, barium, cadmium, chromium, copper, lead, nickel, selenium, silver, and zinc by USEPA Method 6010B;
  - Dissolved and total mercury by USEPA Method 7470B;
  - Geochemical parameters: alkalinity, pH, conductivity, and hardness by USEPA Method 2320B, SM4500 H+, 2510B, 2340C respectively;
  - Dissolved organic carbon by USEPA SM5310 DOC B; and
  - Major cations (sodium, magnesium, potassium, and calcium) and anions (chloride, sulphate, sulfite, carbonate, and bicarbonate) by USEPA Method 6010C, 300.0 and SM4500 SO3 B.
- Existing monitoring wells MW1, MW2, MW18-01, MW18-02, and MW18-03 are located in proximity to the above ground storage tank and identified hydrocarbon-contaminated soil. Groundwater samples collected from these wells will therefore also be submitted for petroleum hydrocarbon parameter analysis including:
  - PAHs by USEPA Method 8270D;
  - DRO by DEC Method AK102; and
  - RRO by DEC Method AK103.

3.4.3 Data Quality Objectives

The primary data quality objectives for the groundwater chemistry relate to laboratory QA/QC practices (e.g., matrix spike recovery, blanks). Data may be rejected if the laboratory fails to achieve the desired detection limits (i.e., Alaska WQGs), or if the matrix spike falls outside the limits specified by the analytical method. Field duplicate samples will be collected concurrently with field samples at a ratio of one blind duplicate sample for every 10 field samples. An RPD of >30% indicates that data may not have sufficient precision and that further evaluation to confirm that sampling methods were properly executed is needed (DEC 2017a).

3.5 Surface Water Sampling

3.5.1 Purpose of Sampling

A targeted surface water sampling program is included as part of the 2019 site characterization program in order to evaluate surface water-groundwater interactions and to support remedial alternatives planning in the vicinity of the mine lake. Proposed surface water sampling locations are shown on Table 2.

Table 2: Proposed Surface Water Sampling Locations

Sample Location ID	Latitude	Longitude	Location	Rationale
SW-003	60.0558	-147.8950	North Blackbird Creek	Surface water sample in proximity to proposed monitoring well I-01.
SW-008*	TBC	TBC	Upper Cove Creek (Historic Lower Copper Creek Channel)	Surface water sample in proximity to proposed monitoring well I-04.
SW-009[a]	60.0486	-147.8998	Pond 32	Surface water sample in proximity to proposed monitoring well ML-02.
SW-010	60.0482	-147.8999	Copper Creek, between Pond 32 and Mine Lake	Surface water sample in proximity to proposed monitoring well ML-02.
SW-011	60.0468	-147.9010	Mine Lake, shore sample	Surface water sample in proximity to proposed monitoring well ML-03.
SW-015[b]	60.0462	-147.9072	Stream flowing toward South Creek	Paired sampling with location SW-027
SW-BG06	60.0488	-147.8972	Copper Creek South Fork, upgradient of the Mine Lake (background sampling location)	Surface water sample in proximity to proposed monitoring well I-03.
SW-024	*TBC*	*TBC*	*South Blackbird Creek, adjacent to proposed monitoring well I-02*	*Surface water sample in proximity to proposed monitoring well I-02.*
SW-025	*TBC*	*TBC*	*Upper North Blackbird Creak*	*Upstream of Blackbird Mine to evaluate background water quality in this drainage*
SW-026[a]	*TBC*	*TBC*	*Ponded Water north of Tram Dump and Pond 32*	*Evaluate water quality on the north side of the tram dump*
SW-027[b]	*TBC*	*TBC*	*South Creek, upstream of SW-015*	*Further characterize background water quality to the south of the mine area*

Notes:
Italic font denotes proposed sample locations that have not previously been monitored (*i.e.*, 'new' surface water sampling locations).
*: Either SW-007 or SW-008 will be sampled, depending on the location of monitoring well I-04.
TBC = to be confirmed. GPS coordinates will be collected in the field at the time of sampling.
a. Because SW-009 and SW-006 are located in proximity to each other (*i.e.* on the south and north sides of the Tram Dump, respectively), the two locations will be sampled on the same day.
b. Because SW-015 and SW-027 are located within the same watercourse, the two locations will be sampled on the same day.

