Minto Mine
Reclamation and Closure Plan
2016-01

Prepared by:
Minto Explorations Ltd.
Minto Mine
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Context of this Document

This sixth revision of the Minto Mine Reclamation and Closure Plan (RCP) is presented for review and will be revised to incorporate reviewer comments as appropriate. This version is a new RCP including future mining already licenced but also identifies measures for decommissioning and reclaiming site developments from past mining. Closure planning is a process continuum, and RCP documents accordingly advance in detail as the Project proceeds through its mine life.

This RCP is now considered to be Revision 7 (2016-01). Significant advancements in the RCP over the 2013 Phase IV RCP and 2014 Phase V/VI RCP include:

- An improved understanding and analysis of site closure hydrology, validated with a regional analysis. This has informed revisions to site runoff conveyance alignments, sizing and design;
- Updated water balance and geochemistry source term evaluation, combined for a revised site water quality prediction;
- Supporting rationale for the selection of isolating soil covers as the primary reclamation measure, based on a further characterization of available construction materials;
- Advancement in landform design and development of Reclamation Land Units (RLU) for providing consistent guidance in regards to landform design, cover design and revegetation strategy;
- Development of water quality objective framework and proposed water quality objectives;
- Incorporation of the Phase V/VI failure modes and effects assessment;
- Advanced support for the eventual application of semi-passive treatment technologies as determined to be reasonable and practical for contaminant load reduction at Minto at closure. This includes the framework for a research program aimed at providing proof of concept for these technologies in the Minto site context and updated applications, concepts and design; and
- An updated closure cost estimate for financial assurance purposes, including all proposed revisions to the closure methodologies and adjustments to the costing based on emergent closure costing guidance from YG EMR.

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Executive Summary

This RCP addresses the long-term physical and chemical stability of the site, including reclamation of surface disturbances. A program is presented for site management and monitoring both during implementation of closure and after decommissioning and reclamation measures are completed.

The RCP has been specifically scoped to fulfill the requirements of closure plan submissions in both of the project's primary regulatory instruments – Quartz Mining Licence QML-0001 (December 2014), and Water Use Licence QZ14-031-1, and to adhere to guidance documentation on closure plan development from both the Yukon Government and the Yukon Water Board.

Research carried out on proposed closure measures intend to cover gaps in knowledge which provides feedback to site specific development of robust closure measures. A systematic approach to decommissioning and closure reclamation has been developed for the Minto project. Progressive reclamation measures have been implemented where possible during mine construction and operations. This approach has and will continue to provide valuable reclamation success feedback for use in advanced/final closure, enhancing ultimate reclamation success.

The temporary closure period of the Minto mine will commence with the cessation of economic mining of known ore deposits and the milling of ore stockpiles with the expectation of recommencing of mining and milling activities with improved economics. During this period the mine site would be actively cared for with full time site personnel, although significantly reduced compared to operational periods. Temporary closure is expected to last no longer than 5 years.

Final closure of the Minto mine will commence with the depletion of known ore deposits or an unfavorable long term outlook which causes cessation of economic mining of known ore deposits and the milling of ores stockpiles. Once permanent closure commences, the mill and other facilities will be decommissioned, closure water conveyance constructed and waste facilities and disturbed areas will be contoured, covered and revegetated. During the active closure period, which is expected to last approximately 3 years, the number of personnel required will vary depending on site activities; however, it is expected that as major decommissioning and reclamation tasks are completed the number of site personnel required will decline.

Cost estimation for implementation of the proposed closure measures is the basis for establishing the financial security that will be required on the project. The reclamation and closure cost estimate has been prepared based on the final extent of disturbance for each of the infrastructure units described in this report. Decommissioning and reclamation cost estimates have been completed for Year 0 and end of mine life (EOM). The estimated closure costs associated with implementing the current RCP for Year 0 and EOM are: $61.0M and $43.9M, respectively.

1 Table of Contents

List of Figures

List of Tables

LIST OF APPENDICES

1 Introduction

Minto Explorations Ltd. (Minto), a wholly owned subsidiary of Capstone Mining Corporation (Capstone), owns and operates the Minto Project located 240 km northwest of Whitehorse, Yukon. For the purposes of this reclamation and closure plan, the “Minto Project” means mining by both open-pit and underground mining methods and related ancillary facilities.

This reclamation and closure plan (the RCP) addresses the long-term physical and chemical stability of the site, including reclamation of surface disturbances from existing development. A program is presented for site management and monitoring both during implementation of closure and after decommissioning and reclamation measures are completed.

1.1 Closure Philiosphy and Guiding Principles

In keeping with its high standards for environmental and social responsibility, Minto intends to implement an environmentally sound and technically feasible decommissioning and reclamation plan for the Minto mine. Closure planning and the implementation of this phase at a mine site must be undertaken with appropriate environmental care while respecting local laws, Selkirk First Nation (SFN) agreements, and the public interest, and ensuring that Minto’s high environmental standards are achieved. Necessary environmental protection measures have been adopted in the development of this Plan to ensure that a healthy environment exists after mine closure. This approach is consistent with Minto’s corporate policies.

A principle tenet of the philosophy followed during the development of this Plan was to work towards an eventual passive closure scenario, with minimal management required to achieve long-term chemical and physical stability of reclaimed mine components. This involved an assessment of the key mine components that require mitigation based on the current understanding of materials contained within these components. Mitigation measures have been incorporated into elements of the RCP to address public health and safety issues and environmental concerns with post-closure monitoring and inspections planned to ensure that this objective is met. Once the effectiveness of each mitigation measure is assured, then management of the site can be safely reduced to a level that is consistent with closure objectives. It is anticipated that final determination of the effectiveness of closure measures will be the subject of review and concurrence with regulatory agencies, SFN and the public.

Minto has entered into a Cooperation Agreement (the Agreement) with the SFN. All activities at the site including closure measures are guided by this Agreement. Therefore, a strong working relationship with the SFN forms a foundation for this document. To that end, meetings with SFN related to closure issues have been ongoing since the first version of the RCP, and their comments on closure and other issues raised during ongoing dialogue were considered in the ongoing development of this Plan. This dialogue continues, and parties continue to work towards refinement of reclamation issues in the ongoing closure planning discussions.

To ensure that the overall closure philosophy and goal can be achieved, Minto has taken an objectives-based approach to the reclamation and closure planning for the site. Section 3 provides information on this approach and the fundamental and site-specific closure objectives.

1.2 Scope of Plan

The RCP has been specifically scoped to fulfill the requirements of the EMR and YWB guidance document Reclamation and Closure Planning for Quartz Mining Projects: Plan Requirements and Closure Costing Guidance released August 2013. In addition, Minto has taken into consideration requirements concerning closure plan submissions in both of the project's primary regulatory instruments – Quartz Mining Licence QML-0001, and Water Use Licence QZ96-006.

Specifically, the requirements for closure plan submission under each licence are:

QML-0001: Section 7.0 Required Plans

7.2 The Licensee must:

a) submit to the Director and updated reclamation and closure plan within one (1) year of the effective date of this License[1]; and

b) Submit to the Director an updated reclamation and closure plan every two years commencing on the anniversary date of this License.

Section 8.0 Implementation of Plans

8.2 The Licensee must undertake reclamation at the site in accordance with the approved closure plan.

WUL QZ14-031: Section 6 Reclamation and Closure Plan

Clause 110 – The Licensee shall submit an updated, detailed RCP to the Board by August 5, 2016 as an application for amendment to this Licence, and every two years thereafter in the operations phase for Review and Approval. The updated RCP shall include, but not necessarily be limited to, the following:

a) a preliminary Closure Failure Modes Effects Assessment and the Main Pit Dam Failure Modes Effects Assessment;

b) plans detailing cover and re-vegetation strategies for the Dry Stack Tailings Storage Facility (DSTSF);

[1] On receipt of the WUL amendment QZ14-031-01, submission of an updated RCP was required on August 5th, 2016. An extension of the RCP deadline under the QML was granted to harmonize the dates.

c) an updated Closure Water Balance and Water Quality Model for the mine site and for Minto and McGinty Creeks, along with the corresponding complete datasets and complete lists of assumption used for the modelling;

d) a detailed Post-Closure Monitoring Program to verify that performance objectives for the all facilities are being achieved;

e) an updated Closure AMP including, but not necessarily be limited to, the following:

   i. numerical values of thresholds for each parameter for each specific threshold for each AMP component;

   ii. consideration of statistical trend analysis to provide future forecasting of potential exceedances;

   iii. threshold for action and responses related to potential poor performance of the Main Pit Dam, and

   iv. management measures to respond to changing conditions in McGinty Creek, water quality at internal monitoring locations, pit water levels in open pits.

f) updated detailed closure cost estimates for all existing and proposed work including, but not be limited to, the following:

   i. all changes required as per this Licence;

   ii. a MS Excel security costing workbook, with all supporting spreadsheets including and describing all formulas and assumptions;

   iii. the plan and cost to move all PAG Waste Rock material to a location which is permanently saturated;

   iv. costing for monitoring of the DSTSF and MVFE1 and MVFE2 until such time as their movement has proven to be decelerated;

   v. separate costing for the works completed between the issuance of this Licence and August 5, 2016, and

   vi. separate costing for works planned between August 5, 2016 and August 5, 2018.

Clause 111 – The updated RCP shall include preliminary designs for the closure of all major mine facilities, including but not limited to dams, spillways, diversion ditches, pits, dumps, mill, and camp facilities based on:

a) Maximum Credible Earthquake;

b) calculations of the inflow design flood proposed for closure and the rationale for the severity or return period of that flood event;

c) risk and consequence of inflows greater than the proposed inflow design flood (including comparison to Probable Maximum Flood (PMF) size event), and

d) designs for the closure water management structures and conveyance channels to withstand the inflow design flood event.

Subsection 6.1 – Application of Water Quality Objectives

Clause 113 – The updated RCP, required by clause 110 shall include Post-Closure (Phases I-II) WQOs that meet the criteria for Non-Degradation of Background Concentrations in Minto and McGinty creeks.

If Non-Degradation of water quality is not achievable, then WQOs shall be set at no more than 50% of the assimilative capacity of Minto Creek, as calculated using the following formula:

Closure and Post Closure WQO = Background Concentrations + (0.5*(WQO Operations – Background Concentrations)

Subsection 6.2 – Reclamation Research Plan

Clause 114 – The Licensee shall submit to the Board for Review and Approval an updated Reclamation Research Plan with the RCP updates described in Clause 110. This plan shall be implemented once approved, and shall specify the following:

a) annual reporting on research activities;

b) phase V and VI research activities;

c) a schedule for implementing the plan, and

d) information on the reclamation research program for both passive and semi-passive water treatment systems and cover systems, including

   i. performance evaluation;

   ii. implementation schedule, and

   iii. specific timelines for completing tasks as soon as practical

Subsection 6.5 Permanent Closure

Clause 121 – The Licensee shall immediately implement the most recently approved RCP upon Permanent Closure.

Clause 122 – The Licensee shall maintain a functioning water treatment plant on site as a contingency until such time as it can demonstrate through the Board's Review and Approval process that the closure WQOs (as defined in clause 113 for the receiving environment) are being and will continue to be met.

Clause 123 – The Licensee shall submit to the Board for Review and Approval, a report demonstrating that the water quality onsite has stabilized prior to the decommissioning of the Water Storage Pond.

YG's Decision Document issued on June 4, 2014 has specific guidance for RCP development for the Minto Site. Specifically, these are:

> ***Clause #25.*** *The Proponent shall provide an updated Reclamation and Closure Plan to Regulators as a part of License applications. This Plan shall include a reclamation research program, performance evaluation, and implementation schedule, for both passive and semi-passive water treatment systems and cover systems that may be implemented during the closure period. When preparing the Plan, the Proponent shall seek and consider input from the advisory committee (referred to in mitigation #13 of Decision Document 2010-0198) prior to submission of documents to regulatory bodies. Regulatory approvals for the Phase V/I project shall include specific time lines for completion of the tasks described in this condition. Those time lines should focus on completing the tasks as soon as practical; and*
>
> ***Clause #33.*** *Non-degradation (compared to historical background quality) of Minto Creek water quality shall provide the basis for the development of water quality objectives for the closure period. However, if non-degradation cannot be achieved using reasonable and practical passive treatment mitigations, then the closure objective shall be guided by what can be practically achieved (as long as the objectives are below the effects levels for aquatic resources with sufficient contingency). Determination of "reasonable" and "practical" mitigations must take into account the expected or actual site performance of a given mitigation, and the cost of the mitigation (both initial cost and long-term maintenance cost) compared to the expected contaminant reductions.*

1.3 Regulatory Requirements

Several government agencies and SFN are involved in reviewing, assessing, authorizing and monitoring the Minto Mine. The relevant legal, regulatory and guideline-based instruments include:

- Selkirk First Nation Cooperation Agreement;
- Metal Mining Effluent Regulations (MMER) of the federal Fisheries Act, including guidance for:
  - Effluent Characterization; and
  - Environmental Effects Monitoring.
- Type A Water Use Licence QZ14-031 ("WUL QZ14-031"), issued in August 2015 and including subsequent amendments, and valid until June 12, 2040;

- Type B Water Use Licence MS15-094 ("WUL-B") issued in July 2016 and valid until June 30, 2041;
- Quartz Mining Licence QML-0001 ("QML-0001") issued in October 1999 and subsequent amendments and renewals and valid until December 3130, 2030;
- Mining Land Use Permit;
- Fish Collection Permits;
- Waste Management Facility Permits;
- Multi-Use Land Treatment Facility Permit;
- Special Waste Permit;
- Commercial Dump Permit; and
- Air Emissions Permit.

In accordance with these instruments, Minto has submitted operational and monitoring plans including but not limited to:

- General Site Plan;
- Site Characterization Plan;
- Mine Development and Operations Plan;
- Underground Mine Development and Operating Plan;
- Main Waste Rock Dump Design Plan;
- Southwest Waste Dump Design Plan;
- Reclamation Overburden Dump and Ice-Rich Overburden Dump Design Plans;
- Dry Stack Tailings Storage Facility Design and Management Plans;
- Engineering Plans and a Construction Quality Assurance Manual for the Water Storage Dam;
- Mill Water Pond Design;
- Waste Management Plans;
- Waste Rock and Overburden Management Plans;

- Tailings Management Plan;
- Spill Contingency Plan;
- Heritage Resource Protection Plan;
- Sediment and Erosion Protection Plan;
- Explosives Management Plan;
- Wildlife Protection Plan;
- Emergency Response Plan; and
- Decommissioning and Reclamation Plan.

1.4 Project Schedule

The Minto Mine is currently an open pit and underground mining operation with conventional crushing, grinding, and flotation to produce copper concentrates with significant gold and silver credits. Concentrates are exported internationally via the Port of Skagway, Alaska for smelting and sale. Closure and reclamation of all mine components follows completion of mining and milling.

The table below outlines the Project development schedule from current status through to the completion of post closure two (PCII).

Table 1-1: Project Schedule

Year	Summary of Main Project Activity
2016	Expected completion of the Minto North Pit, Mill Valley Fill Extension Stage 2 and Main Waste Dump Expansion. Underground mining continues in the Minto South Deposit. Stripping in Area 2 Stage 3 pit begins as the final benches of Minto North are mined out.
2017	Underground production continues from the Minto South underground portal. Open pit mining continues in Area 2 Stage 3 until the pit is completed in the second quarter of the year.
2018	Underground mining from the Minto East deposit and milling continue until the third quarter of the year. Active closure to begin.
2019 – 2021	Active closure period continues (total duration expected three years) with Post-Closure I beginning near the end of 2021.
2022 – 2026	Post-Closure I period continues (total duration expected five years but will be performance based) with Post-Closure II beginning near the end of 2026
2027-2036	Post-Closure II period continues (total duration of Post-Closure II is ten years) until near the end of 2036.

As shown in Table 1-1 above, closure at the Minto Mine has been categorized into three primary closure periods which are Active Closure (AC), Post Closure I (PCI) and Post Closure II (PCII).

The Active Closure period includes the implementation and construction of the large majority of the selected closure measures. Closure measures completed during this period include, but are not limited recontouring, soil placement, closure water conveyance construction, revegetation, construction of passive water treatment facilities and partial decommissioning of the Water Storage Dam, demobilization and demolition. Further details regarding the planned closure measures can be found in Section 7. During the AC period, operational water quality objectives/effluent standards will still apply and active treatment is expected to be the primary source of water treatment. The AC period is expected to span three years but may be completed sooner as closure measures are completed.

The PCI period is intended to provide time which allows the closure measures to establish and assessments to be completed on the performance of the chosen closure measure. During this period, maintenance on soil covers will be ongoing as vegetation begins to establish. Water conveyance features will be commissioned along with the passive treatment system. A pump back system will be established from the passive treatment system to the water treatment plant as there is potential that water quality will not meet effluent standards without active treatment. During PCI operational water quality objectives/effluent standards will still apply. Passive treatment will be commissioned and will become the primary water treatment system utilizing active treatment as required to meet operational water quality objectives and manage site water inventory. During PCI site will be occupied by a small contingent of staff for a five month period. For purposes of costing for this plan, the PCI period spans five years but facilities may advance into PCII as closure criteria/expected performance of the closure measures are met.

The PCII period is intended as a conformational period which will monitor that the closure measures continue to perform as expected. PCII is primarily a monitoring phase with maintenance activities as required. During PCII the closure water quality objectives will apply and passive treatment will be the primary water treatment onsite. During PCII site will be occupied once every five years for two weeks per visit by a small number of staff. The PCII period spans ten years after which Minto has costed for a visit once every ten years over ninety years.

2 Reclamation and Closure Planning

This RCP is an advancement of the measures and methods previously approved or presented in preceding closure plan iterations for the Minto Mine. Section 3.1 outlines the objectives-based approach used to refine this version of Minto's RCP.

Minto has worked with stakeholders (SFN, YG) over the years to refine the proposed closure methods for the Minto site, and this dialogue is ongoing in the context of further refinement of closure objectives and reclamation research programs. Section 2.1 below presents a brief outline of the current status of reclamation and research planning for the Minto site, and Section 2.2 outlines the ongoing and planned reclamation research for Minto's closure planning.

2.1 Status of Reclamation and Closure Planning

Closure planning for mining projects is best understood as a continuum that evolves from a basic conceptual level during pre-production stages towards detailed designs as facilities are completed and as-built details are available for consideration in closure designs. Figure 2-1 illustrates a simplified conceptual model of this type of continuum, in which the level of detail in closure plans and the related implementation strategy for particular closure measures increases as a mine moves through the mine life cycle.

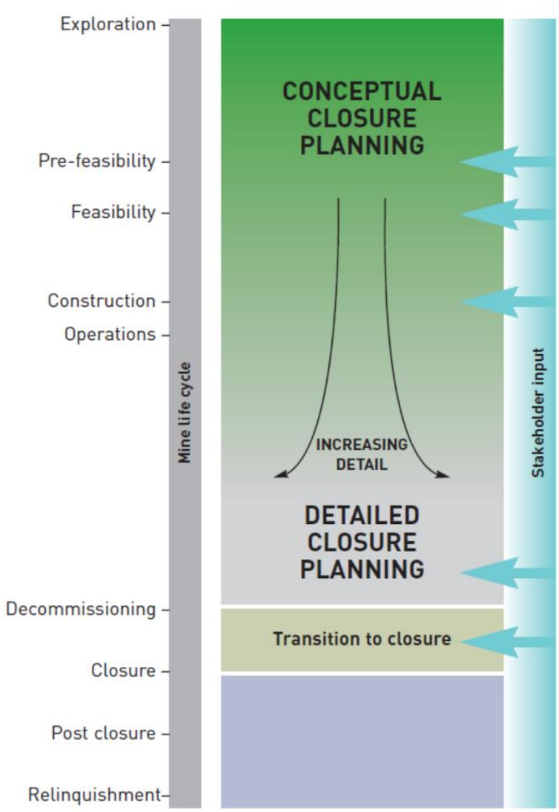

Figure 2-1: Continuum of Closure Planning Relative to Mine Life Cycle

Figure 2-1 presents a useful conceptual model, but it represents a scenario where implementation of closure measures occurs only after operations are complete, and as such this conceptual does not fully reflect the present situation at Minto Mine. At Minto, the various facilities are themselves at different stages within the continuum- for some, construction has not yet begun (e.g. Area 118 Backfill Dump), while others are complete and have seen substantial progressive reclamation (e.g. Southwest Waste Dump). As such, the level of closure planning detail varies with the different facilities across the site, and a general statement about where site-wide closure planning is within the conceptual model of the continuum would be an oversimplification.

From a very practical perspective, this RCP incorporates as-built survey detail into the designs for the proposed closure measures for facilities that are already built. Alone, the use of as-built details in designs puts closure planning at a more advanced stage in the continuum illustrated in Figure 2-1. However, because detailed closure planning has not yet been completed, Minto has included cost allowance for additional closure planning in the liability estimates that are presented in Section 9. Some examples of additional concepts or design details to be considered in future stages of closure include, but are not limited to, the following:

- Further design for construction of high quality bituminous geomembrane (BGM) cover on the High Grade Waste (HGW) portion of the SWD. Refinement of placement methodology and logistics are required, which will include discussions with potential suppliers and Minto's engineering department. Further consideration will also be given to other closure options for the HGW portion of the SWD such as milling the HGW material, disposal of material in saturated conditions in one of the in-pit tailings management facilities or characterizing material to determine whether replacing the BGM cover with a soil cover is appropriate.

- Secondary and tertiary closure water conveyance on waste dump facilities including site drainage – this has been addressed in preliminary detail, but development of a detailed layout for alignments for secondary and tertiary channels is required for each waste storage facility and for the general disturbed areas.

- Additional information is being collected through the Reclamation Research Program, and will inform closure measures and implementation strategies for final closure of the additional level of detail is reasonably expected later in the mine life once final closure is approaching. This will specifically include passive treatment measures, such as:

    - Wetlands;

        - Demonstration scale will refine performance expectations and contaminant removal rates;

        - Stress testing will inform variability of expected performance of wetlands;

        - Foundation investigations will inform locations, constructability and final design; and

    - Design for construction.
  - Lysimeters;
    - Further refine expected performance of closure covers.
  - Vegetation
    - Further refine the development of a sustainable re-vegetation strategy.

- Further consideration to the final closure measure for SAT material currently stored above the final closure water elevation in the Main Pit. This RCP assumes that this SAT material will require relocation to a location that will be saturated over the long term. Other closure options that may be considered include:
  - undertaking geochemical characterization of the placed SAT material to determine whether it is suitable to leave the material in place and cover it with a similar soil cover as planned for other waste rock dumps on site; and
  - evaluate whether a cover of tailings could act as an oxygen barrier cover due to the fine grained material characteristics of tailings.
- Further design and execution planning needs to be given to tailings in the Main Pit that are currently above the final closure water elevation. Consideration will be given to undertaking aterial placement during late winter conditions to reduce execution risks related to trafficability.
- Further consideration to be given to optimizing the cover design (primarily thickness) that should be used on non-waste rock dump facilities such laydowns, yards, stockpile pads, mill and camp pad areas. The merits of placing residuum instead of fine-grained soils in areas where disturbance has been limited to stripping of residuum (such as the camp and fuel farm areas) will be considered.
- Development of final Post-Closure II site specific water quality objectives in collaboration with SFN. Also, required in line with the finalization of closure water quality objectives are integrated Adaptive Management Plans and definition of attainment.

Reclamation and closure planning has been a primary consideration in mine planning and operational decision making. Planning new dumps has been guided by long term closure design criteria (i.e. final slopes, water conveyance requirements), and the completion of dump facilities provides an opportunity for the economical direct placement of overburden as waste dump closure covers during pit stripping activities. Construction of the Main Waste Dump Expansion was completed with closure considerations regarding landform design and facility drainage. The design for the Mill Valley Fill Expansion Stage 2 has incorporated a design-for-closure access road realignment.

Rock materials specifications and quantities for closure water conveyance structures (riprap, bedding materials, and crush rock) have been identified (Section 7) and will be produced and stockpiled during active mining activities to the extent practical. This will reduce requirements to produce or source the materials at closure.

2.2 Reclamation Research

Reclamation research will focus primarily on the key closure measures proposed for the site:

- Soil covers;
- Revegetation; and
- Passive water treatment.

This section provides an overview of in-progress or planned reclamation research initiatives at the Minto Mine.

2.2.1 Soil Covers

Water Licence QZ14-031 Clause 90-b calls for at least one lysimeter to be installed in each waste rock pile. To respond to this license requirement, lysimeters will be installed in the Main Waste Dump and the SWD. Results of the lysimeter monitoring will be used to augment the understanding of how water moves through the WRDs, providing a basis for confirming or improving water and load balance modelling from these sources.

Passive capillary lysimeters are a relatively new development that makes use of a fiberglass wick to keep the soil suction in the sampling columns in equilibrium with that of the natural soil surrounding the installation. Porewater from the soil sample is transferred into the sample collection vessel through the wick due to passive capillary forces. The sample is evacuated by application of pressure to a port.

In the context of the Minto reclamation and closure research program the objective of a lysimeter study is monitoring the hydraulic performance of 0.5m of cover soil overlying waste rock. A passive lysimeter program will provide site-specific data to complement the existing soil cover designs.

Further details can be found in the recently-submitted revision to Minto's Environmental Monitoring, Surveillance and Reporting Plan (EMSRP (Minto 2016a)). The EMSRP has been submitted for review and approval by Yukon Water Board; the lysimeter study will begin following approval of the submitted plan and will be subject to any conditions that are imposed.

2.2.2 Revegetation

Research to Date

Based on the specific reclamation research results to date and on a review of other reclamation and trial projects, the following points will guide reclamation activities during progressive and final closure:

- Chemical analysis of soils indicate that the overburden soils are deficient in macronutrients (nitrogen, carbon, phosphate and potassium), but have adequate micronutrients (copper, iron, manganese, molybdenum, zinc). It is recommended that soils be amended with fertilizer and/or mulched to promote grass/plant growth after seeding;

- The nutrient uptake by northern native seed varieties on nutrient deficient soil is usually more effective than nutrient uptake by southern agronomic species.

- Seeding with agronomic species over most disturbed areas at the Minto mine site may be required because of the high cost and limited availability of northern native revegetation species;

- Where additional areas at the mine may be targeted for progressive reclamation, seed and fertilizer treatments should be formulated based on the monitoring results of the revegetation trials to date. Two seed mixes are recommended below:

    - a dry area seed mix (Table 2-1), which would be applied to most disturbed sites in the area; and

    - a wet area seed mix (Table 2-2) for riparian sites.

Table 2-1: Dry Area Seed Mix.

Species	Botanical Name	Application Rate (kg/ha)	Percentage
Violet Wheatgrass	*Agropyron violaceum*	12	40.0
Sheep Fescue	*Festuca ovina*	7	23.3
Rocky Mountain Fescue	*Festuca saximontana*	7	23.3
Glaucous Bluegrass	*Poa glauca*	4	13.4
Total		**30**	**100**

Table 2-2: Wet Area Seed Mix.

Species	Botanical Name	Application Rate (kg/ha)	Percentage
Violet Wheatgrass	*Agropyron violaceum*	16	53.3
Fowl Bluegrass	*Poa palustris*	8	26.7
Tufted Hairgrass	*Deschampsia caespitosa*	6	20.0
Total		30	100

In addition to each grass mix, a nitrogen-fixing plant species will be added. If native species Yellow locoweed (Oxytropis campestris) and Arctic lupine (Lupinus arcticus) are available, they can be applied at 2 kg/ha. Agronomical species Medicago sp. (Rambler or Drylander) and Alsike clover can also be applied at 2 kg/ha. Rhizobium inoculant is needed for these legume seeds.

- Topsoil and logs (coarse woody debris) should be salvaged during stripping and clearing and stockpiled to the side. The topsoil, as well as being a seed bank, contains micro-fauna and fungus necessary for nutrient cycling. The logs are carbon/moisture reservoirs and provide habitat and preferred regrowth microsites. This material is needed to jump start soil-building processes and to accelerate revegetation growth.

- Vegetation islands of shrubs, trees and coarse woody debris act as a seed banks, attract wildlife which transport seeds and nutrients into the grassed area and speed up vegetation succession. Vegetation islands should be incorporated into both the revegetation research program and the larger scale progressive reclamation efforts.

- Local shrub/tree species can be salvaged and planted on corresponding aspects. Use ecosystem polygons already mapped to assist in finding local plant stock, and in determining species adapted to particular aspects and conditions.

2.2.2.1 *Main Waste Dump Trials*

Previous years' research has provided Minto Mine with information to pursue a large-scale cover project: the cover trial on the Main Waste Dump (MWD) re-contoured rock surface. Two variables were considered in the trial; the suitability of the major types of overburden found on-site as cover material and amendments such as fertilizer and organic material. These will be compared to simply seeding the overburden, allowing Minto Mine to gauge if these amendments improve seeding success. Re-vegetation success will be monitored and will provide Minto with information to customize site-specific reclamation methods. The cover trial will also stabilize inactive slopes, reduce the amount of reclamation taking place at end of mine life, and improve aesthetics on-site.

Ongoing data collection from the next few growing seasons will provide Minto Mine with additional information, including:

- Assessing success of seed mix on large scale plots;

- Determining if different types of overburden on-site can support vegetation; and
- Gauging benefit of using amendments to overburden (organic matter and/or fertilizers).

Figure 2-2 shows the reclamation work that Minto Mine completed on the Main Waste Dump in 2011. At the beginning of the 2012 summer Minto completed the re-contouring of the slopes placed 1m of overburden over the re-contoured slopes (Figure 2-3). As sections of the overburden were placed, they were hand seeded and fertilized (depending on plot amendment) (Figure 2-4). Vegetation established within a couple of growing seasons and established vegetation cover is shown in Figure 2-5.

Figure 2-2: Main Waste Dump near the End of Construction Season 2011 (September)

Figure 2-3: Main Waste Dump as it Appeared in July 2012 with Final Placement of Overburden into Distinct Plots

Figure 2-4: Final Plot Placement in August 2012. Note Seedling Emergence in Upper Right Plots

Figure 2-5: Established Vegetation on the MWD in June 2016.

To support SRK's further investigation into available cover construction materials at site, materials were recovered from the site's Reclamation Overburden Dump, characterized, and placed in distinct plots (Figure 2-6). The naming convention of the overburden plots reflects the position the overburden was placed on the Main Waste Dump. There are two benched areas, identified as "Upper and Lower". West facing slopes and east facing slopes are also pointed out in the naming convention. Table 2-3 indicates the naming convention for the plots, along with their areas.

Table 2-3: Naming Convention, Areas, Volumes and Depths of Each Overburden Plot

<table>
<tr><th></th><th></th><th></th><th>Area (m²)</th><th>Area (ha)</th><th>Depth of OVB cover (mm)</th><th>Total volume of material placed (m³)</th></tr>
<tr><td rowspan="5">Plot Name</td><td>Upper West Slope (UWS) and Upper East Slope (UES)</td><td>UWS and UES Plots</td><td>17229</td><td>1.72</td><td>1000</td><td>17229</td></tr>
<tr><td rowspan="3">Lower West Slope (LWS)</td><td>LWS Plot 1</td><td>10309</td><td>1.03</td><td>1000</td><td>10309</td></tr>
<tr><td>LWS Plot 2</td><td>6237</td><td>0.62</td><td>500</td><td>3118</td></tr>
<tr><td>LWS Plot 3</td><td>6219</td><td>0.62</td><td>1000</td><td>6219</td></tr>
<tr><td>Lower East Slope (LES)</td><td>LES Plot 4</td><td>3970</td><td>0.40</td><td>1000</td><td>3970</td></tr>
</table>

Plot size was chosen to balance the minimum area required to gather scientifically sound information, initiating enough diverse treatments to analyze different scenarios, and field fitting the plots for the most efficient use of space. Each overburden plot was chosen to represent materials available from the overburden stripping that occurred in Main and Area 2 pits. The upper slope plots were capped with material directly excavated and hauled from Area 2 pit development indiscriminately, without much segregation. A selection method occurred for the lower slope's plots within the ROD area. Sites were chosen to represent a wide range of materials on site (gravelly and sandy overburden, to loam-textured, to overburden containing high clay content pockets). Stockpiles and pads of materials were surveyed for material types using field observations (hand texturing, colour comparison, visual estimation of coarse to fine material composition).

Figure 2-6: Origin of Overburden Material from ROD Placed in Distinct plots on the MWD Re-contoured Rock Surface

Minto is currently re-evaluating the reclamation research objectives and structure of these plots, and the ongoing observations and findings from these larger scale efforts will inform revegetation and erosion control measures elsewhere on the site.

Research Going Forward

The next phase of revegetation planning will consist of delineating Reclamation Land Unit (RLU) polygons for the post-closure Minto landscape (i.e., spatially explicit application of the guidance included in the preliminary closure revegetation plan that is part of Appendix E4). This will involve of the following steps:

1. Delineation of erosion-control areas;
2. Refinement of erosion-control revegetation treatments for these areas, based on the guidance provided in the revegetation plan;
3. Delineation of RLUs for the remainder of the mine footprint. This will consist of the following sub-steps:
    a. Spatially explicit modelling of soil moisture regime (SMR) in non-erosion-control areas, based on physical characteristics of the cover materials and underlying waste materials or other substrates, and modifications for topography;
    b. Grouping model results into similar classes based on SMR ranges; and
    c. Associating these classes with occurrence of RLUs and pre-disturbance vegetation types;
4. Refinement of native-species-focussed revegetation treatments for each SMR class/RLU, based on guidance provided in the technical memo.

The process of completing this work may identify knowledge gaps or uncertainties that require further investigation to address/reduce. These would then be prioritized for follow-up work, potentially including further sample collection, on-site testing, and operational-scale trials or implementation.

2.2.3 Passive Water Treatment

2.2.3.1 *Constructed Wetland Treatment System*

Research to Date

Passive and semi-passive treatment has been successfully used for removal of metals and metalloids from water for many decades. There are many examples globally of copper, cadmium, and selenium treatment by constructed wetlands and other passive and semi-passive treatment technologies from which scientific principals can be borrowed for application in new systems along with more recent advances in technology and application (Ness et al., 2014). For the Minto Mine, closure water treatment is being addressed in a site-specific manner, applying evidence-based goals and assumptions. The evidence is being gathered through the reclamation research plan (RRP). A phased approach is being undertaken, consisting of (1) site assessment and information gathering, (2) technology selection and conceptual design, (3) pilot-scale testing and optimization (controlled environment), (4) onsite demonstration-scale confirmation and optimization and (5) full-scale implementation. The first three phases have been completed successfully, along with a year of testing on site for Phase 4. The following sections outline activities associated with the phased development to date, and activities planned until 2018.

Site Assessment and Information Gathering

Detailed findings of the site assessment and information gathering are included in Appendix A1.

The site assessment was initiated by gathering relevant historical and predicted models for the site in closure, and progressed through two site visits in 2013 (timeline provided in Table 2-4). The first site visit (August) familiarized scientists with the Minto site and identified specific locations of interest for sample collection. The second site visit (September) involved a directed research program, specific to the natural wetland between the W10 and W15 areas receiving seepage from the SWD. The wetland assessment produced data indicating that natural treatment is ongoing in this area.

Based on treatment performance of the natural wetland receiving seepage from the SWD upstream of the W15 monitoring point, it is recommended that in closure this natural wetland be retained. As a contingency, options for natural treatment augmentation may be explored in this area, such as structures to decrease channeling of water (and increased retention time).

The second site visit also provided information regarding priority plant species and borrow sites for pilot-scale testing and building the CWTSs. During the second site visit, plants (Carex aquatilis and moss) were harvested from site and brought to Contango's year-round pilot research facilities.

