Amendment

Mining Permit Application Amendment

Copperwood

Volume I

Project I.D.: 17C050

Copperwood Resources, Inc.
Gogebic County, Michigan

March 2018

HIGHLAND
Copper Company Inc.
310 US Highway 2
Wakefield, MI 49968
906.229.3115

March 21, 2018

Mr. Joe Maki
MDEQ Oil Gas and Minerals Division
1504 West Washington Street
Marquette, MI 49855

Re: Amendment to MP012012 for the Copperwood Mine

Please find enclosed an application for amendment to MP012012 originally issued to Orvana Resources US Corporation (ORUSC). Highland Copper Company Inc. (Highland Copper) acquired the Copperwood Mine Project from Orvana Minerals Corp. in June 2014 when it acquired all the outstanding shares of ORUSC. After this acquisition, Highland Copper changed the name of ORUSC to Copperwood Resources Inc. (Copperwood) by amending the articles of incorporation.

Copperwood is currently preparing an update to the feasibility study completed in February 2012 on the Copperwood Mine Project. As a result of preliminary tradeoff studies for certain aspects of the feasibility update, several project changes and improvements are being proposed. Notable changes from the 2012 feasibility study and mine permit include:

- Process plant relocation to the west of the previous site
- Addition of an outdoor ore stockpile
- Modification of the mine ventilation plan
- Addition of on-site power generation using natural gas fuel

While the anticipated date for finalizing the feasibility study update is June 2018, Copperwood desires to move forward now with permitting requirements for the proposed changes.

Please contact myself, Thomas Repaal, with questions or clarification requests at (906) 229-3115 or email at thomas.repaal@highlandcopper.com .

Regards,

Thomas Repaal

Thomas Repaal
Sr. Environmental Engineer

Enclosure

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March 21, 2018

Mr. Tom Repaal
Copperwood Resources, Inc.
310 East US Highway 2
Wakefield, MI 49968

Dear Mr. Repaal:

RE: Copperwood – Mining Permit Application Amendment

Enclosed for your distribution is the *Mining Permit Application Amendment* (*Amendment*) for mining the Copperwood mineral resource. This *Amendment* has been prepared in accordance with the requirements of Part 632 of the Michigan Natural Resources and Environmental Protection Act and Michigan Administrative Rules codified under R 425.206.

Sincerely,

Foth Infrastructure & Environment, LLC

Kris Baran
Project Director/Associate

Mark Ciardelli
Lead Environmental Scientist

Stephen V. Donohue, PH
Vice President - Mining

Mining Permit Application Amendment
Copperwood

Distribution

No. of Copies	Sent To
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1	Mr. Tom Repaal Copperwood Resources, Inc. 310 East US Highway 2 Wakefield, MI 49968

Mining Permit Application Amendment
Copperwood

Project ID: 17C050

Prepared for
Copperwood Resources, Inc.
Gogebic County, Michigan

Prepared by
Foth Infrastructure & Environment, LLC

March 2018

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List of Abbreviations, Acronyms, and Symbols

Amendment	*Mining Permit Application Amendment*
CD	Certificate of Deposit
cm/s	centimeters per second
CO	carbon monoxide
Copperwood	Copperwood Resources, Inc.
CR	County Road
EIA	Environmental Impact Assessment
ERP	Emergency Response Plan
FEL	front-end loader
Foth	Foth Infrastructure & Environment, LLC
GMining	G Mining Services Inc.
Highland	Highland Copper Company Inc.
ICP	Integrated Contingency Plan
km	kilometer
kW	kilowatt
LOM	Life of Mine
m	meter
mm	millimeter
Mt	metric dry tons
MCL	Michigan Compiled Laws
MDEQ	Michigan Department of Environmental Quality
MPA	Mine Permit Application
NCNST	North Country National Scenic Trail
NREPA	Natural Resources and Environmental Protection Act
NO_2	nitrogen dioxide
NPDES	National Pollutant Discharge Elimination System
ORUSC	Orvana Resources US Corp.
Project	Copperwood Project
PTI	Permit to Install
SAG	semi-autogenous grinding
SCR	Selective Catalytic Reduction
TDF	tailings disposal facility
tpd	tonnes per day
tph	tonnes per hour
µm	micrometer
USCS	Unified Soil Classification System
VOC	volatile organic compound
WTP	water treatment plant

1 Introduction

Copperwood Resources, Inc. (Copperwood), formerly known as Orvana Resources US Corp. (ORUSC), is proposing the development of the Copperwood mineral resource in Ironwood and Wakefield Townships, Gogebic County, Michigan. The Copperwood Project (Project) location is shown on Figure 1-1. Copperwood is applying for an amendment to its Mining Permit (MP 01 2012) in accordance with Part 632 of the Michigan Natural Resources and Environmental Protection Act (NREPA) (Michigan Compiled Law [MCL] §324.63207) and rules promulgated under R 425.206 of the Michigan Administrative Code to allow for a revised Project site layout, and modified mining methods. The location of Project components to be permitted as part of this amendment are shown on Figure 1-2. This volume (Volume I) of the *Mining Permit Application Amendment* (*Amendment*) contains the required mine permit amendment form; mining, reclamation, and environmental protection plans; contingency plan; and financial assurance information as required in MCL §324.63207(6)(a) and R 425.206(1)(b-e). Volume II of the *Amendment* provides the Environmental Impact Assessment (Amendment EIA) required in MCL §324.63207(6)(a) and R 425.206(1)(a).

1.1 Background

Highland Copper Company Inc. (Highland), a Canadian copper development company, acquired the Project from Orvana Minerals Corp. in June 2014 when it acquired all of the outstanding shares ORUSC. Subsequent to this acquisition, Highland changed the name of ORUSC to Copperwood by amending the articles of incorporation. A certificate of amendment to the articles of incorporation is provided in Appendix A and an organization report is provided in Appendix B. A mining permit was obtained for the Project in 2012 and was amended 2013. In May 2017, Highland engaged the services of G Mining Services Inc. (GMining) to update the Project design.

1.2 Mining Permit Application Documents

This *Amendment* is being submitted by Copperwood to request an amendment to the existing Part 632 permit for mining of the Copperwood deposit. This *Amendment* includes the following updates:

- A permit amendment form (Appendix C).
- An amended mining plan.
- A discussion of amendments, where applicable, to the containment plan, monitoring plan, reclamation plan, environmental protection plan, and contingency plan.
- A discussion of changes in financial assurance.
- Amendments, as applicable to the EIA (Volume II of this *Amendment*).

1.3 Other Permits

Copperwood currently holds and previously held several permits as required in Michigan's environmental regulations. The current Copperwood permits, as well as, new permits that are being applied for are as follows:

- *Part 632 Mining Permit (MP 01 2012)* for mining and beneficiation activities associated with the Copperwood deposit.

- *National Pollutant Discharge Elimination System (NPDES) Permit (MI0058969)* for process and treated sanitary wastewaters. A renewal application for this permit was submitted in September 2017 with no changes. Depending on the outcome of the Project updates, modifications to the conditions of this permit maybe requested.

- *Part 315 Dam Safety Permit (13-27-0009-P)* for the placement of fill to construct a tailings disposal facility (TDF) for the Project. There are no changes being proposed to the conditions of this permit.

- A *Michigan Air Use Permit to Install (PTI 180-11)* was previously held for the Project for emissions associated with construction and mining activities. This permit was voided on July 28, 2015, because the installation and construction of the equipment approved under this permit had not commenced within 18 months of the issuance of the PTI. An application will be concurrently submitted by Copperwood for approval of a new PTI.

- *Part 301 Inland Lakes and Streams and Part 303 Wetlands Protection Permit (12-27-0050-P)* was previously held for excavating and filling wetlands and streams, modifying existing and creating new stream crossings, and mitigating stream and wetland impacts. This permit expired on February 22, 2018. An application will be submitted by Copperwood for a new Part 301 and Part 303 permit.

- Applications for *US Army Corps of Engineers Rivers and Harbors Act, Michigan Department of Environmental Quality (MDEQ) Part 325 Bottomlands, and Part 327 Water Withdrawal Permits* will be submitted by Copperwood for water withdrawal from Lake Superior, and associated construction and operations of a Lake Superior water intake structure, pumping station, and water transmission pipeline.

1.4 Document Preparers and Qualifications

This *Amendment* was prepared by Foth Infrastructure & Environment, LLC (Foth) under contract to Copperwood. This document incorporates information prepared by qualified professionals working under contract to Copperwood. Table 1-1 is a summary of the organizations and individuals who have contributed to the preparation of this *Amendment* for the Project.

2 Project Location Information

This section describes the site location, land use, surface rights, mineral rights, and conservation easements.

2.1 Site Location

The Project is located in the Upper Peninsula of Michigan, in Ironwood and Wakefield Townships, Gogebic County. The Project is located within Sections 1, 2, 11, and 12 of T49N, R46W; Sections 6, 7, and 8, T49N, R45W; and Sections 35 and 36, T50N, R46W. The location of the Project is shown on Figure 1-1 and the site layout is shown on Figure 1-2. The closest communities to the Project are Wakefield and Bessemer, located along US Highway 2, approximately 20 kilometers (km) south of the site. The Project is accessed via County Road (CR) 519.

The defined Project mining area associated with this *Amendment* remains similar to the mining area presented in the original Mine Permit Application (MPA) (Orvana, 2011). The only change to the mining area occurs along the western portion of the mining area, where its boundary extends further to the southwest to account for the modified layout of the processing and support facilities. The proposed and former mining areas area are shown on Figure 2-1.

2.2 Land Use

Land use remains unchanged from what was previously described in the MPA. Commercial forest production is the primary land use. The land is also utilized by property owners for hunting and fishing.

2.3 Surface and Mineral Rights Ownership

Additional surface rights have been acquired by Copperwood since the MPA. The Property boundary shown on Figure 1-2 depicts Copperwood's current surface ownership that is relevant to this *Amendment*. Mineral rights described in the MPA remain valid with one exception; Copperwood has converted the previously held option to lease to a lease agreement for Section 5 of T49N, R46W.

2.4 Conservation and Historical Preservation Easements

An assessment of known conservation and historic preservation easements was provided in the MPA, which are still valid.

3 Project Geology

Regionally, the Copperwood deposit is located along the southeast flank of the Mesoproterozoic midcontinent rift system of North America. Locally, the deposit is located on the southwest limb of the Presque Isle Syncline within the Nonesuch Formation and is buried by approximately 30 meters (m) of glacial sediments. The deposit is characterized by it geologic simplicity with the ore sequence being sheet-like and tabular in nature and dipping gently to the north. Ore mineralization occurs exclusively as fine-grained chalcocite. Detailed Project geology including regional geology, local geology, deposit type and mineralization, and geologic structures, was described extensively in the MPA. Exploration has continued since the submission of the MPA, with the Project geologic interpretation remaining consistent with the Project geology presented in the MPA.

4 Mining Plan

This section presents information pertaining to the proposed Project mining plan pursuant to R 425.206, including descriptions of general mining activities, surface and underground facilities, and the overall mining plan.

4.1 Project Development

Project development will include the development of both surface and underground facilities. Development will include the following components and will generally occur within the order the components are listed:

- Site preparation including clearing, grading, and excavation
- Roadway and utility construction
- Mine access (box-cut), ore stockpile, and TDF construction
- Preproduction underground mine development
- Process plant construction and commissioning
- Ancillary building construction

4.1.1 Schedule for Construction

Construction and development of the Project is anticipated to take approximately 24 months, and is anticipated to begin at the start of 2019. A generalized construction and development schedule is presented in Table 4-1.

4.1.2 Operations Production Rates and Mining Methods

Mining will be conducted underground using drill-and-blast, mechanized room-and-pillar mining methods. The mining method consists of the extraction of a series of entries and cross cuts in the ore, leaving pillars in place to support the back. The anticipated life of mine (LOM) is approximately 14 years. Production rates will ramp up over the first year of operation to approximately 6,000 tonnes per day (tpd). Table 4-2 summarizes the anticipated mining schedule and approximate production rates.

4.1.3 Employment Schedule

The anticipated number of employees described in the MPA during operations remains valid. During peak construction it is anticipated 400 to 450 employees would be onsite.

4.2 Geochemical Characterization

The proposed Project modifications described in this *Amendment* did not require additional geochemical characterization. Therefore, the geochemical characterization assessment provided in the MPA remains valid.

4.3 Surface Facilities and Operations

Surface facilities and operations described in the MPA remain valid. However, the location of most facilities have been modified, and two new facilities have been added to the Project (i.e., natural gas power plant and outdoor ore stockpile). Proposed locations of Project surface infrastructure across the site are shown on Figure 1-2 and surface facilities located near the process plant are shown on Figure 4-1. The surface facilities and operations that will support the Project include the following:

- Site access, site roads, parking, and lighting
- Access control building
- Ancillary buildings including maintenance shops, truck wash bay, warehouse and yard, and operations and mill offices
- Natural gas power plant
- Emergency generators
- Mine access (box-cut)
- Underground ventilation and heating buildings for intake and exhaust
- Ore mucking and conveying
- Outdoor Ore Stockpile
- Process plant
- Contact water collection system, pumping, treatment, and discharge pipeline
- Water management facilities including tailings disposal facility, water treatment plant (WTP), potable water treatment plant, and water supply intake from Lake Superior
- Sanitary wastewater system (sewage lagoons)
- Information technology and communications infrastructure
- Fuel and reagents storage handling and spill prevention control and countermeasure plans, and a pollution incident prevention plans
- Explosives handling and storage facility
- Site landscaping (berms, grading, and contact/non-contact water control measures)
- Temporary construction facilities

The following subsections describe infrastructure that is new to the Project or has undergone changes since the MPA, beyond being moved to a new location.

4.3.1 Ventilation Raise Pads

One intake ventilation and two exhaust ventilation raises will be required to support the underground mine ventilation requirements. The location of these three ventilation raises are shown on Figure 1-2. The intake raise is on uninhabited commercial forest property currently owned by the Hancock Natural Resource Group and will require some type of use agreement under mineral lease law. The exhaust raises are both on property owned by Copperwood.

The intake ventilation and west exhaust ventilation raises will be constructed during initial mine development. The east exhaust ventilation raise is not anticipated to be installed until after year 6. In addition to the east and west exhaust raises, the mine access box-cut will also serve as an exhaust ventilation location. The conceptual design of the ventilation raise pads are shown on Figures 4-2 and 4-3.

4.3.2 Ore Handling and Storage

During initial mine development, ore will be transported out of the mine using underground mining trucks, and will be placed in a temporary ore stockpile. The location of the ore stockpile is shown on Figure 1-2. As part of mine development, an ore conveyor system, a transfer tower, ore bins, and a reclaim area will be installed. Once installed, all ore that is removed and handled underground will be placed onto a main transfer conveyor that will bring the ore to the surface. At the surface, ore will be first managed at the transfer tower, where ore will either be directed to the ore stockpile using a fixed stacker or to the ore bins/reclaim area. When the process plant is operating, ore that leaves the transfer tower will be shuttled to one of four crushed ore bins for temporary storage prior to being transferred to the process plant. At the ore bins/reclaim area, ore will be stored in one of the bins prior to being fed through a crushed ore feeder to an enclosed belt conveyor for movement to the process plant. The ore stockpile will provide surge capacity and temporary storage of ore as it proceeds from the underground mine to the process plant. An ore feeding system comprising a hopper and pan feeder will allow ore to be fed via front-end loader (FEL) from the ore stockpile, as needed. Locations of the transfer tower, ore bins, and reclaim area are shown on Figure 4-1. The process flow for surface ore handling is shown on Figure 4-4.

The conveyor system will be able to handle an average of 6,000 tpd (dry) of ore. The main conveyor is designed to reach 600 tonnes per hour (tph) at peak. Ore bins can accommodate a short period of peak production, however, under normal operations it is expected that the ore stockpile will provide additional surge capacity between the underground mine and the ore bins. The design of the temporary ore stockpile, including water management plans, are described in Section 5.1.

4.3.3 Beneficiation Facilities and Process

The process plant has been designed for a throughput of 6,000 tpd (dry). The major unit operations are shown on Figure 4-4 and include the following steps:

- Crushed ore reclaim.
- Grinding and classification.
- Rougher flotation.
- Rougher concentrate regrinding.
- Cleaner flotation, using three stages of cleaning.
- Concentrate thickening and filtration.
- Tailings pumping and disposal in the common TDF.

Ore will be transported from the underground workings to the grinding circuit as described in Section 4.3.2. The grinding circuit will receive ore at a nominal top size of 203 millimeters (mm) with an 80% passing size of 150 mm with raw water added to achieve a desired slurry density. The circuit will consist of a semi-autogenous grinding (SAG) mill in closed circuit with a screen and a ball mill in closed circuit with a cyclone cluster to achieve the desired initial grind size of 80% passing 45 micrometers (µm) for feeding the flotation circuit.

The flotation circuit configuration, residence times, and reagent addition rates have been selected based on laboratory metallurgical test work. Chemical reagents are added at various stages in the grinding and flotation circuits to facilitate recovery of a concentrated ore product. Flotation reagents are grouped according to three major functions: 1) Collectors with hydrophobic properties that can selectively attach to a desired mineral species; 2) Frothers that promote uniform air bubble formation that a hydrophobic collector reagent can attach to; and 3) Conditioners that serve various functions such as enhancing desired mineral selectivity or process kinetics. Table 4-3 lists the reagents, their functions, and estimated dosage rates.

Rougher flotation is the first separation step between the copper bearing minerals in the ore and the host (or gangue materials) in the crushed ore. The concentrate product of rougher flotation is directed to further grinding while the tailings are directed to the TDF.

Rougher concentrate reports to a regrind cyclone circuit, along with tailings from the second stage of cleaner flotation, for size classification. Oversized material is directed to a regrind mill where water and a conditioner reagent (if required) will be added to achieve the desired milling density and operating pH respectively. Undersized material meeting the desired final size of 80% passing 20 µm is sent directly to the three-stage cleaner flotation circuit.

Cleaner flotation will consist of three stages of closed circuit cleaning. Final arrangement regarding recirculation of cleaning streams will be flexible based on metallurgical testing and operating experience of the process plant. The objective of the regrind circuit and cleaner flotation is to produce the highest possible copper grade in the ore concentrate without adversely affecting overall mass recovery of copper in the ore feed. The tailings waste product from the first cleaner scavenger stage of the cleaning circuit will be combined with the rougher flotation tailings and directed to the TDF.

Final concentrate from the cleaner flotation circuit will be pumped to a high rate thickener with a flocculant solution added to enhance settling of the finely ground concentrate particles. Thickener overflow is sent to the process water tank for re-use and thickener underflow, at approximately 60% solids, will be pumped to a concentrate filter feed tank.

Thickened concentrate will be pumped in batches to a concentrate filter press that will remove water from the concentrate to meet a target moisture of approximately 9%. A FEL will be used to remove concentrate from beneath the filter press and transfer it to an adjacent storage area. Concentrate will be placed into a loadout hopper by the FEL and transferred to haulage trucks via a concentrate feeder and truck loading conveyor for shipment to an off-site transfer facility. This concentrate is the final product of the Project and will be sold for further processing in a yet-to-be determined smelter. The number of concentrate haul trucks leaving the site on a daily basis will be dependent on the size of truck utilized for transport. If 39.9-tonne (44 short ton) trucks are utilized there will be approximately 12 trucks leaving the site per day. The number of trucks per day would increase to 26 trucks if 18.1-tonne (20 short ton) trucks are utilized.

4.3.4 Tailings Management

As is consistent with the MPA, the process plant will generate tailings, and the tailings will be pumped from the process plant to a TDF for management. The location of the TDF remains consistent with the MPA and is shown on Figure 1-2. Section 5.2 describes the design and management of the TDF.

4.3.5 Site Utilities

Utilities currently do not exist at the Project location. The following subsections define the site utilities that will be required to support the Project.

4.3.5.1 Electric Services and Natural Gas

Electric service is not readily available from a utility at the Project location. Electrical demand of the Project will be met by installing an onsite natural gas power plant consisting of five natural gas power generators. The generators will be Wartsila Model 12V34SG units. Each generator is rated at 5,564 kilowatts (kW) at 100% load. During operations, four generators will operate at any given time, with the fifth generator available as a reserve. Generator use will rotate between the five units during the course of one year. The generators will provide electrical power to the facility 24 hours per day, 7 days per week, 365 days per year. To achieve low emissions, each generator will be equipped with both a Selective Catalytic Reduction (SCR) system for controlling emissions of nitrogen dioxide (NO_2) and Oxidation Catalyst for reducing emissions of carbon monoxide (CO) and volatile organic compounds (VOC). The location of the power plant is shown on Figure 4-1.

The facility will also have three diesel-fired emergency generators that will be used as back-up power for the facility in event of a power outage. One of the back-up generators (1,000 kW) will be located near the underground mine access box-cut, while the other two generators (500 kW each) will be located near the process plant. Locations of each emergency generator is shown on Figure 4-1.

Copperwood is currently working to determine viable options for supplying natural gas to the Project by pipeline. The identified viable option will be permitted as a separate project.

4.3.5.2 Make Up Water

Make up water will be sourced from Lake Superior. An offshore intake structure, pumping station, and raw water transmission pipeline will be constructed and utilized to pump make up water from Lake Superior to the TDF or a fire water tank near the process plant for storage until it is needed. Figure 1-2 shows the location of the pumping station and water transmission pipeline. Permits required to construct the water intake and withdrawal water from Lake Superior are listed in Section 1.3. The amount of make-up water required is described in Section 4.3.7.

4.3.5.3 Potable Water

Consistent with the MPA, make up water sourced from Lake Superior will be treated for potable water needs. The amount of potable water required is described in Section 4.3.7.

4.3.5.4 Sanitary Systems

Consistent with the MPA, a sewage lagoon system will be utilized to manage and treat wastewater prior to discharge to the unnamed west branch of Namebinag Creek. The size of the sewage lagoon system has been increased from the MPA in order to provide additional capacity. The location of the sewage lagoons are shown on Figure 1-2.

4.3.6 Storm Water Management

Storm water management systems describe in the MPA will continue to be utilized and applied to the revised Project layout and mining methods described in this *Amendment*. The following subsections describe the storm water management systems.

4.3.6.1 Contact Storm Water

Contact areas include areas where ore and ore-related process handling equipment and storage may come in contact with precipitation or surface runoff. Contact areas will include the ore stockpile, TDF upstream embankments and basin area, portions of the process plant area, and the mine access box-cut including the access road from the box-cut to the ore stockpile and process area conveyor system. Water management within the process plant area is shown on Figure 4-5. Contact water collected in the contact water areas shown on Figure 4-5 will be routed to the event pond through using a combination of pumping and gravity flow. Contact water within the event pond will then be pumped to the TDF. Contact water management associated with the ore stockpile and TDF are discussed in Section 5.

4.3.6.2 Non-Contact Storm Water

As described in the MPA, non-contact storm water will be from roofs, roadways, and other sources where water does not encounter potential contaminants. Non-contact areas in the vicinity of the process plant are shown on Figure 4-5. Non-contact storm water will be allowed to discharge into the surrounding environment.

4.3.6.3 Soil Erosion and Sediment Control Plan

Soil erosion and sediment control methods described in the MPA will be utilized and applied to the revised Project layout and mining methods described in this *Amendment*. An updated soil erosion and sediment control plan will be developed to reflect the revised Project layout and will be provided to the MDEQ prior to construction.

4.3.7 Project Water Balance, Water Treatment, and Water Discharge

The Project water balance has been updated to account for the revised Project layout and mining methods described in this *Amendment*, including the addition of the contact water associated with the ore stockpile. Variations in the Project water balance will occur over time as the demand for water and water storage capacity in the TDF evolve over the LOM. During the first three years of operations, make up water will be required in order to have enough water stored within the TDF to meet Project demands. Increased inflow from the underground mine will reduce the make-up water requirements to only the potable water demands after year 3. Beginning in year 6, a WTP will be used to control excess water in the TDF, by treating reclaim water and discharging to the west branch of Namebinag Creek, in accordance with NPDES Permit

MI0058969. Water balance schematics with average year 2 annual flows, average year 11 annual flows, and average annual flows at closure are shown on Figures 4-6, 4-7, and 4-8.

4.4 Underground Mine Description

Underground conventional drill-and blast, mechanized room-and pillar mining methods will be utilized. The method consists of the extraction of a series of entries and cross cuts in the ore, leaving pillars in place for support. The entries, cross cuts, and pillars have been sized to increase geotechnical stability and reduce subsidence as described in Section 4.6.

Low-profile electric-hydraulic equipment will be utilized for drilling and bolting. Load-haul-dump loaders, with a capacity of 4.6 cubic meters, will be used to transport ore from the face to a rock breaker-loading point. The rock breaker will reduce the size of the blasted ore and will then transfer it to a belt conveyor system for transfer to the surface. During mine development and for distant mining locations, 30-tonne underground mining trucks will be utilized for ore transportation.

Underground workings have been divided into two sections; the eastern part and the western part. Both sections are subdivided into extraction panels as shown on Figure 4-9. The western section contains panels 1 through 6, and the eastern section includes panels 20 and 22. Mining will commence in the western part of the mine. Mining direction will largely be according to down dip of the geology, with some areas being done at an angle to the dip.

The primary main entry layout is based on four 6.1 m wide entry drifts that are driven into the ore body. Between the mains there will be internal pillars of variable width, and barrier pillars of variable width will also be along the outer boundaries of the entry mains. Pillar width will vary based on the main access depth and mine area. The barrier pillars are very large pillars designed to protect the main access from the deformation caused by the mining room. Figure 4-10 presents a schematic of the main access and barrier pillar layout. Once the area is complete, the barrier pillars will be recovered, as depicted on Figure 4-11, respecting the pillar dimensions of this area. Room pillar dimensions are summarized in Table 4-4.

4.5 Underground Facilities

Underground facilities described in the MPA will continue to be utilized to support the Project, with the exception of the mine ventilation system. The underground facilities that will remain the same including the following:

- Electrical power distribution
- Communication Systems
- Monitoring Systems
- Emergency Response Systems
- Mine Service Water
- Mine Dewatering Systems
- Underground Ore Handling Systems

Ventilation requirements for the fully developed mine is estimated to be approximately 24,069 cubic meters per minute (850,000 cubic feet per minute). Intake air will be brought underground through one ventilation raise, where main fans will be installed. The fresh air will move through the main access drift to the working panel. Exhaust will be evacuated through the west exhaust ventilation raise, east exhaust ventilation raise, and at the mine access box-cut. The flow of each of the ventilation raises will vary over time. The main ventilation layout is depicted on Figure 4-12.

4.6 Mine Stability and Subsidence

The underground mine plan described in Section 4.4 was designed to minimize subsidence based on geotechnical characterization and application of industry standard practices. Rock support methods, such as bolting, will be used to enhance mine stability and reduce subsidence. A technical memorandum summarizing the geotechnical design studies is provided in Appendix D. The recommended pillar dimensions presented in Appendix D, were incorporated within the underground mine design described in Section 4.4. Anticipated surface subsidence as a result of mining will be on the order of 0 to 3 centimeters over the LOM.

5 Treatment and Containment Plan for Mine Related Material

Mine related material, consisting of ore and tailings, will be managed within separate management facilities. The following subsections describe the design of the ore stockpile and TDF, as well as water management within each facility.

5.1 Ore Stockpile

Ore will be managed in an outdoor stockpile. The location of the stockpile is shown on Figure 1-2. The purpose of the ore stockpile is to provide surge capacity between the underground mine and the process plant to facilitate continuous underground mine operation when ore production temporarily exceeds the process plant capacity. The ore stockpile has been designed to temporarily store up to 620,000 tonnes of ore, with a total maximum height of 15 m. The base of the stockpile will be constructed using clay till excavated from the development of the box-cut. The compacted clay till base will be covered with a 60-mil thick high-density polyethylene geomembrane liner. The conceptual design of the ore stockpile is shown on Figure 5-1. Contact water collected on the composite liner will be managed through the use of internal ditches and a pumping station as shown on Figures 4-5 and 5-1. Contact water from the ore stockpile will be routed to an event pond, prior to being pumped to the TDF.

The amount of ore stored within the stockpile will vary over time. During initial mine development, all mined ore will be stored within the stockpile while the process plant is being constructed and commissioned. Once the process plant is operational the amount of ore being managed within the stockpile will be significantly less. Figure 5-2 shows the anticipated amount of ore present within the stockpile over the LOM. The methods utilized for moving ore into and out of the ore stockpile are described in Section 4.3.2.

5.2 Tailings Disposal Facility

Tailings will be pumped as slurry to a disposal facility located to the southeast of the process plant (Figure 5-3). The proposed TDF is designed to store 29 million metric dry tons (Mt) and occupy 316 acres. The proposed TDF size and footprint is largely unchanged from the previously permitted facility that was described in the MPA, which was designed to store 32 Mt of tailings and occupy 346 acres. The proposed TDF design uses a geomembrane liner rather than the previously permitted basin drainage blanket. Decant pump barges are also included in the proposed TDF design rather than the gravity flow decants previously proposed. The ultimate TDF showing basal liner grades is shown on Figure 5-4.

The revised design relies on much of the same information provided in the MPA and it continues to satisfy the requirements of the Part 632 of NREPA, as applicable. Information used to develop the design is provided in the following reports:

- Geotechnical Site Characterization Report, Copper Range Company's White Pine Mine Tailings Impoundments, White Pine, Michigan (Golder Associates, 1998)

- Site Visit Memo Copperwood Project, memorandum prepared by AMEC Americas Limited (AMEC, 2009).

- Draft Copperwood Project Part 202 - Environmental Impact Assessment (AECOM, 2011).

- Third Set of Laboratory Testing for Proposed Copperwood Mine Project, Wakefield Township, Michigan (Coleman Engineering, 2010).