3.5.2 Methodology

Surface water samples will be collected according to DEC (2017a):

- Surface water samples will be collected as grab samples from a discrete depth in the water column. If the flow is not sufficient to fill the bottles directly from the waterbody, a single-use syringe or peristaltic pump with single-use tubing will be used to draw water from the flow or ponded area and discharged into the pre-cleaned laboratory-supplied containers. Care will be taken to avoid sampling if turbidity has been induced by field activities (e.g., walking in an upstream area).
- Samples for dissolved metals and dissolved organic carbon will be filtered in the field using a 0.45 µm in-line or syringe tip filter. Laboratory-supplied, pre-measured preservatives will added to the applicable samples in the field.
- Field water quality parameters, including pH, temperature, dissolved oxygen, specific conductance, and oxidation reduction potential will be recorded after sample collection from the same location as the water quality sample. Turbidity will also be recorded during sampling.
- The general field measurements and records described in Section 2.4 will be collected at each location.
- All surface water samples will be submitted to a state-certified laboratory, and analyzed for the following constituents of potential concern:
  - Dissolved and total metals (USEPA 6010B) and dissolved and total mercury (USEPA 7470B)
  - Geochemical parameters: alkalinity, pH, conductivity, and hardness by USEPA Method 2320B, SM4500 H+, 2510B, 2340C, respectively
  - Dissolved organic carbon by USEPA SM5310 DOC B
  - Major cations (sodium, magnesium, potassium, and calcium) and anions (chloride, sulphate, sulfite, carbonate, and bicarbonate)

This is the same set of parameters that was approved in the 2018 Site Characterization Work Plan.

3.5.3 Data Quality Objectives

The primary data quality objectives for the surface water chemistry relate to laboratory QA/QC practices (e.g., matrix spike recovery, blanks). Data may be rejected if the laboratory fails to achieve the desired detection limits (i.e., Alaska WQGs), or if the matrix spike falls outside the limits specified by the analytical method. Field duplicate samples will be collected concurrently with field samples at a ratio of one blind duplicate sample for every 10 field samples. An RPD of >30% indicates that data may not have sufficient precision and that further evaluation to confirm that sampling methods were properly executed is needed (DEC 2017a).

3.6 Flow Measurements

Stream morphology parameters (steam bed, water depth profile, and stream flow data) will be collected at the cross sections within creeks where surface water samples will be collected (refer to Table 2). The flow will be calculated by measuring the width of the stream from bank to bank and recording water depth and velocity (using a portable water flow meter) at each point along a transect perpendicular to the stream. Data for velocity, depth, and distance along each of the cross sections will be used to estimate discharge using the method developed by the USGS (Turnipseed and Sauer 2010). The cross sections will be documented with photographs, GPS coordinates and field sketches.

A portable flow meter is the preferred approach for flow measurements, but if water is too shallow to use the meter, Golder will take cross-sectional measurements of width and depth and determine the water velocity by timing how long it takes for a floating object (e.g., a ping pong ball) to travel a set distance.

4.0 ENGINEERING INVESTIGATION PROGRAMS

Additional site investigation programs will be implemented in parallel to the site characterization works described in the previous sections of this work plan. The purpose of these programs is to gather information for future remedial action design efforts at the Site. These programs are anticipated to include:

- Geotechnical investigation for the diversion of Copper Creek. A potential remedial action includes diverting Copper Creek to eliminate the creek discharge into Mine Lake. Potential diversion alignments were identified during the August 2018 visit. Generally, these alignments involve diverting Copper Creek upstream of mine activities (just downstream of the fork of North and South Copper Creeks). The proposed diversion alignments generally follow the historic diversion alignment used during mining activities, as shown on the Figure. The geotechnical investigation will support this effort as well as other efforts and includes:
  - Subsurface investigation consisting of four boreholes and three test pits. Data from the other boreholes (wells) described in this work plan will also be used.
  - Test pits for borrow source exploration.
  - Geologic mapping of the area around Mine Lake.
- Safeguarding of identified mine openings:
  - Installation of safeguarding features to restrict access to known mine openings. This will be completed using local borrow, polyurethane foam (PUF) and steel fencing/cables.
  - The Main Shaft and Upper Blackbird South Adit will be safeguarded with high-strength steel chain link fencing. Chenega North Adit will be safeguarded with a steel cable barrier.
  - Features planned to be safeguarded with PUF include: the 70 Manway, the Waste Rock Drift, the Historic Portal and Feature, the Chenega South Adit, the Chenega East Raise, the Upper Blackbird South Raise, and the Blackbird North Raise.
- Geophysical investigation of historic infrastructure:
  - A geophysical investigation will be performed to identify voids remaining from the historic mine infrastructure. These voids potentially pose risks to people and equipment. We assume the following areas will be focused on: the utility trench, the building foundation area for the mill and mine structures (including the cut bank to the Main Adit), and the powerhouse area where accessible.