Table 2-4: Site Assessment Timeline

Item	Description	Date
Site Visit 1	Identify putative sampling locations	August 12-14, 2013
Site Visit 2	Sampling and plant collection	September 21-22, 2013

Technology Selection and Conceptual Design

Constructed Wetland Treatment Systems (CWTS) were selected for evaluation as a method to improve the quality of site runoff water in the post-closure period. Once established, wetlands can become self-sustaining ecosystems and possess the desirable potential to remediate contaminated mine drainage for as long as it is generated. To design pilot-scale CWTSs specifically for the Minto site, information gained from the site visit, past experience of designing CWTSs for copper treatment (and other elements), literature searches, and predicted water quality and conditions at closure, were all taken into account. *Carex aquatilis* (sedge) was chosen for the CWTS, as it is readily available at the Minto site and was one of the first plants to colonize cleared areas, indicating that it may be a good candidate for quickly establishing the CWTS. Moss was also used in some of the pilot-scale CWTS designs, as most locations at Minto with *C. aquatilis* were also colonized by aquatic moss (Appendix A2 Contango, March 2014).

Controlled environment pilot-scale testing and optimization

Detailed findings of the Pilot Scale Study are included in Appendix A2.

A pilot-scale passive CWTS using local wetland plants from the Minto site was tested in three designs and under various operating conditions to measure the effectiveness of metal, metalloid, and nutrient removal. The pilot-scale CWTS was operated over the course of thirty-seven weeks from October 2013 through July 2014 (Table 2-5). Three pilot-scale CWTSs designs were built in duplicate to evaluate the performance of different designs for selenium and copper treatment (Figure 2-7). The pilot-scale CWTS were planted and amended as follows:

- System 1 and 2: *Carex aquatilis*
- System 3 and 4: *Carex aquatilis* and aquatic moss; and
- System 5 and 6: *Carex aquatilis* and aquatic moss, soil amended with biochar.

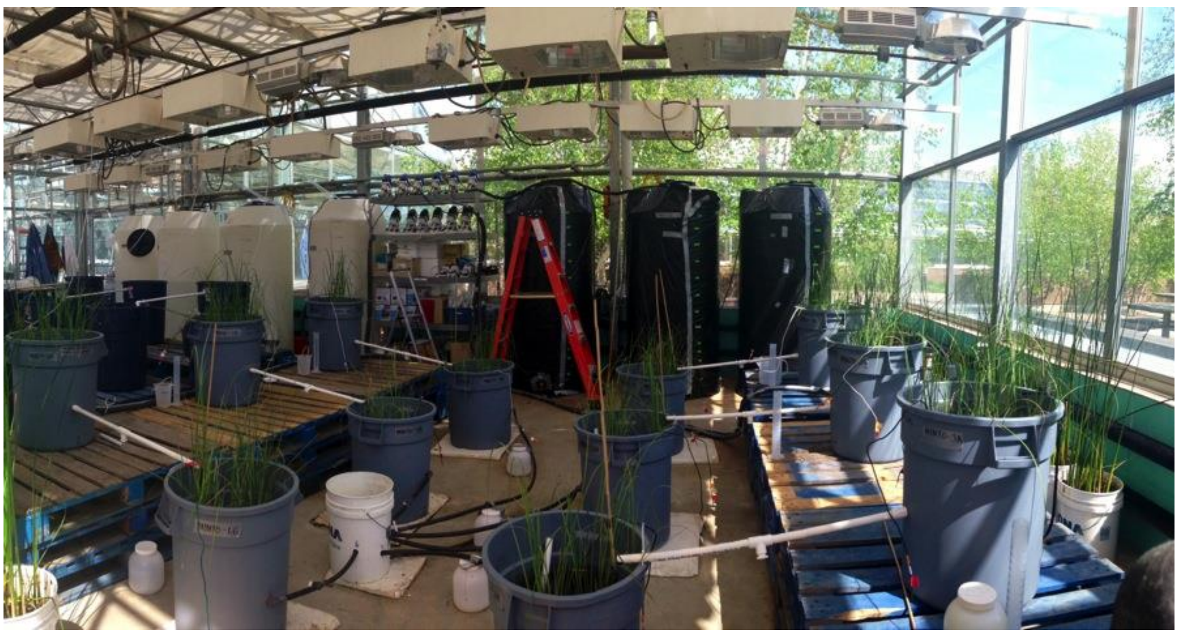

Figure 2-7: Pilot Scale Setup in Contango's Saskatoon Lab

The synthetic water used in the pilot-scale system underwent five iterations of design, testing, and optimization to ensure the composition and method of formulating the water resulted in analytical chemistry that matched the predicted water quality in closure. Design of the synthetic water chemistry focused on constituents requiring treatment and elements/compounds that are expected to affect treatment rates or capacity based on our previous experience and scientific literature.

Table 2-5: Pilot Scale Timeline

Item	Description	Date
Pilot CWTS built	6 series in total, 3 different designs (in duplicate), with 2 cells in each series	October 29-31, 2013
Acclimation	Municipal water (dechlorinated)	Nov 1 – December 10, 2013
Design and testing of synthetic water for pilot CWTS	2010-2012 synthetic water tested	December 1-5, 2013
	Synthetic predicted closure water tested	December 5-10, 2013
	Revised recipe for synthetic predicted closure water tested	December 20, 2013
Synthetic water flowing through pilot CWTS	Synthetic predicted closure water	December 10-16, 2013
	Synthetic predicted closure water (revised recipe)	December 22, 2013 – April 12, 2014
	Long-term closure synthetic water (low ammonia and nitrate)	April 13 – July 28, 2014
Performance Monitoring of pilot CWTS	Basic CWTS mode	December 10 – May 28, 2014
	Hybrid CWTS/bioreactor trial	May 29 – July 17, 2014

Two phases of water chemistries were tested; the first reflecting an early closure scenario where ammonia and nitrate are present from blasting residue in the waste rock. The second water chemistry had lower ammonia and nitrate present, as would occur further into closure once blasting residues have depleted. On average, each pilot CWTS started operating with a hydraulic retention time (HRT) of 39 hours, later increasing to 54 hours once plants were established. Together, all six systems used approximately 1,000 litres of synthetic water per 5 days.

All systems effectively decreased contaminant loads from the water. Systems containing aquatic mosses performed better than those without, so moss was retained in the designs. Biochar did not have any significant effect on performance, and therefore was not brought forward in the design. It was learned that the CWTS could have solid organic material (e.g., straw, hay) added to further enhance treatment, but at a trade-off of operational costs. Testing demonstrated the range of conditions required for effective copper and selenium treatment and highlighted the robustness and adaptability of the design. Based on performance, expected longevity, and cost effectiveness, the system with *Carex aquatilis* and aquatic mosses and sand substrate (no biochar) was progressed to the next phase, on-site demonstration-scale testing.

On-site demonstration-scale testing and optimization

Detailed study design and construction report for the Demonstration Scale CWTS are included in Appendix A3 with a 2015 update provided in Appendix A4. Upon completion and following the results of the off-site pilot-scale CWTS, Minto constructed a demonstration-scale CWTS on site in August 2014. The demonstration-scale CWTS was built with two systems in parallel, with two cells in each series and a final catchment basin that both systems flow into on waste rock fill was prepared and selected for the CWTS and a base of residuum material was placed in compacted lifts to allow for shaping of the structure to design specifications. The demonstration-scale CWTS was planted with *Carex aquatilis* (Sedge) and mosses, as was determined by pilot-scale testing as being the best design for this site and application (Appendix A2 Contango, 2014) (Figure 2-8 and Figure 2-9).

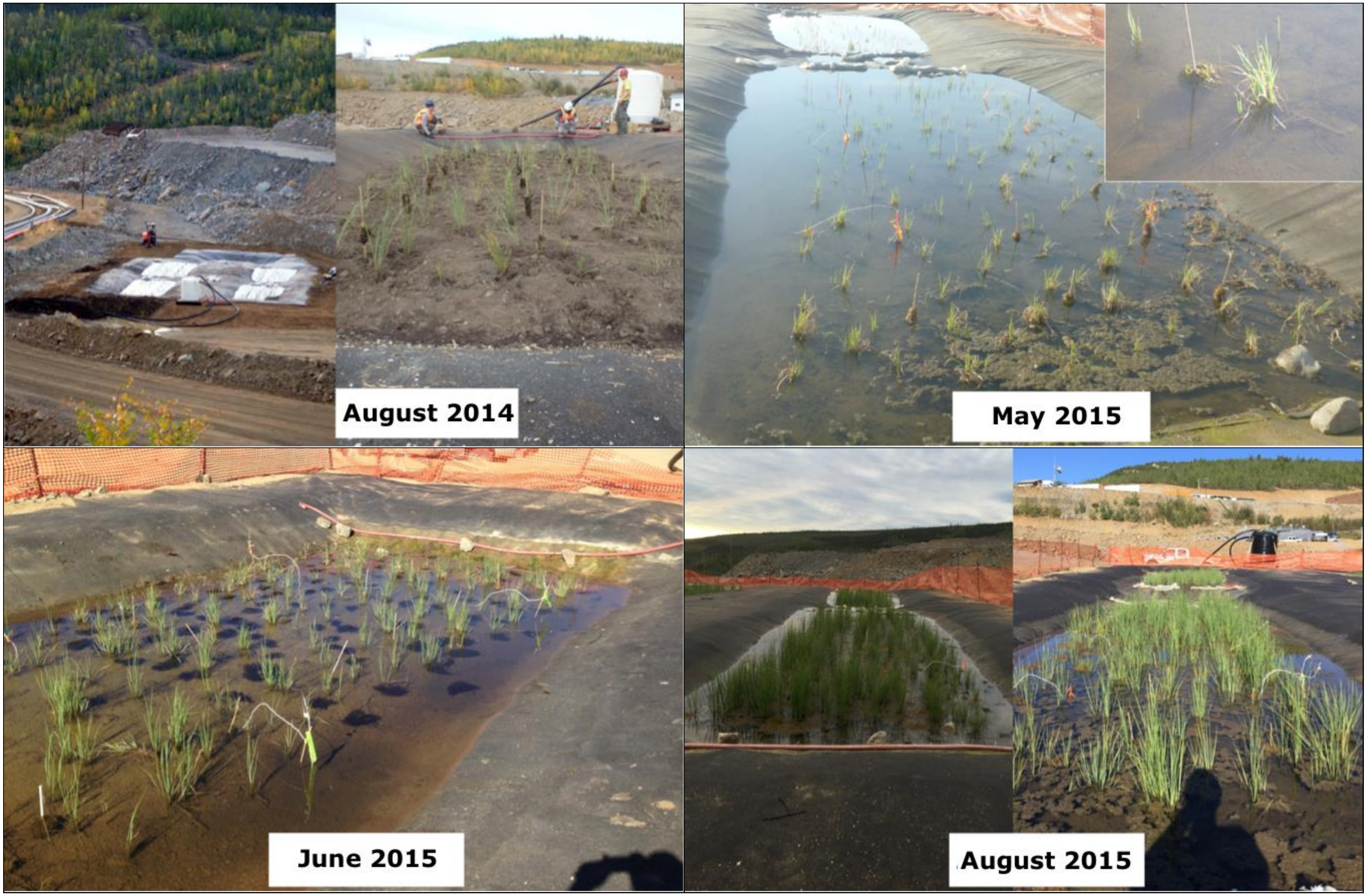

Figure 2-8: Time Lapse Photos of Demonstration Scale Treatment Wetlands at Minto Mine.

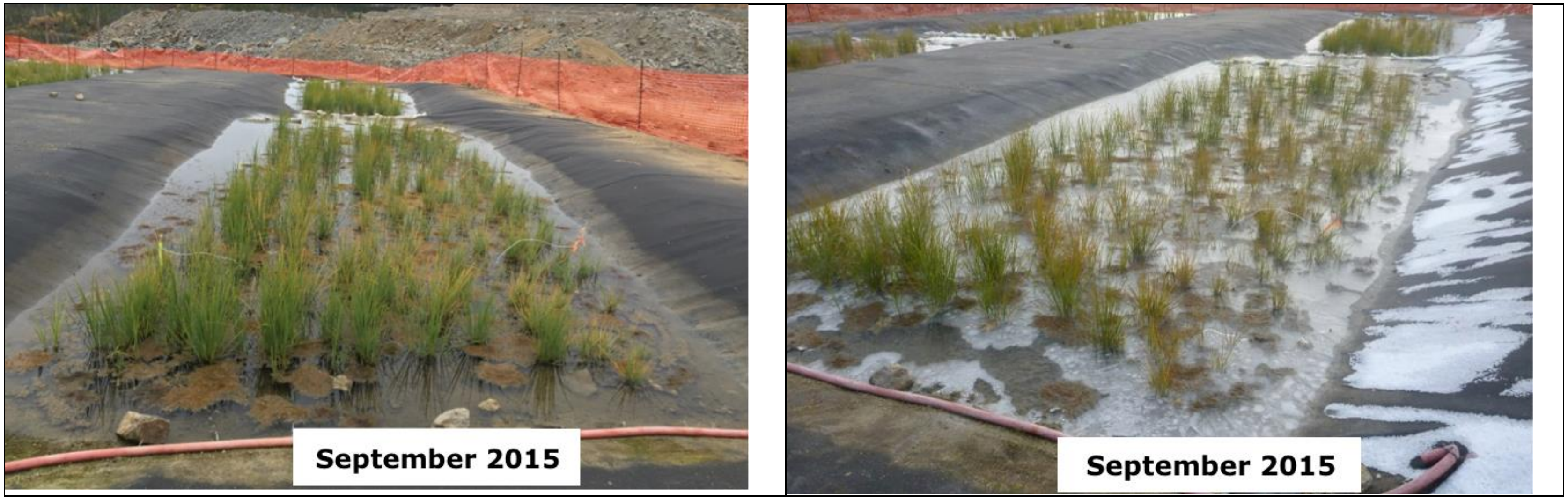

Figure 2-8: Continued.

Figure 2-9: Time Lapse Photos of Moss Establishment.

The primary focuses of the on-site passive water treatment research in 2015 were commissioning activities associated with establishment of plants and natural beneficial microbes, and resulting creation of necessary soil redox conditions for water treatment. Table 2-6 summarizes all of the key activities associated with the demonstration-scale CWTS in 2015, with testing outlined in Table 2-7. Table 2-8 further summarizes the demonstration-scale 2015 testing.

Table 2-6: Events and Sampling Activities since Construction of on-Site Demonstration Scale CWTS.

Who/When	Task	Additional Information	Day of Operation
Minto/Contango (August 2014)	CWTS constructed and planted	First sampling, water started	0-4
Minto (September 2014)	Feed water pumps turned off	Freeze up for winter	23
Minto (May 2015)	Feed water pumps turned on	Start up for 2015	24
Contango site visit 1 (June 2015)	Quarterly sampling [1]	Microbiology, soils, water tested	57
	Carex stem counts	Added more aquatic moss	
	Put black wrap on water tank	Prevent algal growth	
	Adjust water depth	Sandbags added to outflows areas	
Minto (July 2015)	Flow rate increased		82
Contango site visit 2 (August 2015)	Quarterly sampling	Microbiology, soils, water tested and added more aquatic moss	116
Contango site visit 3 (September 2015)	Quarterly sampling	Water tested and started Fe-EDTA test on System 2	148
		Microbiology, soils, plants, water tested	149
Minto (September 2015)	Fe-EDTA Testing	Daily total and dissolved copper analysis	150-157
Minto (September 2015)	Feed water pumps turned off	Freeze up for winter	160

[1] Water sampling was completed weekly, with additional parameters tested monthly and quarterly. See Table 2-7 for full analytical sampling frequencies.

Table 2-7: Summary of Analytical Sampling Types, Frequencies and Locations.

Water	
Dissolved and total metals	Weekly, outflow of each cell and feed
Flow rate	Weekly, feed
pH, DO, ORP, Conductivity (in situ)	Weekly, all cells and feed
Anion Sum	Monthly, outflow of each cell and feed
Cation Sum	
Hardness ($CaCO_3$)	
Ion Balance	
Total Dissolved Solids (TDS)	
Chloride (Cl)	
Sulphate (SO_4)	
Nitrate	
Nitrite	
Nitrogen (Total)	
Alkalinity	
pH	
Conductivity	
Chemical Oxygen Demand (COD)	
Total Organic Carbon (TOC)	
Ammonia	
Total Kjeldahl Nitrogen (TKN)	
Total Suspended Solids	
Biological Oxygen Demand (BOD)	
Bicarbonate (HCO_3)	
Carbonate (CO_3)	
Hydroxide (OH)	
Soil	
Relative soil redox (in situ)	Monthly, all probes (6 per cell)
Cation exchange capacity (CEC)	Seasonally (3x per year)
SAR, pH, EC, %sat, Ca, F, Mg, Na, K, Cl, SO4	
Available NPK and sulphur	
Alkalinity	
Bicarbonate (HCO_3)	
Carbonate (CO_3)	
Hydroxide (OH)	
Total Organic Carbon (TOC)	
Dissolved Organic Carbon	
Metals Analysis (Total)	
Metals Leachable (SPLP)	
Ammonia	
Nitrate	
Nitrite	
Total Dissolved Solids	
Anion Sum	
Cation Sum	

Cation/EC ratio	
Ion Balance	
Sequential Leaching (5 Acid Test)	
Cation exchange capacity (CEC)	
Plant tissue samples	
Metals Analysis	*Carex aquatilis* and aquatic moss, each cell, year end
Microbial samples	
Growth-based most-probable number analysis (nitrate reduction, selenite and selenate reduction, total heterotrophs)	Seasonally (3x per year)
Genetic sequencing analysis for bacterial community composition and distribution	Seasonally (3x per year)

Table 2-8: Summary of Minto Demonstration Scale 2015 Testing.

Objective	Purpose	Key Findings
Evaluate construction	Optimize construction and operational effectiveness of full-scale systems	Layout -Outflow collection pond should have outflow at base (not top), with shutoff valve -Increased slope on sides, and riprap or sandbags added at shores would prevent water short circuiting and deter wildlife access
		Soils -Use substrate with less total and leachable metals and metalloids (especially copper) -Higher sand content would improve hydrology, constructability (ability to level soils, ease of planting) and accessibility for sampling -Organics should be mixed in bulk into soils prior to adding to cells
Assess commissioning timelines	Allow for proper phasing of full-scale system implementation for closure	Water -Copper treatment improving through commissioning period; wetland achieving better treatment than suggested by inflow and outflow concentrations of system, as soils are leaching copper -Cadmium and selenium are also being removed from water -Wetland is maturing as expected and is performing beyond anticipated from the design -Tracer study recommended for 2016 to assess hydrology and pore volume of CWTS and determine hydraulic retention time (HRT) and removal rate coefficients for full-scale sizing
		Soils -Soil redox has decreased as expected, reaching targeted ranges in Series 1 by the end of 2015, while Series 2 continues to establish -Significant amounts of metals are leaching from soil substrate into water, putting additional treatment demands on system
		Microbes -Sulphide-producing bacteria needed for copper and other metals removal have increased over time as soil redox achieved target ranges. Proportions are comparable to those in pilot system at similar point in commissioning -Abundance of selenium- and nitrate-reducing organisms are similar to those in pilot testing, indicating maturation as expected -Selenium treatment performance expected to increase as mosses continue to grow, as they can sorb dissolved selenium and harbour highest abundance of selenate-reducing microorganisms to render the selenium insoluble
Carex aquatilis transplantation effectiveness	Determine if plant propagation and/or replanting schedule will be needed for full-scale systems	->95% survival from transplanting -Within first 2 months a further increase of >20% -Full-scale system could be planted more densely to bring online faster, or less densely if time is less of an issue than sourcing plants (the plants are vigorous and will fill in the wetland in due time)
Moss colonization/distribution		-100% survival from transplanting -Slower to spread, needs to be started more densely -Staking helps maintain moss in 'upstream' parts of wetland, or could be transplanted multiple times through commissioning period

Research Going Forward

In 2016 the CWTS is expected to continue to mature and progress through commissioning, with plants becoming more established and abundant, and microbial communities accordingly acclimating to the targeted conditions. It is expected that targeted ranges of soil redox will be achieved in all CWTS cells in 2016, which will indicate that the commissioning period has completed and allow for the monitoring program to shift focus to testing of operations and performance. All planned activities for the demonstration-scale CWTS are outlined in Table 2-9 and Table 2-10.

Table 2-9: 2016 on-site demonstration scale CWTS research plan.

When	Action	Additional Information
Spring	Add sandbags to perimeter of CWTS	Purpose is to minimize short circuiting around edges of CWTS where liner prevents plant growth. Use sand that was confirmed to be good borrow source in 2016 (i.e., low copper).
	Tracer study (salt)	To develop actual HRT (compared to calculated), and identify any short circuiting or retention issues.
Summer	Adjust flow rates for 2016	Flow rates will be set at a 3 day calculated HRT (compared to 20 hrs previously used) for further extent of treatment to develop rate kinetics.
	Add organic material (e.g., straw) to System 2	This will only be performed if soil redox conditions have not consistently met targeted ranges by July 2016, to provide organic matter until anticipated long-term detritus levels establish. Could be included in full-scale commissioning plan.
	Evapotranspiration test	Stop water flow to measure rate of evapotranspiration occurring in CWTS in warmer months. Incorporate into load removal models.
Fall	Continued performance monitoring	With set flow rate of 3 day calculated HRT, evaluate stability of performance into fall/winter freeze up.
	Evapotranspiration test	Stop water flow to measure rate of evapotranspiration occurring in CWTS in colder months. Incorporate into load removal models.

Table 2-10: 2017 and 2018 on-site demonstration scale CWTS research plan.

When	Action	Additional Information
2017	Set flow rates at constant flow	Do not change flow rate throughout year or make adjustments. Evaluate stability of wetland performance over one year, apply adjustments to models for full scale as necessary.
2018	Fluctuate flow rates	Fluctuate flow rates weekly, based on expected amount of water for full-scale wetland (scaled to size). Evaluate performance of wetland at different key periods.

W15 Area Reclamation Research Plan

A baseline analysis of the SWD seepage, the associated 'volunteered'/natural wetland and the W15 pond area will be initiated to further investigate the findings of the 2013 assessment completed by Contango between W10-W15. The 2013 assessment suggested the natural wetland in the area is possibly treating the seepage from the SWD, however there is currently only the 2013 data set available to support this inference. Therefore, it is necessary to collect additional data on this area to supplement the understanding of baseline characteristics for purposes of evaluating the outcomes of future efforts to enhance the existing natural wetland performance.

For the 2016 research plan, five new sampling sites have been selected. Initial samples are expected to include water, soil, microbial, and plant. Sampling locations correspond to four inflows to the W15 pond (Figure 2-10, FTW-A, -B, -C, -D), and one location upstream of FTW-B in the main creek (Figure 2-10, FTW-B1). In addition to these 5 new sampling sites, seeps W32, W38, W39, W40 will also be included in the sampling program. Sampling will occur at these sites (or a subset thereof) and at W15 twice monthly. However when discharging and W15 is being sampled daily, samples will be collected weekly for internal analysis of total and dissolved copper.

Based on the results of the 2016 baseline monitoring, designs will be developed to target specific seep areas and optimize treatment processes in the area. Conceptually, these may be similar to terraced landforms, providing greater water retention and areal contact in the wetland areas than currently afforded by the existing wetland/ creek complex- an example layout is shown in Figure 2-11. Construction is anticipated to occur in 2017, with testing of performance and explanatory parameters through 2017 and 2018 similar to that which has been undertaken for the on-site demonstration-scale constructed wetland.

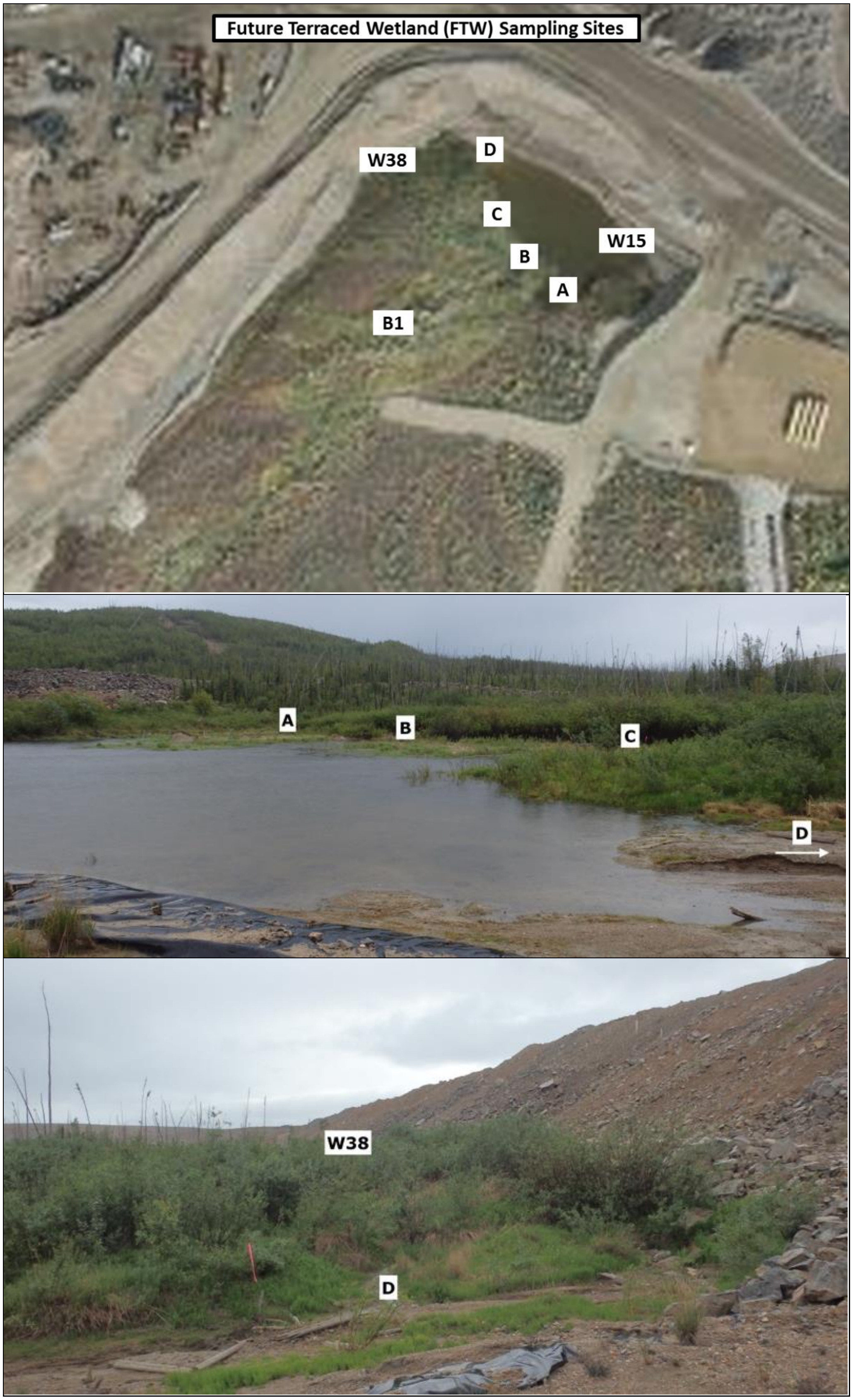

Figure 2-10: New Sampling Sites for the 2016 Research Plan.

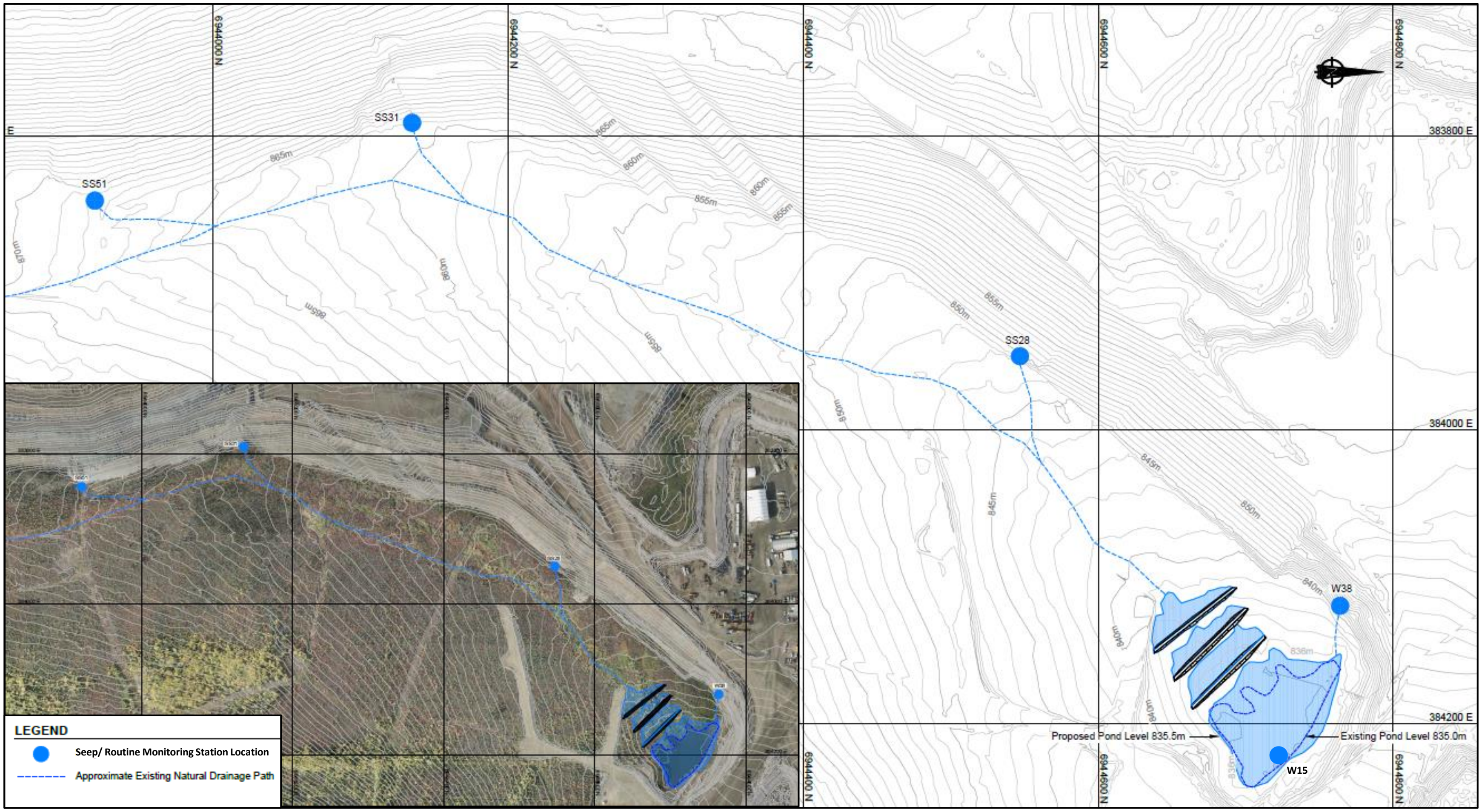

Figure 2-11: Example Layout of Terraced Wetlands Concept Downgradient of Southwest Waste Dump.

2.2.3.2 *Bioreactors*

Research to Date

Four pilot anaerobic bioreactors were commissioned at the Minto mine site in the summer of 2014 (Figure 2-12). Installation was completed on August 7th, 2014 and operation started on August 20th 2014. Bioreactor substrate composition varied among the bioreactors and included mixtures of creek sediments, low-grade or river gravel, wood chips or biochar (a coal made out of wood). During the first year the bioreactors were monitored until September 23rd 2014, after which they were dismantled and stored for the winter. In the following year, the bioreactors resumed operation on June 2nd and were monitored between June 20th 2015 and September 26th 2015.

Results during the four months of operation in the succeeding summer and fall in 2015 suggested that:

- Bioreactors continued to reduce selenium from the influent which had a concentration close to Minto Mine's selenium effluent discharge limit, decreasing to below the discharge limit of 0.003 mg/L as set by Minto's Water Use License;
- Steady copper removal was observed in all bioreactors regardless of temperature drop during the fall months;
- Chipped wood seemed to release organic acid in the effluent (lower pH, higher Total Organic Content) in the first month of operation but not in the second year of operation;
- All bioreactors including two that contained wood chips met pH requirement of mine discharge limit throughout the second year of operation;
- Large amount of organic carbon released from wood chips in the first year seemed to be consumed by bacteria and the concentration settled to the same level as other bioreactors without wood chips by the middle of the operation period;
- Bioreactors amended with wood chips efficiently lowered SO_4; and
- Bioreactors helped to reduce NO_3 concentrations to below discharge limits of 7.65 µg/L.
- No exceedance of the mine effluent discharge limits were observed for NO_2 and NH_3, although high PO_4 (not regulated) was observed in the effluent of the biochar amended reactor.

Figure 2-12: Pilot-Scale Bioreactors at Minto Mine (Picture taken in August 2014)

Research Going Forward

At this time, no further bioreactor research is planned.

2.2.3.3 *Pit Lake Treatment*

Batch treatment of pit lakes in the early closure period has some potential to reduce contaminant inventories in pit lake water and therefore reduce loadings when pit lakes ultimately fill and discharge to Minto Creek. While no study designs have been developed, the concept has been raised in internal Minto discussions from time to time and is considered to have merit. The feasibility of a full-lake trial will be considered for implementation after tailings deposition is complete.

2.3 First Nation Consultation and Community Engagement

Summary of community engagement activities (e.g. governments, local communities, regulatory agencies and non-government agencies) undertaken to support the development of the RCP.

Minto and the Selkirk First Nation (SFN) share the desire to minimize adverse environmental and socio-economic impacts resulting from the Mine operation and during closure. Minto believes this can be accomplished through consultation and open communication with stakeholders that include SFN, project regulators, and others. Accordingly, Minto has continued to focus on stakeholder engagement.

2.3.1 Engagement with Selkirk First Nation

The Minto Mine is located on the west side of the Yukon River within SFN Category A settlement land. As the landowner, SFN is Minto's primary stakeholder. Minto has therefore engaged SFN in a process of meaningful and significant involvement in the planning and development of the Reclamation and Closure Plan.

While Minto and SFN have had a collaborative relationship prior to commercial production commencing in 2007, a number of initiatives have been established to enhance effective engagement through many channels.

These initiatives include regular meetings between Capstone leadership and SFN Chief and council, as well as with SFN leadership representatives.

For the past several years, Minto and SFN have committed a bi-lateral technical working group (BTWG) to discuss technical issues related to the Minto Mine regularly. The BTWG is comprised of Minto and SFN representatives tasked with engagement in the following areas: geotechnical, water quality, consultation, and closure and reclamation.

Minto and SFN are parties to a confidential Cooperation Agreement.

2.3.2 Tri-Partite Socio-economic Working Group

Another important area of engagement is the tri-partite socio-economic working group that is comprised of SFN, YG and Minto. It is responsible for a socio-economic effects monitoring program, as described in the decision document related to Phase IV (YESAB project # 2010-0198). The scope of the monitoring and report program was agreed upon in 2013. The working group meets regularly and discusses availability of data, responsibilities and reporting. The initial draft for the 2014 report has been submitted to all parties for final review and is expected to be published in late 2016. In 2015, a housing surveyor was undertaken in Pelly Crossing and the results of that survey will be published in the 2015 report. Next steps include drafting and publishing of the 2015 report.

2.3.3 Tri-Partite Reclamation and Closure Working Group

A tri-partite reclamation and closure group that is comprised of SFN, YG and Minto was developed to provide an opportunity for Minto to update SFN and YG on the progress of the reclamation and planning process. The group met in November 2015, as well as May and July 2016. The group's discussions included, but was not limited to, submission extension request, scope of upcoming Reclamation and Closure Plan, operations updates, and areas of engagement with SFN. The final meeting was held at Minto and included a tour of the site with a focus on the proposed reclamation and closure measures.