- Orvana Minerals US Corp Copperwood Project, Michigan, Tailings Scoping Study (Crescent Park Consulting, 2010).

- Preliminary Economic Assessment of the Copperwood Project, Upper Peninsula, Michigan, USA (K D Engineering, 2010).

- Glacial Overburden Material at Copperwood Memorandum (AECOM, 2010).

- Report of Supplemental Subsurface Exploration for Proposed Copperwood Mine Project, Wakefield Township, Michigan (Coleman Engineering, 2011).

- Copperwood Project, Prefeasibility Study Report on Tailings Disposal Facility and Ancillary Structures (Knight Piésold, 2011).

- Copperwood Project Feasibility Study Report on Tailings Disposal Facility and Ancillary Structures (Golder Associates, 2012).

5.2.1 Tailings Disposal Facility Site Conditions

The understanding of the site conditions remains unchanged since initial permitting. A recap of the TDF site conditions is provided in this section. The location of the TDF is shown on Figure 1-2. The TDF is bounded to the north by maximum underground mining extent, to the south by the North Country National Scenic Trail (NCNST), to the west by Namebinag Creek, and to the east by Lehigh and Gypsy Creeks. A number of small intermittent streams pass through the TDF site and have eroded channels into the overburden soils. The main drainages are Namebinag Creek, which is just to the west of the TDF site, and Lehigh and Gypsy Creeks, which run through or partially through the TDF site. Lehigh and Gypsy Creeks will be diverted around the eastern side of the TDF. The western edge of the TDF has been designed to maintain a minimum 150-ft setback from Namebinag Creek to avoid interfering with its channel alignment and near-bank environment.

The foundation materials beneath the TDF site consist of glacial till underlain by the Copper Harbor Conglomerate formation bedrock. The Nonesuch Shale formation, which contains the ore body host rock, is present to the north-northwest of the TDF. No additional subsurface geological or hydrogeologic information was obtained as part of this current study. Therefore, the geology and hydrogeology discussion and subsurface models are based on work completed during initial permitting. A hydrogeologic study of the site has been performed, the findings of which are presented in the Environmental Impact Assessment (AECOM, 2011).

The locations of boreholes, test pits, piezometers, and monitoring wells relevant to the TDF design are presented on Figure 5-5. The subsurface stratigraphy beneath the TDF and surrounding area is presented in cross sections through the TDF on Figure 5-6.

Glacial Till

The glacial till appears to be largely homogeneous and varies in thickness within the TDF site from 6 to 36 m. The majority of the till classifies as lean clay with some silt, little sand, and occasionally trace gravel, as classified in accordance with the Unified Soil Classification System (USCS) guidelines. Several localized lenses of silty sand were encountered within the till matrix, and generally range in thickness up to 0.6 m and do not appear to be continuous. To characterize the geotechnical properties of the glacial till, in-situ and laboratory testing was performed, including the following tests:

- Index testing (Atterberg limits, natural moisture content, specific gravity).
- Moisture-density testing (both Standard and Modified Proctor tests).
- Permeability testing.
- Compressibility testing.
- Shear strength testing.
- In-situ SPT testing.

Bedrock

Bedrock below the TDF site is of the Copper Harbor Conglomerate formation. This material has been described as a sedimentary rock containing many rounded pebbles cemented together by finer materials. These particles are often durable igneous rock. In-situ packer testing was performed in the bedrock to estimate its coefficient of permeability, and resulted in an average value of 1.2×10^{-6} centimeters per second (cm/s). It should be noted that this is approximately two orders of magnitude greater (more free-draining) than that of the overburden till. As stated previously, the other bedrock formation in vicinity of the proposed TDF is the Nonesuch Shale, which is mainly located to the north-northwest of the TDF site. No boreholes from the 2011 geotechnical site investigations intersected the Nonesuch Shale formation it the TDF area.

Groundwater

The depth to groundwater varies beneath the project by area and geologic unit. Groundwater within the Nonesuch Shale and Copper Harbor Conglomerate hydrogeologic units appears to be confined, based on measurements of potentiometric surfaces above the top of the rock (AECOM, 2011). Groundwater within these formations is confined by the overlying low-permeability glacial till; with the groundwater likely being contained within fractures in the Nonesuch Shale, and in both fractures and some open pore spaces within the Copper Harbor Conglomerate.

5.2.2 Design of the Tailings Disposal Facility

As mentioned, the proposed TDF is largely unchanged from the previously permitted facility that was described in the MPA. The TDF has been designed to account for the subsurface conditions below the site, the anticipated embankment fill materials, the water and tailings storage requirements, and the physical characteristics of the tailings. The primary criteria for optimizing the TDF to the proposed layout were:

- Generally balanced cut and fill within the footprint of the TDF.
- Staged construction of the facility.
- Storage capacity for the proposed mine production and estimated TDF water balance.

The proposed facility footprint will extend approximately 2,000 m in the east-west direction, 780 m in the north-south direction, and will cover approximately 320 acres (including embankments but excluding perimeter roads). Staged construction of the facility will primarily be horizontally from east-to-west. The TDF will be constructed in 3 stages. The ultimate Stage 1 and Stage 2 TDF is presented on Figures 5-7 and 5-8. The ultimate Stage 3 TDF (final TDF) is presented on Figure 5-4. The TDF has been designed such that each stage will accommodate between 3 and 6 years of tailings production from the current mine plan. The impounding TDF embankment will be constructed using conventional downstream methods, meaning the upstream toe will remain fixed while the downstream toe will progressively advance downstream as the embankment height increases. The embankment crest elevations for each stage were estimated using the current mine production schedule and the storage capacity curves developed for the TDF basin. The TDF storage capacity versus embankment elevation curve is presented on Figure 5-9. Table 5-1 summarizes the staged development of the TDF.

Embankment Configuration

The TDF embankment has been designed as a zoned-fill, water containment type of dam that will be raised in stages using the conventional downstream method of construction. In this method the upstream toe remains fixed, while the centerline and downstream toe progressively advance to the downstream as the embankment height increases by extending the upstream slope to the higher elevation. The embankment will be comprised of the following layer (zones):

- Seal Zone (Zone 1) – This zone will be comprised of moisture-conditioned and well compacted glacial till to create a low-permeability zone to minimize seepage through the embankment.

- Chimney Drain (Zone 2) – This zone will be comprised of free-draining materials that will serve as a filter and drain between the Seal Zone (Zone 1) and Downstream Shell (Zone 3). This drain will prevent a phreatic surface from developing through the dam.

- Downstream Shell (Zones 3) – The Downstream Shell will provide structural stability to the embankment. It will be constructed from compacted local glacial till material.

- Embankment Foundation Drains – Foundation drains will be constructed below approximately two-thirds of the embankment footprint and will act in conjunction with the chimney drain to limit the build-up of a phreatic level within the embankment structural zone.

The dimensions and configuration of these zones are shown on the typical embankment cross section presented on Figure 5-10. In addition to these three embankment zones, a high-density polyethylene geomembrane liner will be installed on the upstream face of the embankment to control tailings water seepage (Figure 5-10). The membrane will protect the Seal Zone (Zone 1) from erosion due to direct precipitation and wave action on the surface of the supernatant pond.

An embankment foundation drain, constructed of the same or similar free-draining material as the Chimney Drain (Zone 2), will be constructed at the base of the Downstream Shell (Zone 3). The foundation drains will rapidly dissipate excess pore pressures that could develop in the Downstream Shell (Zone 3) at the foundation during construction of the embankment. The embankment drains are shown on Figure 5-10. Excess port water collected in the drains will be released to a perimeter channel near the downstream toe of the embankment adjacent to the perimeter access road and handled as non-contact storm water. The embankment will be founded directly on the glacial till that covers the TDF site. Excavations to key the embankment into bedrock are not required to enhance the dam stability or reduce potential seepage from the TDF. Foundation preparation will include topsoil stripping and stockpiling and removal and disposal of deleterious material, followed by rough grading as described below.

The upstream Seal Zone (Zone 1) and Downstream Shell (Zone 3) will be constructed from till excavated from within the tailings basin, or from similar material suitable for dam construction. This material is anticipated to be relatively fine-grained and clayey, with in-situ moisture contents greater than optimum. Some drying of these materials will be necessary. Placement moisture contents will be allowed to remain slightly wet of optimum within the seal zone and likely near optimum for the balance of the embankment. Currently it is envisioned that the materials placed into Zones 1 and 3 will be placed and compacted in lifts not to exceed 1 foot and that method specifications (compaction efforts) will be established based on test pads carried out just prior to embankment construction.

Basin Preparation and Arrangement

The TDF interior basin will be fully developed in sections as delineated for Stages 1 through 3, described above (Figures 5-7, 5-8, and 5-4). Basin preparation will initially include removal and stockpiling of topsoil and unsuitable materials and the removal of vegetation. The interim locations of these stockpile facilities have not yet been defined, however, are anticipated to be mainly around the immediate perimeter of the TDF. A long-term topsoil stockpile will be located near the mill area. Subsurface till will be excavated to defined lines and grades to increase the storage capacity of the TDF and to provide construction materials for the TDF embankment.

Excavation depth of the foundation materials will range from approximately 0 (in the southeast corner of the TDF) to 20 meters (in the northwest corner of the TDF), generally increasing from south to north and following the trend of increasing depth to bedrock. Approximately 4 to 23 meters of the till will remain above the estimated bedrock surface once the TDF basin excavation is completed.

Tailings Disposal Facility Liner System

The liner system within the TDF is generally comprised of low permeability in situ soils (glacial till), engineered low permeability soil fill, and a 60-mil thick high-density polyethylene geomembrane liner (Figure 5-10). During TDF construction, the uppermost 0.3 m of soil across the floor and exterior, below grade side slopes will be scarified and re-compacted to achieve a permeability of 1×10^{-7} cm/s. During construction, the 3 m closest to the surface of the interior face of the embankment will also be compacted to achieve a low permeability while the remainder of the embankment will be placed to meet structural fill standards.

Decant System and Tailings Management Strategy

The tailings deposition and decant systems are presented on Figure 5-11. Tailings slurry will be transported from the Plant Site to the TDF and deposited within the impoundment through a piping network. Under the current design concept, tailings will typically be deposited from several points along the north, east, and west sides of the TDF. For this stage of design, formation of a minus 0.25% tailings beach slope has been assumed. Tailings deposition will take place primarily from the north side of the impoundment crest, with lesser amounts deposited from the west and east embankments. The deposition pattern was developed to facilitate management of the supernatant pond location and fully utilize the capacity of the TDF.

The barge-mounted decant system will be installed in the TDF to recover and remove water from the TDF. Decanted water will be returned to the process plant or be treated for discharge. The barge will be relocated periodically during tailings deposition to manage the supernatant pond and build up a tailings beach near the embankments. In general, the barge will start near the northwest portion of the stage, where the basin elevation is the lowest and will be moved to the southwest as the tailings are deposited. A single barge system will be operated at a time and the barge system will be relocated as additional stages of the TDF are built.

5.2.3 Tailings Contact Water Management

As is similar to what was proposed in the MPA, the TDF water management strategy is to minimize seepage from the TDF, reuse as much supernatant water from the TDF as possible for plant operations, and limit discharges from the TDF to the latter years of operations. The water released from the tailings due to sedimentation and consolidation will report to the supernatant pond within the TDF on top of the tailings mass. The supernatant water will be decanted from the surface of the pond via a barge decant which will convey water through a pumping and piping system to the plant for operations. In later stages of mine life, when the site water balance is a net gain of water, a portion of the decant water will be pumped to the water treatment plant for treatment and discharge.

5.2.4 Closure Cover

The TDF closure concept involves a cover system that is similar to what was proposed in the MPA. The closure plan will be facilitated through the proposed deposition scheme, which will create a tailings surface (beach) sloping from north to south, toward two spillway discharge structures. Near the end of operations, the supernatant pond will be drawn down to the extent practicable to minimize the pond volume remaining at the end of deposition. After the cessation of deposition, the pond will continue to be drawn down until it is removed. The water removed from the supernatant pond during the closure period will be passed through the water treatment plant prior to being discharged to the environment. Once the pond is removed, a soil cover will be placed over the tailings. The general arrangement of the conceptual closure plan is presented on Figure 5-12.

The closure cover will consist of a multi-layered system of geosynthetics and soils, from bottom to top, as follows (Figure 5-12):

- A filter fabric (non-woven geotextile) and geogrid placed on top of the tailings surface. These will be used to prevent tailings intrusion into the cover and provide tensile strength to facilitate placement of the remaining cover components.

- A capillary break layer placed above the fabric and geogrid. This will consist of -0.3 m of sand or gravel to minimize the upward passage of pore fluids from the tailings mass to the surface of the closure cap.

- An initial soil grading layer of till placed over the capillary break layer. This will be used to overbuild the tailings surface to account for the predicted 2 to 3% consolidation of the tailings height during cover placement to maintain slope of the cover to the south.

- A low-permeability layer (0.6-m thick) placed over the soil grading layer. This will be used to shed rainfall and reduce the amount of infiltration of rain water into the tailings mass. Grading and maintenance of this layer will be important to remove any cracking that may occur due to different settlements caused by consolidation of the tailings mass and underlying till.

- An upper topsoil layer that will be seeded with an appropriate mix of grasses and forbs capable of maintaining an adequate stand of vegetation under the predicted conditions.

The conceptual closure cap will be overbuilt to account for potential tailings consolidation. Soil for the closure cover will be obtained from stockpiles of material excavated and stockpiled during TDF construction, and/or from available stockpiles of excess excavated material generated from other sources during the life of the Project (wetland creation, detention ponds, etc.)

6 Monitoring Plan

With only one exception, the operations and closure monitoring plan described in the MPA will continue to be utilized for the Project as previously described. The monitoring plan includes the following elements:

- Monitoring of the TDF
- Groundwater monitoring
- Surface water monitoring
- Biological monitoring

The following subsection describes where modifications to the monitoring plan are proposed to support the revised Project site layout, and modified mining methods. All other previously described monitoring plan elements remain valid.

6.1 Groundwater and Surface Water Monitoring

The groundwater and surface water monitoring plan described in the MPA will continue to be followed during development, operations, and post mining with one exception. Changes to the monitoring well network are required due to the revised Project site layout. Existing well nests at MW-08-3 and MW-08-5 are within the process plant and sewage lagoon layout, respectively, and are likely to be abandoned during construction. The monitoring wells proposed in the MPA (MW-XX-200 through MW-XX-208) for the monitoring of the TDF remain valid with minor adjustments to the proposed locations being warranted due to the revised Project site layout. Table 6-1 presents a summary of the revised proposed locations.

Monitoring wells MW-XX-209A and MW-XX-209B will be moved to the south, to be located immediately downgradient of the ore stockpile. Monitoring wells MW-XX-210A and MW-XX-210B will be moved to the southwest, to be located immediately upgradient of the ore stockpile. The revised proposed coordinates for these wells are provided in Table 6-1.

One new monitoring well nest consisting of MW-XX-211A and MW-XX-211B, is proposed to be added downgradient of the process plant area. MW-XX-211A will be a shallow well screen across the water table. MW-XX-211B will be a deeper well screen at the base of the overburden. This well nest will be monitored for water quality and water levels consistent with the other previously proposed monitoring wells. The revised proposed coordinates for these wells are provided in Table 6-1.

The location of monitoring wells, and an indication of the type of monitoring that will be conducted at each location, is shown on Figure 6-1. Monitoring parameters, methods, and frequency described in the MPA remains valid.

7 Reclamation Plan

With one exception, the reclamation plan described in the MPA will continue to be utilized for the Project as previously described. The reclamation plan includes the following elements:

- Reclaimed topography and land use
- Surface features remaining after reclamation
- Roads and dikes
- TDF reclamation
- Plant site reclamation
- Disposal of waste materials
- Closure of the underground mine access
- Site revegetation
- Groundwater and surface water quality monitoring

The following subsection describes where modifications to the reclamation plan are proposed to support the revised Project site layout, and modified mining methods. All other previously described reclamation plan elements remain valid.

7.1 Ore Stockpile Reclamation

Reclamation of the ore stockpile will occur at the end of operations when the final ore stored within the stockpile is removed and processed through the process plant. Associated equipment and machinery will be removed from the stockpile and sold and reused to the extent possible. The geomembrane liner will be removed and disposed of at a local landfill in accordance with applicable solid waste regulations. Re-grading and revegetation of the ore stockpile area will then be completed in alignment with the reclamation revegetation plan described in the MPA.

8 Emergency Response Plan Contingency Plan

As described in the MPA, Copperwood will prepare an Integrated Contingency Plan (ICP) and Emergency Response Plan (ERP) prior to Project development, with annual updates thereafter. The purpose of these plans will be as follows:

- Assess the risks to the environment and public health and safety that could result from accidents or failures at the Project, and response measures to be followed.
- Provide procedures for emergency notifications, responsibilities, evacuations, and a listing of emergency response equipment available at the Project.
- Provide plans for testing the contingency plan to assure and improve effectiveness.

The primary elements of the ICP and ERP described in the MPA will continue to be utilized and applied to the revised Project site layout and modified mining methods when the ICP and ERP are formally developed for the Project prior to construction. When the ICP and ERP are developed, the contingencies described in the MPA for ore storage will be updated to reflect that ore storage will now take place in an outdoor ore stockpile. In addition, power disruption contingencies will be revised to reflect that primary power will be generated on site in a natural gas power plant and three diesel-fired generators will be utilized to provide backup emergency power. Emergency contact information will also be updated when the ICP and ERP are developed prior to construction.

9 Financial Assurance

This section describes the estimated reclamation costs and the associated financial assurance to be posted for the project.

9.1 Financial Assurance Mechanism

R 425.301(1) requires that the permittee establishes financial assurance in the amount required to account for reclamation and post monitoring closure costs. Copperwood has developed estimates of costs as required under the act and is proposing to implement an acceptable instrument in this amount prior to activity commencing.

To satisfy R 425.301(1), Copperwood will provide financial assurance pursuant to R 435.301. Copperwood currently proposes to file a Certificate of Deposit (CD) (financial assurance instrument) with the MDEQ upon issuance of project permits, and agreement with MDEQ on the financial assurance costs. During the amendment permitting process, Copperwood may propose an alternative method that would also satisfy R 425.301(1).

9.2 Reclamation and Post Closure Estimated Costs

R 425.301(2) further states that the amount of the financial assurance must be sufficient to cover the cost to administer and to hire a third party to implement the reclamation, remediation, and post closure monitoring.

Copperwood has estimated the costs of reclamation and post closure monitoring as required by R 425.301, as shown in Tables 9-1 and 9-2, respectively.

After the mine is depleted of the permitted reserves, final reclamation activities will begin and are anticipated to take approximately six years. Table 9-1 represents the cost required to reclaim and close the facility. After the six-year closure period, the post closure monitoring will begin and is expected to take 20 years. Table 9-2 provides estimates of cost to monitor and maintain the Copperwood site after reclamation is complete.

The TDF will be constructed in three stages as described in Section 5.2.2. Copperwood has used this construction timetable to determine incremental cost increases for reclamation purposes. The estimated cost of reclamation will be a lower amount in earlier stages due to the profiles of the TDF, lower levels of impounded tailings and water, and lower impact to the surrounding area. The amount required to complete reclamation and post closure monitoring is proposed to be set at the amount required for reclamation and post closure monitoring at the end of each specific stage (Stage 1, 2, and 3). Financial assurance would be posted at the beginning of each stage in the amount required to address reclamation and closure costs at the end of each stage.

9.2.1 Reclamation

The estimate of cost to reclaim the mine and process plant area at the end of mine life in year 14 is summarized in Table 9-3.

The estimates for reclamation of the TDF are included in Table 9-1. Also included are the estimates of reclamation costs, should closure occur anywhere from the beginning of the Project until the end of mining. In prior years, as the TDF is being constructed and used, the cost of reclamation is estimated to be less than the full reclamation amount. These estimates are shown in Table 9-1.

The reclamation costs are estimated to be less at the end of each stage than at the mine closure date, due to the smaller impacted area and the amount of material used to construct the dam in preparation for tailings deposition. There will be a lower volume of deposited tails, and lower levels of water to be treated. Also, the reclamation of the processing plant and mine facilities will have higher salvage value in earlier years that can be credited to the reclamation costs.

9.2.1.1 Permitted Mining Activities

The areas requiring reclamation, remediation, and post closure monitoring will consist of the mine access box-cut and ventilation raises, ore stockpile, process plant and surrounding area, utilities infrastructure, and the TDF, which are described in this *Amendment*.

9.2.1.2 Anticipated Mining Activities

Mining activities will be confined to the box-cut for access into and out of the mine, the ore stockpile for storage of ore, the process plant, and other ancillary structures. Reclamation for these areas is summarized in Table 9-3. The TDF also represents an area of mining activity, and the reclamation costs for the TDF are provided in Table 9-1. It is assumed during mining activities, reclamation will be completed on areas that will have been impacted and can be reclaimed prior to closure.

9.2.2 Financial Assurance Estimate

During the review of this *Amendment*, Copperwood will work with representatives of the MDEQ to ensure the amount of financial assurance is of the amount that satisfies the intent of R 425.301.

9.2.3 Reclamation Cost Estimate Method

Cost estimates for the reclamation of the affected area of the mine are based on recommendations from various sources, including the consultants that engineered these areas and have experience closing sites of this nature. Other long-term closure costs and post closure monitoring costs were developed in consultation with consultants, handbooks, publications, and other acceptable sources, and follow generally accepted guidelines for this type of Project.

Reclamation costs include expected credit for salvage value of equipment. The salvage value is based on a discounted book value at the time of the closure in year 14. Average salvage credit in year 14 is estimated to be 22% of original equipment cost. All of the equipment that is currently being proposed for the Project is commonly used in the mining industry. The underground equipment is usually sold to companies that recondition and sell the equipment. The larger common beneficiation equipment used in processing is usually sold as is and the final buyers install and recondition on site. Numerous resellers of such equipment exist as avenues to relocate the equipment to other sites; a common practice in the mining industry. Salvage value in earlier years is expected to be higher since assets will have longer useful lives remaining. Long lead times for this type of equipment, sometimes in excess of 18 months, makes the resale market for mining and processing equipment a viable option for replacement or startups. In some cases, used equipment is purchased for component replacement or spare parts. The estimate for the salvage values are listed in Table 9-4.

9.2.3.1 Reclamation Costs

Reclamation costs are estimated for each of the areas to include the mine box-cut, ventilation raises, ore stockpile, process plant area, TDF, utilities infrastructure and other ancillary areas. A summary of these estimated reclamation costs are shown in Table 9-1.

9.2.3.2 Remediation Cost

R 425.301(2)c(ii) requires cost estimates to include the remediation of any contamination of air, surface water, or groundwater that is in violation of the mining permit. Copperwood does not intend to be in violation of the mining permit; the estimated costs for reclamation includes contingencies that are sufficient to cover any remediation requirements.

9.2.3.3 Administrative Cost for Reclamation

R 425.301(2)c(iii) requires sufficient funds available for administrative oversight. As a reference, Copperwood referred to R 324.9105(11) Part 91 Soil Erosion and Sedimentation Control of the NREPA, which limits administrative fees not to exceed 10%. Copperwood has used 5% as a guideline for estimating administrative costs for Project reclamation. Table 9-5 provides estimates of the administrative fees based on reclamation costs and associated contingency fees.

9.2.3.4 Contingency Fees

R 425.301(2)c(iv) requires reasonable contingencies in the financial assurance mechanism. Table 9-5 includes a 5% contingency fee to be used for any aspect of the reclamation costs. This amount is reasonable and prudent, considering the relatively small area impacted and that all buildings and structures are in close proximity to each other. As new construction, there will be no issues concerning hazardous or toxic material used in construction, such as asbestos, that could have been used in older buildings. Access to the site is via a paved road, with staging areas for equipment to provide efficient access on and off site. Power and water will also be readily available. Under these circumstances, Copperwood believes that the estimated contingency fee is adequate.

9.2.4 Financial Assurance Instrument Fees

Prior to final approval of the financial assurance instrument, the costs or fees associated with the financial instrument will be added to the amount for final approval by MDEQ.

9.3 Financial Assurance Instrument

R 425.301(2)d details the type or combination of types of financial assurance instruments that a permittee can use in regard to the reclamation costs and associated contingencies.

Copperwood will work with the MDEQ to comply with this rule. Based on these guidelines, Copperwood is proposing to use a CD at 100%. This will be reviewed at the end of each phase pending financial strength tests.

The CD will be acquired from an MDEQ-approved financial institution or company. Copperwood has entered into discussions with a number of financial institutions and will decide on the CD provider when the permit amendment is granted.

R 425.301(3) states: "*The financial assurance required under this rule shall consist of an assurance instrument or combination of instruments covering at least 75% of the total required amount. Financial assurance for the balance of the required amount, if any, shall consist of a statement of financial responsibility.*"

9.3.1 Operators Financial Statement

Copperwood has reviewed the R 425.307 Statement of Financial Responsibility and will abide by the details of this rule to comply with financial assurance requirements. Copperwood will apply these tests over the LOM and update the MDEQ accordingly when the company qualifies and also provide a Statement of Financial responsibility with supporting analysis.

10 Final Release of Financial Assurance

Copperwood proposes that the financial assurance instrument will be released at the completion of reclamation and that portions of the release be made upon completion of reclamation of the areas defined in Tables 9-1 and 9-5.

Release of the financial assurance instrument should be made based on the standards listed below.

- Reclamation of the mine box-cut and impacted area.
- Demolition and/or removal of the process plant and the related features.
- Demolition and/or removal of ancillary structures.
- Demolition and/or removal of utilities infrastructure.
- Reclamation of the TDF.
- The reclamation of the TDF is expected to take six years. Release of the financial assurance instrument should be proportional to the work completed; to be determined and agreed upon by MDEQ and Copperwood.
- Full release of the financial assurance instrument upon documentation of:
  - Successful reclamation of TDF
  - Successful reclamation of mine site
  - Successful reclamation of processing facility

11 References

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Crescent Park Consulting Ltd., 2010. *Orvana Minerals US Corp Copperwood Project, Michigan, Tailings Scoping Study*. June 13, 2010.

Golder Associates Inc., 1998. *Geotechnical Site Characterization Report, Copper Range Company's White Pine Mine Tailings Impoundments, White Pine, Michigan.* April 6, 1998.

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K D Engineering, 2010. *Preliminary Economic Assessment of the Copperwood Project, Upper Peninsula, Michigan, USA.* September 24, 2010.

Knight Piésold and Co., 2011. *Copperwood Project, Prefeasibility Study Report on Tailings Disposal Facility and Ancillary Structures.* June 2011.

Orvana Resources US Corp, 2011. *Copperwood Mine – Mine Permit Application.* September 2011.

Tables

Table 1-1
List of Qualified Professionals

Organization	Individuals	Qualifications
Copperwood Resources, Inc.	Sylvain Collard	General Manager
310 East US Highway 2	Thomas Repaal	Senior Environmental Engineer
Wakefield, MI 49968	Brandon Stimac	Environmental Engineer
Foth Infrastructure & Environment, LLC	Stephen V. Donohue, P.H.	Vice President - Mining
2121 Innovation Court, Suite 300	Kris Baran	Project Director/Associate
De Pere, WI 54115	Mark Ciardelli	Lead Environmental Scientist/Geochemist
	Mitch Vanderydt, P.Eng.	Project Geotechnical Engineer
G Mining Services Inc.	Carl Michaud	Underground Engineering Manager
7900 Tacherau Boulevard, Building D, Suite 200	Paul Murphy	Engineering Manager
Brossard, QC J4X 1C2		
Golder Associates Inc.	Tom Rutkowski	Associate Senior Engineer
44 Union Boulevard, Suite 300		
Lakewood, CO 80228		
Golder Associates Inc.	Ryan Shipper	Senior Engineer
15430 Annabelle Place		
Leo, IN 46765		
Golder Associates Inc.	David List, P.E.	Principal
15851 South US-27, Suite 50		
Lansing, MI 48906		
Golder Associates Inc.	Joshua Nasrallah, P.G.	Senior Geological Engineer
1335 Dublin Road, Suite 126-D		
Columbus, OH 43215		
Golder Associates Inc.	Karyn Gallant	Senior Rock Mechanics
9 Monroe Parkway, Suite 270	Karen Moffitt	Principal, Practice Leader
Lake Osewego, OR 97035		
Golder Associates Inc.	Alyssa Seal	Senior Environmental Planner
18300 NE Union Hill Road, Suite 200		
Redmond, WA 98052		
Lycopodium Minerals Canada Ltd	Neil Lincoln, P.Eng.	Processing
5060 Spectrum Way, Suite 400	Manochehr Oliazadeh, Ph.D, P.Eng	Processing
Mississauga, ON L4W 5N5		

Prepared by: JEF1
Checked by: MCC2

Table 4-1
Anticipated Construction and Startup Schedule

Requirement	Year 1				Year 2				Year 3			
	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4
Mine Complex Development Schedule												
Site Preparation												
Box Cut Excavation												
Box Cut Access, Initial Utilities & Cover												
Ore Stockpile & Initial Water Management[1]												
Underground Access and Preproduction												
Drill/Blast Production full production after ramp-up												

Requirement	Year 1				Year 2				Year 3			
Surface Complex Development Schedule												
Site Preparation												
Process Plant Construction												
Process Plant Commissioning/Ramp-up												
Taililngs Disposal Facility - Initial Stage[1]												
Process Wastewater Treatment Plant	No process water discharge until year 6 of mine operation.											

Requirement	Year 1				Year 2				Year 3			
Support Infrastructure												
Roads												
Ancillary Buildings												
Power												
Water Intake												
Potable Water Treatment												
Sanitary Wastewater Lagoons												

Notes:

[1] The ore stockpile must be ready to receive ore, an initial contact water management system in place, and the initial stage of the tailings disposal facility must be capable of storing contact water before underrground mine access and preproduction work can begin.