- Installation of a rain gauge
  - A precipitation station will be installed on the middle shelf, likely near the Chenega South Adit. This station will record accumulated precipitation via a transducer for rain and indirect precipitation falling as snow.
- Reconnaissance of the Upper Blackbird Mine area
  - The area in the vicinity of the Upper Blackbird Mine workings will be assessed to determine location and approximate volume of open mine features to be addressed at a later stage. Potential borrow sources will also be investigated and additional hazard signage installed as needed.
- Additional sign installation and pressure transducer data download:
  - Any remaining hazards that were not signed during the May 2019 field event will be signed. Additionally, any signs that have been damaged or are missing will be replaced. All large signs will be re-installed with permanent (concrete) foundations and stronger and longer posts.
  - The data from the pressure transducer stations will be downloaded. This effort will incorporate inspection of the stream flow and water level monitoring stations to perform any necessary maintenance and/or updates to the monitoring sites. This will include accessing each Hobo to confirm performance, battery status, and to make any necessary adjustments.

5.0 CONCLUSION AND CLOSURE

The scope of work described in this report will be implemented during a two-week field program scheduled for mid-July. Data collected during the program will be documented in a 2019 Site Characterization Report. The Site Characterization Report will meet the data reporting requirements specified by DEC (2017a).

This workplan has been prepared by the following technical staff who are qualified professionals per 18 AAC 75.

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https://golderassociates.sharepoint.com/sites/22907g/technical work/task 620 - 2019 site visits/summer 2019/dec work plan/1781329.2000-620 2019 -workplan-27june19-rev0.docx

6.0 REFERENCES

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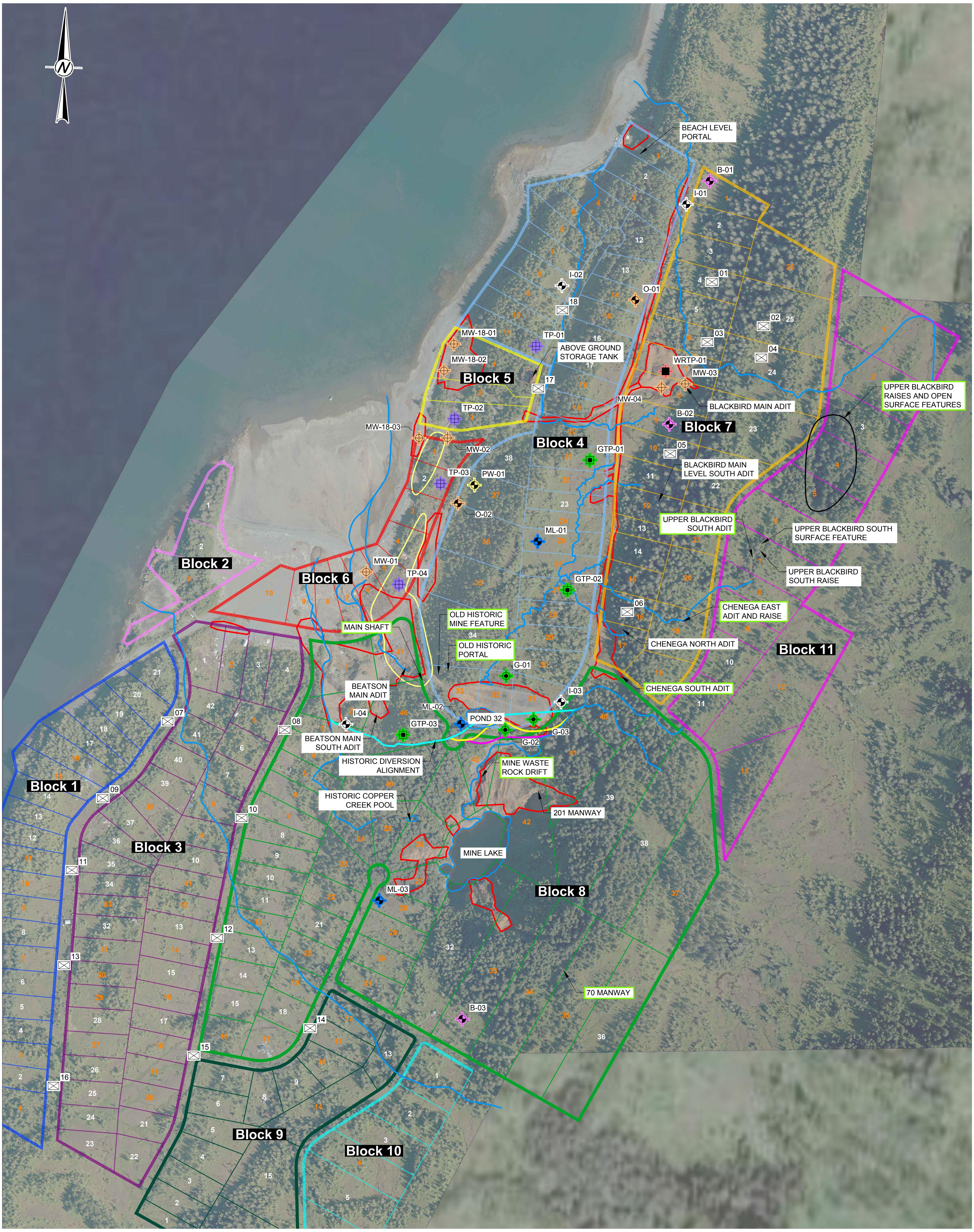
Figure