2.3.4 Identification of Other Stakeholders

Minto recognizes the role that federal/territorial boards and government departments play in protecting the interests of Yukoners as well as providing advice and expertise related to the Project. Therefore, Minto has taken care to engage these stakeholders throughout the reclamation and closure planning process.

This engagement has included communication through technical working groups, site tours, updates, phone calls, regulator meetings, and reports. Stakeholders and regulators who are frequently engaged by Minto are:

- YWB,
- YG EMR,
- YG Water Resources, and
- Environment Canada.

2.3.5 Forms of Engagements

For details regarding specific First Nation, stakeholder, and regulator engagement, please see the SFN, Stakeholder and Regulator Engagement Table (Appendix B). This table provides details of engagement that has occurred since 2011 and includes communication related to earlier phases of the Minto Mine. Forms of engagement include:

- Bilateral Technical Working Group Meetings,
- Community sessions,
- Meetings between SFN leadership and company senior management,
- Bilateral meetings with regulators, and
- Technical meetings involving multiple stakeholders.

2.4 Closure Alternatives

In the process of planning the closure strategies for the Minto Mine site, several tools, techniques, and methodologies were utilized in order to examine the various possible alternatives for closure, and which were best suited to the site, the desired closure goals, objectives, and end land use. This included Interstate Technology and Regulatory Council (ITRC) mine waste treatment technology selection process, Failure Modes and Effects Assessment (FMEA), Scoping level cover assessment, and First Nations consultation on closure alternatives. These are discussed further in the following sections.

2.4.1 ITRC Mining Waste Treatment Technology Selection

The ITRC mine waste treatment technology selection process is recognized as a world class resource on the topic of innovative mine reclamation and treatment technologies. As such, it was selected to use as the primary tool for identifying and evaluating potential treatment technologies for the RCP v4.0.

The process uses a series of questions and decision trees to guide users to a set of treatment technologies that may be applicable to a particular site situation. The decision framework currently includes a total of 22 potential technologies (prevention and treatment) that could be applied to mitigate and/or treat mining impacted surface and groundwater. The list of technologies is reviewed and updated frequently by the ITRC and is comprehensive, spanning operational life and mine closure.

The various stages of closure planning have identified potential risks associated with closure water quality and as well as a need to address the topic of defining “reasonable and practical” passive treatment technologies to assist with the development of closure WQOs.

A complete reassessment of the full range of potential passive treatment technologies was performed to ensure that any changing site conditions and/or emergent technologies were factored into potential passive water treatment technology selection. A re-visiting of relevant site conditions was undertaken and the ITRC Process was then re-applied.

Using the ITRC framework, five (5) passive treatment technologies were short-listed as being considered relevant to the Minto site, and in the context of identifying “reasonable and practical passive treatment” as defined in the decision document. These are:

- Constructed wetland treatment systems (CWTS);
- Biochemical reactors (BCR);
- Permeable reactive barriers (PRB);
- In situ treatment of open pits (chemical precipitation through sulphate reduction); and
- In situ treatment of open pits (enhanced biological treatment using algae to sequester metals).

Of the five (5) technologies that made the short-list, only one (1) has been identified as a primary passive treatment technology in the Minto Mine closure context – CWTSs. This is primarily based on CWTSs being the most passive to operate of all of the shortlisted technologies. The level of site-specific research that has been conducted at the Minto site, and the technologies’ ‘readiness’ for advanced design-level integration into the current closure planning was also taken into consideration.

Four (4) additional technologies are presented as candidate contingency passive treatment technologies – BCRs, PRBs, and two variations of in-situ batch treatment in open pits. Batch treatment of open-pits is subdivided into sulphate reducing batch treatment (which removes metals by precipitation as sulphides) and enhanced biological treatment (which removes metal by algae sequestration which then sinks to the base of the pit). These measures can be considered at a 'contingency' plan level of integration into current closure planning at the Minto site, and some site-specific experimentation has already been completed to date. The full ITRC memo for Minto can be found in Appendix C.

2.4.2 Failure Modes and Effects Assessment

In advance of the submission the Phase IV RCP, Minto conducted a multi-stakeholder Failure Modes and Effects Assessment (FMEA) as a key exercise guiding the evaluation and refinement of the Minto reclamation strategy. The two-day workshop (followed by partial day sessions to complete the exercise with a smaller group) was held in Whitehorse in January of 2013, and involved participants representing Capstone Mining Corp., Selkirk First Nation (SFN), Yukon Government- Energy Mines and Resources (YG-EMR) (represented by Steve Jan Consultants), and the Yukon Water Board (YWB), and was facilitated by Dirk van Zyl of the University of British Columbia.

The goal of the FMEA was to identify the risks involved with components of several different closure option scenarios being considered for the Minto mine. Previous meetings in December 2012 with technical representatives from SFN and YG EMR on closure planning strategies had 'shortlisted' 6 candidate closure scenarios for the Minto Site. Each scenario had a different key closure measure focus. After reviewing some preliminary water quality estimations for each scenario, the FMEA group concurred there were 3 scenarios most appropriate to carry forward through the FMEA process. These are presented below with the key assumptions of each:

Scenario: Source Control Focus

- Highest quality covers on waste rock and tailings; and
- No treatment.

Scenario 2: Hybrid of Source Control and Treatment Focus

- High quality covers on waste rock and tailings; and
- Use of active and passive treatments on site.

Scenario 3: Treatment Focus

- Routine quality covers on waste rock and tailings; and
- Use of active and passive treatments on site, managing water using reservoirs to optimize treatment plant function and collection systems.

The group initially identified classes of failure, which were then used to identify potential failure mechanisms with associated likelihood and consequence factors. The pre-developed spreadsheet tools then assigned each failure mechanism a risk ranking, and the team collaborated on considerations and potential risk mitigation measures for failure modes. The session finished with an understanding that once the final closure strategy for the site was determined, the FMEA exercise should be revisited specific to the proposed closure measures. The outcomes of the preliminary FMEA process were captured in the tables presented in Appendix D1 of the Phase IV RCP v4 (September, 2013).

As a result of the review of the preliminary FMEA findings (specifically, the potential failure mechanisms assigned the highest risk), and further informed by more recent site evaluations (updated water quality prediction and cover material evaluation), Minto has adopted limited source control of potential contaminants as the principle tenets of the reclamation strategy for the site. In addition, Minto has committed to implement reasonable and practical passive and/or semi-passive treatment options, and its ongoing research program will identify appropriate methods as such.

Following the submission of an updated Phase V/VI Reclamation and Closure Plan (RCP v5.1, August 2014) in support of permit amendment applications for the Phase V/VI Expansion mine plan Minto hosted a multi-stakeholder FMEA workshop (in two parts). The first session was held in Vancouver on August 27 and 28, 2014. A second, supplementary FMEA workshop was held in Whitehorse on October 9 and 10 with a smaller subset of the original workshop group to address outstanding mine components and closure aspects that had not been addressed in the first workshop.

As with the January 2013 workshop, the 2014 FMEA used predefined consequence categories, severity descriptors and likelihood terminology to determine where the residual risk associated with the various mine components ranked on a risk matrix (from Low to Very High). The risk rating tools used in the FMEA workshops are presented within the final Report and Risk Register in Appendix D2. The overall objective of the FMEA workshop was to evaluate the residual risks that would remain after implementation of the RCP v5.1.

A pre-workshop teleconference attended by participants from Minto, SRK, SFN, and AEG was held to discuss and refine the methodology to be utilized, so as to maximize the time for risk ratings during the workshop. During this call it was determined that the results of the January 2013 FMEA workshop would be incorporated so as to not lose the information gained from that process.

The 2014 FMEA covered the entire Minto mine site and mainly focused on a time frame during Post Closure II as it is described in the RCP v5.1, when all reclamation activities are completed and the site has entered into a phase of primarily monitoring and maintenance. The Closure FMEA used an approach in which specific combinations of failure modes and resulting effects were rated by participants. For each scenario that was rated, potential risks were identified, recorded, and taken through a facilitated procedure using the consequence-severity and likelihood tools to reach a consensus risk rating. The risk ratings were recorded in a risk register spreadsheet that was projected on a screen for participants to refer to and provide feedback on during the meeting, and the resultant risk IDs were placed on a wall matrix and photographed once the topic was complete.

The first 2014 FMEA workshop was held at SRK's office in Vancouver, BC on August 27 and 28, 2014. The workshop was facilitated by Dr. Dirk Van Zyl (Chair of Mining and the Environment at the Norman B. Keevil

Institute of Mining Engineering, University of British Columbia). The two-day workshop included participation by representatives of Minto, SFN, and YG-EMR. Representatives from Norwest Corporation (in its third party review capacity on geotechnical subjects at Minto Mine, on behalf of Minto and SFN jointly) participated on the second day only (August 28).

The topics rated in the August workshop included:

August 27:

1. Area 2 Pit

9. Source Control – Waste Covers

10. Water Conveyance

August 28:

2/3/6. Main Pit/Main Pit Dump/Main Dam and Spillway

7/8. Dry Stack Tailings Storage Facility and Mill Valley Fill Extension

The August 2014 workshop rated breach of the Main Dam due to permafrost thaw, settling of the dam leading to tailings release, and general failure to conduct preventative maintenance and corrective actions leading to system failures, as the largest perceived residual risks to the site at closure. The lack of inclusion of long-term operation and maintenance of the site was identified as an important issue to be addressed, as was further assessment of permafrost thaw as it pertains to the closure design, in particular for the Main Dam and associated structures.

The supplementary FMEA workshop was conducted over two half-day sessions in October 2014. The workshop was jointly facilitated by Dylan MacGregor and Scott Keesey and the same FMEA protocols and risk rating tools that were used in the August workshop were used once again.

The topics rated in the October workshop included:

October 9:

6. The remaining WRDs (Main Waste Dump, Southwest Waste Dump and Ridgetop Waste Dump)

7. Backfill dumps

October 10:

2. The remaining open pits (Minto North, Ridgetop North)

11. Water Treatment

14. Administration

15. "Domino Effect"

The October workshop found the risk scenarios evaluated to contain relatively low residual risk (i.e., Low to Moderate) and primary mitigative actions identified included implementation of an effective AMP and minor modifications to closure configuration (e.g. regrading to maintain ponds away from spill points). It was agreed that the Reclamation Research Plan needed to advance further in order to better evaluate reasonable and practicably treatment technologies and there is a need to better define water quality objectives before Water Treatment can be properly evaluated by the FMEA process. The group ultimately decided to not rank Water Treatment scenarios but rather flag this topic as significant and consider addressing residual risks associated with Water Treatment using a different process in the future.

The workshop participants also identified a number of "parking lot" issues/concerns that could not be addressed by the FMEA process but which require further consideration. The key issues/concerns raised included:

- Current closure plan was deficient with respect to showing final reclaimed facilities, toes of re-graded slopes and location of secondary and tertiary water conveyance;
- More information requested regarding the status of the Reclamation Research Plan and the Main Waste Dump revegetation trials;
- Trafficability layer is required over the Ridgetop North Pit tailings backfill whereas costing only allows for 0.5m of overburden;
- Need to advance the discussion/determination of what constitutes "reasonable and practicable" passive treatment, establish protocols and revisit the options evaluation;
- SFN reiterated their concern that the consequence category of "Community/Media/Reputation" is biased because SFN are lumped together with groups having other interests and perspective; and
- The current closure plan does not sufficiently address signage and access control. There is a need to retain institutional controls and maintain signage in perpetuity.

The highest overall risks (i.e., High and Very High) identified during the FMEA workshops were associated with Administration, Water Conveyance, and Waste Rock Dumps. Administrative Failures represented the largest perceived residual closure risk. A recurring theme for mitigating residual risk included the implementation of an effective AMP and long-term care and maintenance program.

Table 2-11 contains a list of action items identified by FMEA scenarios that were flagged with high to very high risk ratings, along with how, and where, they are addressed in the RCP.

Table 2-11: 2014 FMEA Results for Scenarios with High to Very High Risk based on the 2014 FMEA Risk Registry

Code	Area/Facility	Failure Mode & Effect	Addressed in RCP 2016-01 Section	Action Taken
6.1	Main dam	Blockage or settlement of Ditch 300 leads to water in Main Pit and the Main dam has settled, leading to overtopping of the Main Dam resulting in breach, release of tailings and water to lower Minto Creek [environmental impact]	NA	No longer applicable, dam has been removed from mine plan.
6.2	Main dam	Blockage or settlement of Ditch 300 leads to water in Main Pit and the Main dam has settled, leading to overtopping of the Main Dam resulting in breach, release of tailings and water to lower Minto Creek [comm/Media/Rep]	NA	No longer applicable, dam has been removed from mine plan.
14.1	Administrative	General failure to conduct preventative maintenance and corrective actions leading to system failures (passive treatment, covers, etc.) resulting in impacts on ecosystems components.	Section 7.12 and Section 9.0	Adequate monitoring and maintenance in place as well as sufficient costing.
14.2	Administrative	General failure to conduct preventative maintenance and corrective actions leading to system failures (passive treatment, covers, etc.) resulting in negative traditional use.	Section 7.12 and Section 9.0	Adequate monitoring and maintenance in place as well as sufficient costing.
14.3	Administrative	General failure to conduct preventative maintenance and corrective actions leading to system failures (passive treatment, covers, etc.) resulting in regulatory/ legal action.	Section 7.12 and Section 9.0	Adequate monitoring and maintenance in place as well as sufficient costing.
14.5	Administrative	General failure to conduct preventative maintenance and corrective actions leading to system failures (passive treatment, covers, etc.) resulting in community/media/reputation impacts.	Section 7.12 and Section 9.0	Adequate monitoring and maintenance in place as well as sufficient costing.
14.8	Administrative	Departure from design of engineered structures, resulting in need for upgrades/ repairs/ redesign	Section 7.12	Monitoring to confirm.
14.9	Administrative	Bankruptcy/ dissolution of the company and inadequate financial security leads to requirement for public government to fund and conduct preventative maintenance and corrective actions to avoid system failures and impacts on ecosystem components.	Section 9.0	Adequate costing currently in place.
12-P5	Primary Channels	SWD toe seepage collection systems inadequate, leading to unacceptable WQ downstream	Section 7.12 and Section 7.7	Monitoring to confirm and enhanced natural wetland conceptual design.

2.4.3 Scoping Level Cover Assessment and Performance Modeling

In August 2013 SRK Consulting completed a scoping level evaluation (Scoping Level Cover Assessment for Minto Closure Covers) of available materials at the Minto site (and commercially available products) to identify types of covers that could be considered for placement on site waste materials at closure. The assessment took into account site specific conditions and overall site wide closure objectives. The full report can be found in Appendix E1.

Site specific conditions such as design life, climate, material availability, waste characterization, seismicity, slope stability, and erosion resistance were carefully evaluated to determine what cover concepts would be most likely to be successful at Minto, and how they could be implemented. Once the cover concepts that are most likely to be successful at Minto were identified, appropriate cover functions were defined to specifically ensure overall site wide closure objectives would be met. Additionally, conceptual cover designs were presented to demonstrate actual implementation plans for each of the concepts.

SRK utilized regional climate data from Environment Canada, as well as previous site studies to determine the mean annual total precipitation for the site, as well as the mean annual evaporation, and concluded that between March and September, the mean monthly climatic water balance is net negative, i.e. evaporation exceeds precipitation. Additionally, the site was classified as Dry Subhumid. Based on these factors, the site is best suited towards either water covers or infiltration controlling covers. Annual average ambient air temperatures, the presence of discontinuous permafrost in the region, and empirical methods were used to determine the annual depth of frost penetration. Based on this it was determined that any low permeability barrier cover that could be damaged through freeze-thaw action would have to be constructed with a protection cover of at least 3 m.

Locally available soils were characterized over numerous programs and the overburden soils can generally be classified as silty sands. Three existing primary candidate cover soil sources were identified; (1) overburden stockpiled on the Main Waste Dump (MWD); (2) the Reclamation Overburden Dump (ROD); and (3) the Ice-Rich Reclamation Overburden Dump (IROD). In total it was estimated that about 2.8 Mt of these soils were available for use as cover material. In addition, the overburden soils that will be produced during mining of the Area 2 Stage 3 Pit have been characterized and found to be similar to the soil in the existing stockpiles, and are therefore suitable for use as cover material.

Indicator property characterization testing and hydraulic testing (i.e., porosity, saturated hydraulic conductivity and Soil Water Characteristic Curves (SWCC)) was carried out on soil samples to further characterize the soils. It was determined that the locally available soils would require amendments in order to be used for construction of low infiltration covers, and could be workable for use as store-and-release materials.

Waste settlement was also considered. The waste rock dumps and dry stack tailings at Minto were not expected to undergo significant settlement; however, the tailings in Main Pit will undergo settlement as a result of self-weight consolidation, as well as the surcharge from cover placement. As such, it was noted that cover design should either allow or compensate for potential settlement, or construction should only be done once settlement is largely complete.

The Minto site is not considered to be particularly seismically active (see Section 4.11). Cover placed on steep side slopes not subject to liquefaction would be subject to classic failure mechanisms such as increased pore water pressures induced by ground shaking. At the Minto site this failure mechanism would only apply to covers constructed on the waste rock piles and the Dry Stack Tailings Storage Facility.

In October 2015 SRK completed a modeling exercise on various soil cover designs being proposed for use at Minto. The model used was a surface flux boundary model that further defines and brackets the likely range of percolation for the proposed soil covers at Minto. The cover modeling methods, scenarios evaluated, as well as results and discussion are summarized in this section below. Additional detail on the soil cover modeling can be found in the Minto Mine Closure Covers: results of Numerical Modelling to Bracket Percolation Predictions Memo in Appendix E2.

The cover modeling methods primarily focused on the model inputs. There were a total of five primary model inputs used, including meteorological data, soil cover material properties, boundary conditions, initial conditions and vegetation. Model input data included meteorological data (daily precipitation and evaporation) from Environment Canada's Pelly Ranch weather station. Evapotranspiration, snowmelt and sublimation were also utilized. Data from field investigations (test pits – particle size distribution) was used to inform the material properties inputs. Top and bottom boundary conditions were considered and being a one-dimensional model no side boundaries were required. Initial soil conditions were expressed in terms of gravimetric moisture content and were set at 7% for waste rock, 18% for tailings and 11% for the soil cover materials, respectively. The final model input was vegetation, which used conservative pasture-type vegetation assumptions and a constant rooting depth of 10cm.

The base case scenario assumed a simple 0.5 m thick soil cover overlying waste rock. The surface is assumed to have no vegetation. Normal precipitation was applied as a 20 year long daily sequence while the snow water equivalent was released over 14 days to simulate freshet. Potential evaporation was equal to 400 mm annually and was distributed monthly in equal daily increments. Sensitivity analysis scenarios were run to evaluate which parameters have the greatest influence on the percolation predictions. The following sensitivity analysis scenarios were completed; a delayed freshet, finer and coarser cover material, finer and coarser underlying waste rock, no sublimation and increased sublimation, increased cover thickness, upset climatic condition and presence of vegetation.

The results of the modeling exercise showed that even the base case had a considerable reduction in percolation. When comparing waste rock and tailings it was predicted that tailings percolation is less due to the finer grained nature of the material, however tailings with a simple soil cover preformed similar to that of the base case. Based on the cover material information modeled there is no preferred material type with which lower percolating covers could be constructed. Increasing cover thickness to 1 m predicted a slightly better percolation rate whereas increasing cover thickness to 2 m had negligible effects on percolation rates. Changing the underlying waste rock characteristics predicted that coarser waste rock would result in higher percolation rates while finer waste rock material resulted in no effects in percolation rates. A delayed freshet timing had a significant effect on the model outcome as the model allowed for some of the freshet water to be evaporated. The model was found to be very sensitive towards sublimation assumptions. The effect of wetter or dryer climatic years was found to have little effects. The final result was on the vegetation where it was determined that only modest increase in cover performance was predicted.

2.4.4 First Nations Consultation on Closure Alternatives

As briefly described in Section 2.3.1, bilateral discussions with SFN and their technical advisors were held during the reclamation and closure planning process. In an effort to have meaningful collaboration in regards to reclamation and closure planning Minto and SFN focused some of the discussions on closure measures alternatives. The primary subjects of focus regarding closure measures alternative were closure water conveyance alignments and constructed wetland configurations/design. The focused alternative measures discussions were held over four separate meetings from January 11th, 2016 to May 3rd, 2016.

As noted in Appendix B a teleconference meeting was held on January 11th, 2016, the subjects discussed at that meeting was different options for closure water conveyance alignments and potential locations for treatment wetlands. Similarly, before proceeding with advancing closure water conveyance design, another teleconference was held on April 5th, 2016 to discuss the effects of closure conveyance routing through the Area 2 pit and the effect on downstream hydrology.

Alternative options for wetland configuration and design were held in Whitehorse on March 1st, 2016 and via teleconference on May 3rd, 2016. Subjects discussed included potential wetland design configurations and water conveyance options within the wetland area.

3 Closure Objectives and Design Criteria

3.1 Objectives-Based Planning

Principles and approaches for reclamation planning from the published Reclamation and Closure Planning for Quartz Mining Projects guidance document (Yukon Government 2013) have been considered in the closure planning approach for the Minto Mine (Figure 3-1). This guidance document provides direction on the level of detail, information required and processes necessary for developing reclamation and closure plans in Yukon. To achieve its purpose, the guide has the following objectives:

- Describing the context for mine closure planning in the Yukon, and the rationale for requirements to submit RCPs and liability estimates;
- Describe the principles, philosophy and broad objectives for closure planning for Yukon mining projects;
- Describe the information expectations for RCPs and liability estimates; and
- Identify key sources of additional guidance for preparing RCPs and liability estimates.

Principles and approaches presented by Yukon Government (2013) include fundamental reclamation and closure objectives, community and regulatory engagement, reclamation and closure principles and principles for estimating liability. The intent of this section is to present the closure goal, principles, objectives, options, measures and criteria specifically for reclamation and closure of the Minto Mine, while following the guidance outlined by the Yukon Government (2013).

In an objectives-based approach, the closure goal is supported by closure principles which guide the selection of clear and measurable closure objectives for all project components. For each closure objective, proponents propose a set of closure options that could achieve the objective, and a selected closure activity is chosen from these options. Closure criteria measure whether the selected closure activity achieves the specific closure objective.

The closure goals, principles and objectives below, have also been guided by input from SFN. Engagement on closure objectives and end land use will continue in the future, however, Minto is using information regarding closure objectives that originated from SFN review of a Decommissioning and Reclamation Plan in 2007. Minto understands that these objectives potentially will be updated, however, are still appropriate for guiding the development of this plan and as such have been utilized during this planning process.

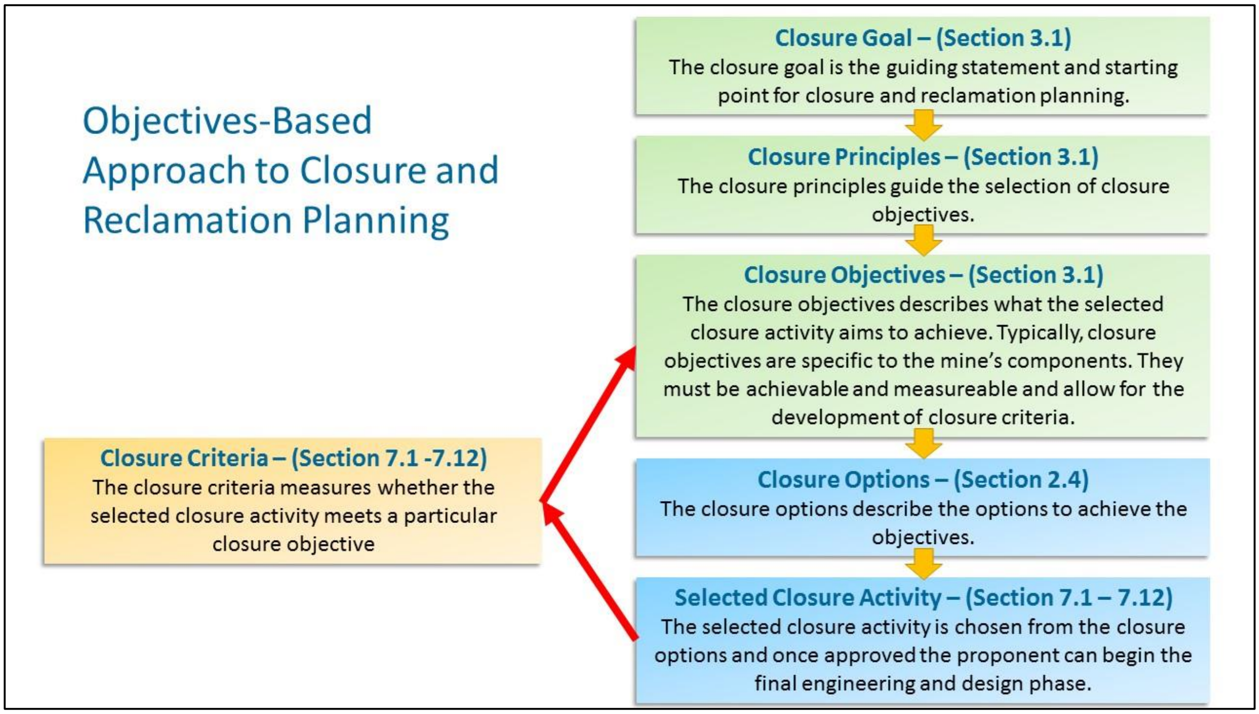

Figure 3-1: Objectives Based Approach to Closure and Reclamation Planning (adapted from MVLWB/AANDC, 2013)

3.1.1 Closure Goal

The closure goal is the guiding statement and starting point for closure and reclamation planning. Establishment of goals are meant to ensure the long-term success of the program by developing a clear and executional plan. The closure goal is met when the reclamation and closure measures satisfied all closure objectives.

For the Minto Project, the closure goal is to return the mine site and affected areas to viable and, wherever practicable, self-sustaining ecosystems that are compatible with a healthy environment over the long term, protective of human health and safety and support traditional activities.

3.1.2 Closure Principles

Closure principles guide the selection of closure objectives. Four core closure principles are applicable to the Minto Project include:

- physical stability;
- chemical stability;
- no long-term active care requirements; and
- future land use (including aesthetics, values, human health and safety).

3.1.3 Closure Objectives

Closure objectives are statements that clearly describe what the selected closure activities aim to achieve. They must be measurable, achievable, and allow for the development of closure criteria. Objectives are short-term concrete stepping stones toward achieving a goal and should be specific, appropriate and realistic (Huggard and Nadeau 2013). Table 3-1 below includes Yukon Government's (2013) fundamental reclamation and closure objectives to be achieved during all stages of reclamation and closure projects in the Yukon and their accompanying value.

Component-specific closure objectives (Table 3-2), categorized under the fundamental closure objectives presented in Table 3-1, are intended to be objectives-based and non-prescriptive. The purpose of implementing performance-based objectives is to encourage research and innovation resulting in cost-effective applications while ensuring public health and safety and environmental protection are met (YG 2008).

Fundamental closure objectives developed by Yukon Government (2013) in the Reclamation and Closure Planning for Quartz Mining Projects along with closure objectives identified by SFN have been used to guide the development of detailed objectives that are site-specific, defined by factors that include environmental conditions, site conditions and community expectations. Minto specific closure objectives are presented in Table 3-2.

Table 3-1: Fundamental Mine Reclamation and Closure Objectives (YG 2013)

Value	Reclamation and Closure Objectives
Physical Stability	All mine-related structures and facilities are physically stable and performing in accordance with designs. All mine-related structures, facilities and processes can withstand severe climatic and seismic events.
Chemical Stability	Release of contaminants from mine related waste materials occurs at rates that do not cause unacceptable exposure in the receiving environment.
Health and Safety	Reclamation eliminates or minimizes existing hazards to the health and safety of the public, workers and area wildlife by achieving conditions similar to local area features. Reclamation and closure implementation avoids or minimizes adverse health and safety effects on the public, workers and wildlife.
Ecological Conditions and Sustainability	Reclamation and closure activities protect the aquatic, terrestrial and atmospheric environments from mine-related degradation and restore environments that have been degraded by mine-related activities. The mine site supports a self-sustaining biological community that achieves land use objectives.
Land Use	Lands affected by mine-related activities (e.g., building sites, chemical and fuel storage sites, roads, sediment ponds, tailings storage facilities, waste rock storage areas, underground workings, etc.) are restored to conditions that enable and optimize productive long-term use of land. Conditions are typical of surrounding areas or provide for other land uses that meet community expectations.
Aesthetics	Restoration outcomes are visually acceptable.
Socio-economic Expectations	Reclamation and closure implementation avoids or minimizes adverse socio-economic effects on local and Yukon communities, while maximizing socio-economic benefits. Reclamation and closure activities achieve outcomes that meet community and regulatory expectations.
Long-term Certainty	Minimize the need for long-term operations, maintenance and monitoring after reclamation activities are complete.
Financial Considerations	Minimize outstanding liability and risks after reclamation activities are complete.

Table 3-2: Minto Mine Specific Closure Objectives

Mine Components	Water Retention and Water Conveyance Structures	Open Pits	Waste Rock Storage Facilities	Tailings Storage Facilities	Mine Infrastructure	Roads and Other Access
Components Breakdown	Constructed wetland areas, Closure conveyance channels, Water storage pond	Main Pit, Area 2 Pits, Area 118 Pit, Minto North Pit	Main Waste Dump/Expansion, Southwest Waste Dump, Mill Valley Fill Extension, Main Pit	Dry Stack Tailings Storage Facility, Main Pit Tailings Management Facility, Area 2 Pit Tailings Management Facility	Milling Complex, Camp, Laydowns, Fuel Farms, Solid Waste Facility	All roads, Airstrip, laydowns, general areas of disturbance
YG Fundamental Closure Objectives	Physical Stability Chemical Stability Long-term Certainty	Health and Safety Physical Stability Chemical Stability	Physical Stability Chemical Stability Long-term Certainty Aesthetics Land Use Ecological Conditions and Sustainability Socio-economic Expectations	Physical Stability Chemical Stability Long-term Certainty Aesthetics Land Use Ecological Conditions and Sustainability Socio-economic Expectations	Health and Safety Land Use Aesthetics Socio-economic Expectations	Land Use Health and Safety Socio-economic Expectations
SFN Fundamental Closure Objectives	• Work towards a passive closure scenario for most mine components. • Ensure long term chemical and physical stability of mine components and disturbed areas. • Reclaim the mine site and affected areas to a state similar to surrounding lands so that people can pursue traditional activities in the manner they did before mining. • To protect the environment from effects of earthquakes, floods, climate change and other natural events.	• Protecting the health and safety of people pursuing traditional activities. • Work towards a passive closure scenario for most mine components. • Ensure long term chemical and physical stability of mine components and disturbed areas.	• Protecting the health and safety of people pursuing traditional activities. • To protect the environment from long-term effects caused by the mine activities and facilities. • Work towards a passive closure scenario for most mine components. • Ensure long term chemical and physical stability of mine components and disturbed areas. • Reclaim the mine site and affected areas to a state similar to surrounding lands so that people can pursue traditional activities in the manner they did before mining. • To protect the environment from effects of earthquakes, floods, climate change and other natural events. • To confirm the effectiveness of closure measure by monitoring the site after closure. • To have a long-term benefit legacy for SFN people and businesses resulting from participation in closure and post-closure activities.	• Protecting the health and safety of people pursuing traditional activities. • To protect the environment from long-term effects caused by the mine activities and facilities. • Work towards a passive closure scenario for most mine components. • Ensure long term chemical and physical stability of mine components and disturbed areas. • Reclaim the mine site and affected areas to a state similar to surrounding lands so that people can pursue traditional activities in the manner they did before mining. • To protect the environment from effects of earthquakes, floods, climate change and other natural events. • To confirm the effectiveness of closure measure by monitoring the site after closure. • To have a long-term benefit legacy for SFN people and businesses resulting from participation in closure and post-closure activities.	• Protecting the health and safety of people pursuing traditional activities. • Reclaim the mine site and affected areas to a state similar to surrounding lands so that people can pursue traditional activities in the manner they did before mining. • To have a long-term benefit legacy for SFN people and businesses resulting from participation in closure and post-closure activities.	• Protecting the health and safety of people pursuing traditional activities. • Reclaim the mine site and affected areas to a state similar to surrounding lands so that people can pursue traditional activities in the manner they did before mining. • To have a long-term benefit legacy for SFN people and businesses resulting from participation in closure and post-closure activities.
Minto Specific Closure Objectives	• Ensure decommissioning of, or upgrades to, water retention and sediment control structures, and appurtenances, in such a way that drainage at, and the site is stable in the long term • Convey flows into and throughout the mine footprint, and off of the site in a controlled, stable fashion under a reasonable range of anticipated conditions • Develop practical designs for structures while considering unforeseen circumstances and events over a long period of time. • Where practical and required include deterrents to limit wildlife usage.	• Ensure physical and chemical stability of decommissioned pit • Able to withstand severe climatic events • Protect humans and wildlife from topographic hazards associated with pit and pit lake	• Ensure long-term physical stability to minimize erosion, subsidence or slope failure • Able to withstand severe climactic and seismic events • Ensure long-term chemical stability such that runoff and seepage do not increase loading and degrade water quality • Where practical incorporate into landform designs, natural topography • Where practical incorporate ascetics and wildlife habitat into closure measures	• Ensure facilities are designed for closure conditions, so as to ensure physical and chemical stability when decommissioned • Minimize potential of mobilization (Aeolian or aqueous) of tailings or contaminants • Able to withstand severe climactic and seismic events • Ensure long-term chemical stability such that runoff and seepage do not increase loading and degrade water quality is considered in closure measures • Where practical incorporate into landform designs, natural topography • Where practical incorporate ascetics and wildlife habitat into closure measures	• Where practical remove potential threats to public health and safety • Decommission facilities in a safe manner • Ensure physical stability of any remaining structures • Consider the site aesthetics and local opportunities during component reclamation.	• Minimize, eliminate or manage invasive species colonization at linear features in closure • Minimize where feasible the risk to public safety • Where practical incorporate local perspective in closure measure

3.1.3.1 *Closure Water Quality Objectives*

This section presents information related to the establishment of water quality objectives (WQOs) for the closure and post-closure periods. It includes a background and guiding language in current project authorizations, a summary of work completed to date with SFN under a framework for closure WQO development, and a working set of interim WQOs for evaluating project performance related to receiving water quality.

3.1.3.1.1 Background

Section 3.1 above discusses the selection and application of closure objectives in a general sense, and also specific to mine components for closure of the Minto Mine. One of the key closure objectives is 'chemical stability' of mine components, and this can be extended to the aquatic receiving environment as well. A key mine closure performance indicator will be maintenance of functioning and healthy aquatic ecosystems in the receiving environment, and SFN also maintains Final Agreement rights as the landowner in the mine receiving area.

Water quality objectives, as a term, has been utilized to refer to 'targets' for water quality at certain locations. They can be narrative, but are more typically numerical. In the closure context as outlined in Section 3.1 above, numerical WQOs are actually a closure criteria – a measurable condition against which achievement of the closure objectives can be evaluated/confirmed. There are a range of methods available for the development of WQOs, and they are specific to an end-member condition (e.g. protection of aquatic life, non-degradation from background conditions). As a jurisdiction, Yukon does not have formalized guidance on preferred methods for the development of WQOs.