Prepared by: JEF1

Checked by: MCC2

Source: Copperwood Resources, Inc.

Table 4-2
Anticipated Mining Schedule and Ore Production

Time	Year	Tonnes per Day
1/1/2019	0	0
4/1/2020	1	3000
5/1/2020	1	4500
6/1/2020	1	5400
7/1/2020	1	6000
1/1/2021	2	6000
1/1/2022	3	6000
1/1/2023	4	6000
1/1/2024	5	6000
1/1/2025	6	6000
1/1/2026	7	6000
1/1/2027	8	6000
1/1/2028	9	6000
1/1/2029	10	6000
1/1/2030	11	6000
1/1/2031	12	6000
1/1/2032	13	6000
1/1/2033	14	6000
8/1/2033	14	0

Notes:
Tonnes per day of ore production is defined as a constant value over the next time interval.

Source: Golder Associates Inc.

Prepared by: JEF1
Checked by: MCC2

Table 4-3
Reagents

Reagent Name	Reagent Function	Dosage per Tonne of Ore Processed
Sodium Hydrosulphide (NaHS)	Conditioner	470 g/t
Sodium Isobutyl Xantante (C-3430)	Collector	233 g/t
Methyl Isobutyl Carbinol (MIBC)	Frother	38 g/t
Dowfroth 250 (D-250)	Frother	38 g/t
Alkylaryl Dithiophosphate (A-249)	Conditioner	175 g/t
n-Dodecyl Mercaptan (NDM)	Conditioner	35 g/t
Sodium Silicates	Conditioner	225 g/t
Carboxymethyl Cellulose Sodium	Conditioner	75 g/t
Hydrated Lime	Conditioner	3000 g/t
Flocculant	Particle attraction	0.28 g/t
Anti-Scalant	Scale inhibitor	6 L/hr

Notes:
g/t = grams per tonne
L/hr = liters per hour

Prepared by: MCC2
Checked by: JEF1

Source: Copperwood Resources, Inc.

Table 4-4
Room Pillar Dimensions

Panel	Depth (meters)	Depth (feet)	Pillar Dimensions (meters)	Pillar Dimensions (feet)
1, 2, 3, 4, 5, 6	91.4	300	5.5 x 5.5	18 x 18
	182.9	600	7.3 x 7.3	24 x 24
	274.3	900	9.45 x 9.45	31 x 31
20	91.4	600	5.8 x 5.8	19 x 19
	182.9	900	7.6 x 7.6	25 x 25
22	121.9	400	4.9 x 4.9	16 x 16

Prepared by: MCC2
Source: G Mining Services Inc.
Checked by: JEF1

Table 5-1
Staged Development of the Tailings Disposal Facility

	Stage 1	Stage 2	Stage 3
Embankment Crest Elevation (meters above mean sea level)	280	286	288.4
Footprint Area (square meters)	314,568	686,419	1,277,043
Total Cumulation Storage Airspace Volume (million cubic meters)	2.13	6.35	21.25
Assumed Average Tailings Density (tonnes/cubic meter)	1.18	1.32	1.37
Approximate Tailings Storage (million tonnes)	10.1	16.86	29.12

Source: Golder Associates Inc.

Prepared by: JEF1
Checked by: MCC2

Table 6-1
Proposed New Monitoring Wells

Well Designation	Proposed Coordinates[1] Northing (m)	Easting (m)	Sample	Rationale
MW-XX-200A	5172641	271550	WL/Chem	Shallow well at base of NW corner of TDF dike (downgradient side)
MW-XX-200B	5172641	271550	WL/Chem	Well downgradient of NW corner of TDF, at base of excavated depth of TDF
MW-XX-200C	5172641	271550	WL/Chem	Well downgradient of NW corner of TDF, at bottom of unconsolidated overburden
MW-XX-201A	5172487	272302	WL/Chem	Shallow well at base of west-center portion of TDF dike (downgradient side)
MW-XX-201B	5172487	272302	WL/Chem	Well downgradient of west-center portion of TDF, at base of excavated depth of TDF
MW-XX-201C	5172487	272302	WL/Chem	Well downgradient of west-center portion of TDF, at bottom of unconsolidated overburden
MW-XX-202A	5172414	271384	WL/Chem	Shallow well at base of WNW portion of TDF dike (downgradient side)
MW-XX-202B	5172414	271384	WL/Chem	Well downgradient of WNW portion of TDF, at base of excavated depth of TDF
MW-XX-202C	5172414	271384	WL/Chem	Well downgradient of WNW portion of TDF, at bottom of unconsolidated overburden
MW-XX-203A	5171709	272192	WL/Chem	Shallow well at base of SSW portion of TDF dike (upgradient side)
MW-XX-203B	5171709	272192	WL/Chem	Well upgradient of SSW portion of TDF, at bottom of unconsolidated overburden
MW-XX-204A	5171609	273072	WL/Chem	Shallow well at base of SSE portion of TDF dike (upgradient side)
MW-XX-204B	5171609	273072	WL/Chem	Well upgradient of SSE portion of TDF, at bottom of unconsolidated overburden
MW-XX-205A	5172142	271473	WL/Chem	Shallow well at base of west portion of TDF dike
MW-XX-205B	5172142	271473	WL/Chem	Well downgradient of west portion of TDF, at base of excavated depth of TDF
MW-XX-206A	5171794	271671	WL/Chem	Shallow well at base of TDF dike, southwest side of TDF
MW-XX-207A	5172150	273282	WL/Chem	Shallow well at base of TDF dike, northeast side of TDF
MW-XX-207B	5172150	273282	WL/Chem	Well at northeast side of TDF, at base of excavated depth of TDF
MW-XX-207C	5172150	273282	WL/Chem	Well at northeast side of TDF, at bottom of unconsolidated overburden
MW-XX-208A	5171797	273575	WL/Chem	Shallow well at base of east portion of TDF dike
MW-XX-208B	5171797	273575	WL/Chem	Well at east portion of TDF, at bottom of unconsolidated overburden
MW-XX-209A	5172627	270622	WL/Chem	Shallow well downgradient of ore stockpile
MW-XX-209B	5172627	270622	WL/Chem	Well downgradient of ore stockpile, at base of overburden
MW-XX-210A	5172308	270826	WL/Chem	Shallow well upgradient of ore stockpile
MW-XX-210B	5172308	270826	WL/Chem	Well upgradient of ore stockpile, at base of overburden
MW-XX-211A	5172526	270290	WL/Chem	Shallow well downgradient of process plant area
MW-XX-211B	5172526	270290	WL/Chem	Well downgradient of process plant area, at base of overburden

Notes:

[1] Provided coordinates are approximate, and may be modified at time of installation. Coordinates system is NAD 1983 UTM Zone 16N.

Chem = Chemistry Sample

m = meters

WL = Water Level

Prepared by: MCC2
Checked by: JEF1

Table 9-1
Reclamation Costs by Stage

Years	Stage 1 *0 to 4*		Stage 2 *4 to 8*		Closure *8 to 14*	
Tailings Disposal Facility						
Area (sq.m)		205,000		500,000		970,000
Unit cost to reclaim ($/sq.m)	$	31.53	$	29.65	$	29.69
Reclamation	$	6,463,650.00	$	14,825,000.00	$	28,799,300.00
Wastewater Treatment						
Median Number of Years to empty TDF		1		2		6
Treatment Cost per Year		1,700,000		1,700,000		1,700,000
Treatment Cost	$	1,700,000.00	$	3,400,000.00	$	10,200,000.00
Reclamation Costs at Closure						
Reclamation	$	10,222,550.00	$	10,222,550.00	$	10,222,550.00
Salvage Value						
Total Equipment Salvage Value	$	(19,355,089.00)	$	(19,355,089.00)	$	(19,355,089.00)
General						
Reclamation	$	56,275.00	$	56,275.00	$	56,275.00
Reclamation Subtotal	**$**	**(912,614.00)**	**$**	**9,148,736.00**	**$**	**29,923,036.00**

Note:
$/sq.m = dollars per square meter
sq.m = square meter
TDF = Tailings Disposal Facility

Prepared by: MCC2
Checked by: MJV2

Source: Copperwood Resources, Inc.

Table 9-2
Post Closure Long-Term Monitoring and Care

Item	Quantity	Units	Unit Cost	Cost
Final cover inspection annually for 20 years	20	each	$ 6,077.70	$ 121,554.00
Erosion repairs annually for 20 years (5 acres/year)	100	acres	$ 2,813.75	$ 281,375.00
Vegetation Control (Eliminate Trees on TDF)	20	each	$ 1,125.50	$ 22,510.00
Groundwater well maintenance (1 per year)	20	years	$ 2,251.00	$ 45,020.00
Groundwater well monitoring, 35 wells quarterly per year for years 19-29	10	years	$ 157,570.00	$ 1,575,700.00
Groundwater well monitoring, 35 wells twice per year for years 29-39	10	years	$ 78,785.00	$ 787,850.00
Surface Water Monitoring, 20 locations quarterly per year for years 19-29	10	years	$ 67,530.00	$ 675,300.00
Surface Water Monitoring, 20 locations twice per year for years 29-39	10	years	$ 33,765.00	$ 337,650.00
Post Closure Total				**$ 3,846,959.00**

Notes:

acres/year = acres per year

TDF = Tailings Disposal Facility

Prepared by: MCC2

Checked by: MJV2

Source: Copperwood Resources, Inc.

Table 9-3
Reclamation Costs at Closure

	Unit Cost	Units	Quantity	Item Total
Site Reclamation				
Place and Compact Soil Cover	2.25	cu.m	200,000	450,000.00
Place and Hydroseed Topsoil	1.95	sq.m	2,330,000	4,543,500.00
Steel Buildings and Structures				
Structural Steel Demolition	600	tonnes	2,500	1,500,000.00
Concrete Demolition	8	tonnes	35,000	280,000.00
Concrete Disposal	2	tonnes	35,000	70,000.00
Modular Buildings and Structures				
Modular Building Removal	50	sq.m	200.00	10,000.00
Mechanical and Electrical Systems				
Mechanical Pipelines	500,000	Allowance	1	500,000.00
Electrical Distribution	500,000	Allowance	1	500,000.00
Reclamation of Fuel Tanks				
Removal and Disposal of Tanks	10,000	Allowance	1	10,000.00
Closure Reclamation Subtotal				**7,863,500.00**
Admin Support 15%				**1,179,525.00**
Contingency 15%				**1,179,525.00**
Total				**10,222,550.00**

Notes:
cu.m = cubic meter
sq.m = square meter

Prepared by: MCC2
Checked by: MJV2

Source: Copperwood Resources, Inc.

Table 9-4
Equipment Salvage Value

Closure Year 14							
Description	Original Equipment Cost	Economic Life	Life at Closure	NBV at Closure	Salvage % NBV	Salvage Value	Salvage Value % of New Equipment Value
120-Workshops/Storage	$75,000.00	25.00	11.00	43,500.00	43.10%	$18,750.00	25%
130-Support Facilities	$1,500,791.20	20.00	6.00	712,875.82	52.63%	$375,197.80	25%
160-Laboratory	$1,802,000.00	25.00	11.00	1,095,616.00	49.34%	$540,600.00	30%
210-Main Power Generation	$21,509,800.00	30.00	16.00	15,487,056.00	55.56%	$8,603,920.00	40%
220-Process Plant Electrical Rooms	$2,355,000.00	14.00	0.00	824,250.00	100.00%	$824,250.00	35%
310-Raw Water Supply & Potable Water	$3,145,795.00	14.00	0.00	786,448.75	100.00%	$786,448.75	25%
400 - Mobile Equipment	$20,962,294.00	14.00	0.00	4,192,458.80	100.00%	$4,192,458.80	20%
430-Surface Mobile Equipment	$400,000.00	14.00	0.00	80,000.00	100.00%	$80,000.00	20%
610-Ore Handling	$2,740,000.00	30.00	16.00	1,653,133.33	24.86%	$411,000.00	15%
620-Grinding	$10,730,000.00	30.00	16.00	6,473,766.67	24.86%	$1,609,500.00	15%
630-Flotation/Regrind Circuit	$9,329,900.00	25.00	11.00	4,888,867.60	28.63%	$1,399,485.00	15%
640-Tailings	$165,000.00	25.00	11.00	86,460.00	28.63%	$24,750.00	15%
650-Copper Concentrate Filtration;Thickening & Handling	$2,098,500.00	25.00	11.00	1,099,614.00	28.63%	$314,775.00	15%
670- Reagents	$674,691.00	25.00	11.00	353,538.08	28.63%	$101,203.65	15%
680- Plant Services	$485,000.00	25.00	11.00	254,140.00	28.63%	$72,750.00	15%
Subtotal Direct	$77,973,771.20			$38,031,725.05		$19,355,089.00	22%
				Total Equipment Salvage Value		**$19,355,089.00**	

Note:
NBV = Net Book Value
% = percent

Prepared by: MCC2
Checked by: MJV2

Source: Copperwood Resources, Inc.

Table 9-5
Financial Assurance Costs by Stage

Stage	1	2	Closure
Years	0 to 4	4 to 8	8 to 14
Reclamation Cost by Stage[1]	$ -	$ 9,148,736.00	$ 29,923,036.00
Post Closure Monitoring and Care	$ 3,846,959.00	$ 3,846,959.00	$ 3,846,959.00
Total Closure and Reclamation Costs	$ 3,846,959.00	$ 12,995,695.00	$ 33,769,995.00
MDEQ Administration Oversight (5% of Total Costs)	$ 192,347.95	$ 649,784.75	$ 1,688,499.75
Subtotal	$ 4,039,306.95	$ 13,645,479.75	$ 35,458,494.75
Contingency Cost (5% of Reclamation/Monitoring and MDEQ Oversight Costs)	$ 201,965.35	$ 682,273.99	$ 1,772,924.74
Total Financial Assurance Cost	$ 4,241,272.30	$ 14,327,753.74	$ 37,231,419.49
Incremental Financial Assurance[2]	**$ 4,241,272.30**	**$ 10,086,481.44**	**$ 22,903,665.75**

Notes:

[1] For Stage 1, the salvage value of equipment exceeds the reclamation costs. A net salvage value is applied over the life of project. The entirety of the post closure monitoring and care costs will be posted in Stage 1.

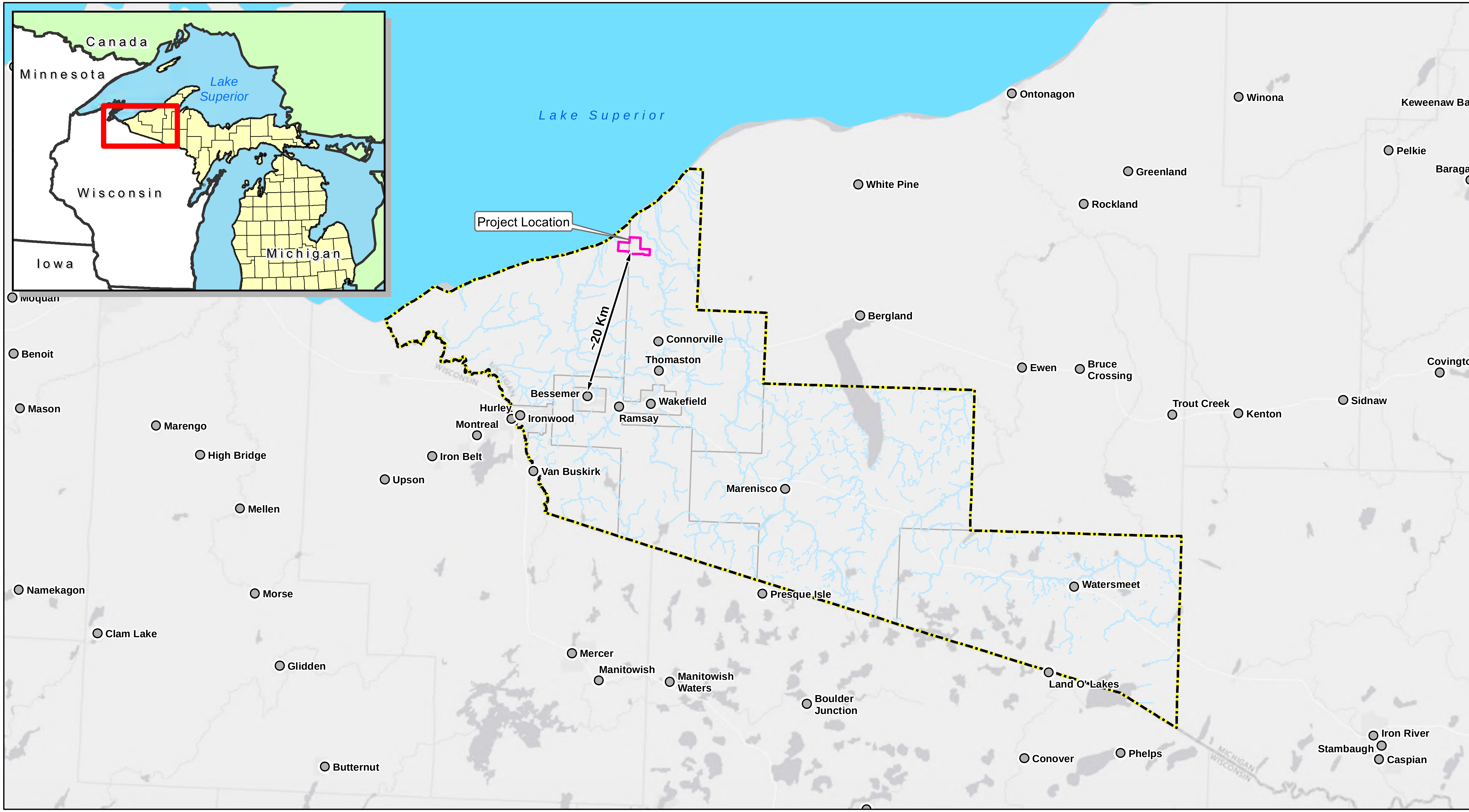
[2] Amount to be added to proposed Certificate of Deposit or approved financial instrument by stage.

MDEQ = Michigan Department of Environmental Quality

Prepared by: MCC2
Checked by: MJV2

Source: Copperwood Resources, Inc.

Figures



NOTES:
1. Coordinate System: NAD 1983 UTM Zone 16N

LEGEND
- Place Name
- Major Roads
- Gogebic County
- Property Boundary

HIGHLAND Copper Company Inc.

Foth

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

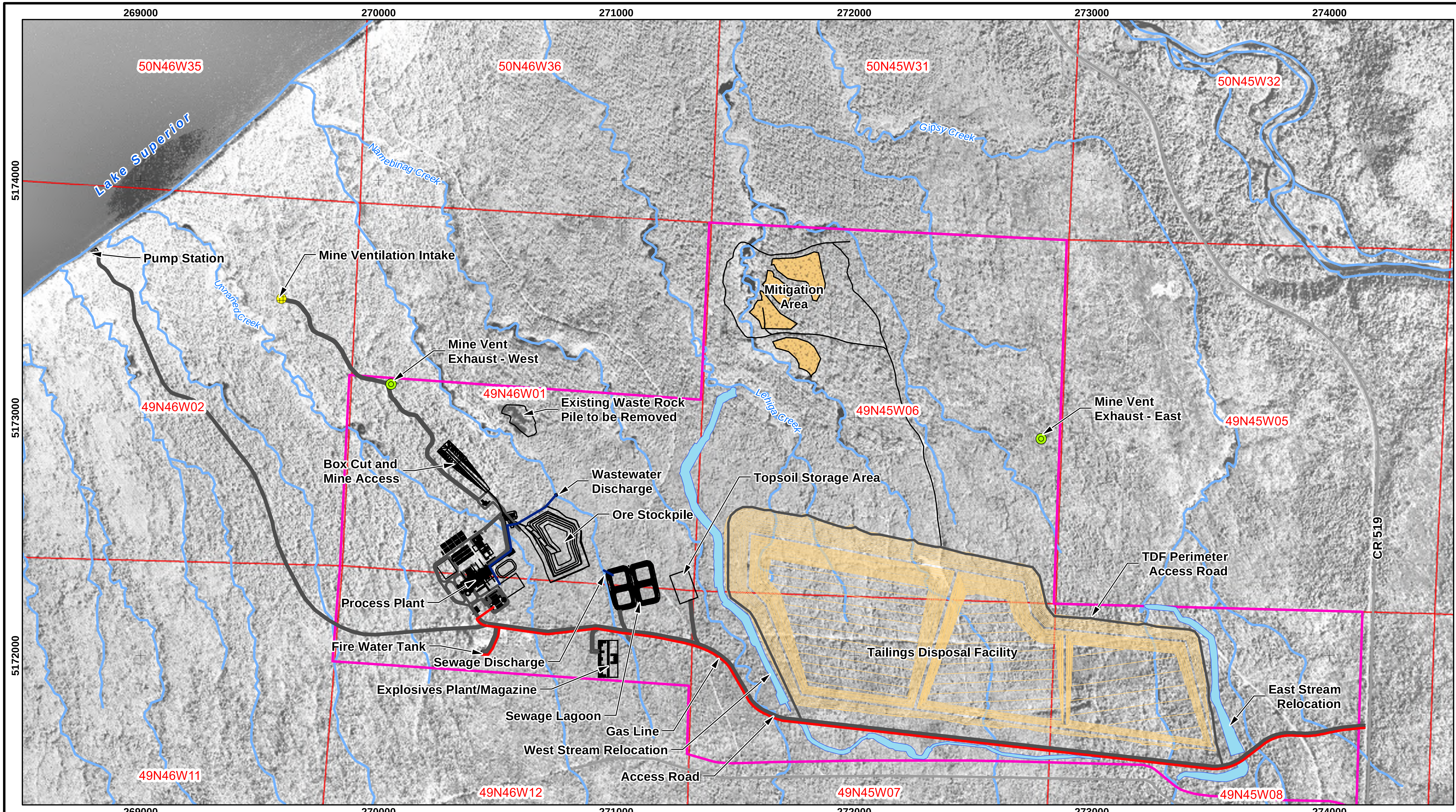
PREPARED BY: MCC2 DATE: MAR. '18
REVIEWED BY: MJV2 DATE: MAR. '18
APPROVED BY: KKB DATE: MAR. '18

COPPERWOOD RESOURCES, INC.

FIGURE 1-1
MINING PERMIT APPLICATION AMENDMENT
PROJECT AREA LOCATION
GOGEBIC COUNTY, MICHIGAN

Scale: 0 5 10 Kilometers
Date: MARCH 2018
Drafted by: DAT
Project: 17C050

Path: Q:\Copperwood Resources\17C050\GIS\mxd\MPAA\Figure 1-1 Project Area Location.mxd Date: 3/21/2018



NOTES:

1. Coordinate System: NAD 1983 UTM Zone 16N
2. Facility layout supplied by G Mining Services Inc.
3. Aerial Imagery downloaded from USDA Geospatial Data Gateway.

LEGEND

- Wastewater Discharge Pipe
- Natural Gas Pipeline
- Roads
- Plant and Facility
- Tailing Disposal Facility
- Access Road
- River and Streams
- Stream Relocation
- Section
- Property Boundary

HIGHLAND Copper Company Inc.

Foth

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION

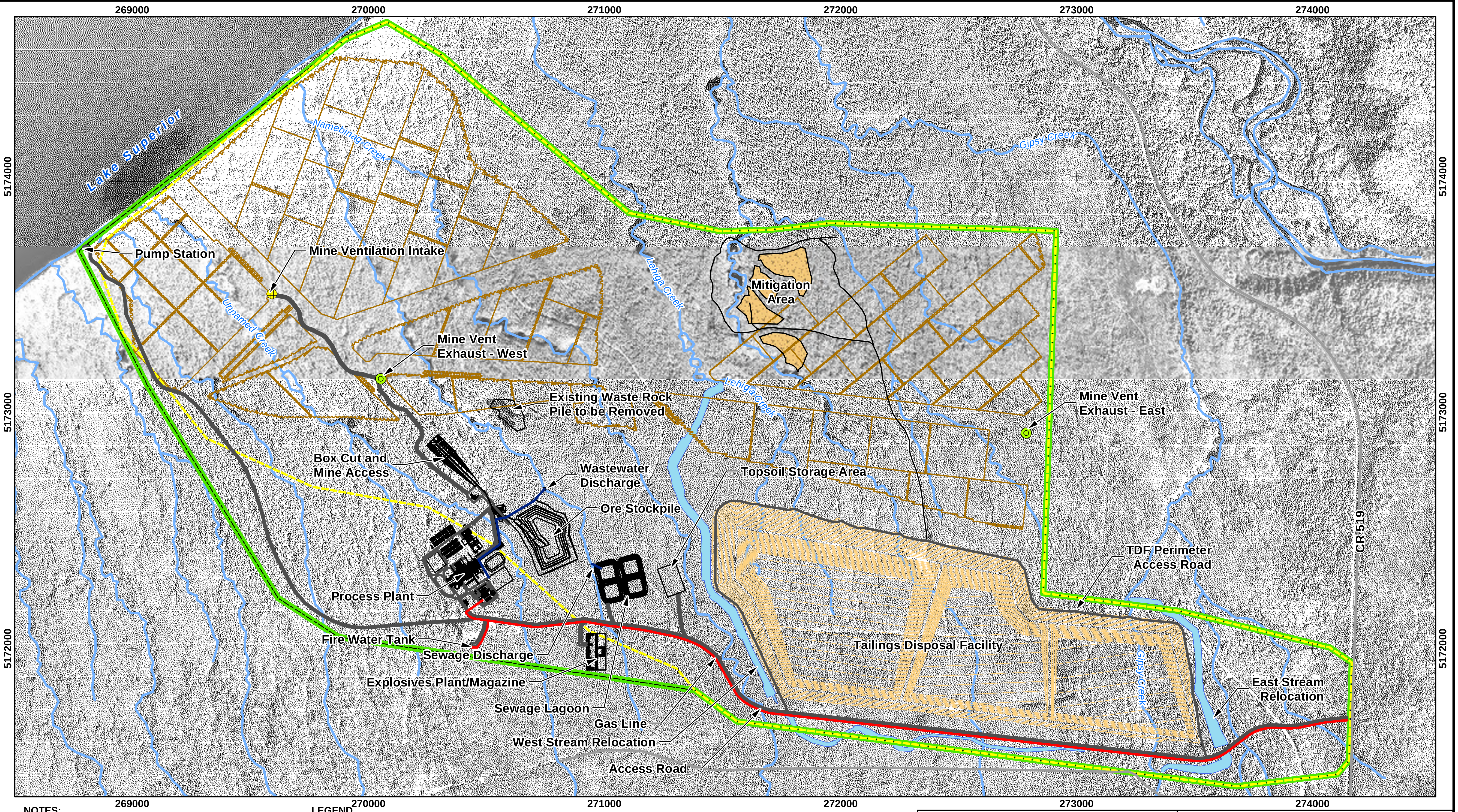
PREPARED BY: MCC2	DATE: MAR. '18
REVIEWED BY: MJV2	DATE: MAR. '18
APPROVED BY: KKB	DATE: MAR. '18

COPPERWOOD RESOURCES, INC.

FIGURE 1-2
MINING PERMIT APPLICATION AMENDMENT
SITE LAYOUT
GOGEBIC COUNTY, MICHIGAN

Scale: 0 150 300 Meters	Date: MARCH 2018
Drafted by: DAT	Project: 17C050

Path: Q:\Copperwood Resources\17C050\GIS\mxd\MPAA\Figure 1-2 Site Layout.mxd Date: 3/21/2018



NOTES:

1. Coordinate System: NAD 1983 UTM Zone 16N
2. Facility layout supplied by G Mining Services Inc.
3. Aerial Imagery downloaded from USDA Geospatial Data Gateway.

LEGEND

- Wastewater Discharge Pipe
- Natural Gas Pipeline
- Roads
- Plant and Facility
- Tailing Disposal Facility
- Access Road
- River and Streams
- Proposed Mining Area - Original
- Proposed Mining Area - Amendment
- Mine Panels
- Stream Relocation

HIGHLAND Copper Company Inc.