LEGEND

- WELL/BOREHOLE
  - I = GW/SW INTERACTION (WHITE)
  - ML = MINE LAKE INVESTIGATION (BLUE)
  - PW = PUMPING WELL (YELLOW)
  - O = OTHER (ORANGE)
  - B = BACKGROUND (PINK)
- MW — EXISTING MONITORING WELL SAMPLE
- TP — HYDROCARBON TEST PIT
- GTP — GEOTECHNICAL TEST PIT
- WRTP — WASTE ROCK TEST PIT
- G — GEOTECHNICAL BOREHOLE
- NON-INTRUSIVE SAMPLE

- 24 — ACCESS APPROVAL RECEIVED FOR AUGUST 2018 FIELD PROGRAM
- INTERIM COPPER CREEK DIVERSION ALIGNMENT - ALTERNATIVE 2
- INTERIM COPPER CREEK DIVERSION ALIGNMENT - ALTERNATIVE 3
- INTERIM COPPER CREEK DIVERSION ALIGNMENT - ALTERNATIVE 4
- STREAM/CREEK FLOW PATHS
- WASTE ROCK
- GEOPHYSICAL INVESTIGATION AREA
- FEATURE NAME — IDENTIFIED MINE FEATURES FOR SAFEGUARDING

NOTE(S)

1. BASE IMAGERY IS COPYRIGHT GOOGLE EARTH, DATED 2004.
2. COORDINATE SYSTEM IS ALASKA STATE PLANES, ZONE 3, NAD83
3. INFORMATION OBTAINED FROM THE STATE OF ALASKA DEPARTMENT OF NATURAL RESOURCES LAND RECORDS WEBSITE (DNR.ALASKA.GOV/LANDRECORDS).
4. PROPERTY LOCATIONS ARE APPROXIMATE.
5. PLAT BOUNDARY AND PROPERTY LINES ADJUSTED BY GOLDER (2018) TO BETTER MATCH ACTUAL TOPOGRAPHY. ACTUAL BOUNDARIES ARE UNKOWN.

DRAFT

0 250 500
1" = 250' FEET

CLIENT
RIO TINTO

PROJECT
BEATSON MINE RECLAMATION
LATOUCHE ISLAND, ALASKA
SUMMER 2019 SITE INVESTIGATION

CONSULTANT
GOLDER

YYYY-MM-DD	2019-06-26
DESIGNED	MC
PREPARED	MC/AG
REVIEWED	CLC
APPROVED	CLC

TITLE
SUBSURFACE INVESTIGATION

PROJECT NO.	PHASE	REV.	FIGURE
1781329	620	D	1

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