QZ14-031 includes numerical WQOs for the operational period, applied in lower Minto Creek. These operational WQOs are the basis of the operational effluent quality standards (EQSs) and are also key values utilized as specific performance thresholds in the operational Adaptive Management Plan. As noted in Section 1.4, post-closure WQOs will be applied to the Post-Closure II period. In the Phase V/VI application, Minto had proposed to use the operational WQOs for the closure and post-closure periods. On review, the Yukon Water Board elected an alternative approach in QZ14-031, as follows:

> *113) The updated RCP, required by clause 110 shall include Post-Closure (Phases I-II) WQOs that meet the criteria for Non-Degradation of Background Concentrations in Minto and McGinty creeks. If Non-Degradation of water quality is not achievable, then WQOs shall be set at no more than 50% of the assimilative capacity of Minto Creek, as calculated using the following formula:*
>
> *Closure and Post-Closure WQOs = Background Concentrations + (0.5 * ((WQO Operations) – (Background Concentrations))*

where *WQO Operations* refers to the Operational period WQOs listed in Table 2- Water Quality Objectives in QZ14-031. The licence further defines Non-Degradation and Background Concentrations as follows:

> *"Background Concentrations" means the datasets presented in the Application:*
> *- Exhibit 1.11.1.6, Section 3.3, Table 3-13 - Access Consulting Group. 2014. Minto Creek*

Water Quality Characterization (Revision 1). Prepared for Minto Explorations Ltd. (MEL); and - Exhibit 1.11.1.10, Section 4.3, Table 4-11 - Access Consulting Group and Minnow Environmental Ltd. 2014. McGinty Creek Water Quality Characterization May 2009- July 2012. Prepared for MEL.

"Non-Degradation" refers to water quality that is not statistically significantly different from the Background Concentrations.

QZ14-031 defines the above-referenced data set for use in defining Background Concentrations in Minto Creek and McGinty Creek, but it does not define how that data set will be used to develop the background definition. The sections that follow outline how Minto has worked with SFN to:

1. Develop post-closure water quality objectives that are achievable, acceptable to Minto and SFN, and reflect the application of reasonable and practical passive treatment; and
2. In the absence of the completion of the final post-closure WQOs development process, refine the definitions above to allow for the meaningul application of the WUL-defined post-closure WQOs as 'interim' WQOs.

3.1.3.1.2 Work to Date

A six-step process for the development of Post-closure WQOs for Minto Creek has been collaboratively developed by Minto and SFN. The framework for the development of these WQOs was a component of the RCP v5.1, and substantial progress has been made, although the process is not complete. Five of the six steps have been completed (as of the date of this version of the RCP), and the remaining steps underway. This section outlines the process and speaks to the work remaining for its completion.

Minto drafted the initial framework in early 2015, prior to the Yukon Water Board's deliberations and issuance of QZ14-031. The framework was therefore based on language in the Phase V/VI Decision Document, which provided clear guidance for the development of post-closure water quality objectives:

33. (Confirm) Non-degradation (compared to historical background quality) of Minto Creek water quality shall provide the basis for the development of water quality objectives for the closure period. However, if non-degradation cannot be achieved using reasonable and practical passive treatment mitigations, then the closure objective shall be guided by what can be practically achieved (as long as the objectives are below the effects levels for aquatic resources with sufficient contingency). Determination of "reasonable" and "practical" mitigations must take into account the expected or actual site performance of a given mitigation, and the cost of the mitigation (both initial cost and long-term maintenance cost) compared to the expected contaminant reductions.

The framework consists of six steps, intended to parallel the development of a plan for the implementation of passive treatment of mine impacted water at the site, in a manner that is both reasonable and practical. The steps, including a description of work completed to data, include:

1. **Confirm technologies -** Selection of viable and reasonable passive treatment technologies for further consideration/research was conducted, and was presented in RCP v5.1 Section 2.2. The technologies were further reviewed to define which technologies are reasonable and practical.

This work is further summarized in Section 2.4.1 and the full memorandum is included in Appendix C.

2. **Develop Configuration Options –** Using the findings from Step 1 (CWTSs), Minto developed a set of options for the layout, timing of construction/implementation, and transition strategy for passive treatment installations. This was informed by spatial constraints at site as well as temporal and regulatory requirement considerations.
3. **Select Configuration and Implementation Strategy –** Minto reviewed the options for configurations of passive treatment installations developed in Step 2 with SFN, and as a team selected the most appropriate configuration and implementation strategy. This is the basis of where and when passive treatment will be reasonable and practical. The configuration of the proposed passive treatment installations is presented in section 7.7.5, and the implementation strategy is outlined in section 8.2.
4. **Refine Performance Expectations –** Minto refined existing performance expectations for the proposed CTWSs based on the outcome of step 3 and the best available information, including results of site specific investigations. These will be reviewed and refined as appropriate in the future based on the ongoing findings of research work outlined in section 2.2.3.1.
5. **Updated WQ Predictions –** Minto incorporated the performance expectations from step 4 into updated Load Balance and Water Quality Predictions for an appropriate range of closure conditions/scenarios. This work is presented in Section 5.4.3.
6. **Define Closure Period WQOs –** This step is in progress currently with SFN. It involves the interpretation of WQ Prediction outcomes and refinement of the definition of background water quality , will consider contaminant effects levels and appropriate contingencies, and will include an evaluation of the feasibility of meeting a non-degradation target with these measures.

For the purposes of meeting the WUL requirement to include in this RCP post-closure WQOs, and to have defined performance criteria by which to measure reclamation success, Minto is adopting the approach to closure WQOs from QZ14-031 as 'interim post-closure WQOs' for both Minto and McGinty Creeks. This is outlined further in the following section, but work to date to support these interim WQOs is presented herein. Both approaches (non-degradation and 50% of assimilative capacity) for the development of closure WQOs require a clearly-defined background water quality condition. Definition of the background water quality of Minto Creek (applicable at lower Minto Creek) was discussed in detail among Minto, SFN, and technical consultants in June 2016 (Appendix F). These discussions covered a number of factors critical to the clear definition of background water quality, including representative sampling stations, contaminants of potential concern (COPCs), dealing with less than method detection limit (MDL) results, dealing with replicate results, identifying outliers, evaluation of possible data groupings, and the designation of summary statistics to be used as WQOs or for the development of WQOs.

Following the application of the rationalized rules for developing the representative background water quality dataset, the dataset was used to calculate two key summary statistics for each COPC to represent background water quality of lower Minto Creek and for potential application as WQOs or for the development of WQOs. Specifically, the two key summary statistics were:

1. the 95th percentile of the background dataset (Appendix F); and

2. the 95th percentile of the annual medians of the background dataset (Appendix F).

The intended use of the 95th percentile of the background dataset is as an "individual data point evaluator" and the intended use of the 95th percentile of the annual medians is as a "central tendency evaluator". In addition, and in accordance with the WUL, associated "50% Assimilative Capacity" concentrations were calculated (Table 3-3). These concentrations were calculated from background concentrations and operational stage WQOs according to the formula provided in the Minto WUL.

Although application of the WQOs in defining attainment is the subject of ongoing discussion between Minto and SFN, a fundamental guiding principle is that, because the summary statistics are 95th percentiles, they will be exceeded at an average rate of 5% in the absence of any mine influence on water quality. Thus, definition of attainment must consider natural exceedance rate, and initial response to any observed exceedence must be focussed on distinguishing a mine related influence from natural variability.

Although not discussed with SFN, Minto has adopted the methodology above for the development of interim WQOs for McGinty Creek as well. The only difference with the methodologies is that background water quality data up to July 2015[2] has been included in the dataset evaluated for the summary statistics, and McGinty Creek will not be subject to 50% assimilative capacity WQOs, as non-degradation from background conditions will be the narrative objective for water quality in the receiving environment of that catchment (Table 3-4).

Both sets of working interim WQOs are presented in the following section.

3.1.3.1.3 Interim Water Quality Objectives

Since this bilateral process for defining post-closure WQOs (outlined above) remains a work in progress, Minto has used the formula from QZ14-031, together with the revised definition of background water quality, to define *Interim Post-closure WQOs* for Minto and McGinty Creeks for inclusion in this RCP. As noted previously, through this amendment application Minto is proposing to apply the Post-Closure WQOs to the Post-Closure II period only, and to have Operational WQOs apply through the end of the Post-Closure I period (for Minto Creek only - see Section 7.7 for additional details). The proposed WQOs for McGinty Creek below would apply to all mine closure periods.

It should be noted that the Interim Post-closure WQOs that result from application of the defining formula have been exceeded from time to time in the historical background monitoring results (i.e. at stations without any mine-related influence), and there is no reason to expect any different in the future.

[2] Mining at Minto North pit started on August 5th, 2015.

Table 3-3: Background Concentrations and Associated 50% Assimilative Capacity (Interim PC WQOs) for Minto Creek, to be applied at Station W2.

Analytes	Background Concentrations		Operational Stage WQO	50% Assimilative Capacity
	Individual Data Point Evaluator (95th percentile)	Central Tendency Evaluator (95th percentile of annual medians)	WUL (QZ14-031)	Individual Data Point Evaluator (95th percentile)
Ammonia (mg/L)	0.12	0.063	0.25	0.18
Nitrite (mg/L)	0.040	0.028	0.060	0.050
Nitrate (mg/L)	0.22	0.15	9.1	4.7
Dissolved Al (mg/L)	0.053	0.032	0.10	0.077
Dissolved As (mg/L)	0.0011	0.00086	0.0050	0.0031
Dissolved Cd (mg/L)	0.000050	0.000044	$e^{(0.736(\ln(hardness))-4.943)}$	0.00022[1]
Dissolved Cr (mg/L)	0.0011	0.0010	0.00100	0.0011
Dissolved Cu (mg/L) (when DOC @ W2 > 10 mg/L)	0.0054	0.0029	0.020	0.013
Dissolved Cu (mg/L) (when DOC @ W2 ≤ 10 mg/L)	0.0054	0.0029	0.013	0.0092
Dissolved Fe (mg/L)	0.91	0.57	1.1	1.0
Dissolved Pb (mg/L)	0.00025	0.00014	0.00400	0.0021
Dissolved Mo (mg/L)	0.0015	0.0011	0.0730	0.037
Dissolved Ni (mg/L)	0.0020	0.0016	0.11	0.056
Dissolved Se (mg/L)	0.00050	0.00046	0.0020	0.0013
Dissolved Ag (mg/L)	0.000010	0.000010	0.00010	0.000055
Dissolved Zn (mg/L)	0.0084	0.0046	0.030	0.019

[1]Cadmium alue calculated using 5th ercentile hardness (225.2 mg) in erational Stage W calculation. Actual objective for comparison with monitoring results will be calculated with observed hardness.

Table 3-4: Background Concentrations (Interim PC WQOs) for McGinty Creek, to be applied at Station MN-4.5.

Analytes	Background Concentrations	
	Individual Data Point Evaluator (95th percentile)	Central Tendency Evaluator (95th percentile of annual medians)
Ammonia (mg/L)	0.118	0.046
Nitrite (mg/L)	0.050	0.005
Nitrate (mg/L)	0.232	0.083
Dissolved Al (mg/L)	0.135	0.047
Dissolved As (mg/L)	0.00061	0.00054
Dissolved Cd (mg/L)	0.000041	0.000015
Dissolved Cr (mg/L)	0.0010	0.0010
Dissolved Cu (mg/L)	0.0035	0.0028
Dissolved Fe (mg/L)	0.403	0.358
Dissolved Pb (mg/L)	0.00020	0.00020
Dissolved Mo (mg/L)	0.0010	0.0010
Dissolved Ni (mg/L)	0.0018	0.0016
Dissolved Se (mg/L)	0.00019	0.00016
Dissolved Ag (mg/L)	0.000020	0.000020
Dissolved Zn (mg/L)	0.0052	0.0050

3.2 Design Criteria

Design criteria are presented in the relevant design documents. The information in this section is provided for summary purposes only- the design documents stand alone and take precedence.

3.2.1 Water Management Structure and Systems

The post-closure water management system at Minto mine will consist of the following:

- Water conveyance system (Primary, secondary, and tertiary channels);
- Water reservoirs (Main Pit and Area 2 Pit); and
- Passive treatment facilities (wetlands) (Appendix G1).

Design criteria and preliminary design specifications for the water conveyance system are provided in the Minto Mine – Closure Water Conveyance System Design Update Report (Appendix G2). The closure conveyance structures are a network of channels, erosion protection features, and energy dissipation structures that convey surface water from the mine surface through to Minto Creek which discharged into the Yukon River.

This design report focuses on the primary arterial network of conveyance structures within the mine footprint. Secondary and tertiary drainage features and swales are not included in the preliminary engineering design for the conveyance channels, however the engineering designs for the closure covers do take account of drainage from the various covered facilities. It is anticipated that the design of the secondary and tertiary drainage features will not have a significant influence on the design of the primary conveyance network.

No specific design criteria were considered for the reservoirs formed by the mined-out pits. These reservoirs are the Main Pit lake and the Area 2 Pit lake. These two will act as flow-through systems and the available capacity will be utilized to effectively attenuate peak flows and provide an area where sediments can be deposited.

3.2.1.1 *Water Conveyance System*

Hydrology: Primary conveyance channels are designed to convey all flows up to the 24-hour duration, 1:200 year return period event.

Channel Alignment: Conveyance channel alignments were selected based on four main criteria: 1) Conveyance of runoff generated from catchment areas, 2) Minimization of channel slopes to the extent practical, 3) Utilization of end pit lakes to attenuate flow and settle sediment, and 4) Ultimately convey flow to a confluence with Minto Creek upstream of the W3 sampling location. In addition, the potential for long term thaw consolidation of ice-rich permafrost overburden soil to cause changes in conveyance alignments was considered, and alignments were selected to limit channel length over deeper permafrost overburden where possible.

Concept of Low Maintenance: Closure conveyance channels must be designed in a manner that their constructed features are robust and durable. Key design criterial should consider:

- Rock riprap erosion protection;
- Robust geometry that reduces the risk of overtopping and erosion;
- Accounts for future climate change conditions and discharge requirements; and
- Utilizes the end pit lakes for mixing, energy dissipation, and sediment deposition.

Typical Channel Geometry: All closure conveyance channels are designed with a typical geometry that reflects the size and capability of the construction equipment that is used onsite. Channel geometry for all channels include a base width of 7 m and side slopes 2:1, and a freeboard of 0.5 m. Channel depths are variable due to channel grade.

Pilot Channel Geometry: Conveyance channel E1 and E2 are designed to include an excavated pilot channel in the base of the main conveyance channel. The pilot channel is designed to convey routine 1:2 year flows. Pilot channel geometry is 3 m wide and 0.5 m deep with 2:1 side slopes.

3.2.1.2 *Energy Dissipation Basins and Aprons*

The energy dissipation apron for Channel A is designed to transition high energy channel flow into the Main Pit and minimize erosion. The apron riprap specification will be defined in a later design stage once as-built surface details are available- at a minimum, the apron riprap will sized to withstand the 1:200 year design flows.

The stilling basin for Channel E Segment 3 is designed to dissipate the energy from the design flows exiting the channel and entering the Primary Head Pond. The stilling basin (including the riprap component) has been designed to handle the Probable Maximum Flood.

3.2.1.3 *Riprap Protection and Seepage Management:*

All primary closure conveyance channels are designed to be lined with rock riprap for erosion protection. Each channel is divided into segments that relate to a typical riprap classification.

Seepage loss though the conveyance channels likely to be limited and is considered to pose a minimal risk to the environment. At later stages of closure design the need for a geomembrane or low conductivity layer will be further evaluated to determine whether segments of the conveyance channels require additional seepage control.

At this stage of design, the potential for sediment migration and erosion of the base material beneath the rock riprap protection has been considered and it does not appear to warrant the use of a geotextile. As such, a geotextile layer has not been included because the excavated material on which the channel alignments are to be constructed consists of either heavily compacted road fills from existing haul roads or coarse rock fills generated during mine development. However, at later stages of design if alignments are altered or the foundation materials change, portions of the channels may require a geotextile separation layer between the riprap and the excavated foundation.

3.2.1.4 *Inlets, Outlets and Spillways*

Conveyance channels C and D are designed to include a pit spillway transition section that conveys the discharge of the Main Pit and the Area 2 Pit. Both spillways are designed to have a 14 m wide spillway section that is 0% slope which transitions to the design channel width and depth. At this stage of design the transition section from 14 m to 7 m width occurs over a 20 m channel length. The upstream surface of spillway entrance section is designed to include rock riprap erosion protection. Riprap sizing for the intake will include rock that is oversize for the classification specification.

3.2.1.5 *Water Reservoirs*

The Main Pit water reservoir is planned to have a nominal water elevation of 786 masl.

The Area 2 Pit water reservoir is planned to have a nominal water surface elevation of 799 masl.

Outflow from both pits will be via spillways that are at least 14m wide, to limit the flow attenuation that occurs in the pits and therefore limit the influence on the hydrological regime that reports to lower Minto Creek.

The Water Storage Dam currently impounds the Water Storage Pond. The Water Storage Pond will be converted to a constructed wetland treatment system during the Active Closure Period, and the Water Storage Dam will be decommissioned over the same period. The Water Storage Dam design stability exceeded the minimum Factor of Safety (FoS) for the following conditions: FoS ≥1.5 for the steady state seepage condition, FoS ≥1.2 for the stability of the upstream face in a submerged condition, and FoS ≥1.2 for seismic loading conditions using a peak ground acceleration of 0.083g (EBA 1995).

3.2.2 Overburden and Waste Rock Dumps

Per Yukon requirements, design criteria for overburden and waste rock dumps are based on the recommended Factors of Safety (FOS) listed in the “Mined Rock and Overburden Piles Investigation and Design Manual” (BC Mine Waste Rock Pile Research Committee 1991); these are provided in Table 3-5.

Table 3-5: BC Mined Rock and Overburden Pile Minimum Factor of Safety Guidelines

Stability Condition	**Suggested Minimum esign alues for S**	
	Case A	**Case**
Stability of Dump Surface		
Short-term (during construction)	1.0	1.0
Long-term (reclamation – abandonment)	1.2	1.1
Overall Stability (Deep Seated Stability)		
Short-term (static)	1.3 – 1.5	1.1 – 1.3
Long-term (static)	1.5	1.3
Pseudo-static (earthquake)	1.1 – 1.3	1.0
Case A Low level of confidence in critical analysis parameters Possibly unconservative interpretation of conditions or assumptions Severe consequence of failure Simplified stability analysis method (charts, simplified method of slices, etc...) Stability analysis method poorly simulates physical conditions Poor understanding of potential failure mechanism(s)		
Case B High level of confidence in critical analysis parameters Conservative interpretation of conditions, assumptions Minimal consequence of failure Rigorous stability analysis method Stability analysis method simulates physical conditions well High level of confidence in critical failure mechanism(s)		

The waste dump seismic design criteria based on BC Mine Waste Rock Pile Research Committee 1991 guidance that outlines that a 10% probability of exceedance in 50 years or the 1:475 event is appropriate for dump design. The peak ground acceleration in the Minto project area is approximately 0.05 g (per the 2015 National Building Code). Table 3-6 lists the design peak ground acceleration utilized in design of waste dumps and other structures at Minto. It should be noted that the range in the design criteria listed in the above table is a function of updates to the National Building Code Seismic Hazard models over time. For example, the Main Waste Dump was designed in the mid-1990s and subsequent to its design, the Geological Survey of Canada revised the seismic hazard model which reduced the peak ground acceleration at Minto for the design event (1:475

year earthquake) from 0.150 g to 0.057 g. The 2015 revision to the seismic hazard model further reduced the peak ground acceleration for the 1:475 year earthquake at Minto to 0.05 g from 0.057 g (see Section 4.11).

Table 3-6: Design Peak Ground Acceleration of Minto Structures

Structure	Design Peak Ground Acceleration	Reference
Water Storage Dam	0.083	EBA 1995
Main Waste Dump	0.15 g	EBA 1998
Ice Rich Overburden Dump	0.055 g	EBA 2006
Dry Stack Tailings Storage Facility	0.055 g	EBA 2007
Southwest Waste Dump	0.055 g	EBA 2008
Main Waste Dump Expansion	0.057 g	SRK 2013a
Area 118 Backfill Dump	0.057 g	SRK 2013c
Main Pit Dump	0.057 g	SRK 2013a
Mill Valley Fill Extension Stage 2	0.057 g	SRK 2015a

3.2.3 Tailings Storage Facilities

The Main Pit TMF and the Area 2 Pit TMF are both in-pit tailings storage facilities and neither is subject to rigorous design criteria. The Main Pit TMF is expected to have a combination of subaerial and subaqueous tailings at the start of Active Closure, while the Area 2 Pit TMF is expected to have only subaqueous tailings at that time.

DSTSF design criteria were: Factor of Safety (FoS) ≥1.3 for long term stability, and FoS ≥1.1 for seismic stability (using a peak ground acceleration of 0.055 g.

3.2.4 Cover Systems (Soil and Vegetation)

Design criteria for soil covers are presented in the cover design report (Appendix E3) and can be summarized as follows:

- Design life: 100 years
- Slope stability of dump surface (long term- Table 3-5): Factor of Safety ≥ 1.1
    - Erosion resistance:
    - Soil loss of <6 t/ha/year after implementation of erosion control measures (e.g. vegetation establishment) are fully implemented
    - No damage following 1:200 year, 24 hour duration storm during peak freshet conditions

Additional qualitative design performance considerations are discussed in the cover design report.

4 Environment Description

4.1 Site Overview

The Minto Mine is located on the west side of the Yukon River, approximately 240 km northwest of Whitehorse, Yukon (Figure 4-1) and is centered at 62°36'N latitude and 137°15'W longitude (NAD 83, UTM Zone 8 coordinates 6945000N, 384000E). Highway 2 (North Klondike Highway) is located on the east side of the Yukon River; the mine can be accessed by road in the summer by barge crossing or in winter by the ice bridge crossing at Minto Landing. The airstrip at the mine allows access by fixed-wing aircraft year-round.

A summary the environmental conditions are summarized in the table below:

Table 4-1: Summary of Environmental Conditions

Project Area Attribute Description	Project Area Attribute Description
Region:	Yukon
Topographic map sheet:	NTS 115 I/10, 115 I/11
Geographic location name code:	Minto Project
Latitude:	62° 36' N
Longitude:	137° 15' W
Drainage region:	Yukon River
Watersheds:	Yukon River, Big Creek, Wolverine Creek, Dark Creek, McGinty Creek, and Minto Creek.
Ecoregion:	Yukon Plateau (Central) - Pelly River ecoregion.
Study area elevation:	Rolling hills above mine site at 1131 to 600 m at the Yukon River Valley bottom.
Site climate:	Temperature ranges from –43.2°C (November 2006) to 30.3°C (July 2009). Mean annual temperature of –1.8°C. Mean annual rainfall is 174mm.
Vegetation communities:	Riparian, black spruce, white spruce, paper birch, lodgepole pine, buck brush/willow and ericaceous shrubs, feather moss, sedge, sagewort, grassland, mixed forest (aspen, balsam, and sub-alpine). Discontinuous permafrost is present on site. Site has been subject to recent forest fires.
Wildlife species:	Moose, caribou, Dall sheep, mule deer, grizzly and black bear, varying hare, beaver, lynx, marten, ermine, deer mouse, fox, mink, wolverine, least weasel, wolf, squirrel, porcupine coyote, muskrat, otter and wood frog. Bird species include: spruce, blue, ruffed, and sharp-tail grouse; waterfowl, raptors, and a variety of smaller birds.
Fish species:	In the Yukon River: Chinook, Coho, and chum salmon, rainbow trout, lake trout, least cisco, Bering cisco, round whitefish, lake whitefish, inconnu, Arctic grayling, northern pike, burbot, longnose sucker and slimy sculpin. In Big Creek: Chinook and chum salmon, Arctic grayling and whitefish species. In Wolverine Creek: Chinook salmon, Arctic grayling, and slimy sculpin. In Minto Creek (lower reaches only): Chinook salmon, slimy sculpin, round whitefish, Arctic grayling, longnose sucker, burbot. In McGinty Creek (lower reaches only): slimy sculpin, Arctic grayling.

The Minto Mine property lies in the eastern portion of the Dawson Range, which is part of the Klondike Plateau Physiographic Region, an uplifted surface that has been dissected by erosion. The area was largely unglaciated during the last ice age and topography consists of deep and narrow valleys, rounded rolling hills, and ridges with relief of up to 600 m (2,000 ft). The highest elevation on the property is 975 m (3,200 ft) above sea level, compared to lower elevations in the region with elevations of 460 m (1,500 ft) along the Yukon River.

The Minto Mine is near the height of the land, with relatively gentle slopes and smooth ridges that often have spines of bedrock outcrops (tors) at their crests arising from long periods of weathering. Broad ridges are typically mantled with felsenmeer (fields of angular, frost-heaved, in situ rock fragments). Below the ridge crests, bedrock exposures are limited or negligible. The Project area lies in a zone of extensive discontinuous (50–90%) permafrost and is included in the western portion of the Yukon plateau central ecozone. North-facing slopes in the area are commonly underlain by permafrost. Valley-bottom deposits and upland soils usually contain ice-rich horizons. Well-drained uplands may have permafrost-free soils.

As the ecoregion is largely unglaciated, the dominant parent materials are stony residual materials along ridge tops and summits, coarse colluvium on upper slopes, and silty colluvium and loess (rich in organic matter) on lower slopes and floors of main valleys. Muck is usually capped with peat and underlain by permafrost. In the Minto Mine area, much of the colluvium on ridge slopes is coarse sand derived from decomposition of the largely granitic bedrock in the area. Overburden of relic soils predating the last glaciation include lacustrine deposits overlain by colluvium and organic silt in some upper valleys, some of which were exposed during excavation on the south side of the pit.

The mine development area is in the transition from the forested to non-forested (alpine) zone. Below the treeline (elev. ~1,000 m) the vegetation patterns reflect the discontinuous distribution of permafrost with stunted black spruce woodlands on cold, north-facing sites and mixed (aspen, white spruce, minor birch) forests on warm, south-facing slopes. The area has been burned over by several wild fires, the latest of which was in 2010 (Minto Landing to lower Minto Creek area). Many of the burnt trees have blown down and natural regeneration of pine and alder is occurring over much of the property and the Project area.

The climate of the region is continental with short, warm summers and very cold winters. The summer period is characterized by temperatures in the range of 10 to 20°C. The winter period is characterized by a much larger day-to-day variation in air temperatures, typically between -10 and -30°C. Annual precipitation ranges from 300 to 500 mm. Diurnal variation in air temperatures tends to be less during the winter period than during the summer. The transitions between winter and summer are characterized by a quick rise or fall in air temperatures. July has been the warmest month on average (14.6°C) while the coldest has been January (−19.1°C). The mean annual air temperature at the site is −1.8°C. The maximum air temperature ever recorded was 30.3°C. The minimum air temperature ever recorded was −43.2°C.

The area is drained by tributaries of the Yukon River. The rate of runoff is controlled by almost total vegetation ground cover and moderate slope gradients. Infiltration rate is expected to be high in areas of thicker colluvium. However, permafrost and seasonally frozen soils inhibit vertical percolation.

Topography in the Dawson Range is moderate and the active geomorphological processes in the study area are typically limited to include slow mass movement (solifluction) and some minor gully erosion. Although there are no reports of large-scale active natural landslides in the Minto Project area, smaller scale instabilities have recently been documented in the Minto Creek catchment area, downstream of the mine site.

capstone
MINTO MINE

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RECLAMATION AND CLOSURE PLAN
REVISION 2016-01

FIGURE 4 -1
PROJECT LOCATION

4.2 Meteorology

The existing meteorology of the Project area and the climate trends and projections of the Minto region of Yukon were described in AEG's Minto Climate Baseline Report (2013) (Appendix H). The meteorological data contained in the report was recorded by two on-site meteorological stations over a period of about seven years. Snow depth data was provided from ten annual on-site snow surveys since 1994. The data used in climate trend analyses was sourced from regional monthly and annual records provided by the Meteorological Service of Canada and applied to the Project area. Environment Canada's Coupled Global Climate Model (CGCM2) provided future temperature and precipitation scenarios for the purpose of climate forecasting for the region. Details of the data collection program and the procedures used for analysis are provided in the Climate Baseline Report in Appendix H.

4.2.1 General Regional Climate

The climate in the Minto region is subarctic continental characterized by long, cold winters and short, cool summers. The area experiences moderate precipitation in the form of rain and snow and a large range of temperatures on a yearly basis with a mean annual temperature below 0°C.

4.2.2 Summary of Meteorogical Condition (2005-2015)

Two meteorological stations installed at the property have recorded wind speed and direction, air temperature, relative humidity, barometric pressure, solar radiation and rainfall in one-hour intervals since September 7, 2005 for the HOBO station and October 15, 2010 for the Campbell Scientific station.

4.2.2.1 *Wind*

Severe rim ice build-up on the HOBO anemometer cups has resulted in extended periods of recorded zero or diminished wind speeds during the winter (EBA 2010c). The Campbell Scientific anemometer has shown to be much less prone to icing. Based on the wind record from the two meteorological stations, and excluding periods where the anemometer was iced up, the two predominant wind directions at site are S to SE and N to NW. Average wind speed is 2.64 m/s at 3 m height and 2.9 m/s at 10 m.

4.2.2.2 *Air Temperature*

Summer is characterized by temperatures in the range of 10°C to 20°C. Winter is characterized by a much larger day-to-day variation in temperatures, typically between –10°C and –30°C. Diurnal variation in air temperatures tends to be less during the winter period than during the summer period. The transitions between winter and summer are characterized by a quick rise or fall in air temperatures. July has been the warmest month on average (14.6°C) while the coldest has been January (–19.1°C). The mean annual air temperature at the site is –1.8°C. The maximum air temperature ever recorded was 30.3°C. The minimum air temperature ever recorded was –43.2°C.

4.2.2.3 *Relative Humidity*

Relative humidity is highest during the winter months, (typically in the range of 75% to 95%), and lowest during the spring and early summer, typically in the range of 40% to 60%. Relative humidity has a much larger day-to-day variability during the summer. The lowest recorded %RH was 10.25%. The highest was 100%. Annually, mean relative humidity is 71%.

4.2.2.4 *Barometric Pressure*

As would be expected at a latitude of 62.6°N, a strong seasonal pattern is evident in solar radiation, with a maximum being received near the summer solstice in late June (daily maximums on the order of 750 W/m^2), and daily maximums slightly above zero around the winter solstice. The average amount of solar radiation received at the site annually is 111 W/m^2. The highest daily average is received in June (230 W/m^2). The lowest is in December (5 W/m^2).

4.2.2.5 *Solar Radiation*

As would be expected at a latitude of 62.6°N, a strong seasonal pattern is evident in solar radiation, with a maximum being received near the summer solstice in late June (daily maximums on the order of 750 W/m^2), and daily maximums slightly above zero around the winter solstice. The average amount of solar radiation received at the site annually is 111 W/m^2. The highest daily average is received in June (230 W/m^2). The lowest is in December (5 W/m^2).

4.2.2.6 *Precipitation*

Rainfall

The tipping bucket rain gauge mechanism used to record precipitation at site is designed to record rainfall. However, wet snow falling into the catch tube and melting in the bucket at temperatures near 0°C would result in an instance of recorded precipitation. In order to provide an accurate estimate of total rainfall only, any recorded precipitation occurring when air temperatures were below zero was omitted from the record (EBA 2010c). Based on a cumulative of average monthly rainfall, 174.2 mm of rain is expected on average at site in a single year (EBA 2010c). August is the rainiest month with an average rainfall of 51.0 mm. The largest monthly rainfall total was 101.8 mm (July 2011). The largest one-day rainfall was 28.2 mm (August 25, 2008). Rainfall has been recorded in every month of the year.

Total Precipitation

On October 14, 2011, a snowfall conversion adaptor was installed on the tipping bucket of the Campbell Scientific station; however, the total precipitations record is not yet long enough yet to provide meaningful statistics. Environment Canada's Canadian Climate Normals (1971-2000) for Pelly Ranch indicate that on average, annual precipitation occurs 64% as rainfall and 36% as snow. With the assumption that regional precipitation is homogeneous and ignoring any significance of elevation, orographic effects or valley orientation, the Minto property can be estimated to receive an additional 100 mm of water-equivalent precipitation in the form of snow annually for a total annual precipitation of approximately 274 mm (EBA 2010c).

Snowpack

Based on the ten years of snow surveys, the average water-equivalent snow depth remaining on the first day of March and April is 95.0 mm and 96.8 mm respectively. In four of the seven May surveys, the snowpack had melted entirely by May 1. In the three years where snow remained on the ground on May 1 (1995, 2006, and 2008), the mean snowpack had reduced to 10%, 27%, and 20%, respectively, of the peak measured snowpack in that year. The data indicates that the majority of runoff due to snowmelt occurs in April.

Evaporation

Evaporation has been indirectly measured via an evapotranspiration (ET) calculation that was incorporated into the Campbell Scientific program in 2012. In 2016, an upgrade to Minto's meteorological monitoring station (Met Station 2) was carried out that added an evaporation pan to allow direct measurement of evaporation at site, and measurements will be available in future from July 2016 onward.

Over the three full years from 2013 through 2015, the calculated average annual ET was roughly 430 mm/year. This compares to an estimated 400 mm/year based on the average daily evaporation estimates from Environment Canada's Pelly Ranch climate station for the 1971–1999 period (EBA 2010c).

4.2.3 Regional Climate Trends (Climate Change)

A detailed analysis of future climate trends was undertaken to support the closure conveyance designs- details of the methods and the outcomes of the analysis are provided in a memo titled "Climate Change Analysis, Minto Mine, Yukon" that is appended to the closure water conveyance design report (Appendix G2). Summary details regarding expectations of future temperature and precipitation conditions are provided in the following sections.

4.2.3.1 *Temperature*

The mean annual air temperature at Minto is expected to increase by about 3.3°C over the next century, with mean annual air temperatures of −0.8°C, 0.2°C, and 1.1°C in the 2020s, 2050s and 2080s, respectively.

4.2.3.2 *Precipitation*

The total precipitation at Minto is forecasted to increase 67.9 mm (15%) during the mine life (2011 to 2040) and 199.3 mm (44%) by 2100.

4.3 Surface Water Hydrology

The baseline surface hydrology of the Minto Creek watershed prior to mining activity was detailed in Clearwater Consultants Ltd.'s Memorandum CCL-MC6 Minto Copper Project—Surface Water Hydrology Conditions (baseline memorandum attached as Appendix I1). CCL-MC6 also covered conditions during mine operations until 2009. In 2013, an updated baseline conditions report was issued by AEG (Appendix I2) along with updates in 2014 and 2015 (Appendix I3 and I4) for a complete reference of all data gathered to date. Additionally, since 2009 data have been gathered from the McGinty Creek catchment which is located directly north of the Minto Creek catchment. The McGinty Creek catchment is similar in size to Minto Creek, and it also drains into the Yukon River. McGinty Creek was named by SFN elders after the family whose traditional trapping area is in the vicinity of the Minto Mine.

Figure 4-2 shows the Minto and McGinty Creek hydrometric monitoring network and catchment areas.

Hydrological data have been gathered by either AEG or Minto representatives. Data coverage from year to year varies, depending on when in situ dataloggers were installed and removed, and when instantaneous discharge measurements were taken. Instantaneous discharge is measured using the velocity-area method and a current meter. Solinst Water Leveloggers are used to collect continuous stage readings which are then corrected based on physical staff gauge measurements. The records are processed into continuous discharge based on the stage-discharge relationship. This relationship (stage and discharge) is re-established each season through rating measurements obtained during regular field visits to the sites.