Foth

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	MCC2	DATE:	MAR. '18
REVIEWED BY:	MJV2	DATE:	MAR. '18
APPROVED BY:	KKB	DATE:	MAR. '18

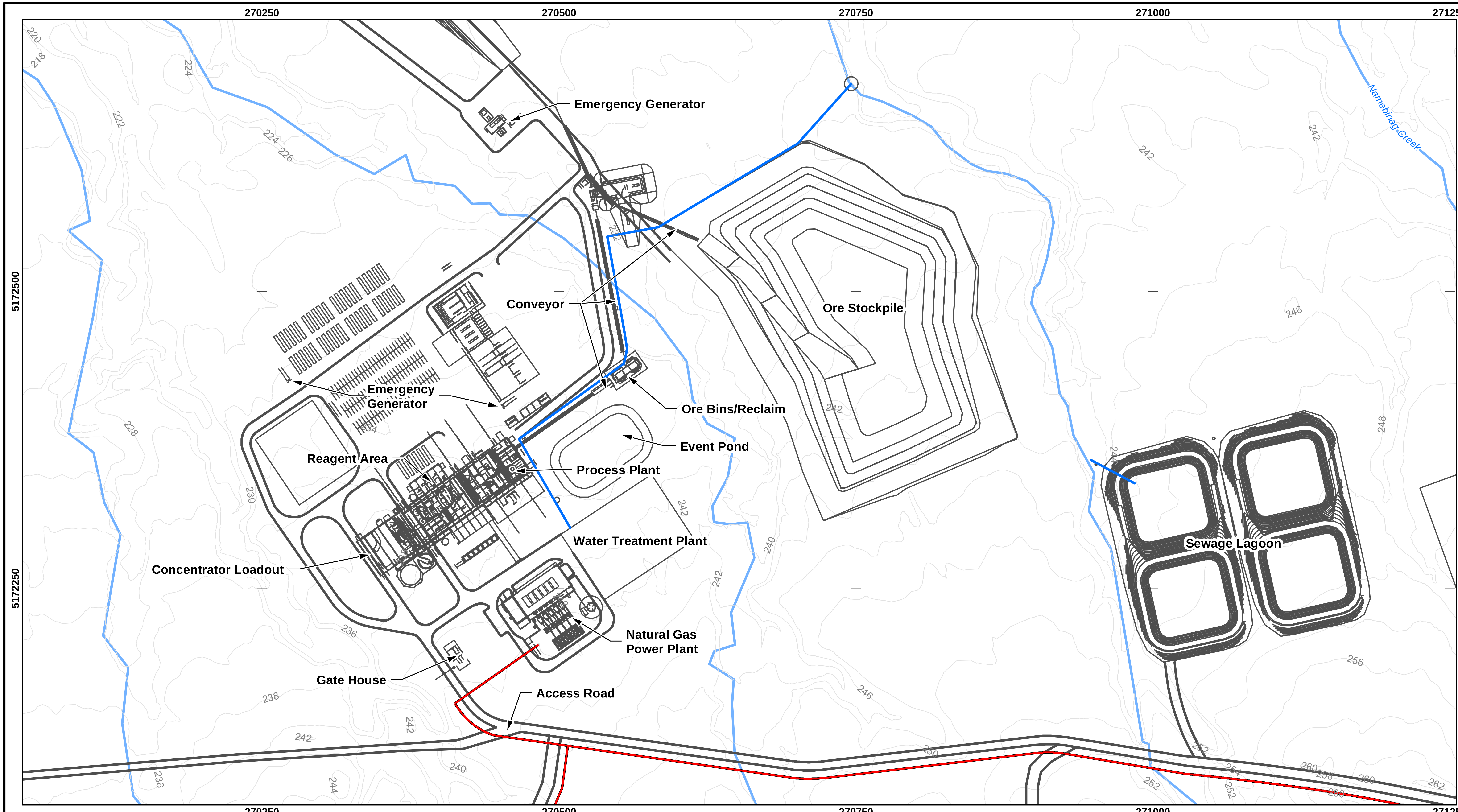
N

COPPERWOOD RESOURCES, INC.

FIGURE 2-1
MINING PERMIT APPLICATION AMENDMENT
PROPOSED MINING AREA BOUNDARY
GOGEBIC COUNTY, MICHIGAN

Scale: 0 150 300 Meters		Date:	MARCH 2018
Drafted by:	DAT	Project:	17C050

Path: Q:\Copperwood Resources\17C050\GIS\mxd\MPAA\Figure 2-1 Proposed Mining Area Boundary.mxd Date: 3/21/2018



NOTES:

1. Coordinate System: NAD 1983 UTM Zone 16N
2. Facility layout supplied by G Mining Services Inc.

LEGEND

- Wastewater Discharge Pipe
- Natural Gas Pipeline
- Plant and Facility
- Access Road
- Contours
- River and Streams

HIGHLAND Copper Company Inc.

Foth

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	MCC2	DATE:	MAR. '18
REVIEWED BY:	MJV2	DATE:	MAR. '18
APPROVED BY:	KKB	DATE:	MAR. '18

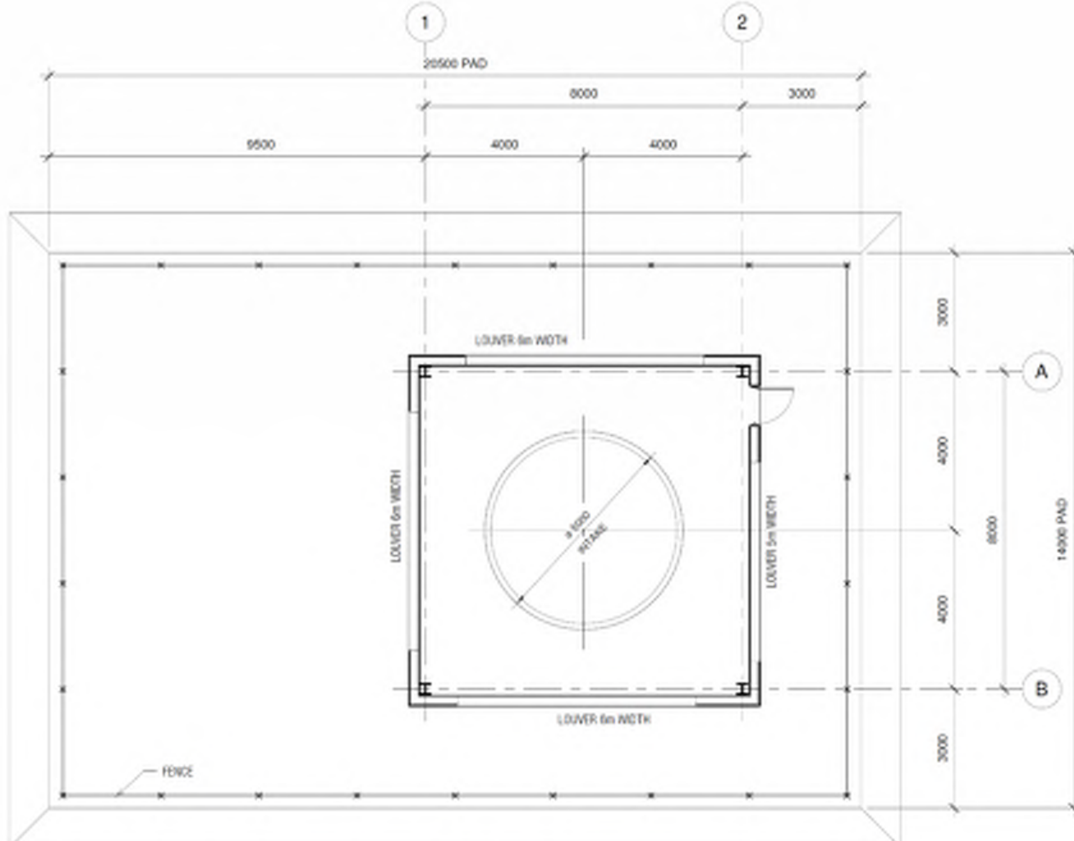
COPPERWOOD RESOURCES

FIGURE 4-1

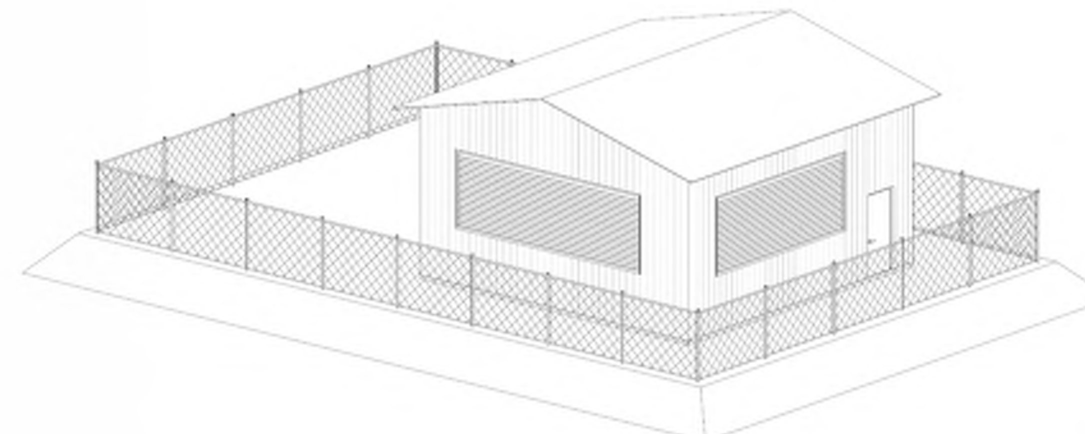
MINING PERMIT APPLICATION AMENDMENT
PROCESS PLANT AREA
GOGEBIC COUNTY, MICHIGAN

Scale: 0 30 60 Meters		Date:	MARCH 2018
Drafted by:	DAT	Project:	17C050

Path: Q:\Copperwood Resources\17C050\GIS\mxd\MPAA\Figure 4-1 Process Plant Area.mxd Date: 3/21/2018

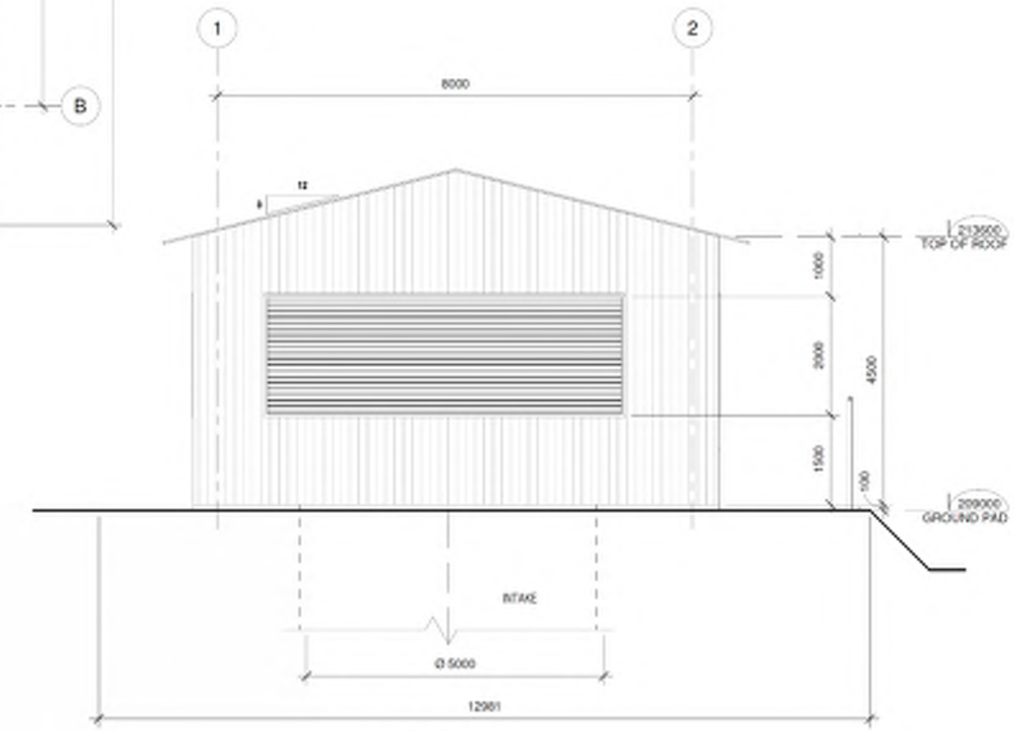


1 PLAN VIEW - FLOOR LEVEL
1 : 75



3 3D VIEW

NOT FOR CONSTRUCTION



2 ELEVATION
1 : 50

NOTES:
1. Graphic supplied by G Mining Services, Inc.

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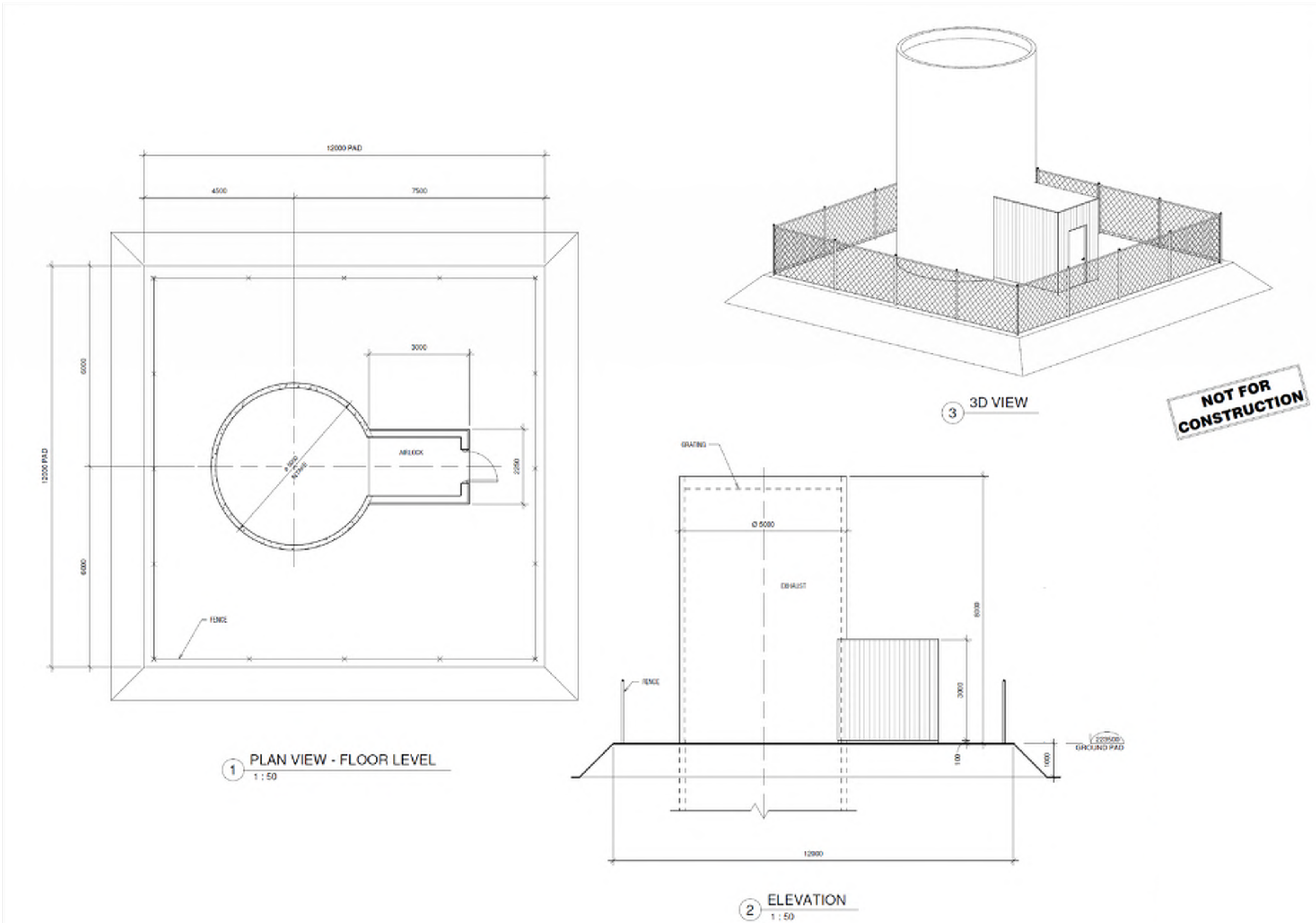
REVIEWED BY: MJV2 DATE: MAR. `18
APPROVED BY: KKB DATE: MAR. `18

COPPERWOOD RESOURCES, INC.

FIGURE 4-2
MINING PERMIT APPLICATION AMENDMENT
INTAKE VENTILATION RAISE
CONCEPTUAL DESIGN
GOGEBIC COUNTY, MICHIGAN

Scale: NOT TO SCALE	Date: MARCH 2018
Drafted by: DAT	Project: 17C050

Path: Q:\Copperwood Resources\17C050\GIS\mxd\MPAA\Figure 4-2 Intake Ventilation Raise Conceptual Design.mxd Date: 3/20/2018

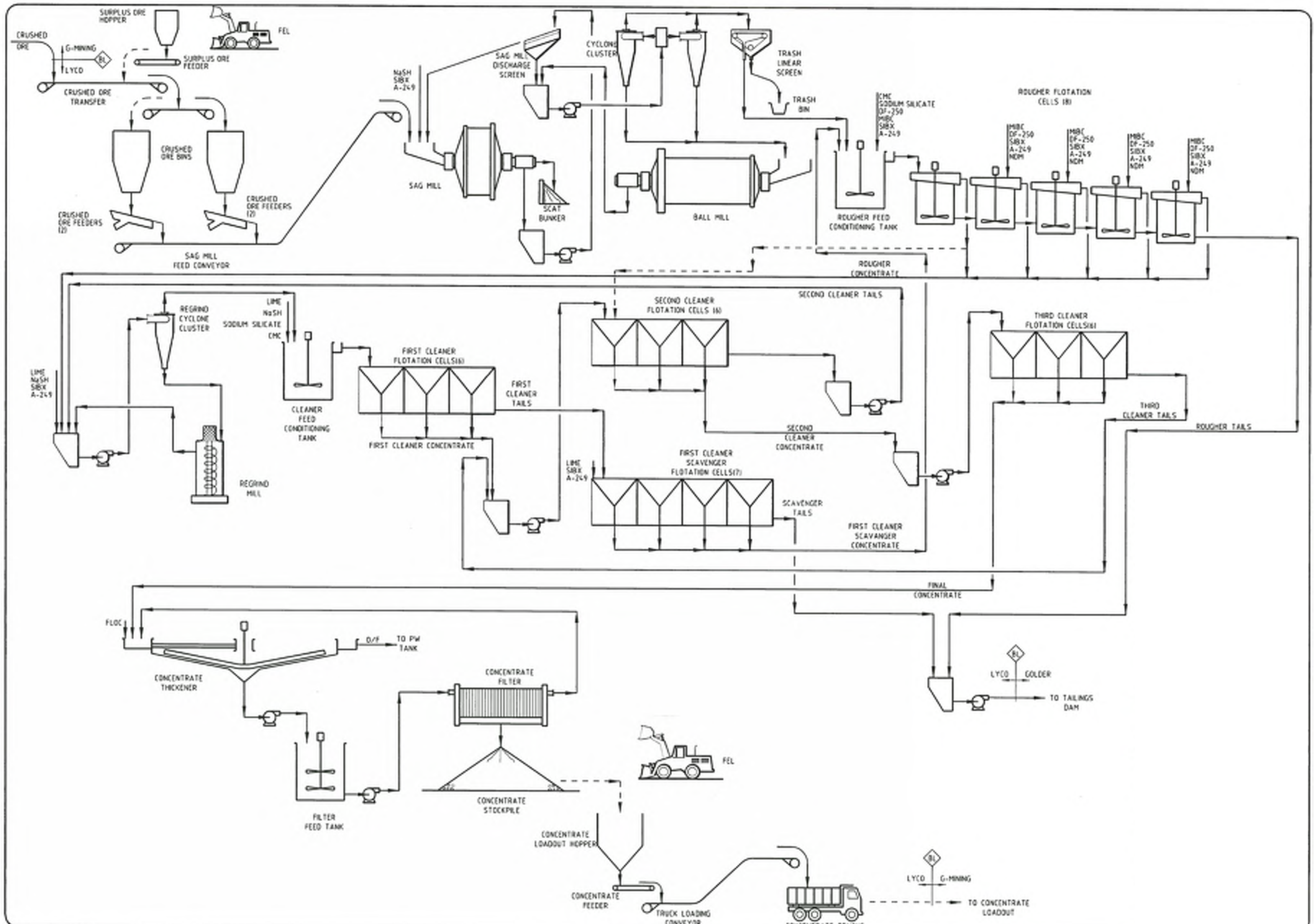


NOTES:
1. Graphic supplied by G Mining Services, Inc.

HIGHLAND Copper Company Inc.

Foth

Foth Infrastructure & Environment, LLC					COPPERWOOD RESOURCES, INC.
REVISED	DATE	BY	DESCRIPTION		**FIGURE 4-3** MINING PERMIT APPLICATION AMENDMENT EXHAUST VENTILATION RAISE CONCEPTUAL DESIGN GOGEBIC COUNTY, MICHIGAN
PREPARED BY: MCC2				DATE: MAR. `18	
REVIEWED BY: MJV2				DATE: MAR. `18	Scale: NOT TO SCALE — Date: MARCH 2018
APPROVED BY: KKB				DATE: MAR. `18	Drafted by: DAT — Project: 17C050



NOTES:
1. Graphics supplied by Lycopodium Minerals Canada Ltd.

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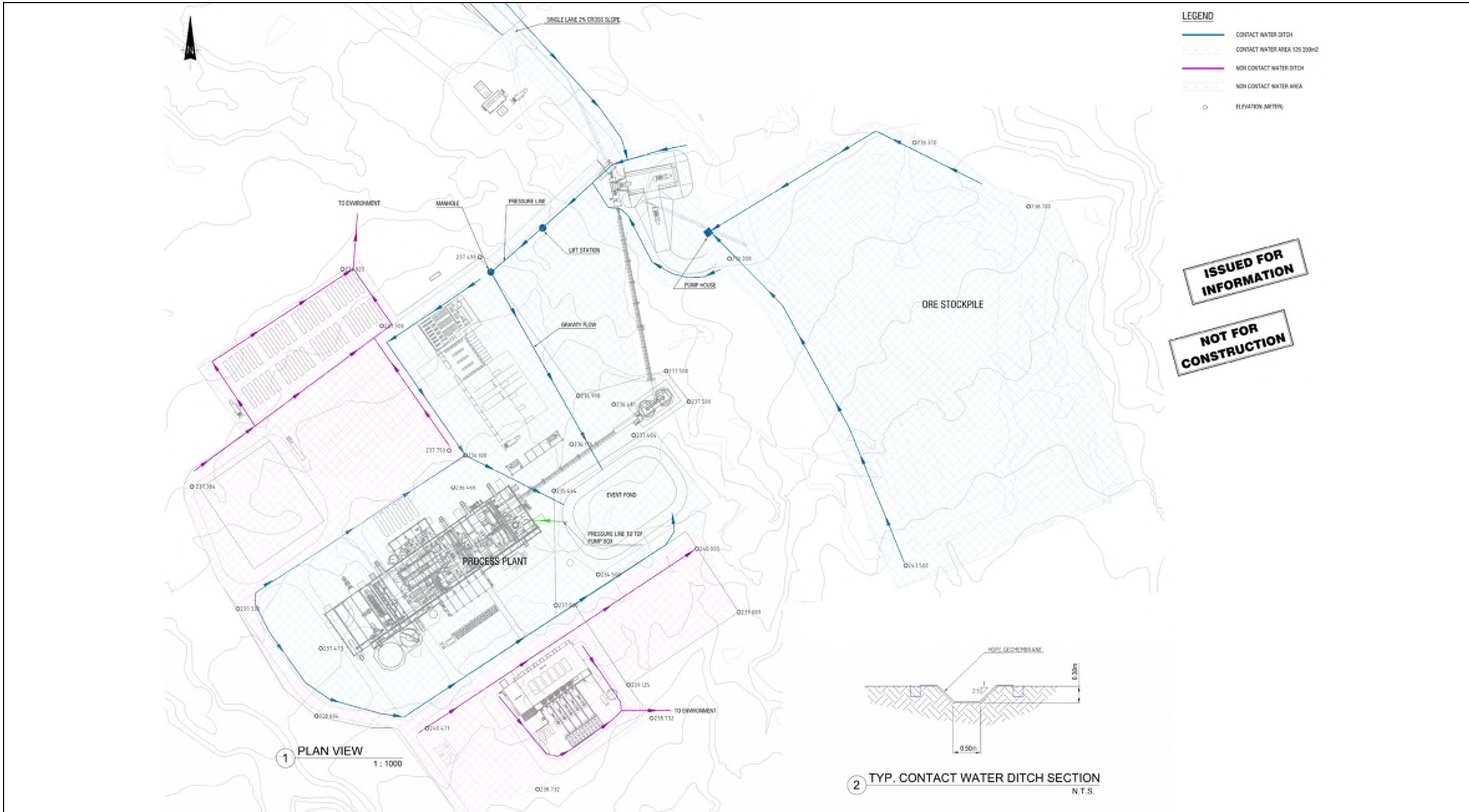
PREPARED BY: MCC2			DATE: MAR. `18
REVIEWED BY: MJV2			DATE: MAR. `18
APPROVED BY: KKB			DATE: MAR. `18

COPPERWOOD RESOURCES, INC.

FIGURE 4-4
MINING PERMIT APPLICATION AMENDMENT
PROCESS FLOW DIAGRAM
GOGEBIC COUNTY, MICHIGAN

Scale: NOT TO SCALE	Date: MARCH 2018
Drafted by: DAT	Project: 17C050

Path: Q:\Copperwood Resources\17C050\GIS\mxd\MPAA\Figure 4-4 Process Flow Diagram.mxd Date: 3/20/2018



NOTES:

1. Graphic supplied by G Mining Services, Inc.

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REVIEWED BY:	MJV2	DATE:	MAR. `18
APPROVED BY:	KKB	DATE:	MAR. `18

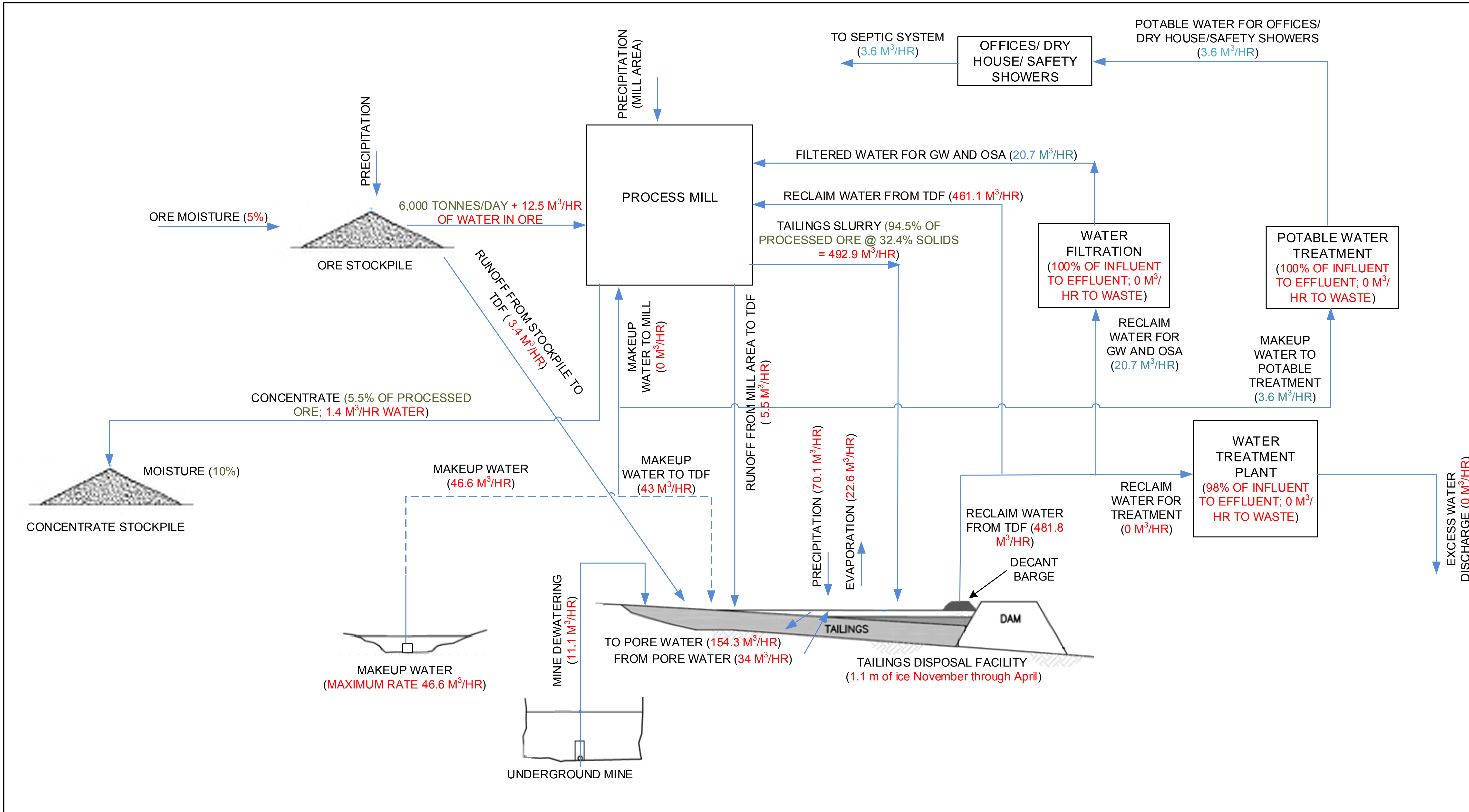
COPPERWOOD RESOURCES, INC.

FIGURE 4-5

MINING PERMIT APPLICATION AMENDMENT
PROCESS PLANT AREA WATER MANAGEMENT
GOGEBIC COUNTY, MICHIGAN

Scale:	NOT TO SCALE	Date:	MARCH 2018
Drafted by:	DAT	Project:	17C050

Path: Q:\Copperwood Resources\17C050\GIS\mxd\MPAA\Figure 4-5 Process Plant Area Water Management.mxd Date: 3/20/2018



NOTES:

1. Graphic supplied by Golder Assoiciates Inc.
2. M3/HR = cubic meters per hour
   TDF = tailings disposal facility
   GW = gland water
   OSA = On-stream analysers

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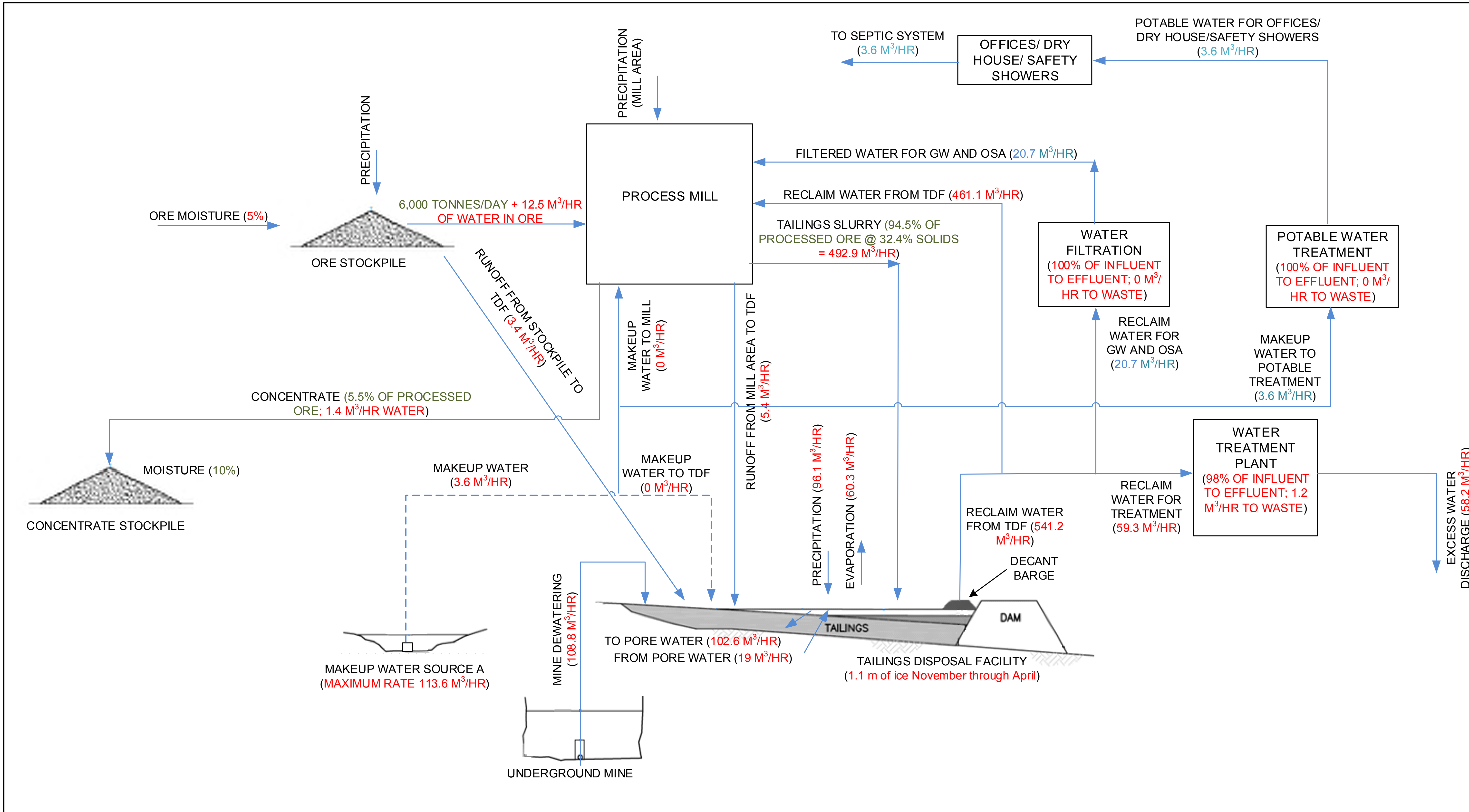
REVIEWED BY: MJV2			DATE: MAR. `18
APPROVED BY: KKB			DATE: MAR. `18

COPPERWOOD RESOURCES, INC.

FIGURE 4-6
MINING PERMIT APPLICATION AMENDMENT
PROCESS WATER BALANCE –
YEAR 2 AVERAGE ANNUAL FLOWS
GOGEBIC COUNTY, MICHIGAN

Scale: NOT TO SCALE	Date: MARCH 2018
Drafted by: DAT	Project: 17C050

Path: Q:\Copperwood Resources\17C050\GIS\mxd\MPAA\Figure 4-6 Process Water Balance – Year 2 Average Annual Flows.mxd Date: 3/20/2018



NOTES:
1. Graphic supplied by Golder Assoiciates Inc.
2. M3/HR = cubic meters per hour
   TDF = tailings disposal facility
   GW = gland water
   OSA = On-stream analysers

HIGHLAND Copper Company Inc.

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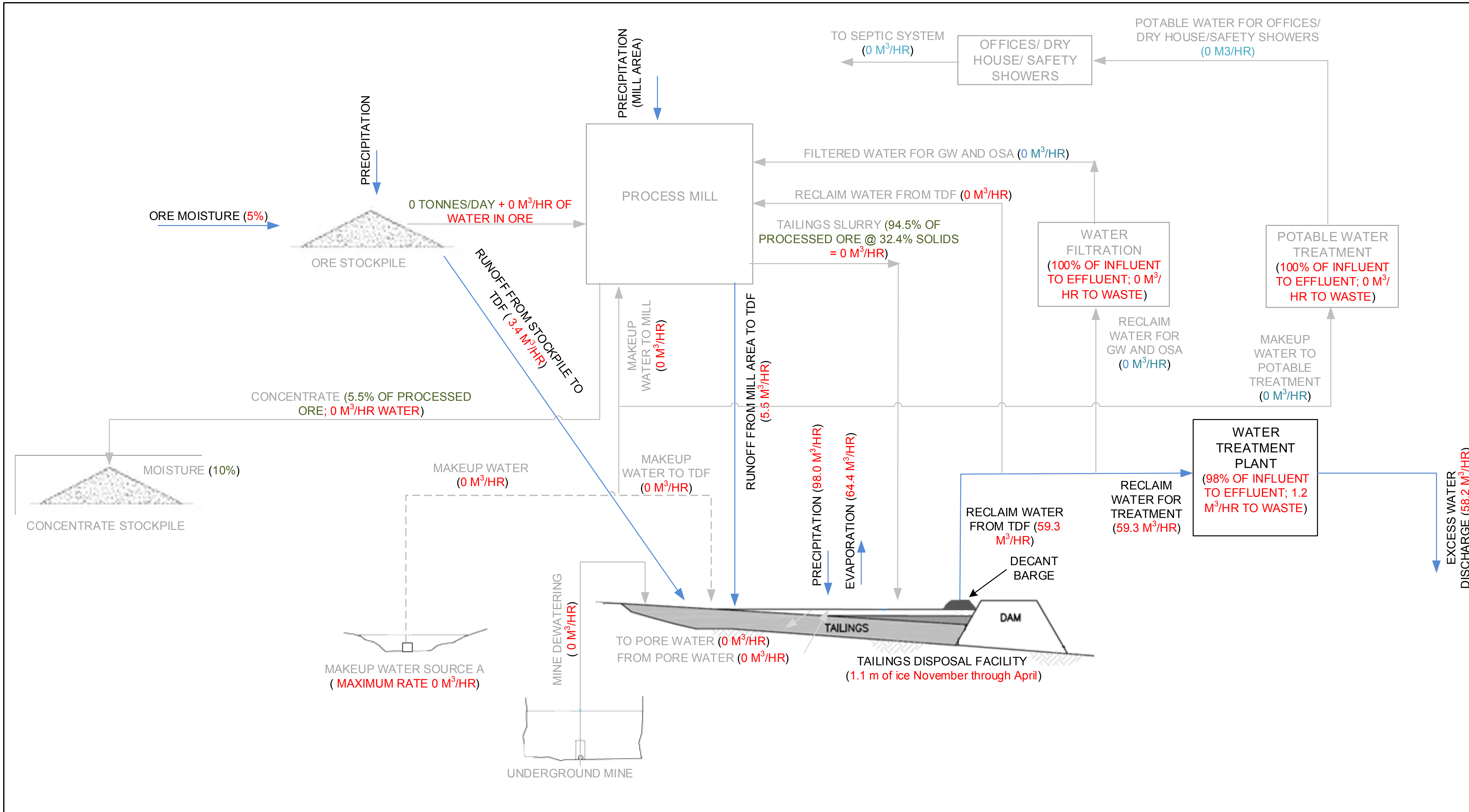
PREPARED BY:	MCC2	DATE:	MAR. `18
REVIEWED BY:	MJV2	DATE:	MAR. `18
APPROVED BY:	KKB	DATE:	MAR. `18

COPPERWOOD RESOURCES, INC.

FIGURE 4-7
MINING PERMIT APPLICATION AMENDMENT
PROCESS WATER BALANCE –
YEAR 11 AVERAGE ANNUAL FLOWS
GOGEBIC COUNTY, MICHIGAN

Scale:	NOT TO SCALE	Date:	MARCH 2018
Drafted by:	DAT	Project:	17C050

Path: Q:\Copperwood Resources\17C050\GIS\mxd\MPAA\Figure 4-7 Process Water Balance – Year 11 Average Annual Flows.mxd Date: 3/20/2018



NOTES:
1. Graphic supplied by Golder Assoiciates Inc.
2. M3/HR = cubic meters per hour
   TDF = tailings disposal facility
   GW = gland water
   OSA = On-stream analysers

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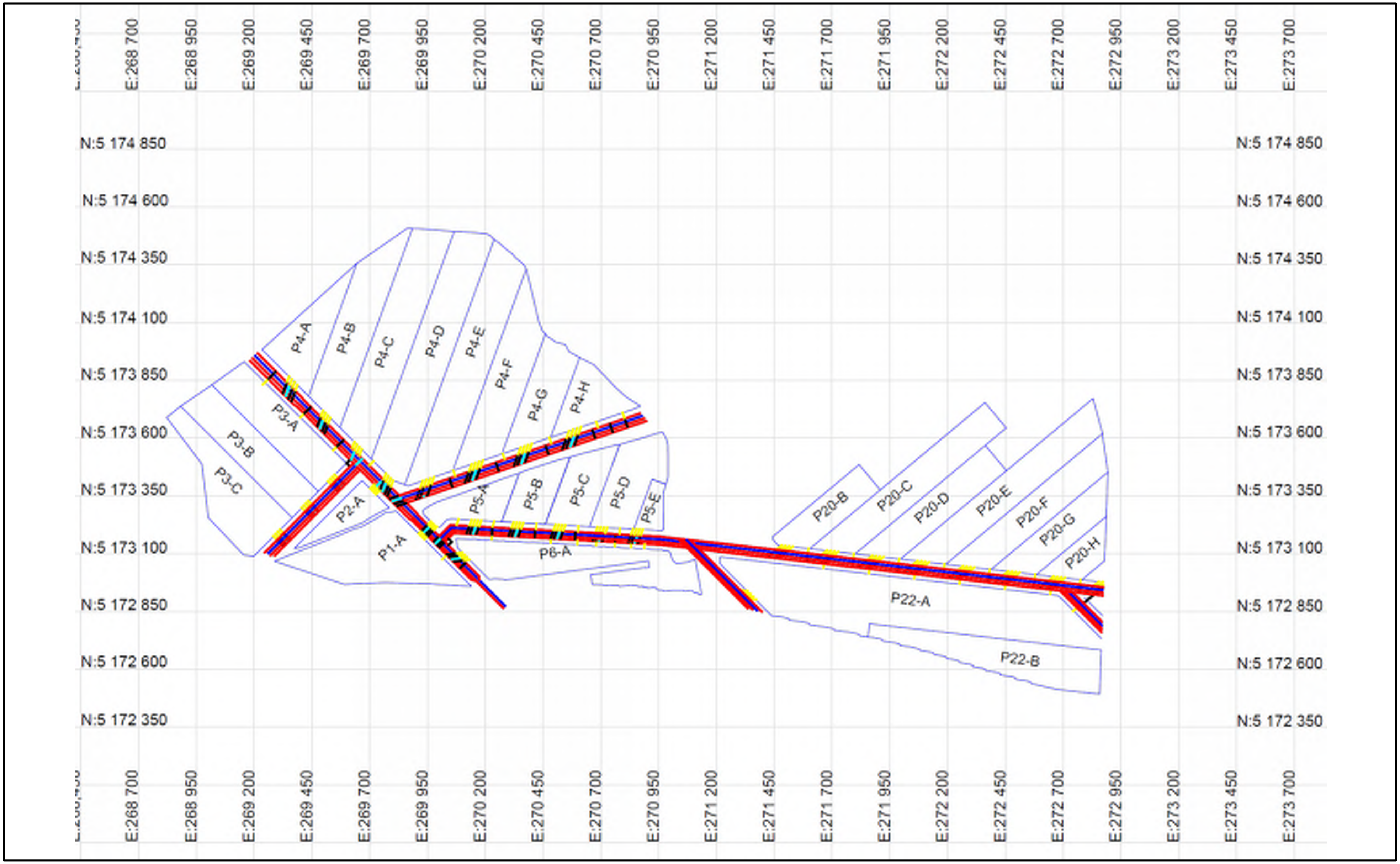
APPROVED BY: KKB			DATE: MAR. `18

COPPERWOOD RESOURCES, INC.

FIGURE 4-8
MINING PERMIT APPLICATION AMENDMENT
PROCESS WATER BALANCE – CLOSURE AVERAGE ANNUAL FLOWS
GOGEBIC COUNTY, MICHIGAN

Scale: NOT TO SCALE	Date: MARCH 2018
Drafted by: DAT	Project: 17C050



NOTES:

1. Graphic supplied by G Mining Services Inc.

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REVISED	DATE	BY	DESCRIPTION

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REVIEWED BY:	MJV2	DATE:	MAR. `18
APPROVED BY:	KKB	DATE:	MAR. `18

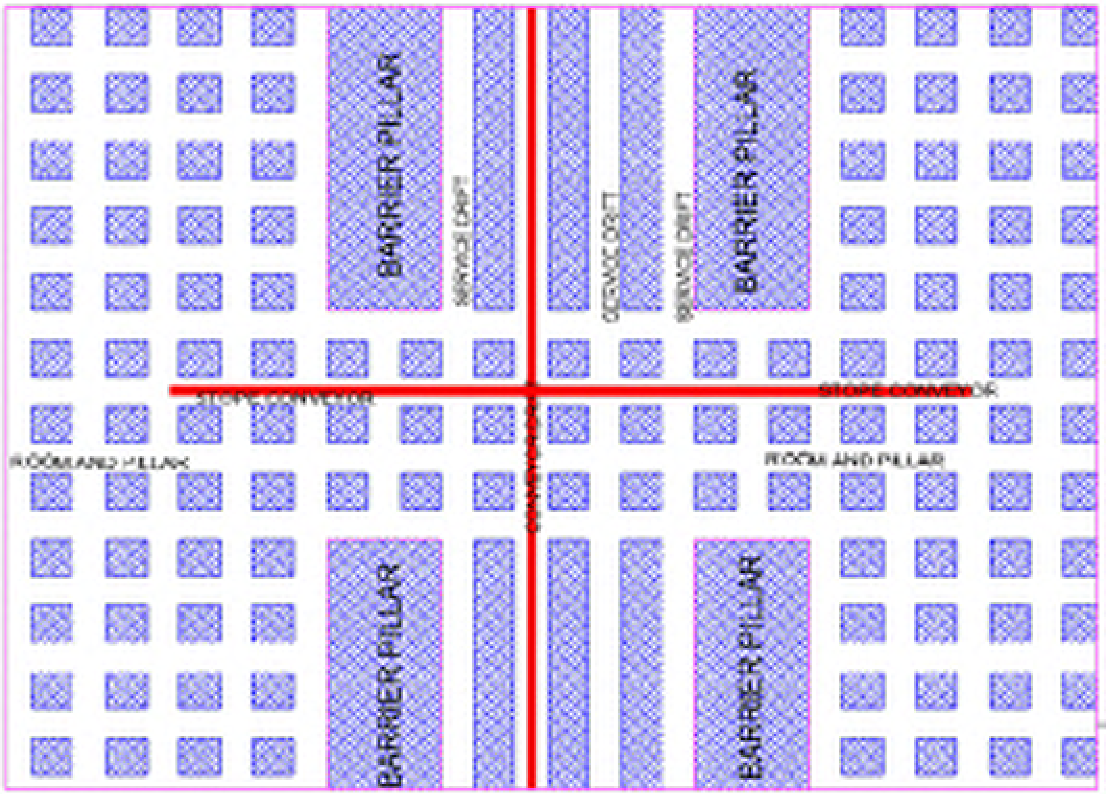
COPPERWOOD RESOURCES, INC.

FIGURE 4-9

MINING PERMIT APPLICATION AMENDMENT
UNDERGROUND MINE DESIGN
GOGEBIC COUNTY, MICHIGAN

Scale:	NOT TO SCALE	Date:	MARCH 2018
Drafted by:	DAT	Project:	17C050

Path: Q:\Copperwood Resources\17C050\GIS\mxd\MPAA\Figure 4-9 Underground Mine Design.mxd Date: 3/21/2018



NOTES:
1. Graphic supplied by G Mining Services Inc.

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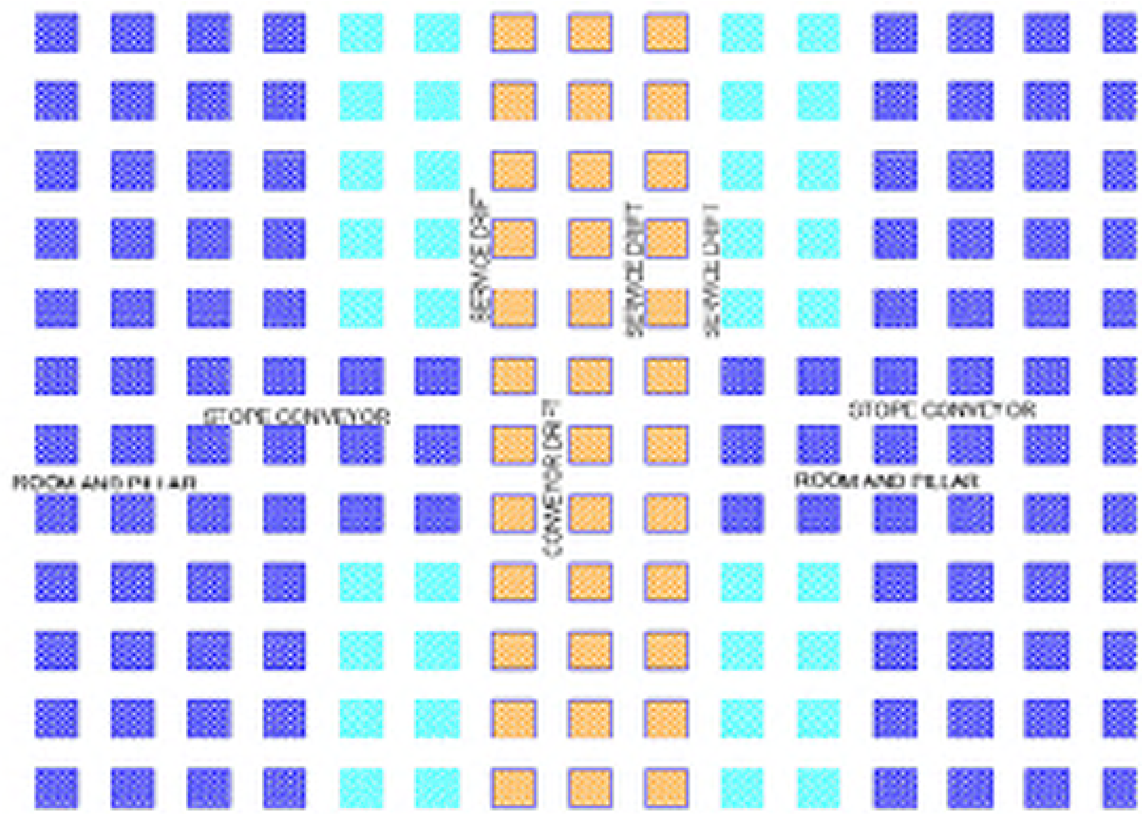
PREPARED BY: MCC2				DATE: MAR. `18
REVIEWED BY: MJV2				DATE: MAR. `18
APPROVED BY: KKB				DATE: MAR. `18

COPPERWOOD RESOURCES, INC.

FIGURE 4-10
MINING PERMIT APPLICATION AMENDMENT
MAIN ACCESS - SERVICE AND CONVEYOR DRIFT
GOGEBIC COUNTY, MICHIGAN

Scale: NOT TO SCALE	Date: MARCH 2018
Drafted by: DAT	Project: 17C050

Path: Q:\Copperwood Resources\17C050\GIS\mxd\MPAA\Figure 4-10 Main Access.mxd Date: 3/20/2018



NOTES:
1. Graphic supplied by G Mining Services Inc.

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REVISED	DATE	BY	DESCRIPTION	
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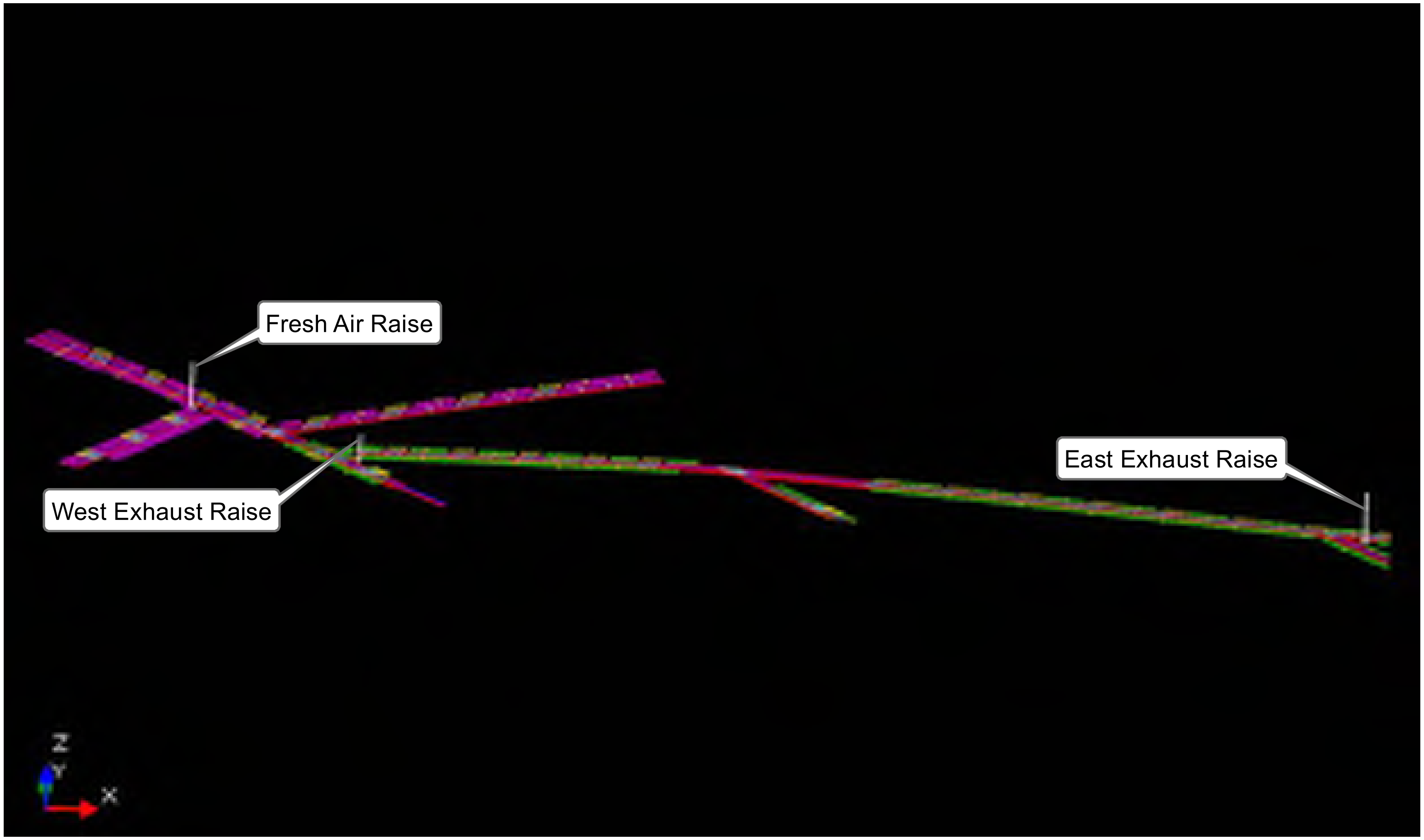
REVIEWED BY: MJV2				DATE: MAR. `18
APPROVED BY: KKB				DATE: MAR. `18

COPPERWOOD RESOURCES, INC.

FIGURE 4-11
MINING PERMIT APPLICATION AMENDMENT
BARRIER PILLARS RECOVERED
GOGEBIC COUNTY, MICHIGAN

Scale: NOT TO SCALE	Date: MARCH 2018
Drafted by: DAT	Project: 17C050

Path: Q:\Copperwood Resources\17C050\GIS\mxd\MPAA\Figure 4-11 Barrier Pillars Recovered.mxd Date: 3/20/2018



NOTES:
1. Graphic supplied by G Mining Services Inc.

HIGHLAND Copper Company Inc.

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PREPARED BY: MCC2	DATE: MAR. `18
REVIEWED BY: MJV2	DATE: MAR. `18
APPROVED BY: KKB	DATE: MAR. `18

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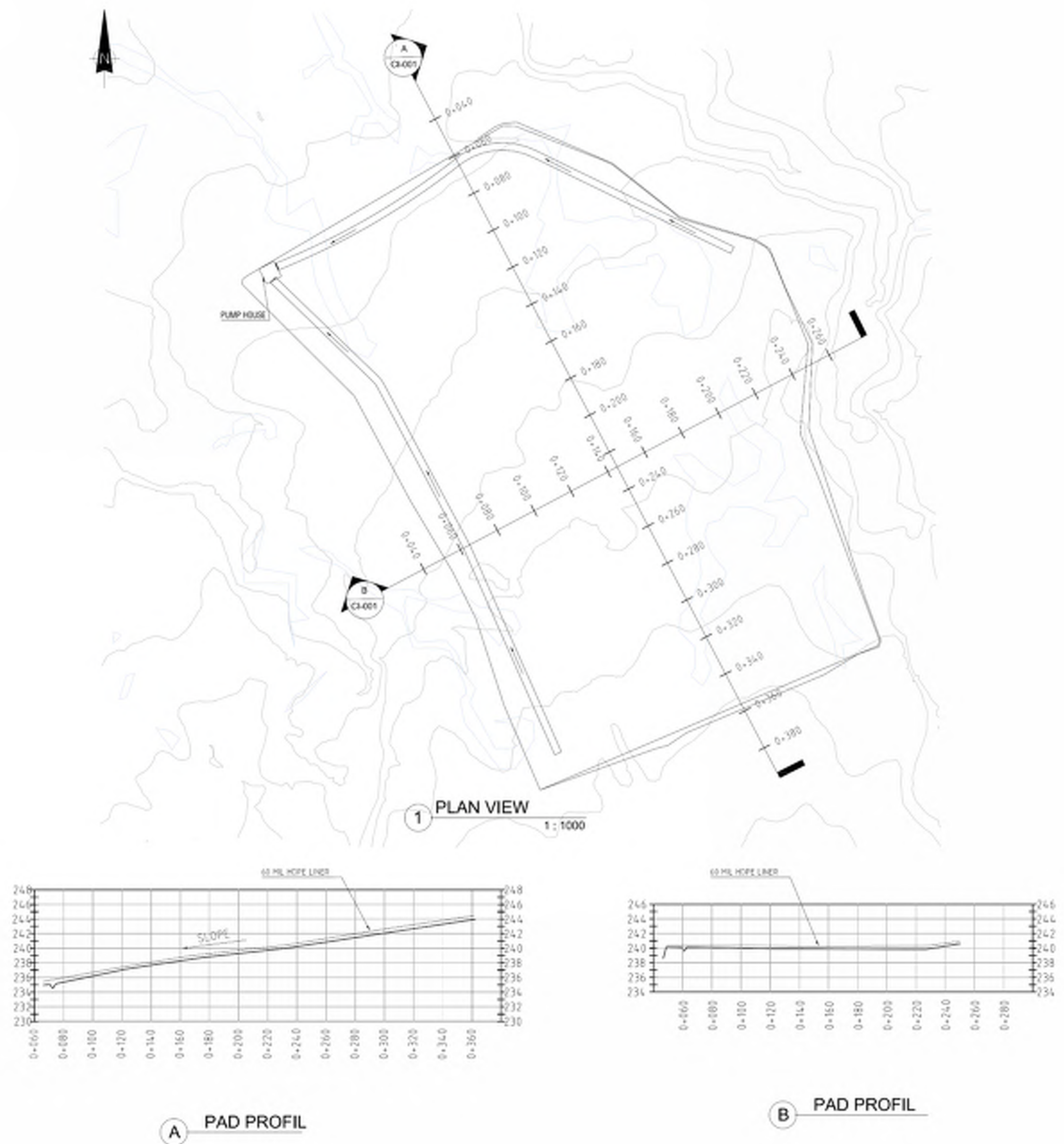
COPPERWOOD RESOURCES, INC.

FIGURE 4-12
MINING PERMIT APPLICATION AMENDMENT
MAIN VENTILATION LAYOUT
GOGEBIC COUNTY, MICHIGAN

Scale: NOT TO SCALE	Date: MARCH 2018
Drafted by: DAT	Project: 17C050

Path: Q:\Copperwood Resources\17C050\GIS\mxd\MPAA\Figure 4-12 Main Ventilation Layout.mxd Date: 3/20/2018



ISSUED FOR INFORMATION

NOT FOR CONSTRUCTION

NOTES:
1. Graphic supplied by G Mining Services, Inc.