The locations for which the greatest amount of data have been collected are stations W1, Minto Creek near the mouth (catchment area of 42 km^2); and W3, Minto Creek downstream of Water Storage Dam (catchment area of 10.4 km^2 area). In 2010, another continuously monitored hydrometric site called MC1 was added, approximately 2 km upstream of W1. In 2011, data collection did not allow for processing of stage records into continuous discharge; however, improved monitoring allowed for successful processing in 2012, 2013, 2014 and 2015. The data collected since the 2013 baseline report (Memo - Minto and McGinty Creek 2014 Hydrology Update and Memo- Minto and McGinty Creek 2015 Surface Hydrology Update) are included as Appendix I3 and I4.

In addition to Minto Creek, McGinty Creek has been monitored since 2009 to support development of the Minto North deposit. There are five stations on McGinty Creek at which discharge is measured. In 2009, four stations were established including MN-4.5, MN-2.5, MN-1.5 and MN-0.5; in 2011 a fifth site, MN-0.2, was added (Figure 4-2). Continuous hydrometric data has been collected at MN-4.5 since 2009, and additional continuous logging instruments were added to stations MN-2.5 and MN-0.5 in late 2012.

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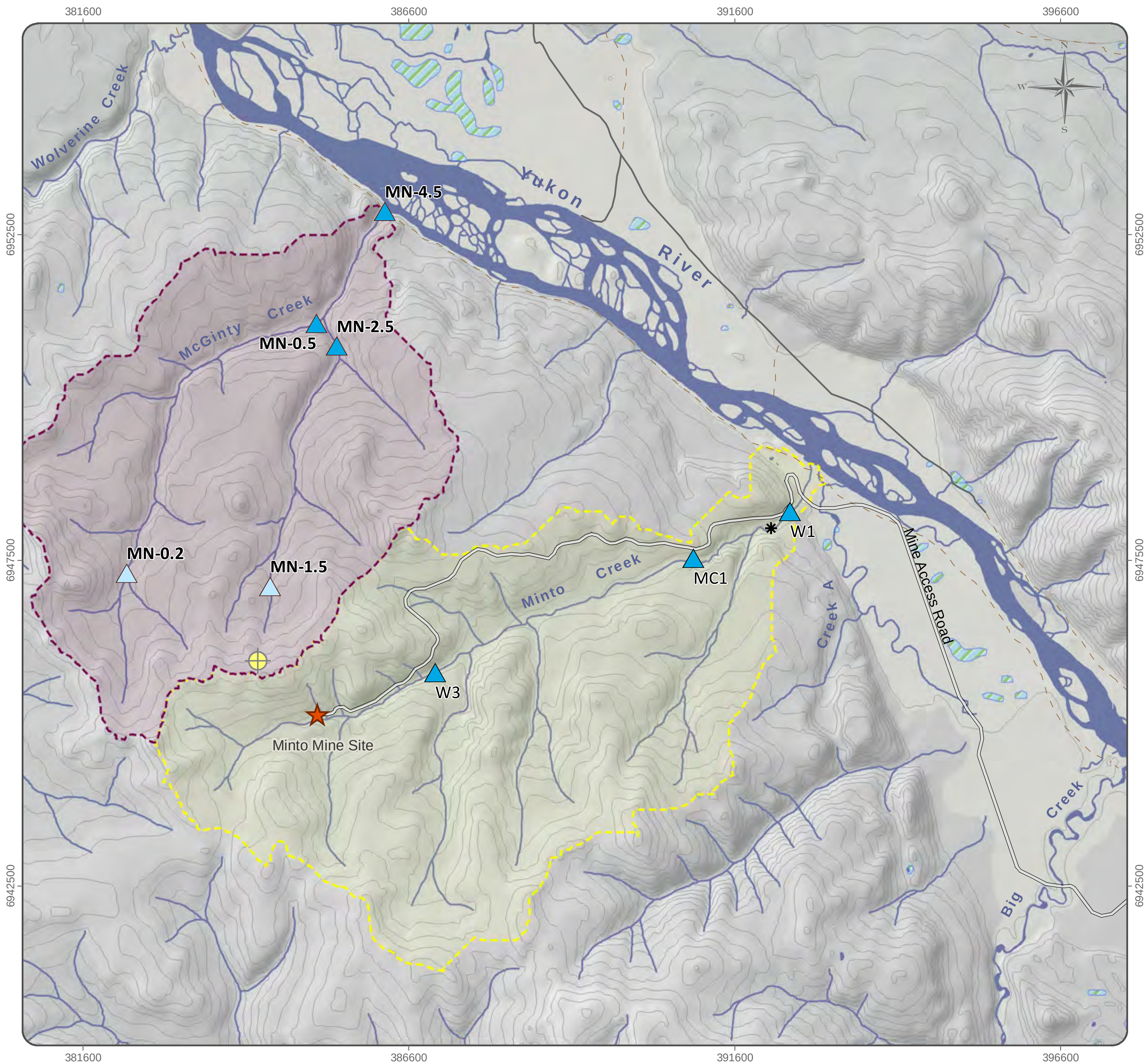
FIGURE 4 - 2

MINTO AND MCGINTY CREEK HYDROMETRIC MONITORING NETWORK AND CATCHMENT AREAS

AUGUST 2016



- Discrete Measurement Site
- Hydrometric Station
- Obeserved Fish Barrier - Minto Creek
- Minto North Deposit
- Minto Access Road
- Limited-use road
- Trail
- Minto Creek Catchment
- McGinty Creek Catchment
- Wetland

1:80,000 *when printed on 8.5 x 11 inch paper*

0 1 2 3 km

NAD 83 UTM Zone 8N

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4.3.1 Minto Creek

Monitoring of hydrological parameters on Minto Creek began in 1993 and has continued intermittently at sites W1 and W3 (Figure 4-2). Monitoring has been more intensive since mine commissioning in 2007. W3 is an in-stream trapezoidal flume with a manufacturer-specified stage-discharge relationship. Both discharge and stage are read on an integrated gauge in the throat of the flume. A Solinst Levelogger record is calibrated with these field observations to process a continuous discharge record at this site. Sites MC1 and W1 are natural stream channels where manual velocity measurements are taken across the channel and discharge is calculated using the velocity area method. Continuous water levels from Solinst Leveloggers are processed into continuous discharge using these rating measurements. Updated mean monthly flows for W1 and W3 are presented in Table 4-2 and Table 4-3, respectively.

Table 4-2: Mean Monthly[1] Discharge (m^3/s) on Minto Creek at Station W1

	Apr	May	Jun	Jul	Aug	Sep	Oct
1993	--	--	--	--	--	0.069	--
1994	--	0.312	0.058	0.095	0.007	0.073	--
1995	--	0.027	0.001	0.091	--	0.133	--
1996	--	0.031	0.024	0.324	--	0.146	--
1997	--	1.447	--	--	0.265	--	--
1998	--	0.161	--	--	0.003	--	--
1999	--	--	--	--	0.033	--	--
2000	--	1.004	--	--	--	--	--
2001	--	0.467	--	--	--	--	--
2002	--	--	--	--	--	--	--
2003	--	--	--	--	0.129	--	--
2004	--	--	--	0.118	--	--	--
2005	--	0.097	0.012	0.127	0.209	0.219	0.134
2006	0.203	0.354	0.15	0.02	0.0068	--	0.031
2007	0.645	0.175	0.053	0.061	0.025	0.034	0.035
2008	--	0.117	0.015	0.026	0.184	0.184	0.026
2009	--	0.868	0.351	0.249	0.139	0.026	--
2010	0.560	0.081	0.038	0.106	0.118	0.125	0.092
2011	--	--	0.229	0.200	0.200	0.082	--
2012	--	0.269	0.073	0.052	0.051	0.078	0.056
2013	--	0.485	0.064	0.065	0.044	0.085	0.059
2014	--	0.138	0.022	0.020	0.014	0.031	0.025
2015	--	0.117	0.010	0.010	0.030	0.024	0.02
Mean							
Pre-Mine 1993 to 2006	0.203	0.433	0.049	0.129	0.093	0.128	0.083
Mining Period 2007 to 2015	0.603	0.281	0.095	0.088	0.090	0.074	0.045
All Data 1993 to 2015	0.469	0.362	0.079	0.104	0.091	0.094	0.053

[1]Monthly flows calculated by averaging all available flow data for a given month. Average flow in months with only a single spot flow measurement assumed equal to the spot flow measurement.

[2]Flows impacted by storage within and emergency releases from the Water Storage Pond in August and September 2008 and in June through October 2009.

[3]2010-2015 flows impacted by storage and/or release from the Water Storage Pond as evidenced by the discharge record at W3.

Table 4-3: Mean Monthly[1] Discharge (m^3/s) on Minto Creek at Station W3

	Apr	May	Jun	Jul	Aug	Sep	Oct
1993	--	--	--	--	--	0.028	--
1994	--	0.101	0.028	0.039	0.011	0.028	--
1995	--	--	0.004	0.017	--	0.027	0.008
1996	--	0.013	--	0.087	--	0.021	--
1997	--	0.554	--	--	--	--	--
1998	--	--	--	--	0.006	--	--
1999	--	--	--	--	0.006	--	--
2000	--	--	--	--	--	--	--
2001	--	0.160	--	--	--	--	--
2002	--	--	--	--	--	--	--
2003	--	--	--	--	0.037	--	--
2004	--	--	--	0.026		--	--
2005	--	0.046	0.008	0.014	0.017	0.022	0.020
2006	0.018	0.128	0.042	0.006	0.015	0.009	0.010
2007	0.001	0.012	0.009	0.006	--	--	--
2008	--	--	--	--	0.064	0.122	0.003
2009	--	--	0.026	0.106	0.092	0.124	0.110
2010	0.002	0.004	0.005	0.034	0.071	0.086	0.070
2011	--	--	0.005	0.005	0.006	0.005	
2012	0.004	0.020	0.003	0.004	0.004	0.004	0.004
2013	--	--	<0.001	<0.001	0.002	0.003	0.003
2014	0.057	0.086	0.003	0.003	0.003	0.004	0.004
2015	0.075	0.052	0.003	0.003	0.004	0.004	0.004
Mean							
Pre-Mine 1993 to 2006	-4	0.167	0.02	0.032	0.015	0.023	0.013
Mining Period 2007 to 2012	0.028	0.035	0.008	0.023	0.031	0.044	0.028
All Data 1993 to 2012	0.026	0.107	0.012	0.027	0.024	0.035	0.024

[1]Monthly flows calculated by averaging all available flow data for a given month. Average flow in months with only a single spot flow measurement assumed equal to the spot flow measurement.

[2]Flows impacted by storage within and emergency releases from the Water Storage Pond in August and September 2008 and in June through October 2009.

[3]2010-2012 flows impacted by storage and/or release from the Water Storage Pond as evidenced by the discharge record at W3.

[4]Insufficient data for calculation.

Table 4-4: shows the discharge data gathered to date at station MC1. Appendix I contains the associated baseline report and annual reports with available hydrographs from 2007-2015 for stations W1, W3, and MC1.

Table 4-4: Instantaneous (2011) and Mean Monthly Discharge (2012) (m^3/s) Measured on Minto Creek at Station MC1

	Month					
Year	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**
2011	--	--	--	--	0.118	0.093
2012	0.179	0.065	0.052	0.041	0.108	-
2013	0.358	0.085	0.103	0.044	0.089	0.064 [2]
2014	0.187	0.028	0.031	0.036	0.028	0.033 [2]
2015	0.862 [2]	0.014	0.028	0.042	0.035	0.031 [1]
Mean	0.397	0.048	0.054	0.041	0.076	0.055

[1]Monthly record incomplete

[2]Calculated from multiple discrete measurements

4.3.2 McGinty Creek

McGinty Creek has two main sub-catchments that each have two water quality monitoring stations, one just above the confluence and one near the headwaters. MN-4.5 is located on the main stem below the confluence of the tributaries near the mouth; just above the Yukon River (Figure 4-2). MN-0.5 and MN-0.2 are the lower and upper stations on the west tributary, respectively. MN-2.5 and MN-1.5 are the lower and upper stations on the east tributary, respectively.

Discrete discharge readings have been gathered on McGinty Creek since 2009 with a continuous data at MN-4.5 beginning in 2011. Dataloggers were installed at MN-2.5 and MN-0.5 late in the season in 2012. Table 4-5: presents the derived monthly mean data from MN-4.5 gathered to date. Attempts to gather continuous data at other sites as proved challenging due to challenging stream morphology and very low flows not conducive to continuous monitoring. Data for the other sites can be found in the 2013 baseline report and 2014 and 2015 annual reports (Appendix I2, I3 and I4).

Table 4-5: Mean monthly discharge (m^3/s), McGinty Creek at MN-4.5

Year	**Month**						
	Apr	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**
2011	-	0.444	0.093	0.125	0.134	0.068	0.045 [1]
2012	0.212 [1]	0.230	0.180	0.082	0.053	0.109	-
2013	-	-	0.054 [1]	0.103	0.093	0.116	-
2014	-	0.230 [1]	0.041	0.037	0.026	0.046 [1]	-
2015	-	-	0.013	0.046	0.049	0.029	0.029 [1]

[1]Monthly record incomplete

4.4 Surface Water Quality

Surface water quality is a key consideration in the evaluation of potential effects of mining and mineral development projects. Effects from mining activities can be observed for significant distances downstream and changes to water quality parameters have the potential to impact aquatic resources and to affect human use of water resources. Both Minto and McGinty Creeks have been monitored for water quality conditions, with more intensity and duration of sampling in Minto Creek as part of the initial baseline, and more recently the intensive operational monitoring under the mine water quality monitoring programs (licenced and otherwise). Characterization reports for water quality in these two watersheds have been developed with the intention of presenting either baseline or existing water quality conditions as the foundation of assessing potential effects from proposed mine expansion activities. These characterization reports are included as Appendix J1 and Appendix J2. Key findings from the characterization reports are included below.

4.4.1 Minto Creek

Water quality in Minto Creek, which forms part of the receiving environment for Minto Mine, has been comprehensively characterized in numerous reports. The most recent characterization of Minto Creek water quality presented in Appendix J1 includes January 2005 to December 2015 monitoring data. Minto Creek water quality data has been reviewed and characterized for key water quality monitoring stations for both the pre-mine operation phase and the operational phase (during periods with mine effluent discharge and without mine effluent discharge). Key results for Minto Creek stations and Minto Mine Facility stations are presented below, while Figure 4-3 shows the water quality monitoring stations locations.

4.4.1.1 *Minto Creek Water Quality*

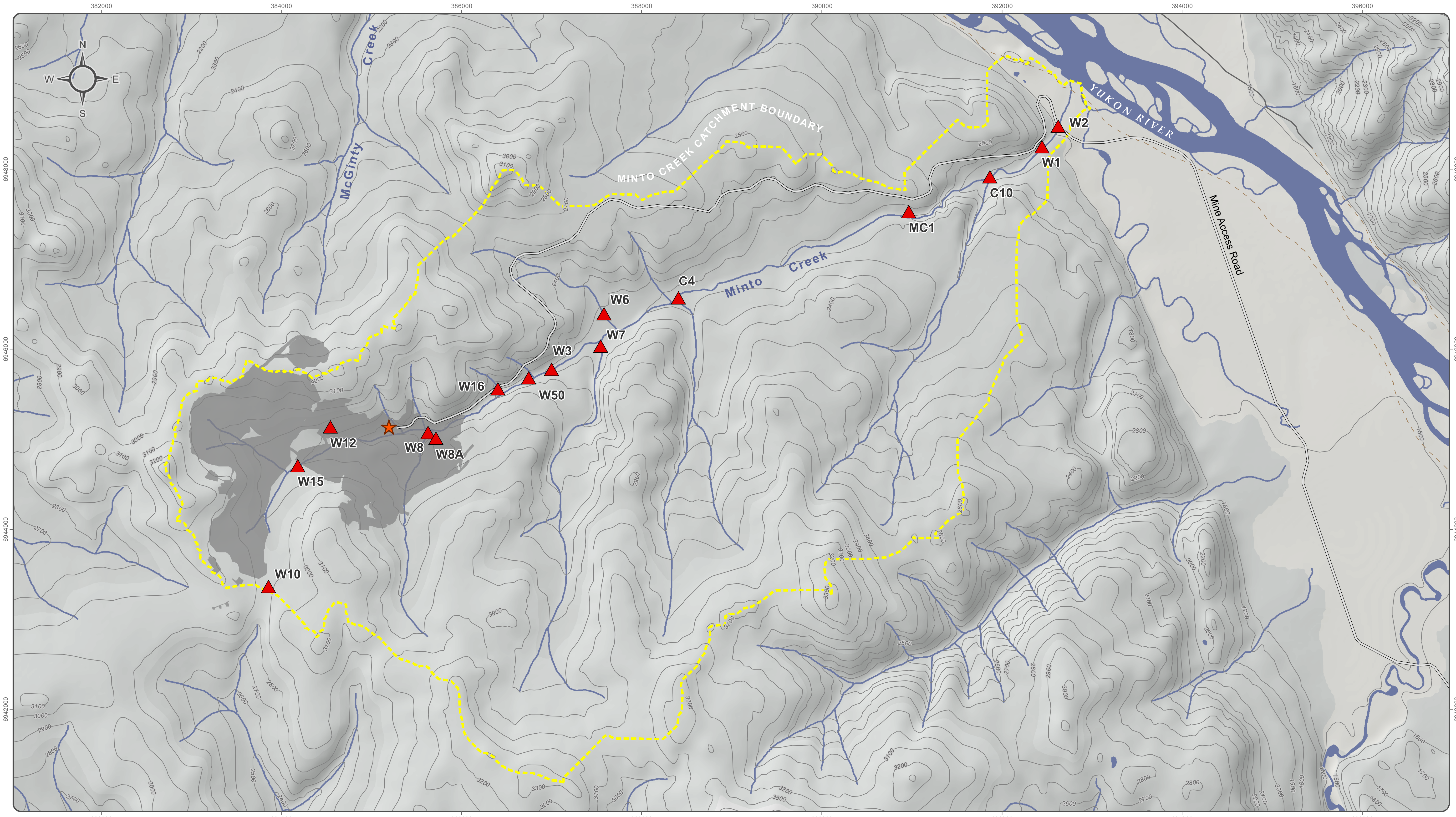
Generally speaking, during the pre-mine operation phase, aluminum, chromium, copper and iron experienced exceedances of their respective Canadian Water Quality Guidelines (CWQG) at station W2, which is the lowermost receiving environment station, where water quality guidelines and objectives for the protection of aquatic life apply. No exceedances of the site specific water quality objectives occurred during that phase.

A much more robust dataset exists for the operations with no discharge phase which also showed exceedances of the CWQGs for the same parameters as during pre-operations, and additional parameters for which exceedances were observed include: arsenic, cadmium, lead, mercury, selenium, silver, zinc, ammonia, fluoride, nitrate and pH. The list of parameters exceeding the Water Quality Objectives (WQOs), which are site specific, is shorter (aluminum, cadmium, chromium, copper, selenium, silver and nitrate) and the frequency and magnitude of exceedances is also reduced. Many of the total aluminum, cadmium, chromium and copper elevated values appear to be correlated to high TSS events. TSS started increasing in 2011, peaked in 2012 during non-discharge and has displayed a decreasing trend since.

During the operation phase with discharge, the same parameters as during non-discharge are found to be in exceedance of their respective CWQG at W2, with the exception of silver and pH and the addition of nitrite. When comparing to the site specific WQOs, only aluminum chromium, copper, selenium, ammonia and nitrate show occasional exceedances, and the majority of them occurred prior to 2012

4.4.1.2 *Minto Mine Facilties Water Quality*

Most parameters exhibit a seasonal pattern, with the highest values occurring during the summer months. Except for total and dissolved cadmium at station W8A and ammonia at station W12 that display a slight increasing trend since 2012, no clear trend emerges for other stations and parameters. Totals and dissolved copper and cadmium values are higher at station W8A than at the other stations since 2010 and 2012 respectively. Some elevated total metals values appear to coincide with high TSS events.



Datum: NAD 83; Map Projection: UTM Zone 8N

- Surface Water Quality Station
- Mine Footprint
- Minto Access Road
- Limited-use road
- Trail
- Contours (100ft)

1:40,000 (when printed on 11 x17 inch paper)

0 0.5 1 2 Kilometres

capstone MINTO MINE

ALEXCO ENVIRONMENTAL GROUP

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REVISION 2016-01

FIGURE 4-3
MINTO CREEK MONITORING STATION LOCATIONS

JULY 2016

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4.4.2 McGinty Creek

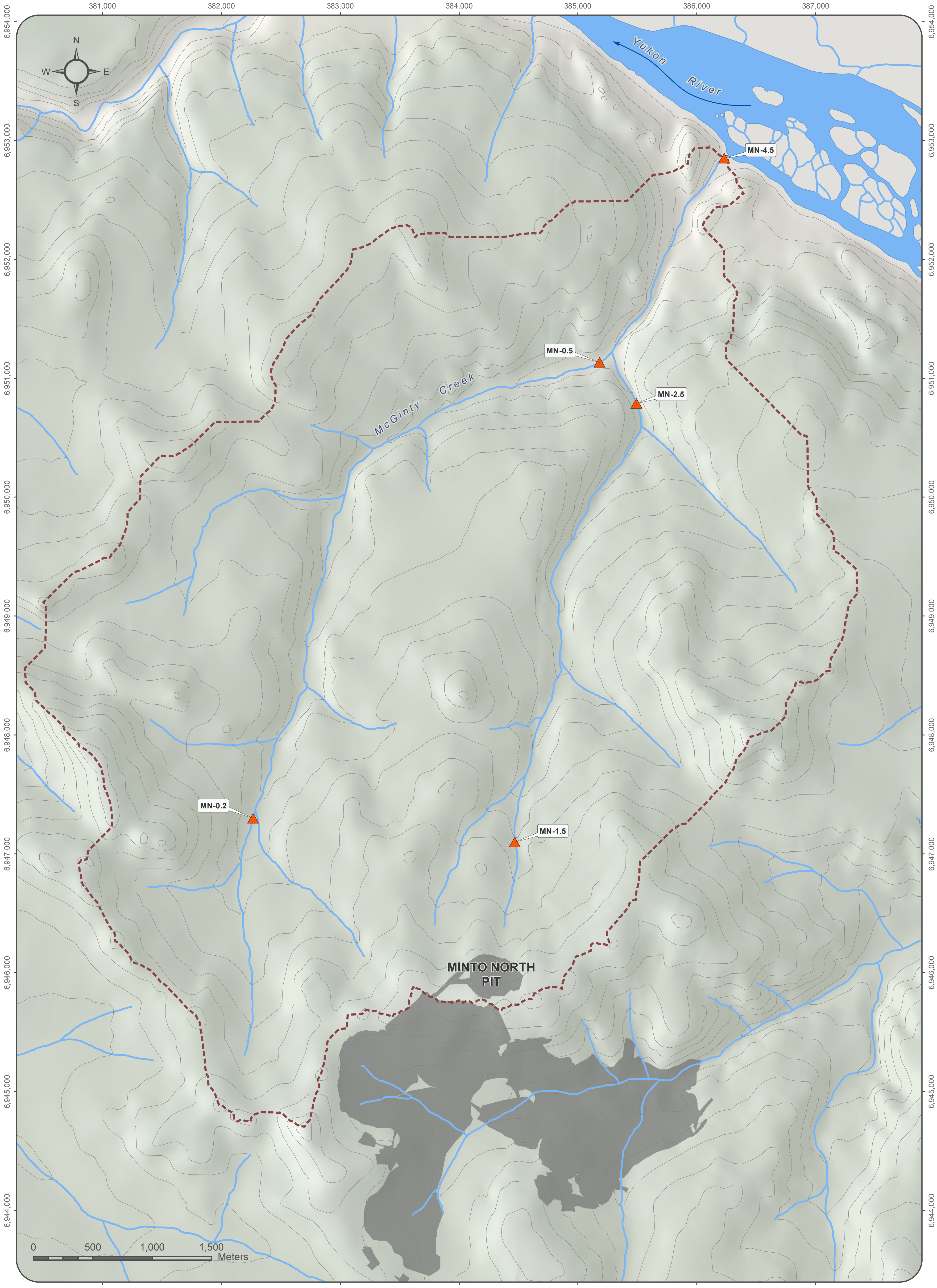
Water quality monitoring in McGinty Creek has been conducted at five stations monthly since May 2009, as conditions allowed. The east arm of McGinty Creek is considered the 'exposure tributary' as it originates downgradient of the Minto North deposit where the Minto North pit is located, while the west arm of McGinty Creek is considered the 'reference tributary' (see Figure 4-4).

Activities to date within the upper watershed consisted of exploration drilling in the vicinity of the Minto North deposit in 2009, while road construction and pit stripping started on August 5th 2015, when water use license QZ14-031 allowing mining of the Minto North open pit was issued.

Parameters that show regular exceedances of the CWQG include total aluminum, cadmium, chromium, copper, iron, lead, zinc, and fluoride. Parameters that have been shown to infrequently exceed the CWQG include arsenic, mercury, silver, ammonia, and pH. Many parameters show spikes in concentrations in the summers of 2010 (August), 2011 (July) and 2012 (June). These spikes in parameters correspond with spikes in TSS and can be attributed to corresponding heavy precipitation events. When TSS concentrations are elevated due to heavy rains or freshet runoff, it is not uncommon for TSS-associated metals to be elevated as well.

Concentrations are typically highest at station MN-1.5, which is located on the upper east arm of McGinty Creek, just downstream of the Minto North deposit. This finding is consistent the expected influence of the natural mineralization in the area. Parameter concentrations appear lowest in the winter, rising again in the spring with peak levels recorded in July and August during precipitation/runoff events. Most parameters do not appear to show a significant change in concentration during the operations period compared to pre-operations, however, this comparison is made using a limited dataset for the operation period (n=2 to 5 depending on stations). Further analyses will be made when a larger dataset is available for the operation period. A complete water quality characterization report for McGinty Creek is available in Appendix J2.

A set of WQO was developed for McGinty Creek (using the entire McGinty Creek monitoring data set to identify SSWQOs, and the CWQG where they were not routinely exceeded.) The WQO are utilized as a screening tool where they are compared with predictive water quality modeling for the McGinty Creek catchment. These WQOs also serve as specific performance thresholds in the adaptive management plan.



Monitoring Station

McGinty Creek Catchment

Mine Footprint

Contour (100 ft interval)

capstone MINTO MINE

MINTO MINE
RECLAMATION AND CLOSURE PLAN
REVISION 2016-01

FIGURE 4-4

SURFACE WATER SURVEILLANCE PROGRAM
MCGINTY CREEK MONITORING STATION LOCATION

JULY 2016

Datum: NAD 83; Projection: UTM Zone 8N

AEG

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4.5 Groundwater

Understanding of the groundwater system has been developed based on results from multiple field investigations and modeling studies completed since 2010. In August 2010, SRK produced a Groundwater Baseline Conditions report for the Minto Mine area. The 2010 report included an assessment of data collected from groundwater wells in the area and resulted in a conceptual model of the groundwater flow system and its interaction with receiving surface water bodies. A monitoring program was devised and subsequently upgraded to monitor any effects on groundwater quality and quantity as the Phase IV mine plan was carried out. In 2013, an updated Minto Mine Phase V/VI Expansion: Hydrogeological Characterization Report was provided by SRK (Appendix K1). The characterization reports and resulting conceptual model was used as the basis for an initial site-wide groundwater model (SRK 2014c). This model was updated in 2015 (SRK 2015b) to incorporate permafrost and used to further estimate groundwater flow quantities moving across the site.

SRK used drilling and piezometer installation information to inform the conceptual model and help determine appropriate locations for the multi-level wells that were installed in 2009 and 2012. These wells were installed downgradient of the waste rock and overburden dumps, Main Pit, Minto North and the DSTSF.

Generally, the groundwater chemistry was observed to be similar to (or better than) the surface water mean annual concentrations (significantly less than 1 order of magnitude difference in concentrations) (Groundwater Baseline Conditions Report, Appendix K2; Minto 2015 Groundwater Model Update, Appendix K3). One notable exception has been the sulphate concentrations in the deeper monitoring zones of well MW12-05 (the furthest downgradient well in the Minto Creek catchment). This is the subject of ongoing investigation which has most recently been described in the July 2016 submission of Minto's Groundwater Monitoring Plan which is part of the Environmental Monitoring, Surveillance and Reporting Plan (Minto 2016a).

Groundwater flow is dominated by topography and most will be confined below the permafrost layer (where it occurs). Minor seasonal shallow subsurface flow will occur above the permafrost in those areas. It is believed that flows both above and below site permafrost ultimately reports to Minto Creek. At Minto North, groundwater flow direction is likewise dominated by topography, with groundwater flowing from the upland areas towards McGinty Creek.

The flow regime at Minto Mine is a relatively simple groundwater system, but the system has some components that are difficult to characterize. With the exception of Minto North Pit, the entire mine footprint exists in a single catchment with Minto Creek as its main channel of surface discharge. However, permafrost distribution is not comprehensively known as it is discontinuous and is undoubtedly affected by mining, which results in changes in the location of permafrost boundaries over time. As permafrost creates an aquiclude (groundwater barrier), precise groundwater flow paths are challenging to determine or incorporate into a numerical model. Because the system has a main drainage location (Minto Creek), groundwater can be monitored at multiple points along the gradient, thus providing the opportunity to track possible effects on groundwater (SRK, 2014c).

Another factor that could significantly affect the groundwater flow regime is the fractured bedrock. If fractures are well connected and not blocked by low permeability materials such as clay, they have the potential to act as conduits for groundwater flow. However, observations of drill core indicate that the bedrock generally has tight fractures or fractures infilled with material including clay and hematite (SRK, 2014c).

The Minto North Pit is part of the McGinty Creek watershed (Figure 4-2). The catchment containing the pit has an area of approximately 10 ha, and is located in the upper portion of the east tributary of McGinty Creek. Minto North Pit is the only mine component within this catchment. Throughout pit operations, the pit sump water will be transferred into the Minto Creek watershed and managed with all other mine water; this transfer will result in a short term depression of the local water table. After pit operations are complete, it is expected that groundwater and local surface runoff will accumulate in the pit resulting in the groundwater table rebounding to near the pre-mining elevation (907 to 896 m above sea level) (SRK, 2014c). As noted elsewhere in this RCP, it is not known at this time whether the pit will fill to a surface discharge point or whether it will discharge via leakage through bedrock fractures.

Hydraulic conductivity data have been collected during two studies at Minto Mine. The first tests were a series of packer injection tests conducted by Golder Associates as part of the initial mine feasibility studies (Golder 1974). In the second study, rising head tests were completed as part of the multi-port (MP) monitoring well installation program in the fall of 2012 (SRK 2013g).

The bulk hydraulic conductivity for different bedrock and overburden characteristics is presented in Table 4-6. These represent the best estimate of hydraulic conductivity for each of the rock categories on site. These values were obtained by averaging all available tests for a given rock condition. Based on observations of pit wall rock, drill core, typical literature values, and experience elsewhere, these values seem reasonable.

Of note is the observation that the “fresh jointed” rock does not exhibit increased hydraulic conductivity when compared to all other rock categories. This implies that the jointing is not well connected through the rock mass (i.e., the fractures do not interlink to provide a flow path). Therefore, it appears that rock on site is consistently low K with a low probability of extensive higher K zones that could transmit significant water flux.

Table 4-6: Assumed Bulk Hydraulic Conductivity Value

Rock Condition	Hydraulic Conductivity (m/s)
Overburden & Highly Weathered Bedrock	2 x 10-07
Moderately Weathered Bedrock	6 x 10-08
Non-Weathered Bedrock	8 x 10-08
Fault Zone	5 x 10-09

The interpretation of relatively low bedrock bulk hydraulic conductivity is further supported by observations of relatively low inflow to the Minto South Underground mining area. Estimated inflow is only on the order of 3.5 L/s over the entire underground. These observations were used to calibrate the 2015 groundwater numerical model, which uses hydraulic conductivity similar to values presented in Table 4-6.

General characteristics for flow regimes across the site are presented in the sub-area descriptions provided in Minto Mine Phase V/VI Expansion: Hydrogeological Characterization Report (Appendix K1), and the conceptual model description in Minto 2015 Groundwater Model Update (Appendix K3). In the Minto Creek valley, groundwater will flow from the ridges on both sides of the valley and discharge along the valley bottom, to the open pits or to the underground. On the south slope, groundwater will have minor seasonal supra-permafrost flow, and deeper water will be confined until it reaches the valley bottom where it will then report to the creek. From the ridge near the airstrip, groundwater travels sub-permafrost beneath the DSTSF and to the Minto Creek valley. This slope contains permafrost, with seasonal flow through the active layer towards the valley. From the west, shallow groundwater will flow through and beneath the SWD, with the permafrost confining deeper water. Shallow groundwater will only flow through the active layer of the overburden before reporting to surface channels. Groundwater will flow down gradient from the east ridge west towards the SWD and will report to surface water in the valley bottom (or to open pits as shallow subsurface flow), and will also be directed to either shallow soils in the active layer or confined below the permafrost. In general, all groundwater emanating from the mine footprint in the Minto Creek catchment is expected to discharge to Minto Creek in close proximity to the mine itself. Cumulative groundwater discharging to Minto Creek by surface water station W3 is expected to be on the order of 20 L/s (~80% background + ~20% groundwater from the mine).

The Minto North Pit will fill with surface and groundwater inflows to a static water level that is expected to approximate pre-mining groundwater levels. Groundwater will flow from the ridge top down gradient into the McGinty Creek watershed. Cumulative groundwater discharging to McGinty Creek will be on the order of 2 L/s and will be 100% background, unless the pit does hold any water, in which case there could be spillover or minor shallow seepage.

4.6 Wildlife

Wildlife assessments were completed within, or near, the Project area between 1994 and 2012. These assessments are summarized in AEG's Summary of Wildlife Baseline Surveys Conducted 1994–2012 (Appendix L). Key wildlife areas are shown on Figure 4-5.

The completed assessments mainly focused on moose (*Alces alces*), Dall's sheep (*Ovis dalli*), caribou (*Rangifer tarandus dalli)*, and raptors. Other wildlife observations and sign (tracks, scat, browse, etc.) were also recorded during these surveys. Table 4-7 lists the wildlife surveys and studies conducted since 1994 in the Minto Mine area.

Table 4-7: Wildlife Surveys and Studies Undertaken in the Minto Mine Project Area

Dates	Type of Survey	Conducted By
January–March 2012	Late Winter Ungulate Studies	EDI, Environment Yukon
Fall 2012	Klaza Caribou Herd Study	Environment Yukon
March 2011	Late Winter Ungulate Study	EDI, Environment Yukon on behalf of Casino Mining Corporation
July 2010	Baseline Ecosystems and Vegetation Report*	Access Consulting Group
March 2010	Minto Mine Environmental Baseline Ecosystems and Vegetation Report	EBA Engineering Consultants Ltd.
February 2010	Late Winter Moose (Aerial)	Access Consulting Group
December 2010	Post-rut Moose Survey (Aerial)	Access Consulting Group
June 2009	Dall Sheep Survey (Aerial)	Environment Yukon
2007	Moose Survey	Environment Yukon
2003	Klaza Caribou Herd Survey	Environment Yukon
1994	Spring Wildlife Survey Spring Dall Sheep Survey Summer Raptor Survey Summer Wildlife Ground Pellet Survey	Hallam Knight Piesold Ltd.

**The 2010 Baseline Ecosystems and Vegetation Study (ACG 2010a) was not focused primarily on wildlife; however, general wildlife observations were made during the vegetation survey and were recorded on plot data sheets. This ground-based survey provided information regarding the presence of smaller animals as well as larger mammals that can be more easily seen by aerial surveys.*

Since the last wildlife baseline studies inventory (EBA 2010d), there have been three YG-led wildlife studies conducted that included the Minto site and vicinity. Two of these were late-winter ungulate surveys performed in 2011 and 2012. The survey area encompassed the Carmacks West Moose Management Unit and the Klaza caribou herd range, for a total area of 6,430 km2. In January 2013, ACG contacted the Mayo Regional Biologist, Mark O'Donoghue, for further information on these studies. Mr. O'Donoghue provided the following bulleted summary (via email) regarding recent ungulate surveys in the Project area:

- A late-winter distribution survey of moose and caribou in March 2011 covering a very large area west and south of the Yukon River (south to about the Nansen Road, west to about the Klotassin River, so covering the Minto Mine area). This was repeated by EDI in March 2012;
- A survey of sheep along the Yukon River from Minto to Fort Selkirk in June 2011 and June 2012—these have been done since 2000;
- A census of Klaza caribou in October 2012 (which followed a composition survey in September). This was done in alpine areas to the west and southwest of the mine;
- A survey to map lambing range of sheep and alpine raptor nests in the Dawson Range in May 2012, to the west and southwest of the Minto Mine. This was only partially completed because of poor weather and we are aiming to complete it in 2013 so there's no survey report yet. This survey was well to the west and southwest of the mine site, though; and
- The sheep survey referenced is attached in Appendix L which includes a figure of the surveyed area.

4.6.1 Moose

The following sections summarize the existing information on moose in the Project area.

4.6.1.1 *2007 Early-Winter Moose Survey*

The early-winter 2007 moose survey for the Carmacks West Moose Management Unit was conducted by Environment Yukon. The following information has been summarized from O'Donoghue et al. (2008).

This survey was conducted in a much larger study area than the surveys conducted by ACG during the winter of 2009/2010, which were specifically focused on the area surrounding the Minto Mine site. However, the densities should be comparable as they are similar habitat types and YG's survey included the study area of the ACG 2010 surveys. The total survey area within this management unit is 4,206 km^2, of which 4,081 km^2 was considered to be suitable moose habitat. A stratified sampling approach was used for this survey, in which the survey area is covered by a grid and each square within the grid is classified as to contain high quality moose habitat or low quality moose habitat (methods as per Kellie and DeLong 2006).

During this survey, a total of 208 moose were observed, with a total population estimate of 520 moose for the study area. The calculated moose density of 124 moose per 1,000 km^2 is considered low. Average moose densities for Yukon are 150 to 249 per 1,000 km^2 (EDI 2011). From the survey data, biologists estimated a ratio of 21 calves and 10 yearlings per 100 cows; this suggests that the survival rate for the previous two years was relatively low. The sex ratio of 75 bulls per 100 cows is considered to be a healthy sex ratio. The average sex ratio for other areas surveyed within Yukon is 68 bulls per 100 cows.

4.6.1.2 *Aerial Moose Survey - Winter 2009/2010*

Aerial moose surveys were completed on December 15, 2009 (post-rut) and February 23, 2010 (late-winter) by AEG (2010). For both of these surveys, the study area included the Minto and McGinty creek drainages (3 in ACG's Summary of Wildlife Baseline Surveys Conducted (2012) (Appendix L)). Results of the 2009 and 2010 moose surveys are presented in Table 4-8. More detailed information for these surveys can be found in the AEG 2010 report.

Assuming a 600 m visibility on both sides of the helicopter, the total area surveyed was 112 km^2. Using this survey area, the moose density for the post-rut survey was estimated to be approximately 125 moose per 1,000 km^2, which is nearly the same density found in the 2007 early-spring aerial survey conducted by YG. The calf-to-cow ratio estimated from this data was 25 calves and no sub-adults for every 100 adult cows, and the estimated adult sex ratio was 50 mature bulls for 100 cows, which is low and could be a factor in the low recruitment ratio.

For the late-winter survey, estimated densities were approximately 45 moose per 1,000 km^2. The yearling to cow ratio was 1:1 sub-adults to cows, and no calves were observed during this survey. The estimated adult sex ratio was 300 mature bulls for 100 cows. The difference in this ratio from the YG survey result could be attributed to a small survey area, low number of observations and lack of visual confirmation of gender. It should be noted that on seven occasions during this survey fresh tracks were observed without an associated moose observation.

Table 4-8: Summary of Moose Observations during the 2009 and 2010 Winter Surveys

Survey	Total	Adult Male	Adult Female	Sub-adult	Calf	Unknown
Post-rut survey December 15, 2009	14	4	8	0	2	0
Late-winter survey February 23, 2010	5	3	1	1	0	0

4.6.2 Caribou

Two woodland caribou herds have the potential to occur within the Minto Mine area: the Klaza and Tatchun. Although neither range for these herds overlap with the Project area, caribou may still occasionally pass through, as documented by HKP during baseline surveys in 1994. No caribou were observed in the Project area during the 2009 and 2010 aerial surveys conducted by AEG.

4.6.2.1 *Klaza Herd*

In 2005, the Klaza herd population was estimated at 650 and predicted to increase (Yukon Environment 2005). There are concerns for this caribou herd, as the impacts of increased exploration projects and road development may combine to reduce their population. The herd's range is west of the Minto site. Because the area around the Minto Mine site has experienced numerous fires recently, the habitat is of minimal value for caribou, according to Troy Hegel of Environment Yukon, a caribou, sheep, & goat biologist (pers. comm.). A wildlife key area (WKA) for woodland caribou winter range was identified approximately 9 km west-northwest of the Project area (Yukon Environment 2010). Members of Klaza herd could travel through the site area occasionally and sightings should be recorded and reported. A recent fall (rut) count of the Klaza herd was conducted by Environment Yukon, Environmental Dynamics Inc. (EDI 2010a), and Little Salmon Carmacks First Nation members in 2012. The results of this study have yet to be released.

4.6.2.2 *Tatchun Herd*

The Tatchun Caribou herd's range is to the east of the Yukon River and does not overlap with the Minto Mine Project area. This caribou herd is small, heavily harvested, and should be managed carefully. In 2005, the population estimate for the Tatchun herd was 500 animals. A rutting season composition survey that focused on this range was conducted in 2007, and indicated that the count was much lower than in previous years. The reduced count could result from caribou congregating in areas such as tree cover, where they could not be detected (Yukon Environment 2007). Another count was conducted in the fall of 2012; results are still under analysis and the report is pending.

MINTO MINE

RECLAMATION AND CLOSURE PLAN
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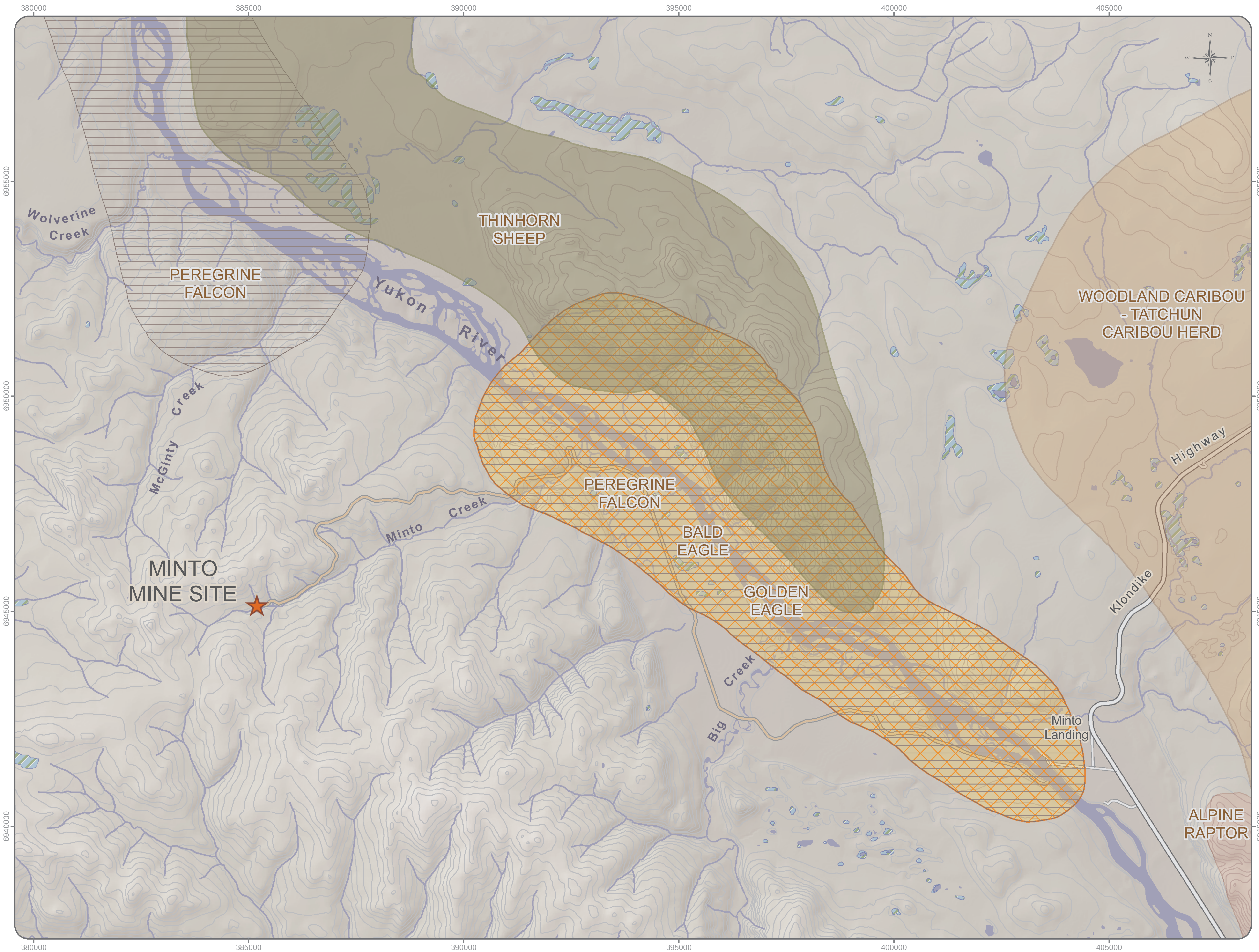
FIGURE 4 - 5
KEY WILDLIFE AREAS

JUNE 2016



- Minto Mine Site
- Highway
- Local Road
- Mine Access Road
- Contours
- Waterbody
- Wetland

Wildlife Key Areas

- Bald Eagle
- Peregrine Falcon
- Alpine Raptor
- Golden Eagle
- Thinhorn Sheep
- Woodland Caribou

1:85,000 when printed on 11 x 17 inch paper

0 0.5 1 2 3 Kilometers

Wildlife Key Area data compiled by the Yukon Department of Environment.
Publication Date: May 2009
Obtained from Geomatics Yukon.
Canvec compiled by Natural Resources Canada at a scale of 1:10,000 - 1:50,000. Reproduced under license from Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources Canada. All rights reserved.

Projection: NAD 83 UTM Zone 8N

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(*Last edited by: amatlashevska;07/08/2014/17:00 PM*)

4.6.3 Sheep

Dall's sheep are known to inhabit the Project area, particularly the Minto Bluffs along the east side of Yukon River (O'Donoghue 2009). Although the access road to the Minto Mine passes near sheep habitat, sheep habitat within the project area itself is limited, and sheep are not expected to occur in the project area for any extended length of time.

Between 2000 and 2009, Yukon Department of Environment conducted annual sheep surveys within close proximity of the Minto Mine site. The survey area extends from the Minto Landing airstrip downstream (north) along the Yukon River to Fort Selkirk (O'Donoghue 2009). Surveys have also been conducted opportunistically by air (in 1989, 1991, 1994, and 2000) and by boat (2000–2009). Between 2000 and 2008, sheep surveys of the Minto–Pelly Bluffs resulted in the observations of between 31 and 91 sheep annually; with the majority of observations being ewes, yearlings, and lambs. During the 2009 survey, 97 sheep were observed, 34 of which were observed on the Minto Bluffs (which is located about 8 kilometres downstream of Minto, across the river from the Minto Mine site). This is the highest recorded population for this area. Most sheep observed during these surveys have been located on the Minto Bluffs, Split Mountain, and Mount Hansen (O'Donoghue 2009).

Aerial sheep surveys were conducted in 1994 as part of the wildlife baseline studies conducted prior to the start-up of Minto Mine. This survey focused on the cliffs on the northeast side of the Yukon River from Minto Landing. Unfortunately, data from this survey were not included in the final report. This report did indicate that sheep were observed, but location(s) were not mentioned.

4.6.4 Other Wildlife

Fur and big game harvest statistics indicate that the following species occur in the Minto project area: grizzly bear, black bear, coyote, gray wolf, red fox, wolverine, marten, least weasel, river otter, beaver, and lynx. Cougars may also have the potential to occur in the area as they are known to follow mule deer (Smith et al. 2004); however, the probability of an occurrence is considered to be low.

Of the species listed above, the following species or sign of the species have been observed, on site: grizzly bear, black bear, gray wolf, lynx, river otter (HKP 1994, Capstone 2007, Capstone 2008, ACG and Horizon Ecological Consultants 2010).

Small mammals common to the area include red squirrel, varying hare, fox, mink, weasel, vole, and shrew. The Minto Mine site is situated at the apex of five drainages that are part of the Yukon River watershed, so wildlife uses the area to access the valleys offering conduits from lowlands to highlands for seasonal foraging and hunting (ACG 2010).

A total of 13 raptor species (Summary of Wildlife Baseline Surveys Conducted (2012) (Appendix L)) have the potential to occur within the study area. Raptors may breed throughout the study area, with select areas attracting higher breeding densities (e.g., riparian zones) than other areas (e.g., pine stands). Species that have been observed and documented in the Project area include the red-tailed hawk (HKP 1994), peregrine falcon (Mossop, pers. comm. as cited in HKP 1994), and golden eagle. Only one aerial-based raptor survey was conducted as part of the Minto Mine baseline studies (HKP 1994).

High quality riparian cliff habitat for raptors exists along the Yukon River downstream of the Minto Mine access road. A wildlife key area (WKA) for golden eagle summer nesting habitat has been identified approximately 3 km to the east of the project area (Yukon Environment 2010) (Figure 4-5). This WKA is primarily associated with the steep bluffs along the Yukon River and includes a buffer area. No cliff-nesting raptor habitat has been identified within the Project area itself. The access road to the Minto Mine, however, runs adjacent to potential nesting areas for cliff-nesting raptors, such as the golden eagle and peregrine falcon.

Game birds that have been observed or that have the potential to occur in the study area include grouse (spruce, ruffed, sharp-tailed) and ptarmigan (willow, white-tailed, and rock). Of the species of grouse that live in Yukon, the sharp-tailed grouse is currently the only species of management concern. Sharp-tailed grouse have a limited distribution in Yukon due to the lack of suitable habitat. Gravel outwashes with fairly stable aspen parkland habitat and wet sedge-hummock meadows after fire are considered suitable habitat for this species. Sharp-tailed grouse have been observed in the Project area.

4.6.5 Species at Risk

There are currently eleven wildlife species in Yukon rated as “threatened,” “of conservation concern,” or “of special concern” by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2011). Ten of these species have ranges that could include the area around Minto Mine site. Species that have the potential to occur in the study area are listed in Table 4-9.

Table 4-9: List of Species at Risk in Yukon Considered Possible to Occur in the Study Area

Species	Status	Source
Birds		
Peregrine Falcon* (*Falco peregrinus anatum/tundrius*)	Special concern	COSEWIC (2007), Yukon Wildlife Act (2002)
Short Eared Owl* (*Asio flammeus*)	Special concern	COSEWIC (2008)
Common Nighthawk* (*Chordeiles minor*)	Threatened	COSEWIC (2007)
Olive-sided Fly Catcher* (*Contopus cooperi*)	Threatened	COSEWIC (2007)
Rusty Blackbird* (*Euphagus carolinus*)	Special concern	COSEWIC (2006)
Gyrfalcon (*Falco rusticolus*)	Specially protected	Yukon Wildlife Act (2002)
Trumpeter Swan (*Cygnus buccinator*)	Specially protected	Yukon Wildlife Act (2002)
Barn Swallow* (*Hirundo rustica*)	Threatened	COSEWIC (2011)
Bank Swallow* (*Riparia riparia*)	Conservation concern	Yukon Environment (2011)
Canada Warbler (*Wilsonia canadensis*)	Threatened	COSEWIC (2008)
Northern Shrike (*Lanius excubitor*)	Conservation concern	Yukon Environment (2011)
Mammals		
Wolverine* (*Gulo gulo*)	Special concern	COSEWIC (2004)
Grizzly Bear* (*Ursus arctos*)	Special concern	COSEWIC (2009)
Woodland Caribou* (*Rangifer tarandus caribou*)	Special concern	COSEWIC (2002), SARA (2002)
Mule Deer (*Odocoileus hemionus*)	Specially protected	Yukon Wildlife Act (2002)
Mountain Goat (*Oreamnos americanus*)	Conservation concern	Yukon Environment (2011)
Cougar (*Puma concolor*)	Specially protected	Yukon Wildlife Act (2002)
Collared Pika* (*Ochotona collaris*)	Special concern	COSEWIC (2011)
Little Brown Bat (*Myotis lucifugus*)	Endangered	COSEWIC (2012)

** confirmed presence in the mine site vicinity*

4.7 Aquatic Resources

A complete report on Aquatic Resources is presented in the *Aquatic Resources Baseline Report* (AEG 2012) (Appendix M), which constitutes an update to EBA's 2010 report. A summary of the key findings of AEG's report is presented in the sections below.

4.7.1 Aquatic Systems Overview

The Minto Mine region includes the Yukon River and its smaller tributaries, including 7 km upstream to Big Creek and 13 km downstream to Wolverine Creek. The local study area related to the Minto Mine centres on three small drainages in the mine area that drain directly to the Yukon River: Minto Creek, Creek A, and McGinty Creek.

4.7.1.1 *Minto Creek*

Minto Creek, with its headwaters in the mine area, is the primary drainage affected by mining operations. Minto Creek flows northeast from the existing mine site ~17 km to the Yukon River, and covers an approximate area of 41 km^2. The creek has five primary tributaries along its length, and flows through large tracts of land that have been recently influenced by forest fire. Water from the mine area flows into the upper reaches of Minto Creek through the water storage pond and other conveyances. Investigations into Minto Creek have found it to be generally shallow, ephemeral in nature, and to have frequent build-ups of layered ice during the winter (sometimes to the substrate).

4.7.1.2 *Creek A*

Creek A is a small watercourse that drains an area adjacent to the Minto Mine access road and the Yukon River. The headwaters of Creek A originate approximately 4 km southeast of Minto Creek and flow for 7 km along a riparian floodplain into the Yukon River. The drainage area of Creek A is traversed by the Minto Mine access road, including one direct watercourse crossing.

4.7.1.3 *McGinty Creek*

McGinty Creek (formerly referred to as Unnamed Creek B) is located to the north of Minto Creek and flows north-northeast for 9.5 km to the Yukon River confluence. Minto North Pit, which is to be mined as part of Phase V/VI, is located near the McGinty Creek headwaters and within the McGinty Creek catchment area.

4.7.2 Fish and Fish Habitat

4.7.2.1 *Regional Overview (Yukon River)*

A variety of resident and migratory fish species inhabit the Yukon River near Minto Mine. These include Chinook, Coho and chum salmon, lake trout, least cisco, Bering cisco, round whitefish, lake whitefish, inconnu, Arctic grayling, northern pike, burbot, longnose sucker, and slimy sculpin.

Previous studies on the Yukon River within the vicinity of Minto Mine have identified both spawning and rearing areas for salmon. Spawning shoals are present in the Ingersoll Islands (downstream of the Project area) as well as around islands upstream of Minto Mine, near Big Creek. These offer an extensive network of side channels and sloughs which provide good spawning gravel.

This portion of the Yukon River also provides rearing habitat for Chinook salmon, as evidenced by past studies in the Project area. Juvenile Chinook salmon (JCS) generally spend up to 1.5 years feeding and growing in fresh water tributaries prior to out-migrating to the ocean, and feed or stage in various tributaries to the Yukon River during this slow out-migration. Usage of the Project area tributaries by JCS is outlined further below.

As outlined in Appendix M, Yukon River salmon runs have observed moderate variability over the last 50 years; however, there has been a general decrease in salmon returns over the last ten to fifteen years. Chinook returns began to drop markedly beginning in 1998, and poor runs are still observed to present. Chum salmon returns demonstrated a marked reduction in 1997 through 2002, but have been demonstrating trends that are more positive for summer and fall since 2001 and 2003, respectively.

4.7.2.2 *Minto Creek*

Fish and fish habitat studies of Minto Creek have been ongoing for many years, with contemporary studies including those from 1994 through to 2012. A summary of effort and catches is presented in Table 4-10 while complete results can be found in Appendix M. Generally, Minto Creek has been noted to provide only limited habitat to fish. Flows within the stream are quite variable on a yearly basis, with intermittent flows and extensive ice build-up during winter that limits the potential for overwintering habitat for fish. Also, the distribution of fish within Minto Creek has been observed to be limited to the lower 1.5 km of the watercourse, as there is a barrier and steep canyon upstream of that location. As noted above, Chinook salmon, slimy sculpin, Arctic grayling, longnose sucker, burbot, and round whitefish have been captured in Minto Creek; however, the latter have not been observed since the original baseline studies in 1994. Slimy sculpin have been observed consistently, but at a low density.

During baseline studies, it was noted that trends in annual Chinook salmon occurrence in Minto Creek can be related to water temperature on a seasonal basis. During the early summer (e.g., May/June), the occurrence of JCS has been low, with individuals captured more frequently near the Yukon River confluence. Catches in July, August, and September have generally been higher; presumably, because out-migrating Chinook seek out non-natal tributaries as foraging habitat and cover. During the summer of 2009, there was a marked increase in Chinook salmon captures which coincided with an emergency release of water from the Minto Mine tailings dam (catch per unit effort (CPUE) of at least three times the previous highest catch records). Similarly, high numbers of JCS were captured in 2010, when the mine was discharging water into Minto Creek. It is believed that the stable, elevated flow and warmer, more consistent temperature regime (i.e., a narrower diurnal temperature fluctuation) associated with the release may have attracted JCS into the system from the Yukon River. In response to the observed high density of JCS in Minto Creek during these releases, a fish transfer program was initiated during the fall of 2009 and 2010 to prevent these fish being stranded by the onset of winter.

4.7.2.3 *Creek A*

Creek A was investigated during the 1994 baseline study program at the Project site, at which time no fish were observed or captured (including a site at the road-crossing location). Creek A is not considered to offer high quality habitat for fish.

4.7.2.4 *McGinty Creek*

Arctic grayling and slimy sculpin were captured in McGinty Creek in 1994, through electrofishing and minnow trapping. Because substantial deadfall caused by a forest fire changed creek conditions, only minnow trapping was used in 2009–2011, yielding very low numbers of slimy sculpin. Since these captures were consistently made in close proximity to the Yukon River, these fish were presumed to be associated with the Yukon River, as opposed to McGinty Creek. These results are similar to those found in the 1994 survey, in that fish were only captured in close proximity to the Yukon River confluence. The physical nature of the McGinty Creek drainage is not conducive to a consistent year-round use by fish. Many factors, including gradient, discharge volume, depth, configuration, and paucity of an upstream reservoir, limit wintering habitat potential for fish. Also, several potential natural fish barriers were observed and documented in the lower reach of McGinty Creek.

Table 4-10: Minto Fish Habitat Studies: 1994 – 2012

Study Timing		Study Type	Minto Creek		Creek A		McGinty Creek	
Year	Month		Effort	Catches	Effort	Catches	Effort	Catches
1994	June	Baseline Environmental Studies	EF, MT	Rw, Ss	EF	-	EF, MT	Ss, Ag
	August	Baseline Environmental Studies	EF, MT, A	Ss, Ag	EF	-	EF, MT	Ss, Ag
	September	Baseline Environmental Studies	EF, MT	Ag	EF	-	EF	-
2006	September	Baseline / Permitting	MT	-	-	-	-	-
2007	May	Baseline / Permitting	EF, MT	Cs	-	-	-	-
	June	Baseline / Permitting	EF, MT	Cs, Ss	-	-	-	-
	August	Baseline / Permitting	MT	Cs, Ag, Ss	-	-	-	-
	September	Baseline / Permitting	MT	Cs	-	-	-	-
2008	June	EEM, Cycle 1	EF, MT	-	-	-	-	-
	September	EEM, Cycle 1	EF, MT	Cs	-	-	-	-
2009	May	Baseline, Minto North	-	-	-	-	MT	Ss
	June	Baseline, Minto North	MT	-	-	-	MT	Ss
	July	Ongoing Monitoring	MT	Cs, Ss	-	-	-	-
	September/ October	Fish Relocation, Minto North	-	-	-	-	MT	-
2010	June	Mark-Recapture Study	MT	Cs, Ss	-	-	-	-
	July	Mark-Recapture Study, Minto North	MT	Cs, Ss	-	-	MT	Ss
	August	Mark-Recapture Study	MT	Cs, Bb, Ag	-	-	-	-
	September	Mark-Recapture Study	MT	Cs, Bb, Ss, Ag	-	-	-	-
	October	Mark-Recapture Study	MT	Cs, Bb	-	-	-	-
	November	Fish Relocation	MT	Cs	-	-	-	-
2011	July	Ongoing Monitoring	MT	Cs, Ss	-	-	-	-
	August	Ongoing Monitoring	MT	Cs, Ls	-	-	-	-
	September	Ongoing Monitoring, Minto North	MT	Cs, Ss, Ls	-	-	MT	-
	October	Ongoing Monitoring	MT	Cs, Ss	-	-	-	-
2012	June	Ongoing Monitoring	MT, EF	Ss, Ag	-	-	-	-
	July	Ongoing Monitoring	MT	Ss	-	-	-	-
	August	Ongoing Monitoring	MT	-	-	-	-	-
	September	Ongoing Monitoring	MT	Cs, Ss	-	-	-	-

Effort: EF=backpack electrofishing, MT=minnow trapping, A=angling

Catches: Cs=Chinook salmon, Ag=Arctic grayling, Ss=slimy sculpin, Rw=round whitefish, Bb=burbot, Ls=longnose sucker

4.7.3 Aquatic Environment and Habitat

4.7.3.1 ***Stream Sediments***

Stream sediments were studied for particle size and metal concentrations in 1994, and annually since 2006. Sediment particle size distribution was notably different when comparing earlier sampling years to more recent years. The change in distribution from 1994–2009 compared to 2010–2012 reflects methodological changes that were implemented in 2010. Sediment metal concentrations were also complicated by the change in methodology. With this qualification in mind, concentrations of arsenic, copper, and occasionally chromium exceeded the interim sediment quality guideline (ISQG) levels over the years but are not greater than the probable effect level (PEL). Copper was the only metal that consistently exceeded guideline levels every year, including during baseline sampling in 1994. This could indicate that there are naturally high levels of copper at the exposure area. Arsenic was above the ISQG in most sampling years except during baseline sampling in 2007 and 2009.

Additional detailed results for sediment physical and chemical parameters are available in Appendix M.

4.7.3.2 ***Benthic Invertebrate Community***

Benthic macroinvertebrates (benthos) are non-backboned animals inhabiting the bottom substrates of aquatic habitats. The abundance, diversity, and taxonomic composition of benthos can be used as indicators of changing environmental conditions as their distribution and abundance can be influenced by a wide variety of physical parameters. Baseline and numerous other benthic invertebrate studies were undertaken in the Minto Mine area from 2006–2012.

Basic results of the 2008 and 2011 environmental effects monitoring (EEM) benthic analyses indicated that Minto Creek (treatment) had a significantly higher benthic invertebrate density and slightly lower number of taxa (not significant) compared to McGinty Creek (Appendix F of Appendix M). The 2011 EEM benthic results show that Minto Creek had significantly higher number of taxa and higher density compared to both reference sites. Increased taxa, higher density, and lower evenness are indicative of a site that is experiencing nutrient enrichment.

Under the terms of Minto's Water Use License #QZ06-006, benthic macroinvertebrate communities are required to be monitored annually in Minto Creek. In 2011, the mean number of taxa in lower Minto Creek was less than in the reference area in lower Wolverine Creek and less than the 1994 baseline. This result is contrary to the 2011 EEM results but could be explained by the use of a different reference site, or by temporal variability. The 2011 count was an increase over that measured in 2006, another year that the mine did not discharge. Changes in density and evenness over time likely reflected high temporal variability of benthic invertebrate communities in the region, also evident at reference areas.

A detailed report on Minto Creek sediment, periphyton and benthic invertebrate community was prepared by Minnow (2012) and is presented in Appendix F of Appendix M.

4.7.3.3 ***Periphyton***

Periphytic algae are simple aquatic plants which inhabit the substrate of water bodies. They can provide a valuable biological monitoring tool to assess potential impacts of nutrient enrichment and metal toxicity. Chlorophyll *a* is the primary photosynthetic pigment common to all algae. Determining chlorophyll *a* concentrations provides a measure of algae biomass and, thus, the primary productivity of a given location. Periphyton was sampled in 1994, 2011, and 2012, in Minto Creek (exposure) and Wolverine Creek (reference). Overall, the periphyton community of lower Minto Creek relative to lower Wolverine Creek had lower density and taxon richness. Periphyton communities of lower Minto Creek and lower Wolverine Creek in 2011 both differed from the community documented at lower Minto Creek in 1994.

Detailed results and analysis are presented within Appendix M (and specifically Appendices F and I therein).

4.8 Vegetation

The Minto Mine lies within the Boreal Cordillera ecozone and is situated in the far western part of the Yukon Plateau ecoregion, adjacent to the Klondike Plateau ecoregion in the west. This area was part of the eastern extent of Beringia, which remained ice-free approximately 15–20 thousand years ago. Endemic and rare plant species are associated with the Beringia area as it was a unique and isolated ecosystem. These remnant species are usually associated with grasslands and wetlands.

The Minto property lies within the eastern part of the Dawson Range, with elevations from 700 to 950 m; the landscape has rounded mountains intersected by broad valleys and drainages that are part of the Yukon River watershed. Discontinuous permafrost occurs on northern slopes and low-lying areas where sunlight is reduced.

Forest fires are frequent in this part of Yukon as it lies in the rain shadow of the St. Elias–Coast Mountains and receives less than 300mm of precipitation per year (Smith et al. 2004). As a result, the study area around Minto Mine has experienced numerous fires over the last forty years, rendering it a complex mosaic of plant communities at various stages of succession.

The following subsections summarize vegetation surveys conducted in the Project area. For further detail, please see the Minto Ecosystems and Vegetation Baseline Report (2013) in Appendix N.

4.8.1 Vegetation Survey (2010)

Vegetation surveying and mapping was undertaken in 2010 and resulted in the *Vegetation Baseline Survey* (2010) included in the Minto Ecosystems and Vegetation Baseline Report (Appendix N). A previous survey was conducted in 1994, before any mine development had begun in the area. The 2010 survey provides a record of current vegetation communities that exist within a 3,626 ha study area, and estimates the type and area of vegetation to be removed in the Project area. In the intervening years between the 1994 and 2010 studies, the local landscape has been altered by the footprint of the current mine, further exploration and three major fires (See Fire History Map, Appendix N).

In the 2010 *Vegetation Baseline Survey*, different vegetation communities that exist within the study area were identified through aerial photo interpretation and delineated into polygons. Since most of the study area is regenerating from past fire disturbances, a mosaic of vegetation communities at different successional stages was delineated and classified. It was found that willow and trembling aspen have the greatest crown cover within the study area as they are indicative of early forest succession. Lodgepole pine is a later successional species that will gradually dominate mid and upper slopes of well-drained southern aspects.

Shade-tolerant white spruce was often found in the understory as seedlings. It is a climax species that will eventually overgrow the pine and trembling aspen communities, particularly on cooler aspects. Black spruce is also a climax species that is adapted to wetter, cooler sites, and often the persistent species in white/black spruce mixed areas along the toe of slopes and valley bottoms. Small areas of grasslands are scattered along dry crests and steep south facing slopes; these locations do not retain enough moisture to sustain tree growth and are more likely to contain rare or uncommon plants.

4.8.2 Site Conditions: Vegetation Types

During the survey, plants species with 0.5% or greater coverage were identified and recorded on data sheets at each plot. Rare or uncommon species were searched for within plots and between plots, as well as uncommon ecosystems, i.e., wetlands and grasslands. No rare plants were found during the field investigations. That does not mean that the rare species do not exist within the study area, only that they were not located in the areas or in the season that the fieldwork was undertaken. The main plant communities identified in and around the Minto property are briefly described in the subsections below.

4.8.2.1 ***Trembling Aspen/Lodgepole Pine***

This association is found in early successional forests originating after fire disturbance, on mesic to subxeric sites. Lodgepole pine (*Pinus contorta latifolia*) is more dominant than trembling aspen (*Populus tremuloides*) on well-drained south facing slopes and terraces. Coarse soils are often exposed, and lichens are well represented in the ground cover. Typically, these sites have low growing shrubs such as lingonberry (*Vaccinum vitis idaea*), kinnikinnick (*Arctostaphylos uva-ursi*), and prickly rose (*Rosa acicularis*).

4.8.2.2 ***Black Spruce/Labrador Tea/Sphagnum***

Found in low lying areas and north facing slopes (cool sites), usually sparse to open forests (<50% crown cover), common shrubs in this ecosystem include Labrador tea, scrub birch, willow, and bog blueberry. Herbs present were sweet coltsfoot (*Petasites frigidus*), cloudberry (*Rubus chamaemorus*), and horsetail (Equisetum sp.) Sites are poorly drained (hydric to mesic) with peat horizons over mineral soils, often associated with permafrost.

4.8.2.3 ***White/Black Spruce***

This association is typically located on south facing lower slopes with upland willow species and Labrador tea. A thick carpet of feather mosses and sphagnum covers the mineral soil. Ground cover shrubs include lingonberry, bog blueberry, and crowberry.

4.8.2.4 *Willow/Trembling Aspen*

This was the most common vegetation association in study area, indicative of regenerative growth (>10yrs) after a fire event. Most trees and shrubs are less than 5 m tall; cover can be open to closed as the canopy layer is of uniform height. Other species that may be present include: Alder (*Alnus crispa*) and Alaskan birch (*Betula neoalaskana*) on north facing slopes. Lodgepole pine and white spruce are also present in the understory and will eventually overtop other competing species to form the dominant canopy as the forest matures. The moisture regime ranges from subhygric to subxeric.