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PREPARED BY: MCC2			DATE: MAR. `18
REVIEWED BY: MJV2			DATE: MAR. `18
APPROVED BY: KKB			DATE: MAR. `18

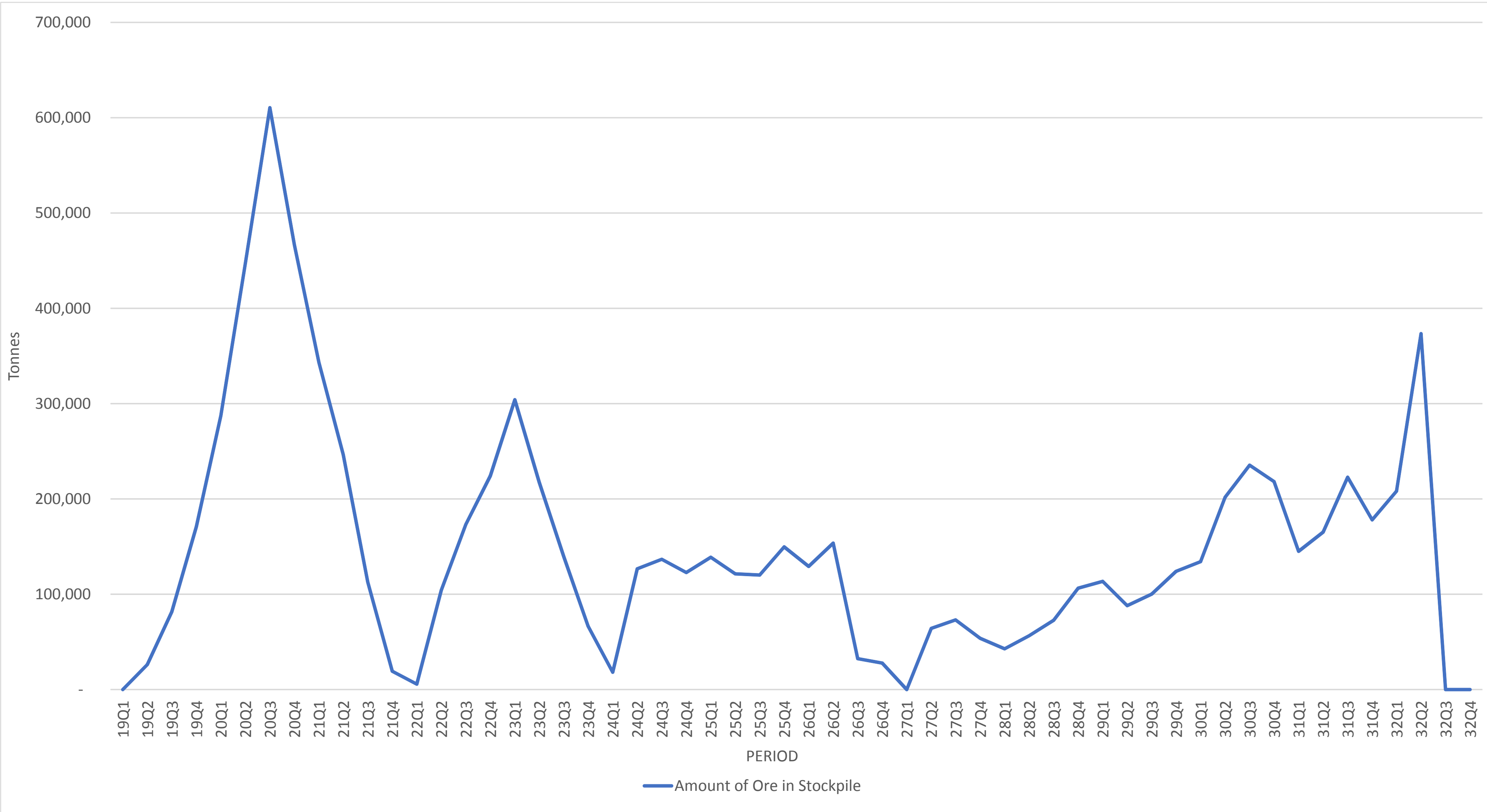
COPPERWOOD RESOURCES, INC.

FIGURE 5-1

MINING PERMIT APPLICATION AMENDMENT
ORE STOCKPILE CONCEPTAUL DESIGN
GOGEBIC COUNTY, MICHIGAN

Scale: NOT TO SCALE	Date: MARCH 2018
Drafted by: DAT	Project: 17C050

Path: Q:\Copperwood Resources\17C050\GIS\mxd\MPAA\Figure 5-1 Ore Stockpile Conceptual Design.mxd Date: 3/20/2018



NOTES:
1. Graph supplied by G Mining Services Inc.

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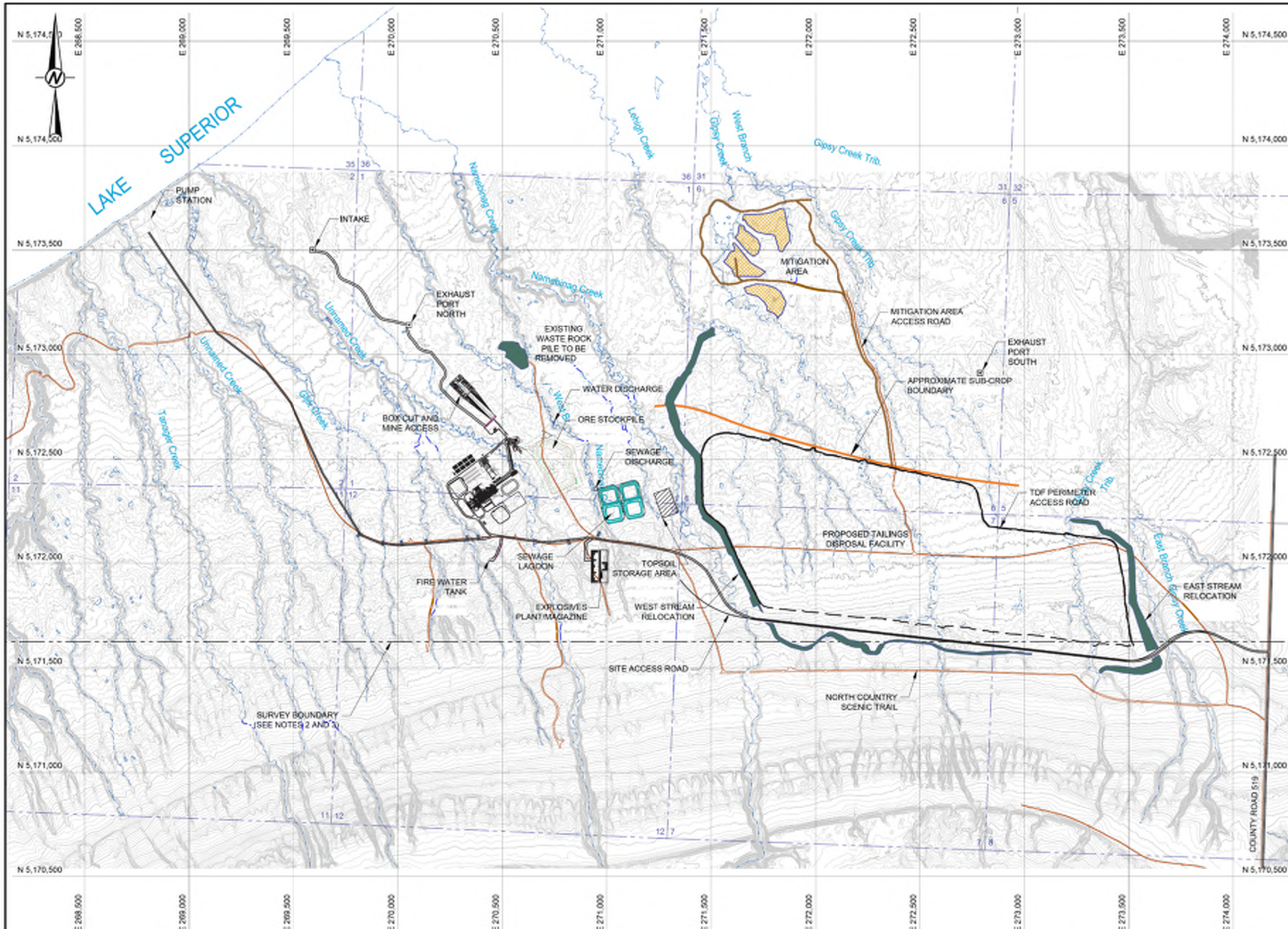
PREPARED BY: MCC2	DATE: MAR. `18
REVIEWED BY: MJV2	DATE: MAR. `18
APPROVED BY: KKB	DATE: MAR. `18

COPPERWOOD RESOURCES, INC.

FIGURE 5-2
MINING PERMIT APPLICATION AMENDMENT
MASS OF ORE IN STOCKPILE
GOGEBIC COUNTY, MICHIGAN

Scale: NOT TO SCALE	Date: MARCH 2018
Drafted by: DAT	Project: 17C050

Path: Q:\Copperwood Resources\17C050\GIS\mxd\MPAA\Figure 5-2 Mass of Ore in Stockpile.mxd Date: 3/20/2018



LEGEND

280	EXISTING GROUND (SEE REFERENCES 2 AND 3)
	EXISTING ROADS AND TRAILS
	EXISTING DRAINAGE
	PROPOSED TAILINGS DISPOSAL FACILITY FOOTPRINT (STAGE 3 (ULTIMATE) CONDITION)
6 5 / 7 8	SECTION LINE AND NUMBER

NOTES:

1. COORIDINATE SYSTEM SHOWN IS UTM, NAD 83 DATUM ZONE 16, METER, CENTRAL 87dW.
2. TOPOGRAPHY NORTH OF SURVEY BOUNDARY LINE PROVIDED BY HIGHLAND COPPER COMPANY INC., COMPLETED IN 2017.
3. TOPOGRAPHY SOUTH OF SURVEY BOUNDARY LINE COMPILED BY AERO-METRIC, INC. FROM AERIAL PHOTOS TAKEN MAY 4, 2009.
4. FIGURE ADAPTED FROM THE "ISSUED FOR PERMIT" DRAWINGS PROVIDED BY GOLDER ASSOCIATES IN THE TDF DESIGN MEMO DATED MARCH 13, 2018.

HORIZONTAL SCALE:

200 0 200 400 600

SCALE 1:1 METERS

HIGHLAND Copper Company Inc.

Foth

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	MJV2	DATE:	MAR. '18
REVIEWED BY:	MCC2	DATE:	MAR. '18
APPROVED BY:	KKB	DATE:	MAR. '18

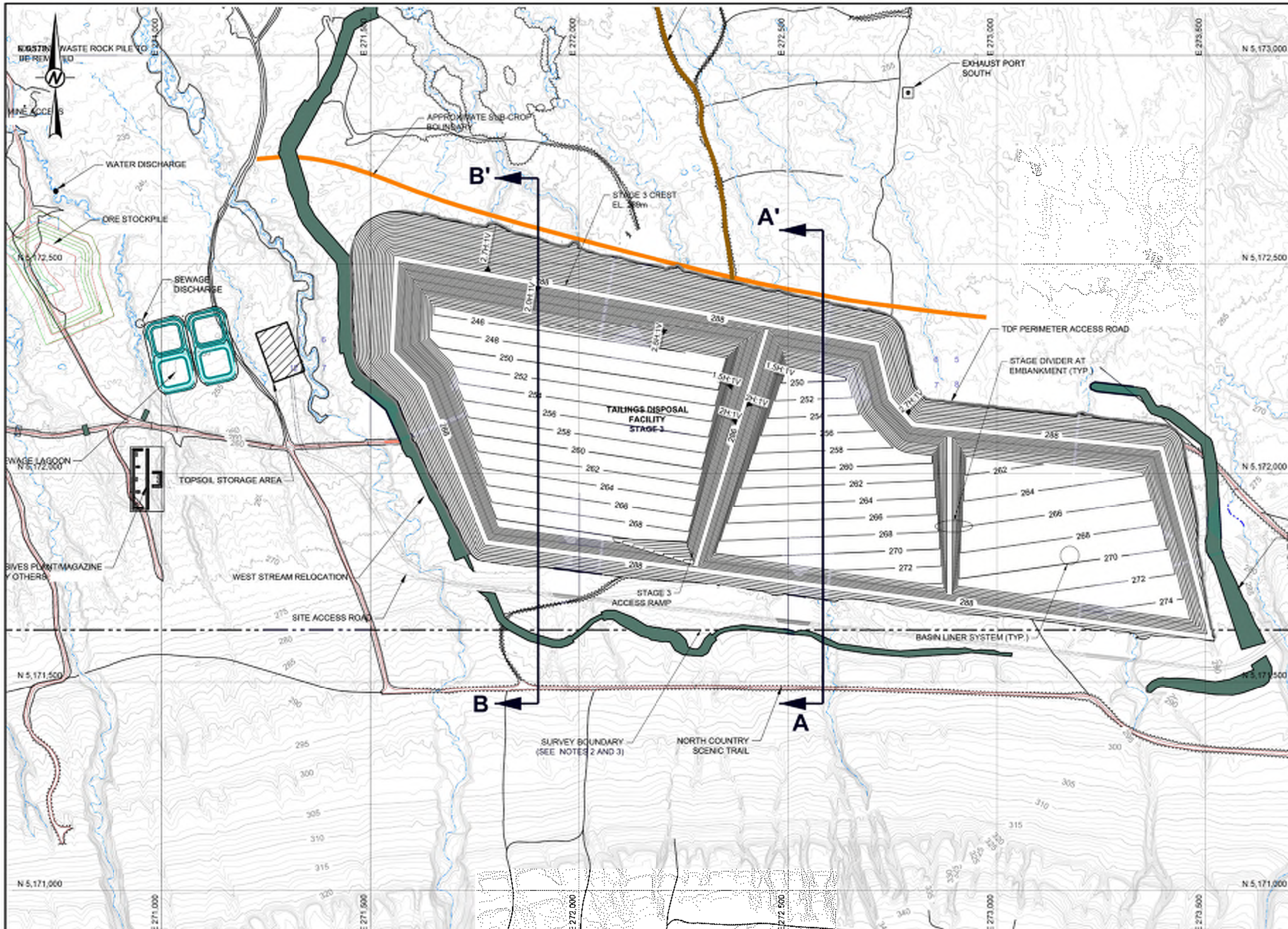
COPPERWOOD RESOURCES, INC.

FIGURE 5 - 3

MINING PERMIT APPLICATION AMMENDMENT
GENERAL SITE LAYOUT

Scale:	AS SHOWN	Date:	MARCH 2018
Drafted By:	JRB2	Project No.	17C050

pw:\\PW-APS1.foth.com:PW_IE\Documents\Clients\Copperwood Resources\0017C050.00\CAD\Figures\MPAA\Figure 5-3 General Site Layout.dgn
3/21/2018 8:39:22 AM JRB2



LEGEND

260	EXISTING GROUND (SEE REFERENCES 2 AND 3)
260	PROPOSED TAILINGS DISPOSAL LINER GRADING
	EXISTING ROADS AND TRAILS
	EXISTING DRAINAGE
6 5 / 7 8	SECTION LINE AND NUMBER

NOTES:

1. COORIDINATE SYSTEM SHOWN IS UTM, NAD 83 DATUM ZONE 16, METER, CENTRAL 87dW.
2. TOPOGRAPHY NORTH OF SURVEY BOUNDARY LINE PROVIDED BY HIGHLAND COPPER COMPANY INC., COMPLETED IN 2017.
3. TOPOGRAPHY SOUTH OF SURVEY BOUNDARY LINE COMPILED BY AERO-METRIC, INC. FROM AERIAL PHOTOS TAKEN MAY 4, 2009.
4. FIGURE ADAPTED FROM THE "ISSUED FOR PERMIT" DRAWINGS PROVIDED BY GOLDER ASSOCIATES IN THE TDF DESIGN MEMO DATED MARCH 13, 2018.

HORIZONTAL SCALE:
100 0 100 200 300
SCALE 1:1 METRES

HIGHLAND Copper Company Inc.

Foth

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REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	MJV2	DATE:	MAR. '18
REVIEWED BY:	MCC2	DATE:	MAR. '18
APPROVED BY:	KKB	DATE:	MAR. '18

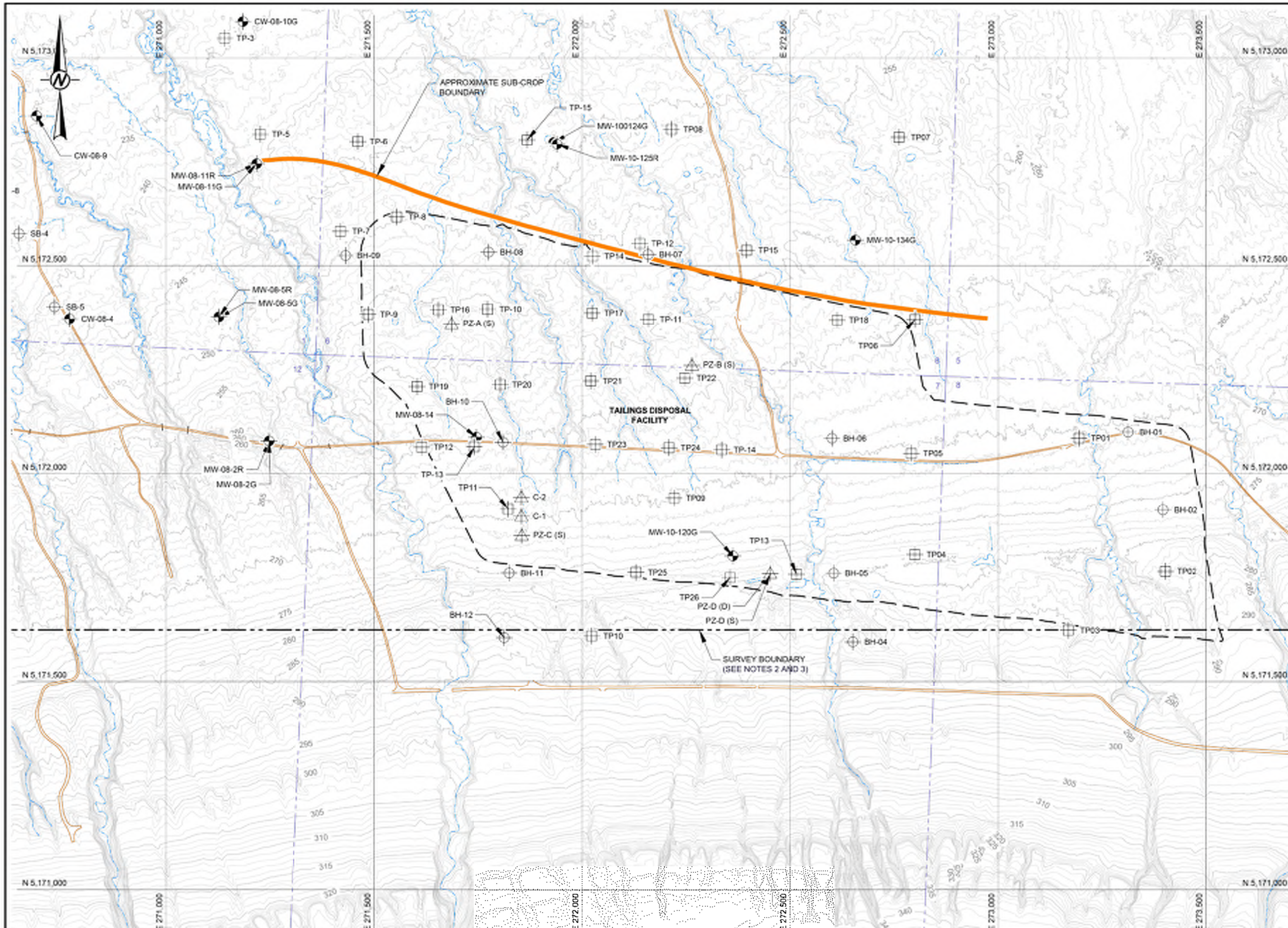
COPPERWOOD RESOURCES, INC.

FIGURE 5 - 4

MINING PERMIT APPLICATION AMMENDMENT
STAGE 3 TDF SHOWING BASE LINER GRADES

Scale:	AS SHOWN	Date:	MARCH 2018
Drafted By:	JRB2	Project No.	17C050

pw:\\PW-APS1.foth.com:PW_IE\Documents\Clients\Copperwood Resources\0017C050.00\CAD\Figures\MPAA\Figure 5-4 Stage 3 TDF Showing Base Liner Grades.dgn
3/20/2018 3:53:48 PM JRB2



LEGEND

260	EXISTING GROUND (SEE REFERENCES 2 AND 3)
	EXISTING ROADS AND TRAILS
	EXISTING DRAINAGE
	PROPOSED TAILINGS DISPOSAL FACILITY FOOTPRINT (STAGE 3 (ULTIMATE) CONDITION)
	MONITORING WELL
	TEST PIT
	SOIL BORING
	PIEZOMETER/SOIL BORING (INSTALLED BY COLEMAN ENGINEERING DEC. 2011)
6 5 / 7 8	SECTION LINE AND NUMBER

NOTES:

1. COORDINATE SYSTEM SHOWN IS UTM, NAD 83 DATUM ZONE 16, METER, CENTRAL 87dW.
2. TOPOGRAPHY NORTH OF SURVEY BOUNDARY LINE PROVIDED BY HIGHLAND COPPER COMPANY INC., COMPLETED IN 2017.
3. TOPOGRAPHY SOUTH OF SURVEY BOUNDARY LINE COMPILED BY AERO-METRIC, INC. FROM AERIAL PHOTOS TAKEN MAY 4, 2009.
4. FIGURE ADAPTED FROM THE "ISSUED FOR PERMIT" DRAWINGS PROVIDED BY GOLDER ASSOCIATES IN THE TDF DESIGN MEMO DATED MARCH 13, 2018.

HORIZONTAL SCALE:

100 0 100 200 300

SCALE 1:1 METERS

HIGHLAND Copper Company Inc.

Foth

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	MJV2	DATE:	MAR. '18
REVIEWED BY:	MCC2	DATE:	MAR. '18
APPROVED BY:	KKB	DATE:	MAR. '18

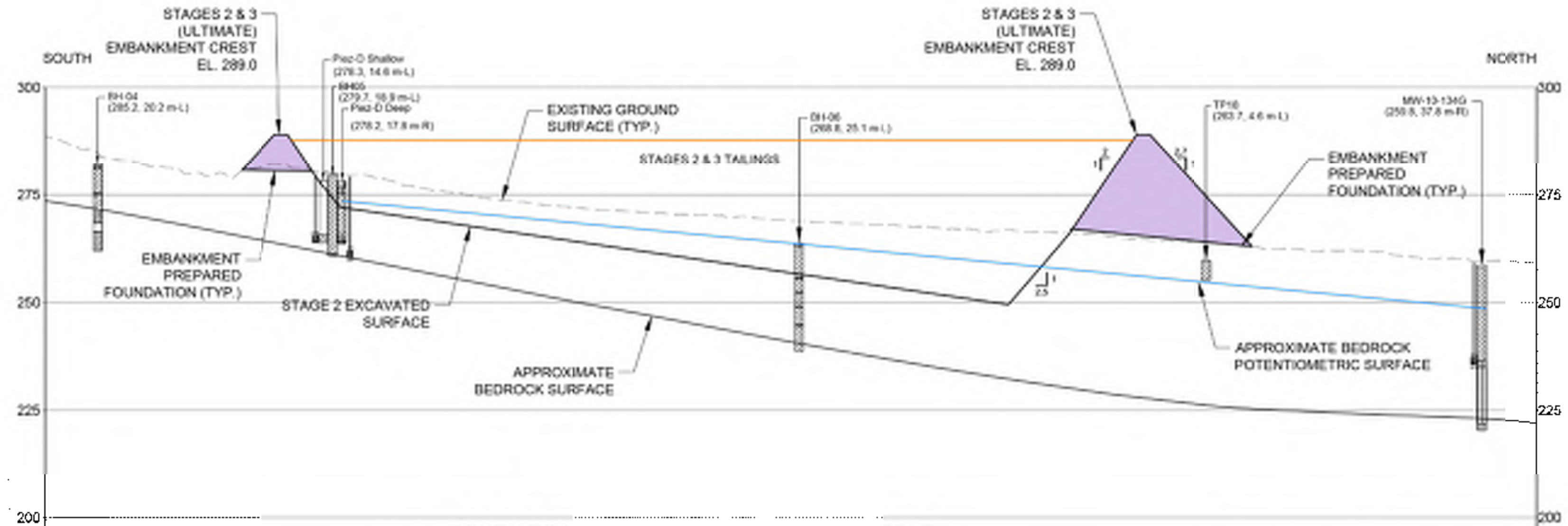
COPPERWOOD RESOURCES, INC.

FIGURE 5 - 5

MINING PERMIT APPLICATION AMMENDMENT
EXISTING CONDITIONS AND GEOTECHNICAL
SITE INVESTIGATION PLAN

Scale: AS SHOWN		Date: MARCH 2018	
Drafted By:	JRB2	Project No.	17C050

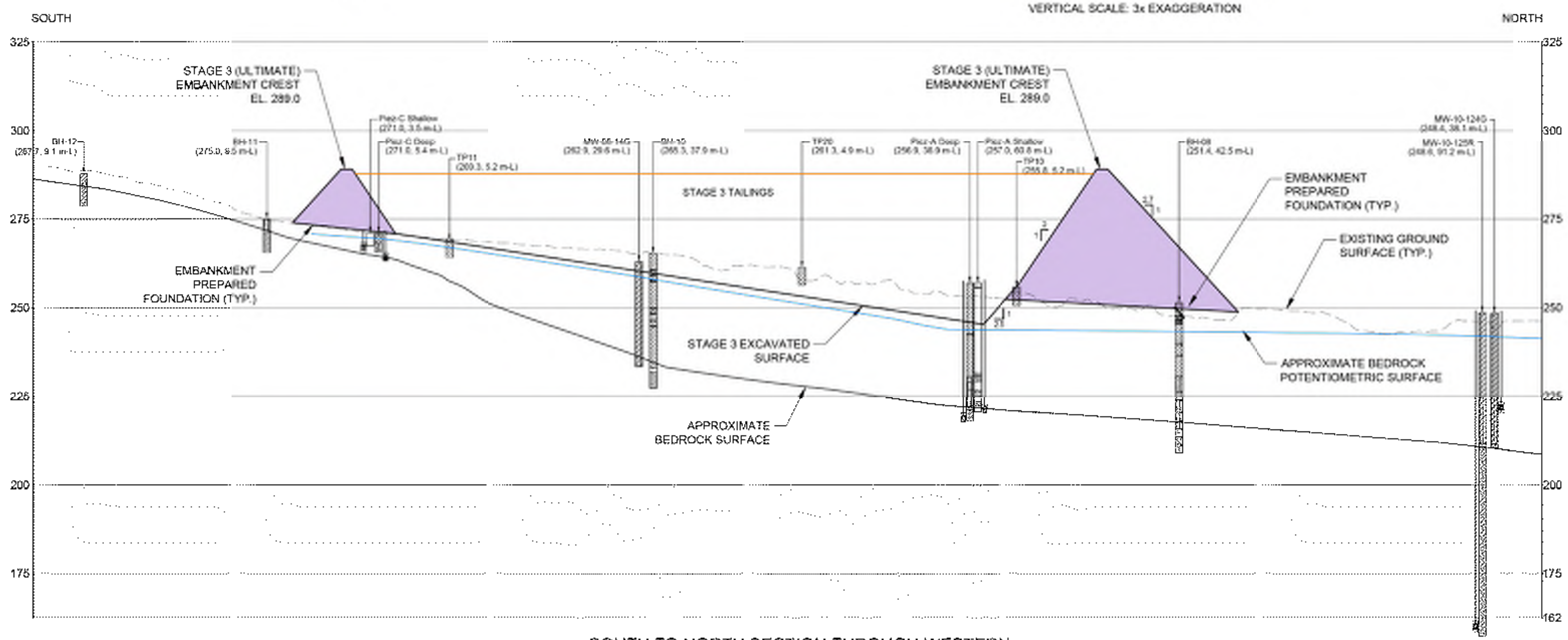
pw:\\PW-APS1.foth.com:PW_IE\Documents\Clients\Copperwood Resources\0017C050.00\CAD\Figures\MPAA\Figure 5-5 Existing Condition and Geotechnical Site Investigation Plan.dgn
3/20/2018 4:03:55 PM JRB2



A-A' / 6 SOUTH TO NORTH SECTION THROUGH MIDDLE PORTION OF TAILINGS DISPOSAL FACILITY

LEGEND

- WELL SCREEN INTERVAL
- FILTER SAND PACK
- STAGE 3 EMBANKMENT (CREST EL. 288.3 m)
- TP11 (269.3, 5.2 m-L) BORING/PIEZOMETER ID (GROUND ELEVATION, DISTANCE AND DIRECTION PROJECTED TO SECTION)



B-B' / 6 SOUTH TO NORTH SECTION THROUGH WESTERN PORTION OF TAILINGS DISPOSAL FACILITY

LITHOLOGY GRAPHICS

- SILTY SAND
- BEDROCK
- POORLY-GRADED SAND
- TOPSOIL
- LOW PLASTICITY CLAY
- LOW PLASTICITY SILTY CLAY
- POORLY-GRADED SAND WITH SILT
- LOW PLASTICITY SANDY CLAY
- BOULDERS AND COBBLES
- LOW PLASTICITY GRAVELLY CLAY
- SILT

NOTES:

1. CROSS SECTION LOCATIONS SHOWN ON FIGURE 5 - 4.
2. FIGURE ADAPTED FROM THE "ISSUED FOR PERMIT" DRAWINGS PROVIDED BY GOLDER ASSOCIATES IN THE TDF DESIGN MEMO DATED MARCH 13, 2018.

HIGHLAND Copper Company Inc.