4.8.2.5 *Willow/Scrub Birch*

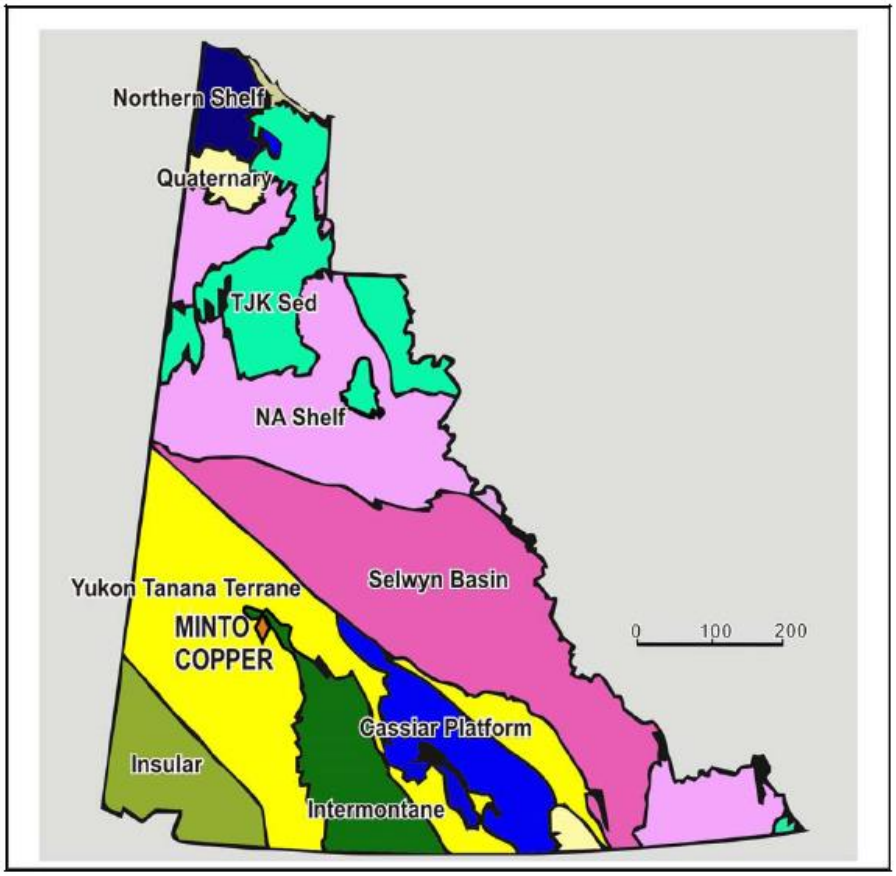
Willow (Salix sp.) and scrub birch (*Betula glandulosa*) occur in fluvial ecosystems adjacent to streams and fens. Other shrubs present are bog blueberry (*Vaccinum uliginosum*), Labrador tea (*Rhododendron groenlandicum*), and shrubby cinquefoil (*Potentilla fruticosa*). Associated graminoids include water sedge (*Carex aquatilis*), bluejoint grass (*Calamagrostis canadensis*), and rushes (Juncus sp.). Sphagnum, feather, and glow mosses are common.

4.8.2.6 *Trembling Aspen/Grassland*

This association features sparse to open cover of trembling aspen (*Populus tremuloides*), often with lodgepole pine (*Pinus contorta latifolia*) present as a minor component. Found on steep south and southwest facing slopes, its understory shrubs include prickly rose (*Rosa acicularis*), soapberry (*Shepherdia canadensis*), kinnikinnick (*Arctostaphylos uva-ursi*), purple reedgrass (*Calamagrostis purpurascens*), glaucous bluegrass (*Poa glauca*), threadleaf sedge (*Carex filifolia*), death camas (*Zygadenus elegans*), common yarrow (*Acillea millefolium*), pussytoes (Antennaria sp.), and prickly saxifrage (*Saxifraga tricuspidata*).

4.9 Geology

The Minto Project is found in the north-northwest trending Carmacks Copper Belt along the eastern margin of the Yukon-Tanana Composite Terrain, which is comprised of several metamorphic assemblages and batholiths (Figure 4-6). The Belt is host to several intrusion-related Cu-Au mineralized hydrothermal systems. The Yukon-Tanana Composite Terrain is the easternmost and largest of the pericratonic terrains accreted to the Paleozoic northwestern margin of North America (e.g., Colpron et al., 2005). It is regarded to be the product of a continental arc and back-arc system, preserving metaigneous and metasedimentary rocks of Permian age on top of a pre-Late Devonian metasedimentary basement (e.g., Piercey et al. 2002).



From: Yukon Geologic Survey "Maps Yukon" website (www.geology.gov.yk.ca)

Figure 4-6: Yukon Geology (from Yukon Geologic Survey "Maps Yukon" website, www.geology.gov.yk.ca)

The Minto Property and surrounding area are underlain by plutonic rocks of the Granite Mountain Batholith (Early Mesozoic Age) (Figure 4-7) that have intruded into the Yukon-Tanana Composite Terrain. They vary in composition from quartz diorite and granodiorite to quartz monzonite. The batholith is unconformably overlain by clastic sedimentary rocks thought to be the Tantalus Formation and andesitic to basaltic volcanic rocks of the Carmacks Group, both of which are assigned a Late Cretaceous age. Immediately flanking the Granite Mountain Batholith, to the east, is a package of undated mafic volcanic rocks, outcropping on the shores of the Yukon River. The structural relationship between the batholith and the undated mafic volcanics is poorly understood because the contact zone is not exposed.

Geobarometry and geothermometry data (Tafti and Mortensen, 2004) suggests that the Granite Mountain Batholith was emplaced at a depth of at least 9 km, while the presence of euhedral to subhedral epidote, interpreted by Tafti and Mortensen as magmatic in origin, suggests a deeper emplacement depth in the order of 18 to 20 km.

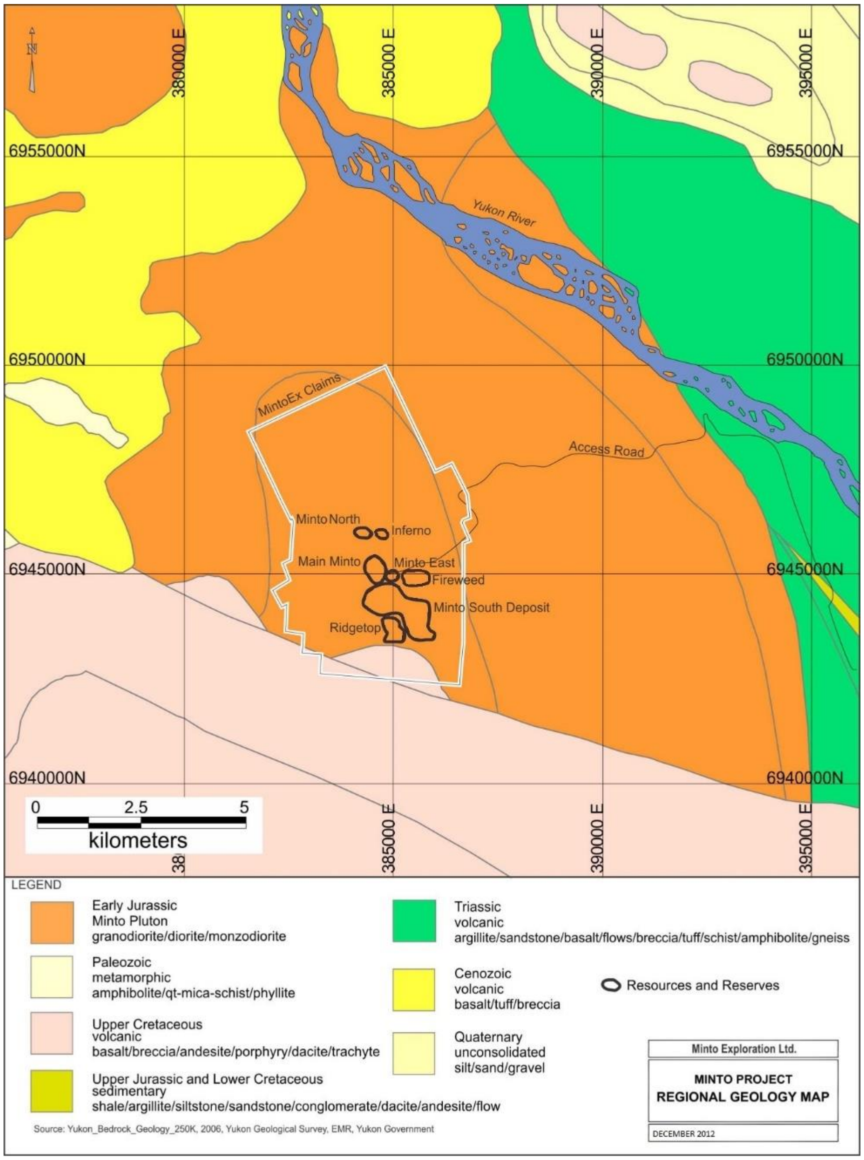


Figure 4-7: Regional Geology

4.9.1 Property Geology and Lithological Description

Much of the geological understanding of the rock around the Minto deposits is based on observations from diamond drill core and extrapolation from regional observations. The reason for this is poor outcrop exposure (less than 5% coverage), as well as the deep weathering and oxidation of any existing exposed outcrop. The terrain was not glaciated during the last ice age event.

Four additional deposits of mineralization are reported in this document outside of the Minto Main Deposit: Minto South Deposit, Minto North, and Minto East. For the purpose of this report Area 2, Area 118, Copper Keel, and Wildfire resource sub-domains are now considered continuous and reported as one deposit, namely

Minto South Deposit (MSD) located immediately south of Main Minto. Names of these resource sub-domains are retained for ease of discussion when discussing regions within MSD.

The Minto North deposits are located about 700 m north of the Main Deposit, the Minto East deposit is located about 200 m east of the south end of the Minto Main deposit, while the Copper Keel and Wildfire sub-domains form a southeast extension from Area 2/118. Each of these deposits closely shares a similar style of mineralization of shallow dipping copper sulphide mineralized zones. The Main Minto deposit was exposed in the dormant open pit mine; similarly, this flat geometry is currently exposed in the Minto South Deposit (Area 2 resource sub-domain) starter pit. In addition to these mineral deposits, which have NI 43-101 compliant mineral resources, there are several significant mineral prospects. These deposits and prospects define a general north-northwest trend.

The hypogene copper sulphide mineralization at Minto is hosted wholly within the Minto pluton, which intrudes near the boundary between the Stikinia and Yukon-Tanana terrains, however since the contact is not exposed it is unclear if the pluton stitches the two terrains. The Minto pluton is predominantly of granodiorite composition. Hood et al. (2008) distinguish three varieties of the intrusive rocks in the pluton. The first variety is a megacrystic K-feldspar granodiorite. It gradually ranges in mineralogy to quartz diorite and rarely to quartz monzonite or granite, typically maintaining a massive igneous texture. An exception occurs locally where weakly to strongly foliated granodiorite is seen in distinct sub-parallel zones several meters to tens of meters thick.

A second variety of igneous rock is quartzofeldspathic gneiss with centimetre-thick compositional layering and folded by centimetre- to decimetre-scale disharmonic, gentle to isoclinal folds (Hood et al., 2008). The third variety of intrusive is a biotite-rich gneiss. Minto Exploration Ltd geologists consider all units to be similar in origin and are variably deformed equivalents of the same intrusion.

Copper sulphide mineralization is found in the rocks that have a structurally imposed fabric, ranging from a weak foliation to strongly developed gneissic banding. For this reason all core logging by the past and present operators separates the foliated to gneissic textured granodiorite as a distinctly discernible unit. It is generally believed by Minto Exploration Ltd geologists that the foliated granodiorite is just variably strained equivalents of the two primary granodiorite textures and not a separate lithology.

While this interpretation, based upon detailed observations from logging of tens of kilometers of drill core, is highly likely it still needs to be conclusively proven. Tafti & Mortensen (2004) noted that the relatively massive plutonic rocks have similar mineral and chemical composition as the foliated rocks

The contact relationship between the foliated deformation zones and the massive phases of granodiorite is generally very sharp. These contacts do not exhibit chilled margins and are considered by Minto Exploration Ltd geologists to be structural in nature, separating the variably strained equivalents of the same rock type. Tafti and Mortensen (2004) had interpreted the sharp contacts to be zones of deformed rock within the unfoliated rock (i.e. rafts or roof pendants). Supergene mineralization occurs proximal to near-surface extension of the primary mineralization and beneath the Cretaceous conglomerate.

Conglomerate and volcanic flows have been logged in drill core by past operators. Drilling has confirmed the presence of conglomerate, but not the volcanic flows. The latter cannot be confirmed by the authors as the drill core from historic campaigns was largely destroyed in forest fires and no new drilling has intersected such rocks. However, undated volcanic rocks are mapped by Hood, near the southwest margin of the property, south of a fault that is inferred from geophysics to separate them from the Jurassic Age intrusive rocks. The conglomerate has been dated (unpublished date pers. com. Dr. Maurice Colpron - Yukon Geological Survey) as Cretaceous Age. It is now recognized as an outcrop within a borrow pit exposure located west of the airstrip as well as in numerous recent drill holes. Observations of foliated and even copper mineralized cobbles in drilling indicate that “Minto-type” mineralization was exposed, eroded and reincorporated in sedimentary deposits by the Cretaceous Age.

Other rock types, albeit volumetrically insignificant, include dykes of simple quartz-feldspar pegmatite, aplite; and an aphanitic textured intermediate composition rock. Bodies of all of these units are relatively thin and rarely exceed the one meter core intersections. These dykes are relatively late, and observed contact relationships suggest they generally postdate the peak ductile deformation event; however some pegmatite and aplite bodies observed in a rock cut located north of the mill complex are openly folded.

It is unclear if this folding is contemporaneous with foliation development in the deformed rocks or post-dates the foliation development. Observations from drill core and open cut benches in the mine show examples where the foliation and the pegmatitic/aplitic intrusions are both folded, as well as examples where the intrusions are not folded, suggesting two populations of minor dykes.

4.10 Soil and Bedrock

4.10.1 Overburden

Overburden thickness across the site is correlated with geomorphological features. Near topographic highs (or ridges) there is little to no overburden, while overburden thickness increases down valley slopes and is generally thickest in valley bottoms. Unconsolidated material deposited along the valley bottom varies in thickness. Typically, the ridge tops are dominated by sandy, residual soils grading to weathered bedrock. It is generally observed that fine weathering products have been washed down slope. Overburden in the valley bottoms consists of finer materials dominated by sandy silts and clays. A representative selection of drill hole logs from various geotechnical drilling programs is presented in Appendix K1. The drill holes shown provide spatial coverage within the core site footprint and high quality data regarding depth to bedrock. In isolated cases, drill holes that did not reach bedrock are also included; these provide minimum bedrock depths.

Several geotechnical studies have been conducted across the site (e.g. SRK 2007, SRK 2015a (and references therein)). Figure 3 in Appendix K1 presents the overburden depth determined from these studies. It should be noted that overburden thicknesses for the Dry Stack Tailings Storage Facility generally represent data collected post-construction, and therefore reflect combined tailings and overburden thickness. The drill holes located at the toe of the SWD were drilled prior to the full extent of the current waste rock and provide a good indication of the overburden depth.

Along the ridge near the Ridgetop deposits (no longer in mine plan), bedrock is close to the surface (less than 15 m). In most cases, the bedrock is within 5 m of the surface. The proposed Minto North Pit also has minimal overburden near the ridge top. To the north/northeast of the Dry Stack Tailings Storage Facility, overburden is controlled by the steep valley slopes and Minto Creek cutting through the bottom of the valley. The overburden thickness near the creek bed is less than 15 m, but increases in some areas, especially along the southern valley slopes. In some areas, this overburden can exceed 50 m, but typically ranges between 30 and 50 m.

The ridge tops to the north and south of the mine footprint have little overburden, and that which exists consists of sandy residual soils that grade into weathered bedrock. In the valley east of the SWD, the subsurface soils consist of sand and silt layers that overlie the residual sandy soil and weathered bedrock. Some locations have a mix of sand, silt, and gravel layers with no clear stratigraphic continuity evident through the valley (SRK 2013c).

4.10.2 Bedrock

The Minto Mine site is underlain predominantly by igneous rocks of granodiorite composition. The granodiorite is generally categorized based on textures which are associated with foliation and crystal size. Rock texture ranges from massive granodiorite to foliated granodiorite, with foliated granodiorite typically characterized by increased biotite content. The biotite-rich foliated granodiorite hosts mineralized zones of copper sulphide. Crystal textures range from equigranular to porphyritic.

Other minor lithologies consisting of small dykes of simple quartz-feldspar pegmatite, aplite, and an aphanitic textured intermediate composition rock are also observed. Bodies of all of these units are relatively thin and rarely exceed one metre core intersections. These dykes are relatively late, generally postdating the peak ductile deformation event; however, some pegmatite and aplite bodies observed in a rock cut located north of the mill complex are openly folded. There has been evidence of conglomerate and volcanic flows in drill core by past operators, and drilling has demonstrated that a conglomerate unit bearing local granodiorite pebbles occurs across much of the southern part of the project area. This is of particular note in the vicinity of the Ridgetop deposits.

There are both ductile and brittle phases of deformation around the Minto deposits. Copper-sulphide mineralization is strongly associated with foliated granodiorite. This foliation is defined by the alignment of biotite in areas of weak to moderate strain, and by the segregation of quartz and feldspar into bands in areas of higher strain, giving the rock a gneissic texture in very strongly deformed areas. The deformation zones form sub-horizontal horizons within the more massive plutonic rocks of the region and can be traced laterally for more than 1,000 m in the drill core. They are often stacked in parallel to sub-parallel sequences.

The Minto Creek Fault (MC Fault) bisects the Minto Main deposit, dividing it into north and south areas and is modeled as dipping steeply north-northeast with an apparent left lateral reverse displacement. The northern block moved up and to the west relative to the southern block. Both the vertical and horizontal displacements are evident by offsets in the main zone mineralization and appear to be minimal. A lack of marker horizons in the plutonic rocks, however, makes it difficult to determine the absolute magnitude of the movement (SRK 2008).

The DEF Fault defines the northern end of the Minto Main deposit. It strikes more or less east-west and dips north-northwest and cuts off the Main Zone mineralization. The vertical orientation of most of the drilling is less than optimal to intersect steep to vertical faults; the DEF fault may have a similar sense of movement to the MC fault, however, a significant amount of displacement is inferred.

4.11 Seismicity

The tectonics and seismicity of southwestern Yukon are influenced primarily by the Pacific and North American lithospheric plate margins. In Yukon's St. Elias region, northwest British Columbia and southeast Alaska, the boundary of the two lithospheric plates changes from right lateral transform to subductive. Instead of sliding past each other, the Pacific Plate is forced beneath the stable North American plate resulting in the St. Elias region being uplifted. This transfer of force along the fault into uplift or mountain building dissipates tectonic energy, reducing seismic effects on the region northeast of and across the fault (SRK 2007).

An assessment of seismic hazard, including peak ground acceleration, was performed for the Minto project area using the 2015 National Building Code Seismic Hazard Calculation as shown in Figure 4-8 below.

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

July 31, 2016

Site: 62.618 N, 137.241 W User File Reference: Minto Mine

Requested by: , Minto Explorations Ltd.

National Building Code ground motions: 2% probability of exceedance in 50 years (0.000404 per annum)

Sa(0.05)	Sa(0.1)	**Sa(0.2)**	Sa(0.3)	**Sa(0.5)**	**Sa(1.0)**	**Sa(2.0)**	**Sa(5.0)**	**Sa(10.0)**	**PGA (g)**	**PGV (m/s)**
0.154	0.229	**0.269**	0.246	**0.207**	**0.146**	**0.083**	**0.030**	**0.012**	**0.125**	**0.156**

Notes. Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC 2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are specified in **bold** font. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. ***These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.***

Ground motions for other probabilities:

Probability of exceedance per annum	0.010	0.0021	0.001
Probability of exceedance in 50 years	40%	10%	5%
Sa(0.05)	0.025	0.060	0.091
Sa(0.1)	0.034	0.086	0.134
Sa(0.2)	0.052	0.114	0.166
Sa(0.3)	0.060	0.118	0.163
Sa(0.5)	0.058	0.110	0.146
Sa(1.0)	0.047	0.085	0.109
Sa(2.0)	0.028	0.049	0.063
Sa(5.0)	0.0098	0.018	0.023
Sa(10.0)	0.0039	0.0068	0.0089
PGA	0.022	0.050	0.075
PGV	0.046	0.087	0.114

Figure 4-8: 2015 National Building Code Seismic Hazard Calculation for the Minto Mine

5 Project Description

5.1 Project Location and Background

Minto Mine is a copper-gold-silver project located on the west side of the Yukon River approximately 75 km north-northwest of Carmacks, Yukon Territory. The mine site and access road lie within the traditional territory of the Selkirk First Nation (SFN) and comprise part of land claim settlement parcels R6A, R-44A (Type A settlement lands) and R-40B. Minto concluded a comprehensive Cooperation Agreement with the SFN on September 16, 1997. This agreement is still in effect; however, an amended agreement was executed on November 5, 2009.

The Minto Project consists of 284 claims. There are 120 pending quartz claims, 99 quartz claims and 65 quartz claims under lease. Minto is the 100% registered owner of the claims and leases. The property is accessible by crossing the Yukon River at Minto Landing. Barge landings have been constructed for ice-free crossing and an ice bridge is used upon freeze-up of the Yukon River.

Copper deposits were first discovered in 1970 and claims were staked in 1971. The claims and leases cover an area of approximately 10 square miles. Extensive exploration yielded the first significant drill intersection in July of 1973. Figure 5-1 and Figure 5-2 present visual depictions of the general project location within the Yukon and the current project area overview respectively.

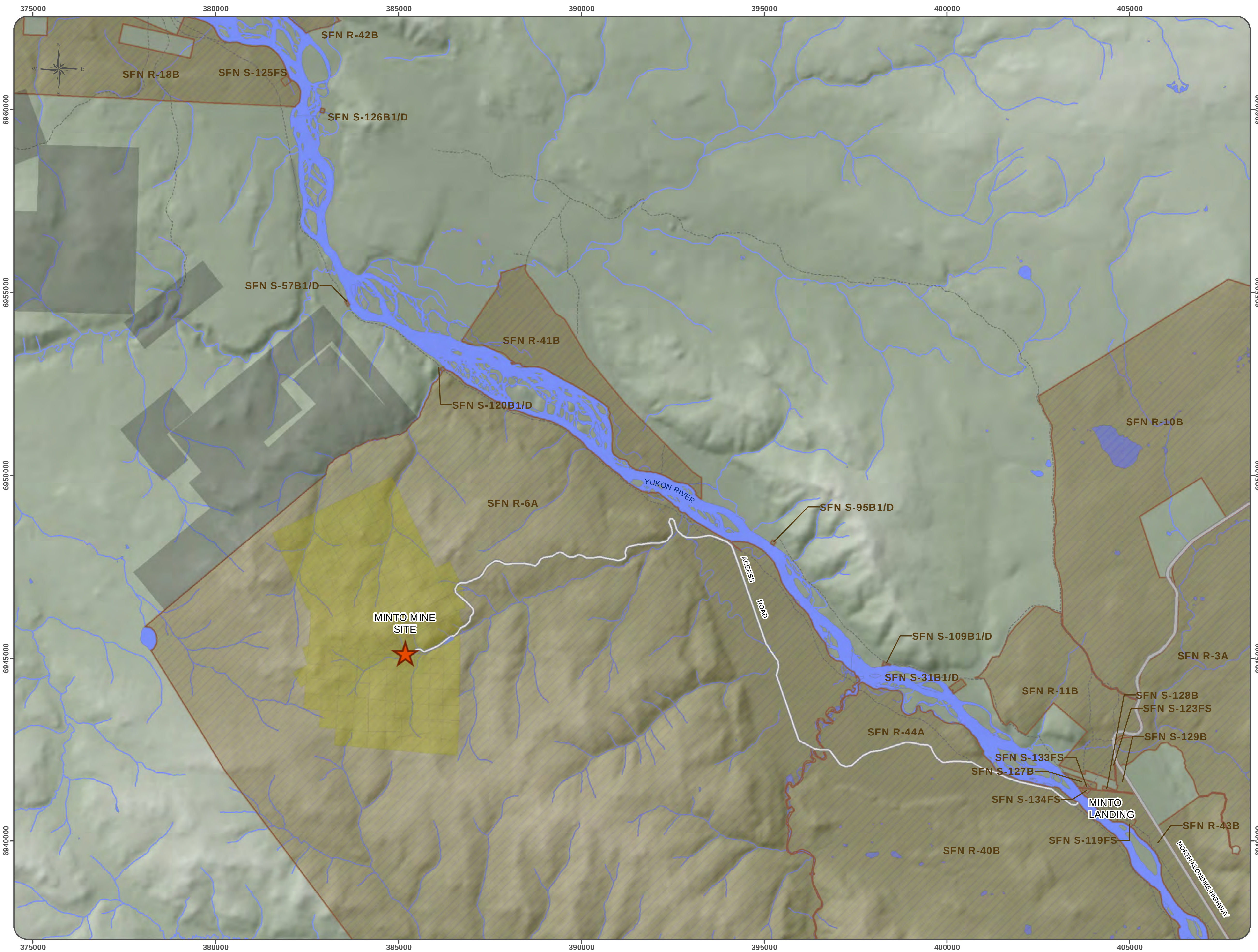
Preliminary site development was initiated at the property in 1996 and continued during the following decade with Minto commencing operations in October 2007. From 2007 through April 2011, mining at Minto took place in what is known as the Main Pit. Exploration during those years identified several other areas of the ore deposit that are amenable to both surface and underground mining. These areas were upgraded from resources to reserves by a series of prefeasibility studies completed in 2010, 2011, and 2012.

The first of these reserves were submitted to YESAB for assessment in November of 2010 as application 2010-0198 (the Phase IV Project Proposal). Decision documents approving the application were issued in March 2011. Subsequent amendments to the mine's Quartz Mining License and Water Use License authorized the mining and ancillary activities associated with the Phase IV Project Proposal.

Another application (2010-0100) was submitted to YESAB in July 2013, aimed primarily at assessing further increases in reserves (the Phase V/VI Project Proposal). Decision documents were issued in June 2014, after which amendments to the mine's Quartz Mining License and a renewal of its Water Use License authorized the additional mining proposed in the application.

Operations consisted solely of open pit mining from 2007 until August 2012, at which time development of the Minto South Underground commenced with stripping of overburden around the portal access. To date, two ore zones have been mined out (M-Zone and Area 118), and a third is currently active (Area 2).

The open pits at Minto are mined via a conventional truck/shovel process, while the underground mine uses primarily longhole open stoping. Mineral separation is via an on-site crushing, grinding, and flotation plant. A 256- person camp houses mine personnel.



MINTO MINE

RECLAMATION AND CLOSURE PLAN
REVISION 2016-01

FIGURE 5 - 1

AREA OVERVIEW

JULY 2016

capstone MINTO MINE

ALEXCO ENVIRONMENTAL GROUP

First Nation Settlement land obtained from Natural Resource Canada. Quartz claim boundaires and ownership are current as of Feb 18 th 2013. Data obtained from Mineral Resources Branch, Energy Mines and Resources Department, Government of Yukon.Site hydrology data provided by Minto Explorations Ltd, May 2009.

Datum: NAD 83 Projection: UTM Zone 8N

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(*Last edited by: amatlashevska;7/26/2016/09:47 AM*)

5.1.1 Current Activities

The following activities are currently in progress at Minto Mine:

- Mining of the Minto North pit (substantially complete as of August 2016);
- Construction of the Main Waste Dump Expansion using Minto North waste rock;
- Construction of the Mill Valley Fill Extension Stage 2 using Minto North waste rock;
- Deposition of SAT waste rock within the Main Pit Dump;
- Milling of the ore released from active mining areas and stockpiles;
- Deposition of tailings into both the Main and Area 2 open pits;
- Mining of the Minto South Underground: the Area 2 zone is in progress and the Area 118 zone has been completed;
- Regrading of waste dumps as part of progressive reclamation work;
- Operational water management; and
- Progressive reclamation of infrastructure components whenever possible to reduce site liability.

Figure 5-2 shows the current (Year 0) site layout. This site configuration is the basis of the Year 0 closure cost liability calculation in Section 9.

MINTO MINE

RECLAMATION AND CLOSURE PLAN
REVISION 2016-01

FIGURE 5-2

SITE CONFIGURATION- YEAR 0 (AUGUST 2016)

AUGUST 2016

capstone MINTO MINE

Pit

Dump

Tailings and Water

Minto North Access Road

Tailings Diversion Ditch

1:13,500 *when printed on 11 x 17 inch paper*

0 50 100 200 300 400 500 Meters

ALEXCO ENVIRONMENTAL GROUP

Aerial imagery obtained from Challenger Geomatics. Imagery acquired September 9th 2014.

Datum: NAD 83 Projection: UTM Zone 8N

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(*Last edited by: amatlashevska;8/5/2016/08:43 AM*)

5.1.2 Future Activities

The following activities are planned between Year 0 and the completion of the mine life in Q2-2018:

- Mining of the Area 2 Stage 3 pit using conventional surface mining methods, including an expanded network of haul roads to accommodate the mining activities;
- Continued mining of the Minto South Underground and Minto East Underground using conventional underground mining methods, all accessed via the Minto South Portal;
- An increase in open pit mine life to Q3-2017, underground mine life and milling to Q2-2018;
- Creation of a new waste rock dump (Main Pit Dump) within the footprint of the mined-out Main Pit;
- Continued placement of waste rock on the existing Main Waste Dump Expansion; and
- Backfilling of the completed Area 118 pit, and the creation of the Area 118 Backfill Dump, using excess overburden from the stripping of the Area 2 Stage 3 Pit.

Additional details and information on the project are presented in the following sections, and Figure 5-3 shows the expected site layout at the completion of mining activities. This site configuration is the basis of the end of mine life closure cost liability calculation in Section 9.

5.1.3 Activities Licensed but not Currently Planned

Certain parts of the mine plan presented as part of licensing are not planned at current market conditions. These are:

- Construction of a tailings dam (Main Dam) to increase the storage capacity of the Main Pit Tailings Management Facility;
- Mining of the Ridgetop North and Ridgetop South open pits;
- Creation and use of the Ridgetop North Tailings Management Facility;
- Creation of the Ridgetop Waste Dump to store rock from the Ridgetop North and Ridgetop South pits;
- Creation of a dedicated portal (the Wildfire Portal)to access the Wildfire ore zones; and
- Creation of a dedicated portal (the East Keel Portal) to access the Minto East and Copper Keel ore zones (these will instead be accessed via the Minto South Portal).

MINTO MINE

RECLAMATION AND CLOSURE PLAN
REVISION 2016-01

FIGURE 5-3

SITE CONFIGURATION-END OF MINING (2018)

AUGUST 2016

- Pit
- Dump Covered
- Dump Not Covered
- Pit Lake
- Minto North Access Road
- Tailings Diversion Ditch

1:13,500 *when printed on 11 x 17 inch paper*

0 50 100 200 300 400 500 Meters

Aerial imagery obtained from Challenger Geomatics. Imagery acquired September 9 th 2014.

Datum: NAD 83 Projection: UTM Zone 8N

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5.2 Mine Features, Facilities, and Equipment

5.2.1 Open Pits

Since stripping began in 2006, four pits have been mined at Minto. Their development histories are summarized in this section.

The Ridgetop North and Ridgetop South pits were added to the reserve as part of a technical report prepared in June 2008 and updated in subsequent prefeasibility studies. These pits were assessed as part of the Phase V/VI Project Proposal but have since been removed from the mine plan at current market conditions. The configuration of the open pits are shown in Figure 5-4.

5.2.1.1 *Main Pit*

The Main Pit was mined in five stages between 2006, when stripping first began, and April 2011.

The Main Pit cuts through the original drainage channel for Minto Creek. The north wall of the pit is benched in competent bedrock. The south wall is composed of a thick layer of overburden soil underlain by weathered bedrock hosting oxidized copper mineralization, transitioning into un-weathered bedrock that hosts sulfide ore.

The south wall was mined to a 30° angle, and a large volume of overburden was excavated to a shallower slope near the rim of the pit; despite this, a slope failure occurred shortly after the completion of the pit in April 2011. Movement had been observed in the pit for several months prior to the failure, and extensive monitoring provided warning of the impending failure. Analysis showed that the bulk of a 50m-thick silty / sandy overburden layer had slid into the pit along a thin layer of ice-rich permafrost clay.

A buttress was originally planned for the south wall to guard against sloughing, thawing, and small-scale failures. The slope failure necessitated a redesign of the buttress, which was completed in July 2011. Construction of the buttress has been completed. Additional fill was also placed around the rim of the pit to provide a new haul road bypassing the one mined out by Area 2 pit. Finally, SAT waste was deposited both on top of the buttress and in front of it, effectively increasing its size while storing this waste within the footprint of the pit.

Tailings deposition into the Main Pit began in November 2012. The Main Pit Tailings Management Facility has since received 3.3 Mt of slurry tailings; it also hosts the infrastructure that supplies the mill with process water. The current Main Pit configuration with South Wall Buttress and SAT dump are shown in Figure 5-5.

5.2.1.2 *Area 2 Pit*

Area 2 was first added to the mine’s mineral reserves by a prefeasibility study (PFS) completed in November 2007, though the pit design created at that time did not include the Stage 3 pushback. The subsequent Phase IV PFS confirmed the design, still without the Stage 3 pushback; this design formed the basis for the Phase IV mine plan. The Phase V PFS expanded Area 2 to include the Stage 3 pushback.

Area 2 Pit is located south of the mill area and southeast of the Main Pit. It was mined in two stages to provide timely ore release, the first starting in April 2011 and finishing in April 2013, and the second finishing in January 2014.

Upon completion of the pit, an underground portal was created in the highwall. The ore lens, referred to as the M-zone, at the bottom of the pit extended into the highwall another 120m at a plunge angle of approximately 10°, but the large amount of overlying waste rock rendered surface mining impractical. Between February and November 2014, underground mining methods were used to extract this ore via the portal at the bottom of the pit.

Upon completion of M-zone underground mining and remnant ore recovery from the pit's access ramp, tailings deposition began. Since March 2015, the Area 2 Pit Tailings Management Facility has received approximately 1.6 Mt of tailings, increasing by 120,000 tonnes per month. A pump system sends excess supernatant water to the Main pit via a pipeline, where the mill's water reclaim infrastructure is located.

The Area 2 Stage 3 Pit is the next open pit to be mined, however, it is susceptible to market conditions. Further details on the specifications of this pit are presented in Section 5.3. The Area 2 Pit (including Area 2 Stage 3) configuration are shown in Figure 5-6.

5.2.1.3 *Area 118 Pit*

The resource in Area 118 pit was extensively drilled in 2008 and became part of the reserve in 2009 with the creation of a pit design as part of the Phase IV PFS.

Area 118 is a relatively small pit completed between January and October 2014. It is located to the southwest of the Area 2 pit and partly overlaps it. As a small shallow pit, most of the ore it released was partially oxidized.

Mining took place at a reduced rate (approximately 5,000 BCM/d vs. typical production rates >10,000 BCM/d) in an effort to extend the duration of mining activity to cover the licensing timeline for subsequent surface deposits. The current Area 118 Pit configuration is shown in Figure 5-6.

The mining plan proposes that the pit be backfilled with overburden from Area 2 Stage 3 mining, after which an overburden dump would be placed on top of its footprint.

5.2.1.4 *Minto North Pit*

The Minto North deposit was brought into the mine's reserves in late 2009 with the release of the Phase IV prefeasibility study; the Phase V and Phase VI studies updated the reserve to reflect changes in the cut-off grade and optimization of the pit design.

The Minto North Pit is located northeast of the Main Waste Dump in the McGinty Creek drainage. Minto North mining began upon receipt of the necessary licenses in August 2015 and is substantially complete as of August 2016.

This pit is characterized by a single continuous zone of high-grade ore, plunging from east to west. The shallower and lower-grade parts of the ore zone were expected to be partially oxidized, but minimal alteration was seen and nearly all of the pit's ore release is un-weathered sulfide ore.

The pit's south highwall hosted several continuous multi-bench wedge structures that were shown by analysis to be unstable. These wedge structures were pre-emptively excavated out of the highwall. The expected Minto North Pit configuration is shown in Figure 5-7.

5.2.2 Overburden and Waste Rock Dumps

Several waste rock and overburden dumps were constructed during operations, as illustrated in Figures 5-2. A summary of the quantities placed in each dump by the end of 2015 are provided Table 5-1. Although these are not the final volumes for some of the facilities, it provides an indication of the relative magnitude of each facility. The final volumes will be updated in subsequent revision of this Plan, or at time that operations are complete and transition into closure begins.