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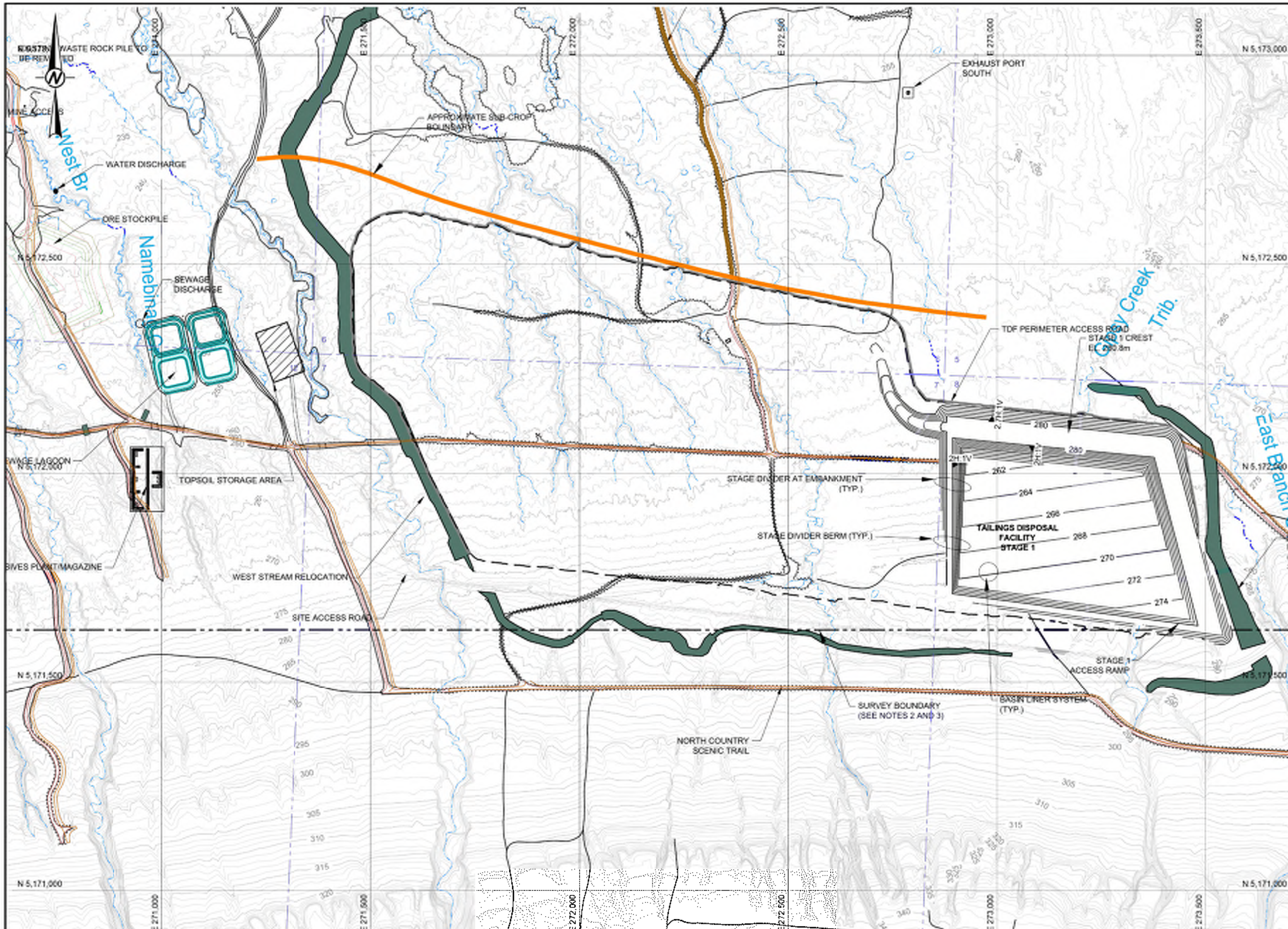
REVIEWED BY:	MCC2	DATE:	MAR. '18
APPROVED BY:	KKB	DATE:	MAR. '18

COPPERWOOD RESOURCES, INC.

FIGURE 5 - 6

MINING PERMIT APPLICATION AMENDMENT
GEOTECHNICAL CROSS SECTIONS

Scale:	AS SHOWN	Date:	MARCH 2018
Drafted By:	JOW	Project No.	17C050



LEGEND

280	EXISTING GROUND (SEE REFERENCES 2 AND 3)
280	PROPOSED TAILINGS DISPOSAL LINER GRADING
	EXISTING ROADS AND TRAILS
	EXISTING DRAINAGE
6 5 / 7 8	SECTION LINE AND NUMBER

NOTES:

1. COORIDINATE SYSTEM SHOWN IS UTM, NAD 83 DATUM ZONE 16, METER, CENTRAL 87dW.
2. TOPOGRAPHY NORTH OF SURVEY BOUNDARY LINE PROVIDED BY HIGHLAND COPPER COMPANY INC., COMPLETED IN 2017.
3. TOPOGRAPHY SOUTH OF SURVEY BOUNDARY LINE COMPILED BY AERO-METRIC, INC. FROM AERIAL PHOTOS TAKEN MAY 4, 2009.
4. FIGURE ADAPTED FROM THE "ISSUED FOR PERMIT" DRAWINGS PROVIDED BY GOLDER ASSOCIATES IN THE TDF DESIGN MEMO DATED MARCH 13, 2018.

HORIZONTAL SCALE:
100 0 100 200 300
SCALE 1:1 METRES

HIGHLAND Copper Company Inc.

Foth

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	MJV2	DATE:	MAR. '18
REVIEWED BY:	MCC2	DATE:	MAR. '18
APPROVED BY:	KKB	DATE:	MAR. '18

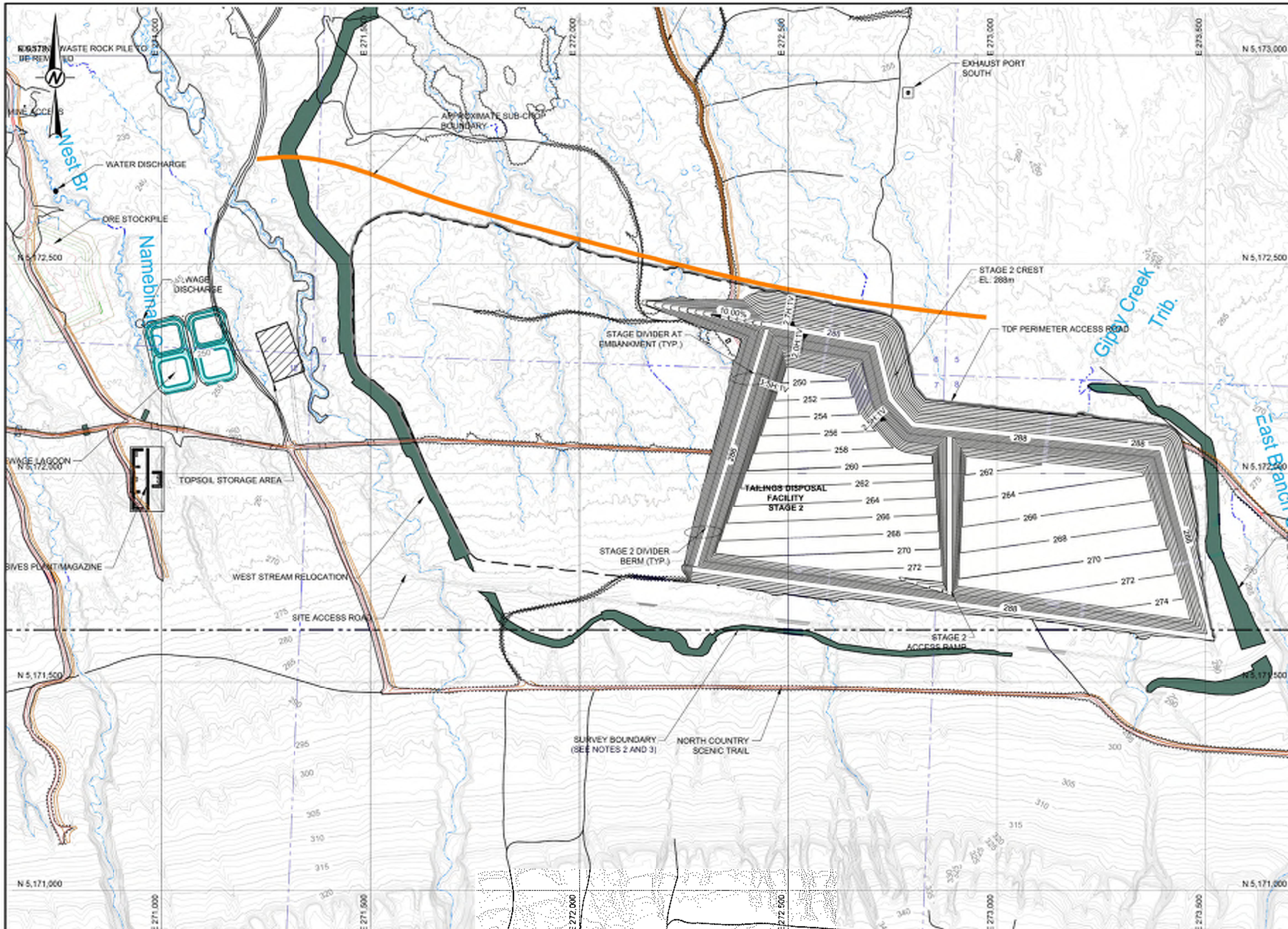
COPPERWOOD RESOURCES, INC.

FIGURE 5 - 7

MINING PERMIT APPLICATION AMMENDMENT
STAGE 1 TDF SHOWING BASE LINER GRADES

Scale:	AS SHOWN	Date:	MARCH 2018
Drafted By:	JRB2	Project No.	17C050

pw:\\PW-APS1.foth.com:PW_IE\Documents\Clients\Copperwood Resources\0017C050.00\CAD\Figures\MPAA\Figure 5-7 Stage 1 TDF Showing Base Liner Grades.dgn
3/21/2018 8:20:27 AM JRB2



LEGEND

260	EXISTING GROUND (SEE REFERENCES 2 AND 3)
260	PROPOSED TAILINGS DISPOSAL LINER GRADING
	EXISTING ROADS AND TRAILS
	EXISTING DRAINAGE
6 5 / 7 8	SECTION LINE AND NUMBER

NOTES:

1. COORIDINATE SYSTEM SHOWN IS UTM, NAD 83 DATUM ZONE 16, METER, CENTRAL 87dW.
2. TOPOGRAPHY NORTH OF SURVEY BOUNDARY LINE PROVIDED BY HIGHLAND COPPER COMPANY INC., COMPLETED IN 2017.
3. TOPOGRAPHY SOUTH OF SURVEY BOUNDARY LINE COMPILED BY AERO-METRIC, INC. FROM AERIAL PHOTOS TAKEN MAY 4, 2009.
4. FIGURE ADAPTED FROM THE "ISSUED FOR PERMIT" DRAWINGS PROVIDED BY GOLDER ASSOCIATES IN THE TDF DESIGN MEMO DATED MARCH 13, 2018.

HORIZONTAL SCALE:
100 0 100 200 300
SCALE 1:1 METRES

HIGHLAND Copper Company Inc.

Foth

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION

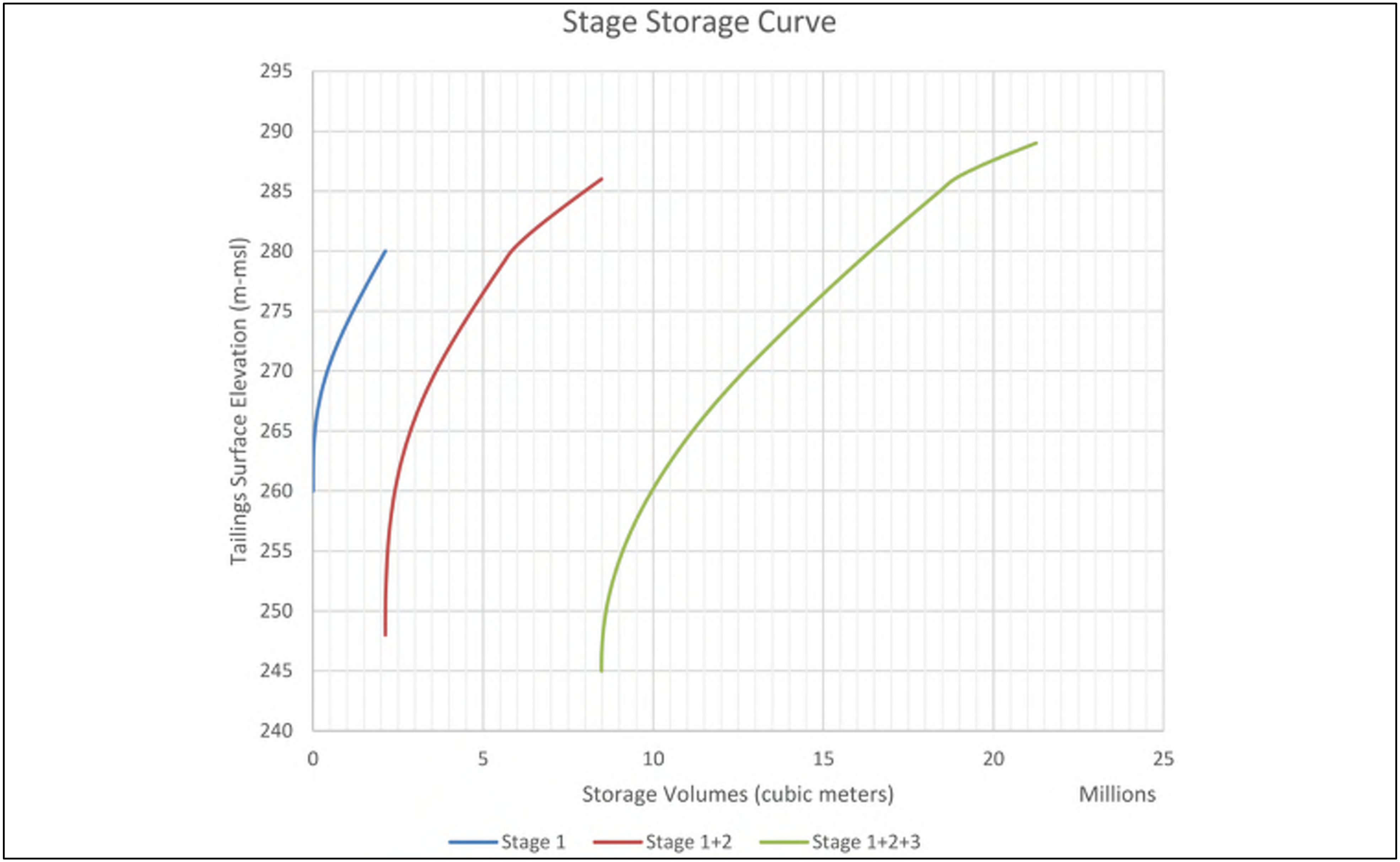
PREPARED BY:	MJV2	DATE:	MAR. '18
REVIEWED BY:	KKB	DATE:	MAR. '18
APPROVED BY:	KKB	DATE:	MAR. '18

COPPERWOOD RESOURCES, INC.

FIGURE 5 - 8

MINING PERMIT APPLICATION AMMENDMENT
STAGE 2 TDF SHOWING BASE LINER GRADES

Scale:	AS SHOWN	Date:	MARCH 2018
Drafted By:	JRB2	Project No.	17C050



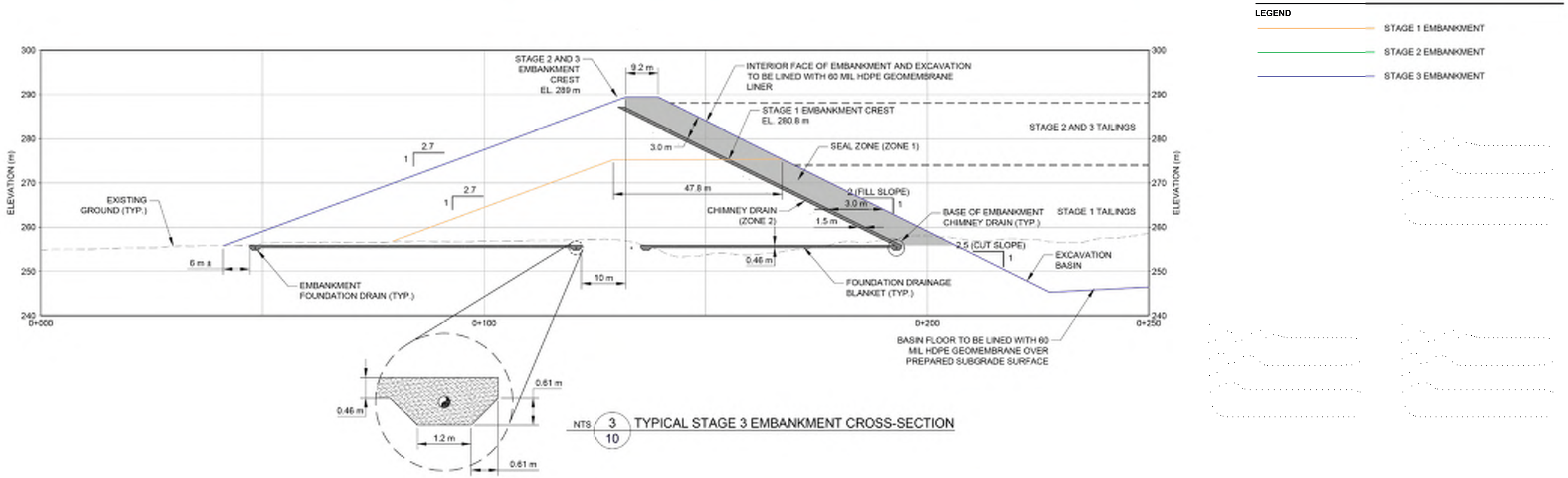
NOTES:
1. Graphic supplied by Golder Associates Inc.

HIGHLAND Copper Company Inc.

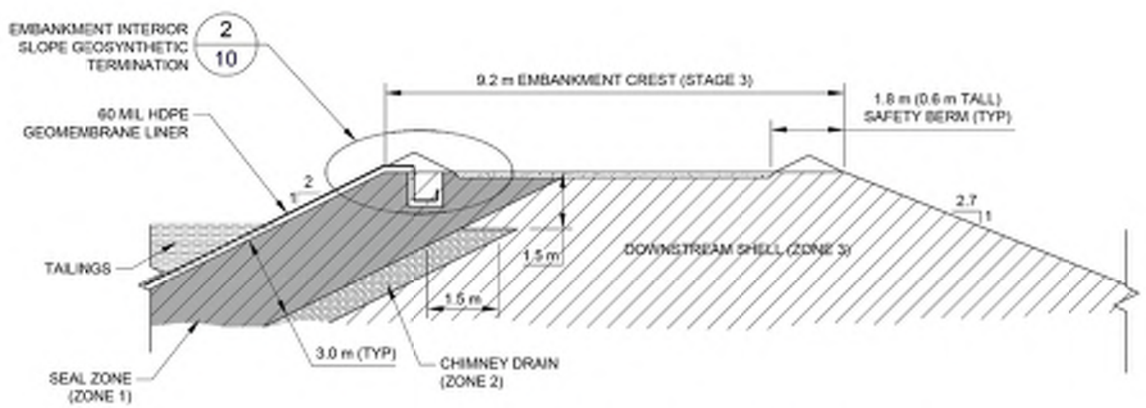
Foth

Foth Infrastructure & Environment, LLC				COPPERWOOD RESOURCES, INC.
REVISED	DATE	BY	DESCRIPTION	
				FIGURE 5-9 MINING PERMIT APPLICATION AMENDMENT TDF STAGE STORAGE CURVE GOGEBIC COUNTY, MICHIGAN
PREPARED BY: MJV2			DATE: MAR. `18	
REVIEWED BY: MJV2			DATE: MAR. `18	Scale: NOT TO SCALE — Date: MARCH 2018
APPROVED BY: KKB			DATE: MAR. `18	Drafted by: DAT — Project: 17C050

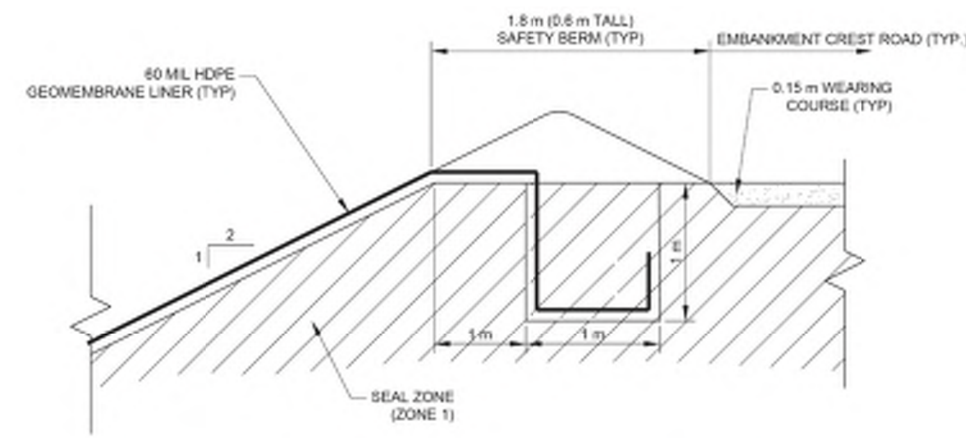
Path: Q:\Copperwood Resources\17C050\GIS\mxd\MPAA\Figure 5-9 TDF Stage Storage Curve.mxd Date: 3/20/2018



NTS 3/10 TYPICAL STAGE 3 EMBANKMENT CROSS-SECTION



NTS 1/10 STAGE 3 (ULTIMATE) EMBANKMENT CREST



NTS 2/10 TYPICAL EMBANKMENT INTERIOR SLOPE GEOSYNTHETIC TERMINATION

NOTE:

1. FIGURE ADAPTED FROM THE "ISSUED FOR PERMIT" DRAWINGS PROVIDED BY GOLDER ASSOCIATES IN THE TDF DESIGN MEMO DATED MARCH 13, 2018.

HIGHLAND Copper Company Inc.

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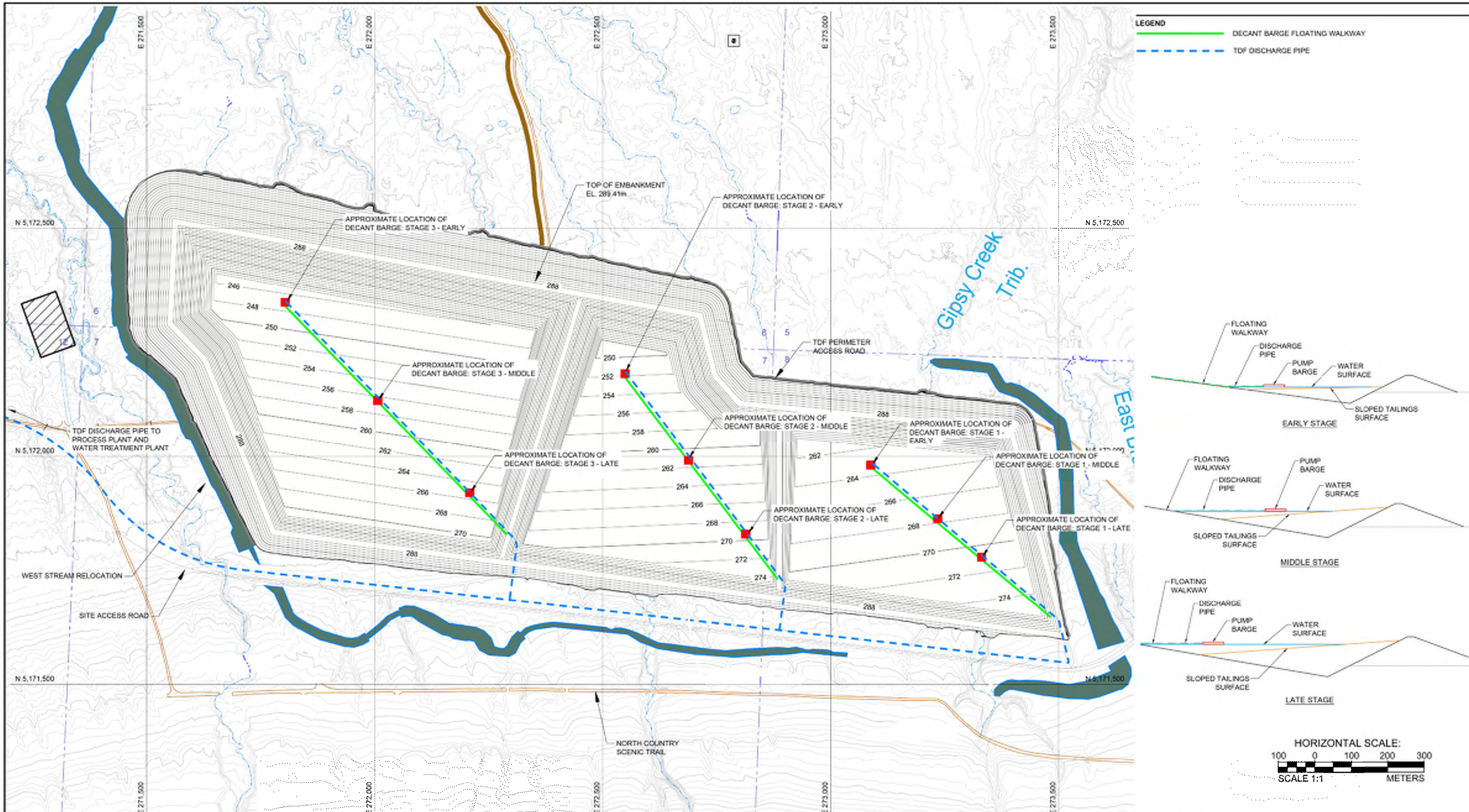
Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION
PREPARED BY:	MJV2	DATE:	MAR. '18
REVIEWED BY:	MCC2	DATE:	MAR. '18
APPROVED BY:	KKB	DATE:	MAR. '18

COPPERWOOD RESOURCES, INC.

FIGURE 5 - 10

MINING PERMIT APPLICATION AMENDMENT
TDF EMBANKMENT AND BASIN DETAILS

Scale:	NOT TO SCALE	Date:	MARCH 2018
Drafted By:		Project No.	17C050



NOTES:

1. COORIDINATE SYSTEM SHOWN IS UTM, NAD 83 DATUM ZONE 16, METER, CENTRAL 87dW.
2. TOPOGRAPHY NORTH OF SURVEY BOUNDARY LINE PROVIDED BY HIGHLAND COPPER COMPANY INC., COMPLETED IN 2017.
3. TOPOGRAPHY SOUTH OF SURVEY BOUNDARY LINE COMPILED BY AERO-METRIC, INC. FROM AERIAL PHOTOS TAKEN MAY 4, 2009.
4. FIGURE ADAPTED FROM THE "ISSUED FOR PERMIT" DRAWINGS PROVIDED BY GOLDER ASSOCIATES IN THE TDF DESIGN MEMO DATED MARCH 13, 2018.

HIGHLAND Copper Company Inc.

Foth

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

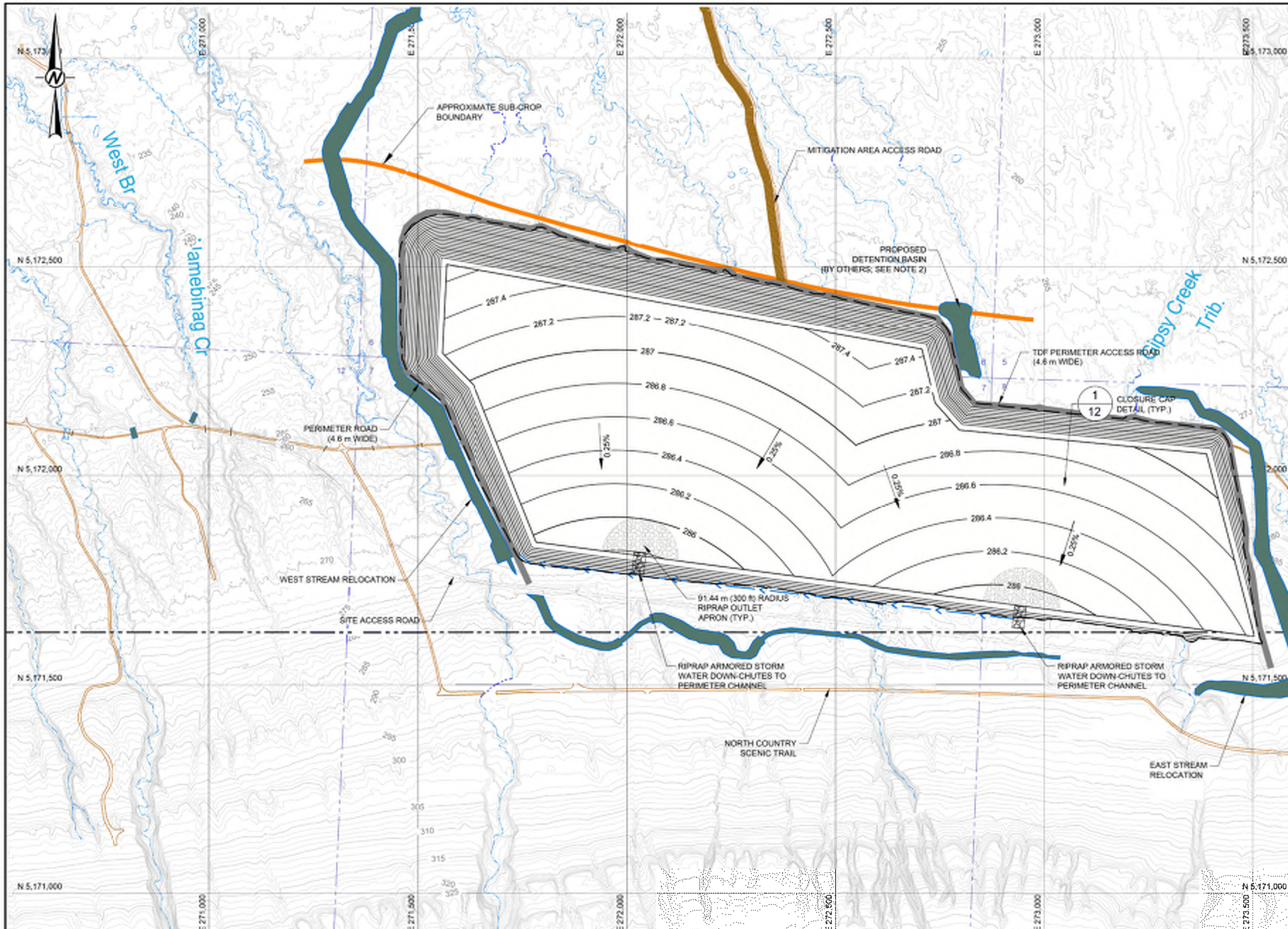
PREPARED BY:	MJV2	DATE:	MAR. '18
REVIEWED BY:	MCC2	DATE:	MAR. '18
APPROVED BY:	KKB	DATE:	MAR. '18

COPPERWOOD RESOURCES, INC.

FIGURE 5 - 11
MINING PERMIT APPLICATION AMMENDMENT
STAGED PROGRESSION OF DECANT BARGE AND PIPING

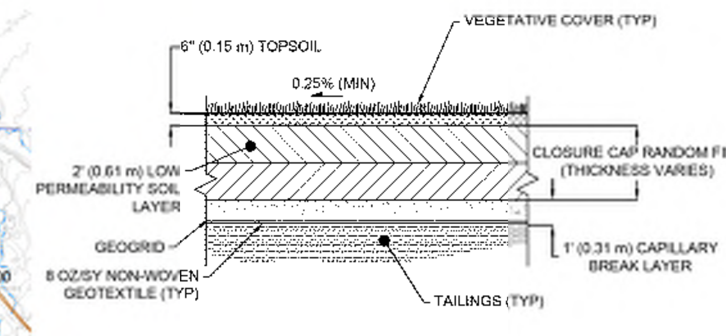
Scale:	AS SHOWN	Date:	MARCH 2018
Drafted By:	JRB2	Project No.	17C050

pw:\\PW-APS1.foth.com:PW_IE\Documents\Clients\Copperwood Resources\0017C050.00\CAD\Figures\MPAA\Figure 5-11 Staged Progression of Decant Barge and Piping.dgn
3/20/2018 5:06:56 PM JRB2



LEGEND

280	EXISTING GROUND (SEE REFERENCES 2 AND 3)
280	PROPOSED TAILINGS DISPOSAL CLOSURE CAP FINAL GRADING
	EXISTING ROADS AND TRAILS
	EXISTING DRAINAGE
	PROPOSED TAILINGS DISPOSAL FACILITY FOOTPRINT (STAGE 3 (ULTIMATE) CONDITION)
	PROPOSED TAILINGS DISPOSAL FACILITY PERIMETER CHANNEL
6 5 / 7 8	SECTION LINE AND NUMBER



NTS 1/12 TYPICAL CLOSURE CAP DETAIL

NOTES:

1. COORIDINATE SYSTEM SHOWN IS UTM, NAD 83 DATUM ZONE 16, METER, CENTRAL 87dW.
2. TOPOGRAPHY NORTH OF SURVEY BOUNDARY LINE PROVIDED BY HIGHLAND COPPER COMPANY INC., COMPLETED IN 2017.
3. TOPOGRAPHY SOUTH OF SURVEY BOUNDARY LINE COMPILED BY AERO-METRIC, INC. FROM AERIAL PHOTOS TAKEN MAY 4, 2009.
4. FIGURE ADAPTED FROM THE "ISSUED FOR PERMIT" DRAWINGS PROVIDED BY GOLDER ASSOCIATES IN THE TDF DESIGN MEMO DATED MARCH 13, 2018.

HORIZONTAL SCALE:
100 0 100 200 300
SCALE 1:1 METRES

HIGHLAND Copper Company Inc.

Foth

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	MJV2	DATE:	MAR. '18
REVIEWED BY:	MCC2	DATE:	MAR. '18
APPROVED BY:	KKB	DATE:	MAR. '18

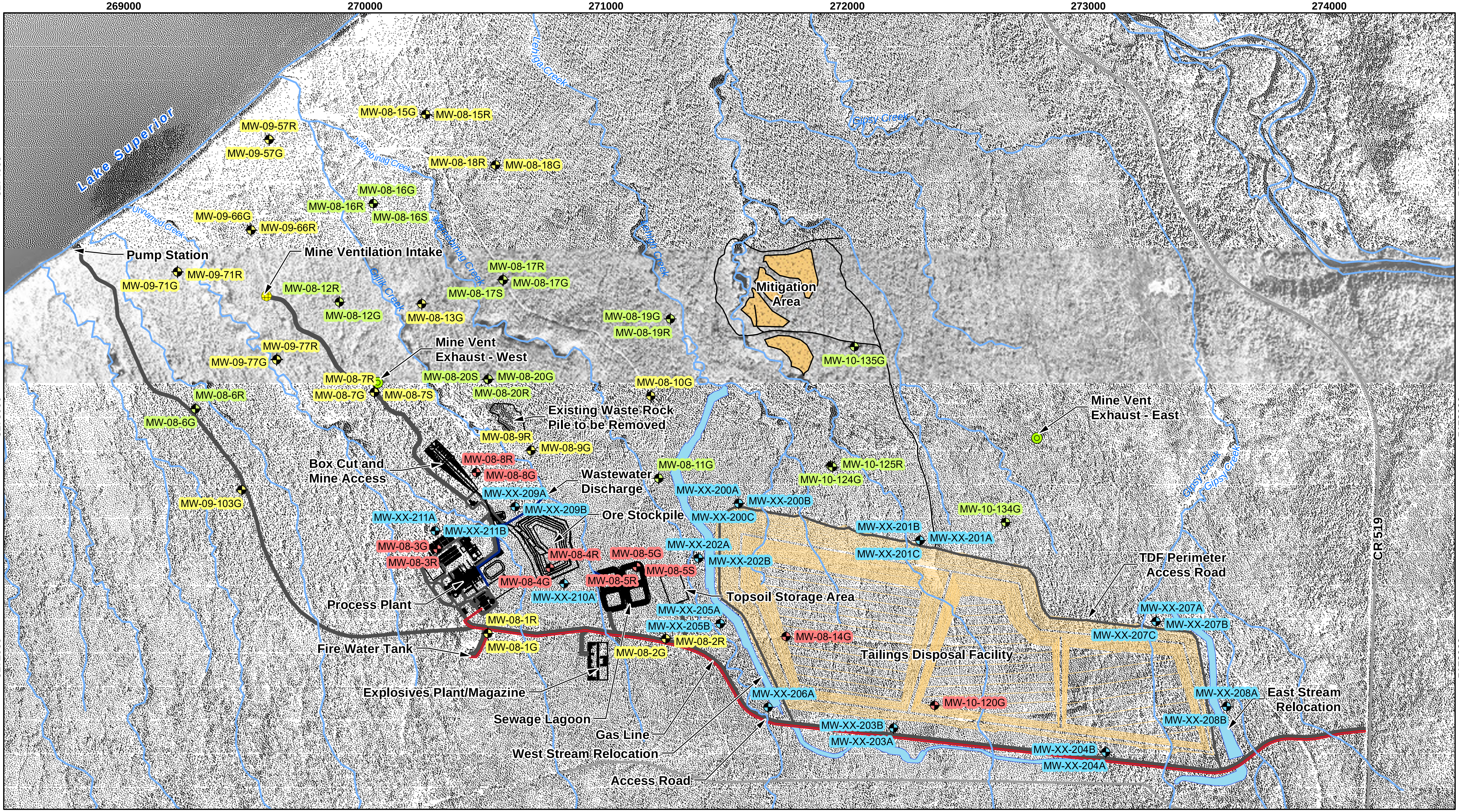
COPPERWOOD RESOURCES, INC.

FIGURE 5 - 12

MINING PERMIT APPLICATION AMMENDMENT
TDF CLOSURE COVER DESIGN

Scale:	AS SHOWN	Date:	MARCH 2018
Drafted By:	JRB2	Project No.	17C050

pw:\\PW-APS1.foth.com:PW_IE\Documents\Clients\Copperwood Resources\0017C050.00\CAD\Figures\MPAA\Figure 5-12 TDF Closure Cover Design.dgn
3/21/2018 8:46:13 AM JRB2



NOTES:

1. Coordinate System: NAD 1983 UTM Zone 16N
2. Facility layout supplied by G Mining Services Inc.
3. Aerial imagery downloaded from USDA Geospatial Data Gateway.
4. Monitoring Wells supplied by Copperwood Resources, Inc.

LEGEND

- Abandoned During Construction
- Proposed - Samples / Water Level
- Samples / Water Level
- Water Level
- River and Streams
- Wastewater Discharge Pipe
- Natural Gas Pipeline
- Roads
- Plant and Facility
- Tailing Disposal Facility
- Access Road
- Stream Relocation

HIGHLAND Copper Company Inc.

Foth

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	MCC2	DATE:	MAR. '18
REVIEWED BY:	MJV2	DATE:	MAR. '18
APPROVED BY:	KKB	DATE:	MAR. '18

COPPERWOOD RESOURCES, INC.

FIGURE 6-1
MINING PERMIT APPLICATION AMENDMENT
GROUNDWATER MONITORING LOCATIONS
GOGEBIC COUNTY, MICHIGAN

Scale: 0 150 300 Meters		Date:	MARCH 2018
Drafted by:	DAT	Project:	17C050

Path: Q:\Copperwood Resources\17C050\GIS\mxd\MPAA\Figure 6-1 Groundwater Monitoring Locations.mxd Date: 3/21/2018

Appendix A

Certification of Amendment to the Articles of Incorporation

MICHIGAN DEPARTMENT OF LICENSING AND REGULATORY AFFAIRS

FILING ENDORSEMENT

This is to Certify that the CERTIFICATE OF AMENDMENT - CORPORATION

for

COPPERWOOD RESOURCES INC.

ID NUMBER: 01912J

received by facsimile transmission on March 21, 2017 is hereby endorsed.

Filed on March 21, 2017 by the Administrator.

This document is effective on the date filed, unless a subsequent effective date within 90 days after received date is stated in the document.

In testimony whereof, I have hereunto set my hand and affixed the Seal of the Department, in the City of Lansing, this 21st day of March, 2017.

Sent by Facsimile Transmission

Julia Dale

Julia Dale, Director
Corporations, Securities & Commercial Licensing Bureau

CSCL/CD-515 (Rev. 02/17)

MICHIGAN DEPARTMENT OF LICENSING AND REGULATORY AFFAIRS
CORPORATIONS, SECURITIES & COMMERCIAL LICENSING BUREAU

Date Received

This document is effective on the date filed, unless a subsequent effective date within 90 days after received date is stated in the document.

Name Anthony A. Pearson		
Address 55 Campau Avenue NW, Suite 300		
City Grand Rapids, Michigan 49503	State	ZIP Code

EFFECTIVE DATE:

Document will be returned to the name and address you enter above. If left blank, document will be returned to the registered office.

CERTIFICATE OF AMENDMENT TO THE ARTICLES OF INCORPORATION

For use by Domestic Profit and Nonprofit Corporations

(Please read information and instructions on the last page)

Pursuant to the provisions of Act 284, Public Acts of 1972, (profit corporations), or Act 162, Public Acts of 1982 (nonprofit corporations), the undersigned corporation executes the following Certificate:

1. The present name of the corporation is: Orvana Resources US Corp.

2. The identification number assigned by the Bureau is: 01912J

3. Article 1 of the Articles of Incorporation is hereby amended to read as follows:

Article 1
The name of the corporation is Copperwood Resources Inc.

03/21/2017 9:32AM (GMT-04:00)

COMPLETE ONLY ONE OF THE FOLLOWING:

4. Profit or Nonprofit Corporations: For amendments adopted by unanimous consent of incorporators before the first meeting of the board of directors or trustees.

The foregoing amendment to the Articles of Incorporation was duly adopted on the ______________ day of ______________, ________, in accordance with the provisions of the Act by the unanimous consent of the incorporator(s) before the first meeting of the Board of Directors or Trustees.

Signed this ________ day of ________________, __________

(Signature)	(Signature)
(Type or Print Name)	(Type or Print Name)
(Signature)	(Signature)
(Type or Print Name)	(Type or Print Name)

5. Profit Corporation Only: Shareholder or Board Approval

The foregoing amendment to the Articles of Incorporation proposed by the board was duly adopted on the 9 th day of March, 2017, by the: (check one of the following)

- [ ] shareholders at a meeting in accordance with Section 611(3) of the Act.
- [x] written consent of the shareholders having not less than the minimum number of votes required by statute in accordance with Section 407(1) of the Act. Written notice to shareholders who have not consented in writing has been given. (Note: Written consent by less than all of the shareholders is permitted only if such provision appears in the Articles of Incorporation.)
- [ ] written consent of all the shareholders entitled to vote in accordance with Section 407(2) of the Act.
- [ ] board of a profit corporation pursuant to Section 611(2) of the Act.

Profit Corporations and Professional Service Corporations

Signed this 13th day of March, 2017

By Carole Plante
(Signature of an authorized officer or agent)

CAROLE PLANTE
(Type or Print Name)

03/21/2017 9:32AM (GMT-04:00)

Appendix B

Mining Permit Application Amendment Form

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
OIL, GAS, AND MINERALS DIVISION

Part 632 Nonferrous Metallic Mine Organization Report

By authority of Part 632 of Act 451 PA 1994, as amended. Non-submission and/or falsification of this information may result in fines and/or imprisonment. This is a Microsoft Office Word form. The gray 'form fill-in boxes' change to accept what is entered.

Name of applicant or permittee	Copperwood Resources Inc.
Mine or beneficiation facility	Copperwood Mine
Location (section, township, range)	Section 1, Township 49N, Range 46W
Permit Number (if issued)	MP 01 2012
Name of authorized representative	Sylvain Collard
Title	General Manager
E-mail	sylvain.collard@highlandcopper.com
Telephone (include area code)	906-229-3115
Address 1	310 Highway US 2
Address 2 (if needed)	

City Wakefield State MI Postal Code 49968

SCollard, 03-12-2018

5. Signature, Date

CERTIFICATION "I state that I am authorized by said applicant. This report was prepared under my supervision and direction. The facts stated herein are true, accurate and complete to the best of my knowledge."

List below the following:

All corporate officers, directors, incorporators, and limited liability company managers.

All other partners, shareholders, limited liability company members, or other persons who have the authority to make, or are responsible for making, operational decisions, including the construction, operation, closure, postclosure monitoring, reclamation, and remediation of a mine.

Name of Company Copperwood Resources Inc.

Name of person	Title	
David Fennell	President	☒ principal ☐ agent
Carole Plante	Secretarty	☒ principal ☐ agent
Alain Krushnisky	Treasurer	☒ principal ☐ agent

Name of Company Copperwood Resources Inc.

Name of person	Title	
Carlos Bertoni	Director	☒ principal ☐ agent
		☐ principal ☐ agent
		☐ principal ☐ agent

This form is to be filed annually to reflect changes that have occurred.

Attach additional materials as needed.

R-7202---- (03/09/2018)

Appendix C

Part 632 Nonferrous Metallic Mine Organization Report

DEQ

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
OIL, GAS, AND MINERALS DIVISION

Part 632 Nonferrous Metallic Mine ☐ Application ☒ Amendment

By authority of Part 632 of Act 451 PA 1994, as amended. Non-submission and/or falsification of this information may result in fines and/or imprisonment. This is a Microsoft Office Word form. The gray 'form fill-in boxes' change to accept what is entered.

1. Name of mine or project Permit No.	Copperwood Mine - MP 01 2012
2. Surface location of mine or project	
County Name	Gogebic
Township Name	Ironwood, Wakefield
3. Applicants name and business information:	
Company Name	Copperwood Resources, Inc.
Name	Sylvain Collard
Title	General Manager
E-mail	sylvain.collard@highlandcopper
Telephone (include area code)	906-229-3115
Address 1	310 East US Highway 2
Address 2 (if needed)	□□□□□
City Wakefield State MI Postal Code 49968	

S. Collard, General Manager, 03-12-2018

5. Signature, Title, Date

CERTIFICATION "I state that I am authorized by said applicant. This application was prepared under my supervision and direction. The facts stated herein are true, accurate and complete to the best of my knowledge."

Check items that are to be included:

- ☐ Application Fee
- ☒ Environmental impact assessment
- ☒ Mining plan
- ☒ Reclamation plan
- ☒ Contingency plan
- ☒ Financial assurance
- ☒ Maps and illustrations
- ☐ other (describe)

An applicant shall submit to the department paper copies of the documents and shall also submit the documents in an electronic format approved by the department as outlined in the document "OGS eFile specifications.doc."

The applicant has the burden of establishing that the terms and conditions set forth in the permit application; mining, reclamation, and environmental protection plan, environmental impact assessment and subsequent revisions additions or modifications will result in a mining operation that reasonably minimizes actual or potential adverse impacts on air, water, and other natural resources and meets the requirements of this act."

Part 632 Rules and Regulations are available online at:
http://www.michigan.gov/documents/deq/DEQ-OGS-metallic-mining-Part632_308856_7.pdf

Appendix D

Geotechnical Design Studies for the Proposed Room-and-Pillar Mining of the Copperwood Deposit

TECHNICAL MEMORANDUM

DATE 14 March 2018 **Reference No.** 1787471-008-TM-Rev0-3000

TO Carl Michaud
G Mining

CC Sylvain Collard, Ross Hammett, Karen Moffitt

FROM Karyn Gallant and Karen Moffitt **EMAIL** Karyn_Gallant@golder.com; Karen_Moffitt@golder.com

GEOTECHNICAL DESIGN STUDIES FOR THE PROPOSED ROOM-AND-PILLAR MINING OF THE COPPERWOOD DEPOSIT

1.0 INTRODUCTION

Golder Associates Inc. (Golder) has been retained by Highland Copper Company Inc. (Highland) to provide geotechnical services in support of a feasibility study for the Copperwood project. The scope of this work has involved a detailed review of historical studies on the deposit, development of a geotechnical model, and an evaluation of appropriate room and pillar dimensions. This assessment was undertaken using both empirical and numerical techniques, the results of which were also used to estimate surface disturbance that would result from the proposed mining. A site visit was undertaken in November 2017 to inspect rock core from the Copperwood deposit and to discuss the geotechnical characterization with Highland's geologists and the mine engineering consultant (G Mining). This memorandum summarizes the geotechnical work completed by Golder and provides a summary of the design recommendations resulting from this study as well as an estimate of the expected subsidence that could occur as a result of mining.

The Copperwood project is a proposed room and pillar copper mine located in Michigan Upper Peninsula. The Copperwood deposit is hosted in the base of the Nonesuch Formation and located on the western limb of a broad, gently northwest plunging syncline (Figure 1). As shown in Figure 1, it is located approximate 20 to 30 km southwest of historic White Pine mine.

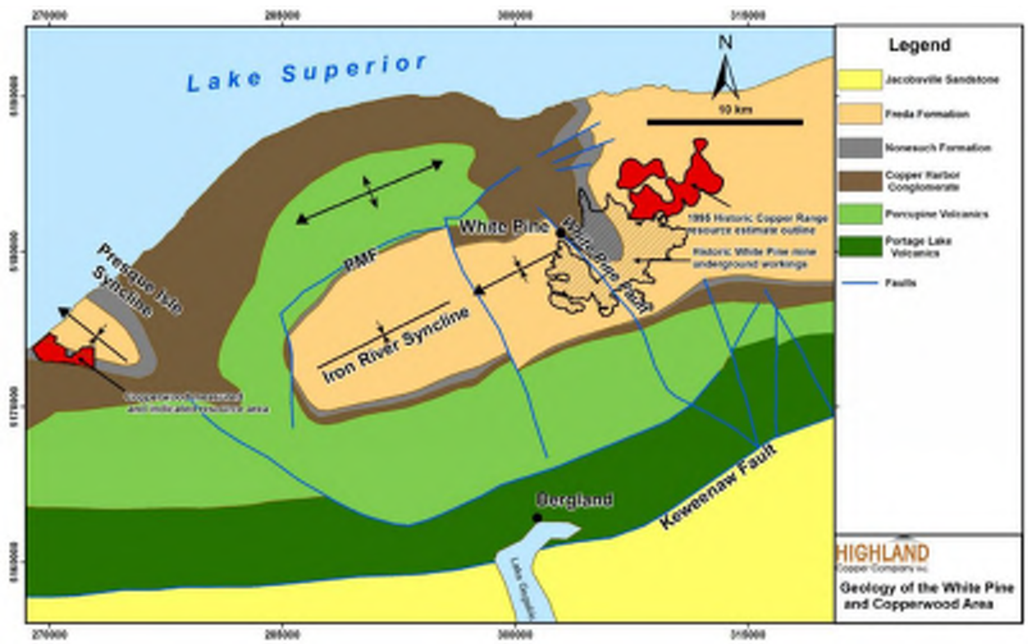


Figure 1: Location of Copperwood Project and White Pine Mine

The Copperwood deposit is split into 2 mining areas: the west (or main) orebody and the east orebody (Figure 2). The orebody generally dips toward the north. The main orebody dips between 12º (at the southern end) and 7º (at the northern end). The east ore body is steeper and dips between approximately 20º and 7º. The depth of the orebody is between 65 ft at the shallowest southern edge up to 900 ft at the northern edge of the deposit. The sedimentary sequence is overlain by unconsolidated glacial sediments generally to a depth of 25-50 ft.

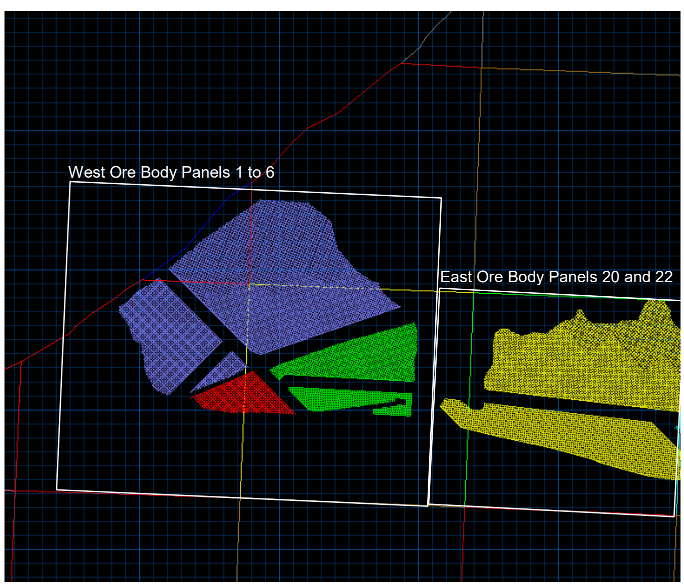


Figure 2: Copperwood Project Mine Layout

2.0 GEOLOGICAL AND GEOTECHNICAL SETTING

2.1 Geology

Numerous available company documents and publications provide in depth geological information in the vicinity of the project. The base of the Nonesuch Formation is also referred to as the Parting Shale which is subdivided into six units (Red Siltstone, Gray Siltstone, Red Laminated, Gray Laminated, Red Massive and Domino). The bottom three sub-units host the mineralization and are referred to the Copper Bearing Sequence (CBS) at Copperwood. Table 1 describes the subunits that comprise the CBS as the immediately overlying Red Laminated subunit.

Table 1: Subunit Geology and Descriptions

Subunit	Mine Location	Description
Red Laminated (RLAM)	Roof/Back	Thickness ranges from 0 to 10 ft, average thickness reported as 4.6 ft. Laminated siltstone with bimodal color distribution of maroon to red-brown and grey. Mineralization is restricted to the lower 12”. Contact with underlying GLAM is transitional.
Grey Laminated (GLAM)	Orebody - copper bearing	Thickness ranges from 0 to 8.5 ft, average thickness reported as 3.3 ft. Light to medium gray to reddish grey laminated and locally massive siltstone. A 0.4 to 2” thick zone of calcareous nodules in grey siltstone occurs in holes near base of the GLAM (Golder, 2013). Contact with RMAS is transitional.
Red Massive (RMAS)	Orebody - copper bearing	Thickness ranges from 0 to 4 ft, average thickness reported as 1.0 ft. Massive, dark red-brown siltstone with beds of fine grained sandstone. Contact with DOMN is sharp with an abrupt change from dark grey or black (DOMN) to red-brown (RMAS).
Domino (DOMN)	Orebody - principal copper host	Thickness ranges from 0 to 7.5 ft, average thickness reported as 5.2 ft. Laminated dark grey to black shale and siltstone, red-brown layers present throughout. A thin, typically < 1” thick zone of convoluted sedimentary layers is often present at or near the base, referred to as the Basal Shear Zone and is believed to reflect soft-sediment deformation.

As indicated in the table above, a layer of gouge termed the ‘basal gouge layer’ is present at the base of the Domino formation (at the contact with the underlying sandstone). This gouge is typically between 1 and 8 inches thick and is very soft and plastic over extensive areas of the deposit.

2.2 Geotechnical Characterization

The key aspects of the geotechnical characterization based on historical reports and recent studies are summarized as follows:

- ***Rock Structure***: Rock mass fabric is dominated by bedding. In some of the units (e.g., Red Laminated) the rock is relatively thinly laminated and tends to break easily along these laminations when exposed to water. There is limited information available regarding joints and discontinuities. Historical data indicates the presence of vertical joint sets that caused stability issues in the test mine.

- ***Basal Gouge***: The basal gouge layer at the contact between the Domino and the underlying sandstone will affect the ability of pillars to maintain lateral stresses and has therefore been taken into account in assessing the strength of the pillars and determining the pillar sizes. Laboratory testing on the gouge indicated a friction angle of 17 degrees.
- ***Rock Quality***: The rock generally has a high RQD generally ranging between 80 and 100%, indicating relatively massive conditions. However, anecdotal information from the test mine and physical inspection of the core as part of this study have indicated that the rock tends to break relatively easily along the thin bedding laminations within the rock. This is particularly true for the Red Laminated unit where the closely spaced laminations are particularly weak when exposed to water.
- ***Rock Strength***: A number of laboratory testing campaigns have been conducted on core samples from the Copperwood deposit. A summary of the UCS strength testing results for the subunits of interest is presented in the Table 2 below.

Table 2: Summary of UCS Testing Results

Subunit	West Ore Body		East Ore Body	
	Number of Tests	Average UCS (psi)	Number of Tests	Average UCS (psi)
RLAM	17	8550	16	10,600
GLAM	16	8550	19	12,750
RMAS	11	10,600	5	12,900
DOMN	16	6700	7	7800

3.0 GEOTECHNICAL DESIGN

Golder completed numerical stress modelling to assess the stability of the proposed mine layout and room and pillar dimensions. Initial numerical models were benchmarked against empirical approaches to pillar design for validation. However, empirical approaches were not appropriate for design since the empirical databases on which these approaches are based do not consider the presence of a weak clay gouge zone at the base of the pillars. Since the strength of the pillars is related to the lateral confining stress within the pillar, and the basal gouge layer will result in slip along the pillar base and loss of confinement, the basal gouge will reduce the load carrying capacity of the pillars. As such, the design of pillars for Copperwood has relied on the interpretation of results from 3D numerical models. All room widths were maintained at 20 ft. Multiple numerical analysis computer models were analysed with varying pillar dimensions. The pillar dimensions that were selected for design were those that reproduced a similar stress state to case studies that the empirical charts indicate would have a Factor of Safety (FOS) of 1.2. The pillar design recommendations are shown in Table 3.

Table 3: Recommended Pillar Dimensions for Copperwood

Orebody	Panel	Depth (ft)	Assumed Pillar Height (ft)	Recommended Pillar Dimensions (ft)
East	20	600	7.5	19x19
		900	9.5	25x25
	22	400	10	16x16
West	1 to 6	300	10	18 x 18
		600		24 X 24
		900		31 x 31

The documentation describing the historical test mining experience and the observations of the core suggest that the Red Laminated unit in the back may separate along the thin laminations and result in some potentially severe unraveling of the back. As a result, Golder has recommended 12 inches of Grey Laminated material be left in the back (limiting exposure of the Red Laminated) and to implement a system of mesh and pattern bolting of the back.

Numerical modeling indicates local areas of overstressing in the pillar ribs. Design recommendations include pattern bolting of the pillar ribs to prevent this material from unraveling in order to maintain the load carrying capacity of the pillars.

The results of the 3D geotechnical analyses were used to estimate the potential surface subsidence. The largest subsidence is predicted to occur in the deepest part of the deposit. The model predicts a maximum convergence of the top and bottom of pillars of approximately 0.1 ft. If it is assumed that all of this deformation is experienced as subsidence on surface, a maximum surface subsidence of approximately 0.1 ft would be experienced. In practice, surface subsidence measurements indicate that only a portion of the underground deformation transfers to surface. Thus it is expected that the small magnitudes of subsidence would be difficult to detect without precise surveys and would have minimal surface disturbance. This conclusion is consistent with surface disturbance experienced above the stable mining areas at White Pine.

4.0 SUMMARY

Geotechnical characterization of the Copperwood deposit has considered all available historical data, previous analyses, discussions with Highland Copper geologists, and documented experience at the historical test mine. Due to the presence of a layer of gouge at the base of the pillars which would impact pillar strength (as compared to pillars with no basal gouge layer present), the design of pillars for the proposed Copperwood mine have been based on the results of 3D numerical modeling of pillars at various depths, considering also the variability in orebody dip and stratigraphy spatially across the deposit.

The amount of surface disturbance is expected to be minimal, and comparable to the surface impacts over the stable areas of the White Pine mine. Numerical models of the proposed room and pillar layout indicate that surface subsidence as a result of mining will be on the order of 0 to 0.1 ft over the life of the mine.

5.0 CLOSURE

We trust the above meets your present requirements. If you have any questions or require additional information, please contact the undersigned.

Golder Associates Inc.

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