Table 5-1: Waste Dump Footprint and Storage Volumes

Dump Location	Quantity Stored as of June 30, 2016 (m^3)	Footprint (m^2)
Southwest Waste Dump*	12,117,903	681,841
Reclamation Overburden Dump	4,304,347	297,857
Main Waste Dump	8,168,182	496,414
Main Waste Dump Expansion	3,214,827	
Mill Valley Fill Extension	1,441,040	171,634
Mill Valley Fill Extension 2	1,303,428	
South Wall Buttress	2,533,390	234,016
SAT Dump	1,645,865	
Total Waste Dumped	**34,728,982**	**1,881,762**

**Includes volume of Ice-rich Overburden Dump*

5.2.2.1 *Main Waste Dump / Main Waste Dump Expansion*

The Main Waste Dump (MWD) was Minto's first rock dump and initially held most of the material from the mining of the Main Pit between startup in 2006 and the start of SWD development in early 2009. Dumping on the Main Waste Dump finished in September 2009 and was not resumed until the approval of an expansion in 2015.

The MWD is located west of the Main Pit. It is sitting on a foundation of solid bedrock and its close proximity to Minto North Pit made an expansion of the dump an attractive option for disposal of Minto North waste rock and overburden; the Main Waste Dump Expansion was approved as part of Phase V/VI licensing, increasing the dump height by approximately 30m.

The dump is substantially complete as of August 2016. To date, no physical stability issues have been observed.

5.2.2.2 ***Reclamation Overburden Dump***

The Reclamation Overburden Dump (ROD) was developed in two stages, first to a design for overburden from stages 1 through 4 of the Main Pit's development, and then to a significantly larger design that would hold overburden from Stage 5, Area 2, and Area 118.

The ROD is designed with a low fill thickness and a shallow slope to allow for long-term storage of excess overburden; however, the contents of the dump may be partly mined out for use in reclamation.

5.2.2.3 ***Ice-Rich Overburden Dump***

The Ice-Rich Overburden Dump (IROD) was initially a free-standing dump consisting of a rockfill berm structure behind which ice-rich overburden would be placed so that this material would not impact the stability of the larger overburden dumps on site.

As the SWD grew around it, the IROD berm ceased to be identifiable as a distinct structure: the dump is now identifiable only as a small area of exposed overburden along the west side of the SWD. The dump received mud and ice-rich overburden during Main Pit mining, mostly from Stage 5 in 2010 / 2011.

For reclamation purposes, the IROD is treated as a part of the SWD.

5.2.2.4 ***Southwest Waste Dump***

The SWD was initially designed to contain waste rock from the Stage 4 and Stage 5 expansions of the Main Pit. The original Main Waste Dump had reached its capacity with the completion of Stage 3, and the high cost of haulage precluded an expansion of the MWD's height. Construction of the SWD began in March 2009.

The SWD was designed to hold both waste rock and thaw-stable overburden, provided that the latter was not dumped within 30m of the ultimate crest. It received a significant quantity of overburden from the mining of Stage 5 of the Main Pit in 2010/2011.

The height and extents of the dump were increased as part of Phase IV licensing, allowing for the deposition of waste rock from the Area 2 and Area 118 pits. Phase IV also introduced changes to waste rock management practices; specifically, segregation of waste rock into classes on the basis of copper content. Waste rock grading more than 0.10% Cu was originally slated for disposal within the footprint of the Main Pit, both within a buttress and on top of the overburden slope at the 810 bench, but the failure of the pit's south wall and the greater-than-expected quantity of this waste rock rendered that plan unworkable. Instead, separate areas within the SWD for waste rock of low, medium, and high grades were designated, with the intention that each portion of the dump would be receive a cover appropriate to its contents.

With the exception of the high grade waste portion of the dump, the SWD has been largely re-contoured. The high grade waste portion of the dump remains on hold until final closure measures have been decided and approved.

The dump's location above the Minto Creek valley, on a foundation of overburden, has resulted in some down-slope movement, particularly at the south end of the dump where the fill thickness is greatest. Current movement rates are between 0.5 mm/d and 1 mm/d, having decreased from the rates seen during active construction of the dump; these are evaluated annually and reported in the Annual Geotechnical Inspection Reports.

5.2.2.5 *Mill Valley Fill*

The Mill Valley Fill is located in the Minto Creek valley near the mill. It was constructed early in the life of Minto Mine to provide space for milling and related activities. The first stage of expansion (Mill Valley Fill Extension Stage 1) was constructed in previous phases of mining. The Mill Valley Fill Extension Stage 2 began construction in December 2015 and was constructed with waste rock from Minto North. There will be no significant change between the Mill Valley Fill Extension Stage 2 condition at Year 0 and the end of mine life.

In September 2010, EBA Engineering Consultants Ltd. recommended the construction of a valley-fill buttress, called the Mill Valley Fill Extension (MVFE), downslope (north) of the DSTSF as a measure to arrest the movement of the DSTSF. The construction of the MVFE (later referred to as the MVFE Stage 1) began in January 2012 and was completed by late 2013 (Minto 2013). The survey hubs that are being used to monitor rates of DSTSF movement have shown a significant deceleration (see Section 5.2.5 (DSTSF) for details). A subsequent SRK study in 2012 and the independent third party review that followed recommended an approach to increase the stability Factor of Safety by 50%, resulting in the design and construction of an enlargement of the existing buttress, i.e. MVFE Stage 2. The design of the MVFE Stage 2 is presented in Figure 7-3. The total volume of the Stage 2 extension is 1.4 Mm^3 and was made entirely of waste rock.

The MVFE Stage 2 was constructed by raising the existing MVFE Stage 1 and expanding the footprint to the east. It consists of three tiers at approximate elevations of 766 m, 776 m, and 781 m. The faces of each of the tiers are at an overall 3H:1V. The eastern limit of the Stage 2 extension was designed such that the toe is 75 m upstream from the Water Storage Pond at the maximum operational pond elevation of 716.3 m. The resulting toe is approximately five meters above the maximum pond elevation and two meters above the crest of the Water Storage Dam.

The initial toe blanket layer of coarse waste rock was constructed over previously undisturbed areas using run of mine construction grade waste rock. This lift was end dumped from a height of 10 m to create a coarse toe blanket layer along the valley floor. Vegetation and topsoil from previously undisturbed areas were stripped prior to fill placement.

Mill Valley Fill Extension Stage 2 is substantially complete at the time of RCP v6 submission (August 2016).

5.2.2.6 *South Wall Buttress and Main Pit Dump*

Construction on the South Wall Buttress began in May 2011 after a failure of the south wall of the Main Pit was observed. The South Wall Buttress is a rock fill structure designed to buttress the south wall of the Main Pit and preserve the remainder of the pit volume for tailings deposition. The South Wall Buttress was receiving waste rock from Area 2 Pit and was completed in 2013.

Development of the Main Pit Dump will be, effectively, a continuation of placement of waste rock on top of the South Wall Buttress within the footprint of the Main Pit. It will receive waste rock from Area 2 Stage 3 Pit and the underground areas and is permitted to hold up to 2.17 Mm^3 of waste rock and overburden.

The lowest toe elevation of the Main Pit Dump will be about 780 m, while the design crest is 855 m, slightly exceeding the southwest rim of the Main Pit. A stability assessment completed in 2013 (SRK 2013d – Main Pit Dump Stability Report) concluded that all factors of safety meet or exceed the guidelines for long-term stability (BC Mine Waste Rock Pile Research Committee 1991). The continued placement of waste in this location will serve to stabilize the south wall area further.

5.2.2.7 *SAT Dump*

The Phase IV quartz mining and water licences required Minto to segregate waste rock from open pits on the basis of acid-base accounting (ABA) characteristics, with material having NP:AP[3]≥3 being suitable for bulk disposal in upland waste dumps and material having NP:AP≤3 to be stored in a location that would ultimately be saturated over the long term. Since the material with NP:AP<3 was planned to be dumped subaqueous for closure, this material has been categorized as 'SAT' for communications related to on-site materials handling during routine mining operations. Bulk waste is simply called 'waste' for on-site communication.

SAT was used in the initial construction of the South Wall Buttress, together with bulk waste to expedite construction. Later, SAT was placed on top and to the west of the buttress, and in 2016 in a discrete dump ramping down to the 786m level northwest of the buttress was commenced. Together, all of the SAT waste that has been placed outside of the design shell of the South Wall Buttress has been referred to as the SAT Dump. As of July 2016, about 576k m^3 of SAT is stored in the dump below the 786 masl elevation (i.e. the expected elevation of the final pit lake surface) while 1,040k m^3 of SAT is stored above the 786 masl elevation.

5.2.2.8 *Area 118 Backfill Dump*

Construction of the Area 118 Backfill Dump will be carried out by backfilling of Area 118 Pit during mining of Area 2 Stage 3 Pit beginning in late 2016. A mix of thaw stable and ice rich overburden will be dumped below the pit rim while only thaw stable overburden will be dumped above the pit rim.

5.2.3 Ore Stockpiles

There are four stockpile pads southeast of the mill complex. Three of these pads are generally used for sulfide ore and the fourth is used for partially oxidized ore. Two additional stockpile pads have been constructed west of the Main Pit and are used to store partially oxidized ore and low-grade ore. Milling of all stockpiled ore will be completed before final closure. Both the high grade sulphide stockpile and pad located south of the mill and the low grade sulphide stockpile and oxide ore pad located between the Main Pit and the Main Waste Dump will be depleted prior to final closure. No stability issues have been identified to date with either of the ore stockpiling areas.

[3] ratio of neutralization potential (NP) to acid potential (AP), as determined through laboratory ABA testing

MINTO MINE

RECLAMATION AND CLOSURE PLAN
REVISION 2016-01

FIGURE 5-5

OVERVIEW OF MAIN PIT

AUGUST 2016

Capstone MINTO MINE

- Pit
- Dump
- Main Pit Lake
- Contours (5m)

1:3,000 *when printed on 11 x 17 inch paper*

0 25 50 75 100 125 Meters

ALEXCO ENVIRONMENTAL GROUP

Aerial imagery obtained from Challenger Geomatics.
Imagery acquired September 9th 2014.

Datum: NAD 83 Projection: UTM Zone 8N

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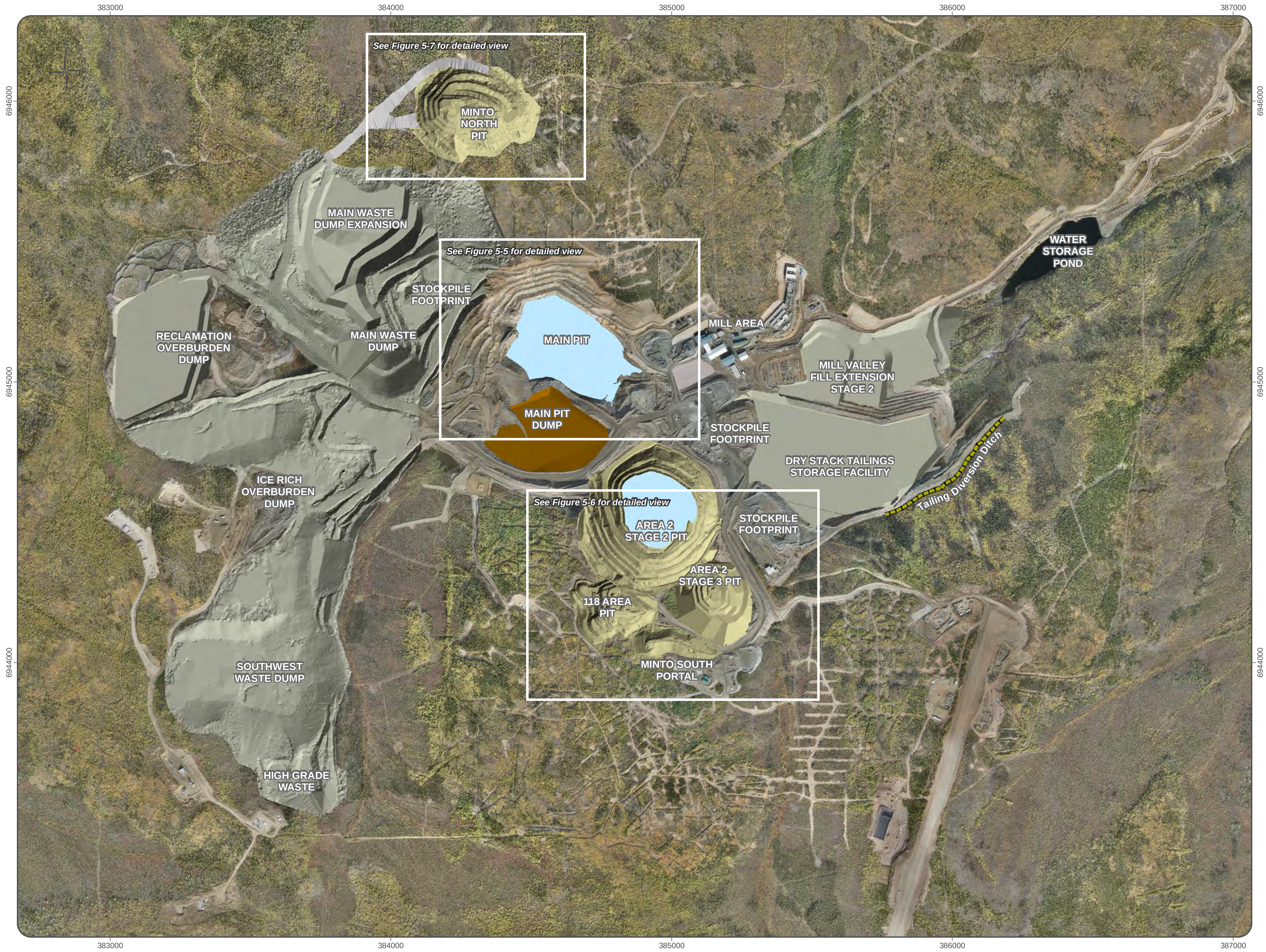

MINTO MINE

RECLAMATION AND CLOSURE PLAN
REVISION 2016-01

FIGURE 5-4

OVERVIEW OF OPEN PITS

AUGUST 2016

capstone MINTO MINE

- Pit
- Dump Covered
- Dump Not Covered
- Minto North Access Road
- Pit Lake
- Tailings Diversion Ditch

1:13,000 *when printed on 11 x 17 inch paper*

0 50 100 200 300 400 500 Meters

ALEXCO ENVIRONMENTAL GROUP

Aerial imagery obtained from Challenger Geomatics. Imagery acquired September 9[th] 2014.

Datum: NAD 83 Projection: UTM Zone 8N

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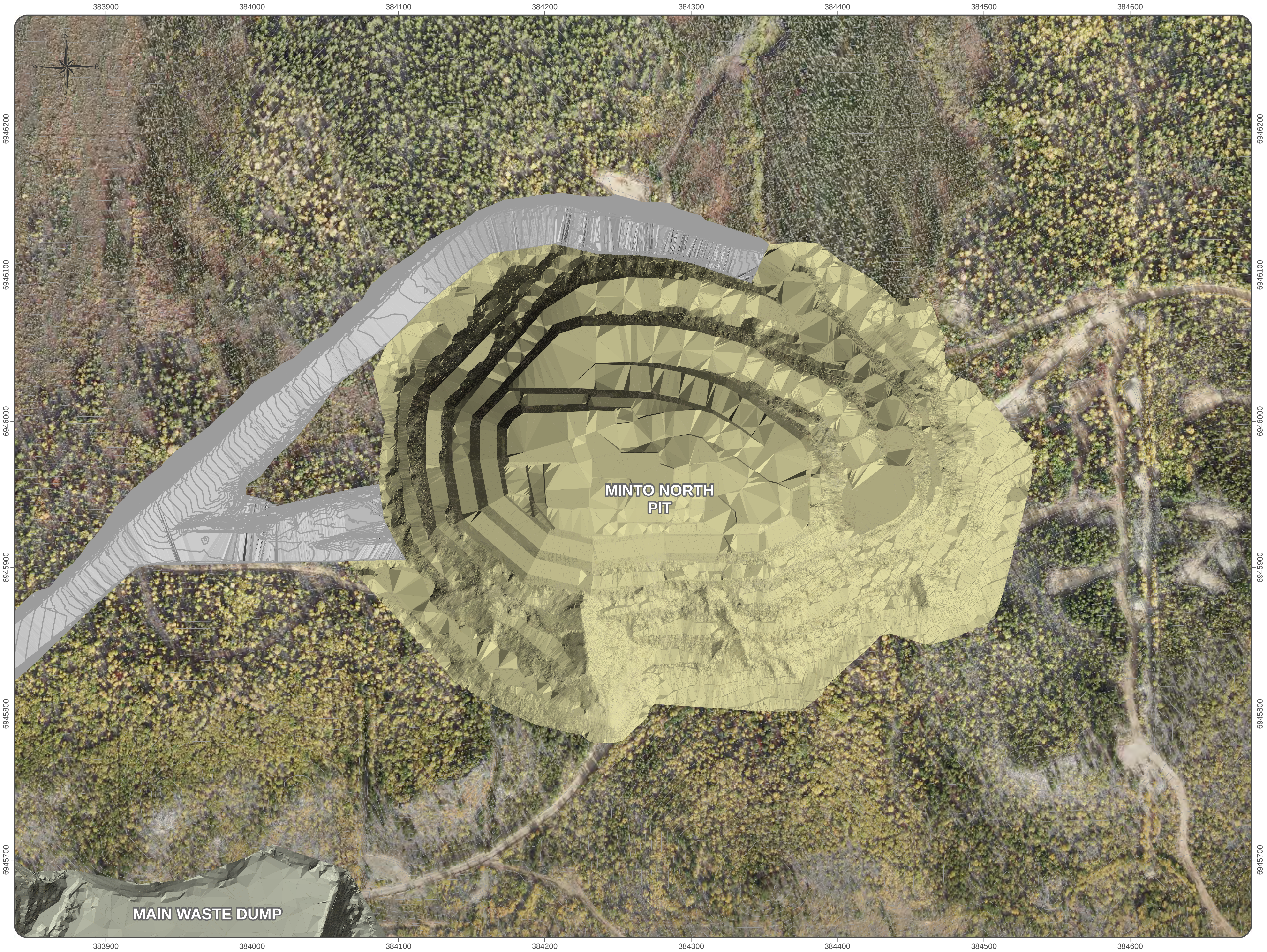

MINTO MINE

RECLAMATION AND CLOSURE PLAN
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FIGURE 5-7

OVERVIEW OF MINTO NORTH PIT

AUGUST 2016

capstone
MINTO MINE

Pit

Dump

Minto North Access Road

1:2,500 *when printed on 11 x 17 inch paper*

0 25 50 75 100 Meters

ALEXCO ENVIRONMENTAL GROUP

Aerial imagery obtained from Challenger Geomatics.
Imagery acquired September 9 th 2014
Site contours derived from 2014 aerial imagery obtained from Challenger Geomarics

Datum: NAD 83 Projection: UTM Zone 8N

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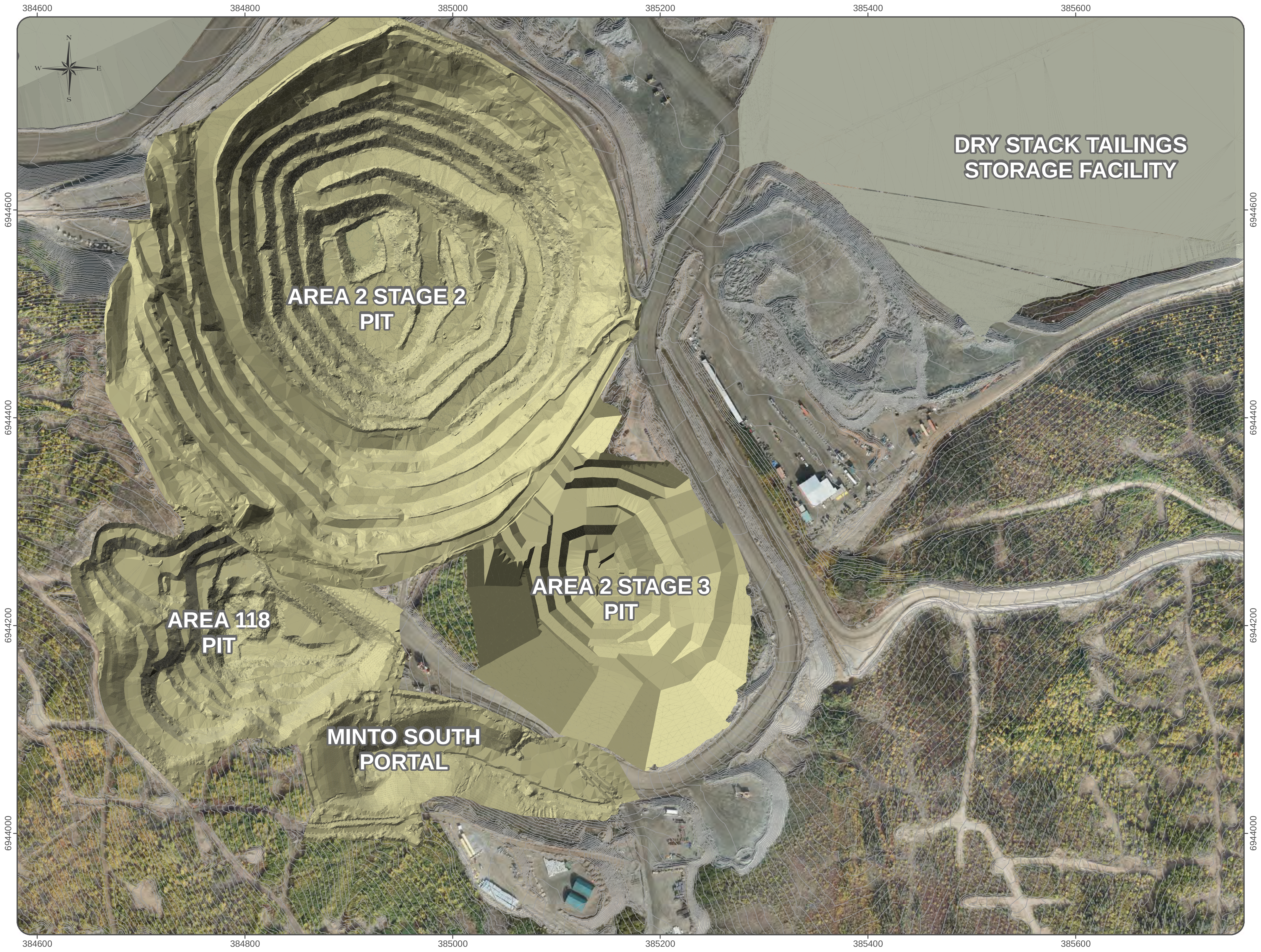

MINTO MINE

RECLAMATION AND CLOSURE PLAN
REVISION 2016-01

FIGURE 5-6

OVERVIEW OF AREA 2 (INCLUDING STAGE 3), AREA 118, AND MINTO SOUTH PORTAL

AUGUST 2016

capstone
MINTO MINE

Pit
Dump
Contours (1m)

1:3,500 *when printed on 11 x 17 inch paper*

0 25 50 75 100 125
Meters

ALEXCO ENVIRONMENTAL GROUP

Aerial imagery obtained from Challenger Geomatics.
Imagery acquired September 9 th 2014.
Site contours derived from 2104 aerial imagery obtained from Challenger Geomatics

Datum: NAD 83 Projection: UTM Zone 8N

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5.2.4 Mine Infrastructure and Ancillary Facilities

The following sections describe major mine infrastructure that requires consideration at closure. Other infrastructure items that will require general closure measures include: access road, barge landing, Pelly laydown, Pelly camp, warehouse, warehouse laydown, underground shop, airstrip and explosives plant site.

5.2.4.1 *Mill Complex*

The mill is located adjacent to the Main Pit. It processes ore via conventional crushing, grinding, flotation, and dewatering to produce copper concentrates with significant gold and silver credits, and a slurry tailings stream that is pumped to one of the mine's tailings management facilities.

The mill facilities include:

- Two-stage grinding circuit composed of a single semi-autogenous grinding (SAG) mill and two ball mills;
- Bulk flotation in rougher and scavenger stages, followed by cleaner flotation;
- Centrifugal gravity concentration of coarse gold;
- Concentrate thickening and pumping;
- Concentrate filtration;
- Concentrate storage;
- Tailings thickening and pumps;
- Adjacent to the mill is a concentrate storage building, which is a large tent structure with a concrete foundation;
- South of the mill and concentrate storage building is tailings filtration plant, which was formerly used to dewater tailings for deposition on the Dry Stack Tailings Storage Facility; and
- Surface Area: 11.12ha (Mill, Camp, Fuel Storage and Crusher)

5.2.4.2 *Mine Camp and Related Infrastruture*

In 1999 Minto completed construction of a camp for mine staff that included living quarters for 42 persons – a seven-unit accommodation/kitchen/diner/change room complex. In 2006, the camp was expanded by the addition of trailers and other construction to provide capacity for 140 persons, including an office complex. The facility provides a potable water supply (drilled groundwater well, 1998), gas-fired heat, a local power supply, and sewage disposal to two adjacent septic fields. The septic system has now been converted to a packaged treatment plant, and the camp has been expanded again to allow for greater occupancy (up to 256 persons). Several structures behind the facility house the fuel supply to the furnaces, relay power from a diesel electrical generator, and pump fresh water. Several structures behind the main camp buildings house the fuel supply to the furnaces, relay power from a diesel electrical generator, and pump fresh water.

5.2.4.3 ***Solid Waste Facility***

Minto Mine operates a solid waste facility under Commercial Dump Permit # 81-005 issued by YG, Department of Environment, Environmental Programs Branch. The facility includes a burning pit for untreated wood and paper waste, a construction waste disposal area, metal and rubber tire disposal areas and an incinerator for food waste and other wastes. No material is placed in the landfill that could potentially be an animal attractant. The burn pit and incinerator are surrounded by an exclusion (bear) fence. Figure 5-8 below shows the current locations of all the waste management facilities on site.

MINTO MINE

RECLAMATION AND CLOSURE PLAN
REVISION 2016-01

FIGURE 5-8

SOLID WASTE MANAGEMENT INFRASTRUCTURE

JULY 2016

capstone MINTO MINE

1:4,000
when printed on 11 x 17 inch paper

0 50 100 150
Meters

ALEXCO ENVIRONMENTAL GROUP

Aerial imagery obtained from Challenger Geomatics. Imagery acquired September 9th 2014.

Datum: NAD 83 Projection: UTM Zone 8N

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5.2.4.4 *Water Storage Pond and Water Treatment Plant*

The Water Storage Pond is currently being used as a clean water storage reservoir. Water from un-impacted or minimally impacted areas of the mine site are diverted to the WSP for storage until discharge to Minto Creek. The water treatment plant can also discharge treated water to the pond for storage prior to discharge. The pond has a total capacity of approximately 320,000 m^3 and retention is provided by the Water Storage Dam. Further details on the WSP can be found in the Water Management Section 5.4.

Water used for grinding and flotation is currently sourced from the Main Pit. After cycling through the mill complex, water is disposed of in either the Area 2 Pit or the Main Pit as tailings slurry.

The Water Treatment Plant accepts water from the Main Pit or the Water Storage Pond and discharges treated water to the Main Pit, Water Storage Pond or Minto Creek. The Water Treatment Plant discharges sludge and reverse osmosis concentrate to the Main Pit. The Water Treatment Plant consists of:

- Ballasted lamellae clarifier unit (Actiflo) for removal of TSS and total metals;
- Multiple stages of filtration; and
- Two reverse osmosis trains to remove dissolved solids (including nitrate and selenium).

The RO process removes 95-99% of all constituents in the feed water. The process produces two streams: 75% of the water is a clean water stream (with 95-99 % removal of dissolved solids) which is discharged to the WSP, and 25% is a concentrated reject stream that is added to the tailings slurry and co-disposed with the tailings. Further details regarding water treatment can be found in the Water Treatment Section 5.4.4.

5.2.5 Tailings Storage Facilities

5.2.5.1 *Dry Stack Tailings Storage Facility*

The DSTSF is located southeast of the mill and on the south slope of the Minto Creek Valley. The DSTSF was designed by EBA in 2006 (EBA, 2007), with construction and operation of the DSTSF occurring between 2007 and 2012. The tailings were dewatered in a filtration plant to a target water content of 15% (by weight), hauled to the DSTSF, spread into 1m lifts, and compacted to a target density of 95% of standard proctor maximum dry density. Tailings deposition was completed in October 2012, at which point slurry tailings deposition commenced in the Main Pit. A total of 5.1 million m^3 of tailings were placed in the DSTSF over the six years of active operations. An interim soil cover was placed over the tailings during stripping of the Area 2 and Area 118 pits between November 2012 and June 2013. The interim cover serves to limit water erosion of tailings and prevent wind erosion and dispersion of tailings dust until the final engineered cover system for the DSTSF is in place.

Movements in the DSTSF were identified in early 2009. Following drilling and instrumentation campaigns in 2009, 2010 and 2011, a valley-fill buttress, called the Mill Valley Fill Extension (MVFE Stage 1) was recommended by EBA. Construction of the buttress occurred between May 2011 and March 2013 with 1.4

million cubic meters of waste rock. At the time of the initial buttress design, it was recognized that a larger buttress might be necessary to sufficiently arrest the DSTSF movements, particularly in the northeast corner.

Geotechnical instrumentation installed to monitor movement rates of the DSTSF showed deceleration ranging between 20 and 60 percent within the first two years since the completion of the MVFE Stage 1. The most recent geotechnical drilling investigation was completed in 2013 and included installation of inclinometers, survey hubs, thermistors, and piezometers. The objective of the 2013 investigation was to gain further understanding of the movement and foundation soils to support the design of an additional extension of the MVFE (referred to as the MVFE Stage 2) to incrementally slow and ultimately arrest the movement. The conceptual design of the MVFE Stage 2 was completed in 2014, with the final design completed in 2015.

In parallel to the MVFE Stage 2 design development, Minto and Selkirk First Nation appointed an independent third party reviewer to review geotechnical conditions at the mine and provide recommendations, including the design of MVFE Stage 2. The resulting final design incorporated all design and construction recommendations provided by the third party reviewer.

Construction of the MVFE Stage 2 occurred between October 2015 and August 2016 using approximately 1.4 million cubic meters of waste rock. Although bulk material placement has only recently been completed, the monitoring data has shown that movement rates have slowed as a response to the MVFE Stage 2, with all rates now less than 1.0mm/day at all survey hub locations as of July 2016. For comparison, peak movement rates of the DSTSF were up to 8.6 mm/day prior to the MVFE Stage 1 construction and up to 1.4 mm/day prior to MVFE Stage 2 construction. Movement rates at the DSTSF and MVFE Stage 2 continue to be monitored on a weekly basis.

5.2.5.2 *In-Pit Tailings Management Facilities*

From November 1, 2012, when dry-stacking operations ceased, through the completion of the life-of-mine (LOM) plan, tailings would be deposited into pits as per the Tailings Management Plan. Table 5-2 summarizes the storage capacities below the natural spill elevations of each of the in-pit tailings management facilities (TMFs).

Table 5-2: Natural Storage Capacities for In-pit TMFs (including Area 2 Stage 3).

In-pit TMF	Approximate Spill Elevation (m above sea level)	Volume Below Spill Elevation (Mm^3)
Main Pit	791	4.9
Area 2 Pit (Stages 2+3)	802	7.9
Total volume below spill elevations		**12.8**

Tailings is sent through pipeline into the pits where it is able to settle to the bottom of the pit. The large surface areas of the pit bottoms result in the bottom of the pit having a variable depth of tailings. For example, the current elevation of tailings in the Main Pit varies by several meters depending on where the deposition point was into the pit. From November 2012 through June 2016, about 2.4 Mm^3 of tailings have been sent to the Main Pit TMF and 1.2M m^3 sent to the Area 2 TMF.

5.3 Mining Operations

5.3.1 Open Pit Mining

Area 2 Stage 3 Pit is the final open pit included in the current mining plan. This pit is planned on being mined from Q4 2016 through Q3 2017. Stripping of Area 2 Stage 3 Pit will produce a total waste volume of 2.1M BCM with 1.2M BCM of that being overburden material. It is expected that the overburden would be placed directly as cover material on completed waste rock and tailings storage facilities during the mining operation as part of progressive reclamation.

5.3.1.1 *Mine Equipment*

The open pit portion of the mine is a conventional truck/excavator operation using diesel-powered excavators, trucks, drills, and auxiliary equipment. Rock is broken by blasting using ANFO where ground- and surface-water conditions permit and by emulsion where the presence of water makes the use of ANFO impractical. Overburden is ripped and pushed using dozers, or blasted if necessary.

The following Table 5-3 lists the fleet available on site at the time of publication; with the exception of one blasthole drill, all machines are contractor-owned.

Table 5-3: Open Pit Equipment Fleet

Equipment Type	No. of units
Hitachi 2500 Shovel	1
Hydraulic Excavators, Hitachi EX1200 or similar	3
100-ton Haul Trucks, Cat 777 or similar	9
Front-end loaders, Cat 990 or similar	2
Small Hydraulic Excavators, Cat 330 or similar	2
D11-class dozer	2
D10-class dozers	2
Graders, 16' blade	2
Blast hole drills	3

5.3.1.2 *Grade Control and Material Segregation Practices*

Accurate in-pit separation of ore from waste, as well as segregation of various types of waste, will continue to be essential to the successful operation of the mine. Grade control practices for waste rock and ore can be summarized as follows:

- Drill cuttings from every blast hole are sampled, tagged, and sent for assay at the on-site lab prior to blasting;
- Representative samples of the cuttings are assayed using atomic absorption (AA) to determine the metal content;

- The on-site assay lab, under supervision of the chief assayer, tests each sample for copper, soluble copper, and silver content;
- The environmental assay lab tests the sample for total sulfur and total carbon content, allowing for a determination of NP/AP ratio;
- The assay results are sent to the geology department for interpretation;
- The geology department plots the results spatially, then draws polygons enclosing holes with similar assay results to identify regions of similar average grade (for ore) or similar waste class (for waste);
- After blasting, the aforementioned polygons are laid out in the field by the mine surveyor working with the production geologist, using stakes and flags of various predefined colours; and
- Mine operations personnel, under the supervision of the pit foreman, excavate and haul material to the destination designated for the material type. Destinations are communicated to foremen and operators by the production geologist.

Further detail on waste handling and placement can be found in the Waste Rock and Overburden Management Plan (Minto 2014c).

5.3.2 Underground Mining Operations

Underground mining started in 2012 with the collaring of the Minto South Portal. Development of the Minto South Underground continued through late 2013.

In January 2014, through continued consultation with Yukon Government Department of Energy, Mines and Resources, Minto sought approval for changing the mining sequence such that the “M-zone,” originally the final ore zone to be mined in the Phase IV plan, could be brought ahead in the schedule and accessed from a portal at the bottom of the completed Area 2 Stage 2 pit. Approval to proceed was granted on January 10, 2014.

The M-zone was completed in October 2014, at which time mining resumed in the Minto South Underground, specifically the Area 118 zone. The Area 118 zone was completed in April 2016. Development of a decline to the Area 2 zone, the next in the mine plan, was begun in March 2016, and ore production began in July.

The M-zone portal and completed underground workings, located at the bottom of Area 2 pit, have been flooded by tailings and water.

The waste rock from the underground is handled following the approved Waste Rock and Overburden Management Plan. To date, geochemical characterization for the underground waste rock recovered from core samples show that underground waste rocks are similar in geochemical properties to waste rock from Area 2 and Area 118 open pits.

The following are a summary of planned underground mining:

- Mining Rates: 1500-2000 tonnes of ore per day
- Ore mined: 1,035,000 tonnes
- Waste mined: 250,000 tonnes
  - Estimated 20% PAG – 50,000 tonnes

5.3.2.1 *Supporting Surface Infrastructure*

Figure 5-9 shows underground supporting surface infrastructure.

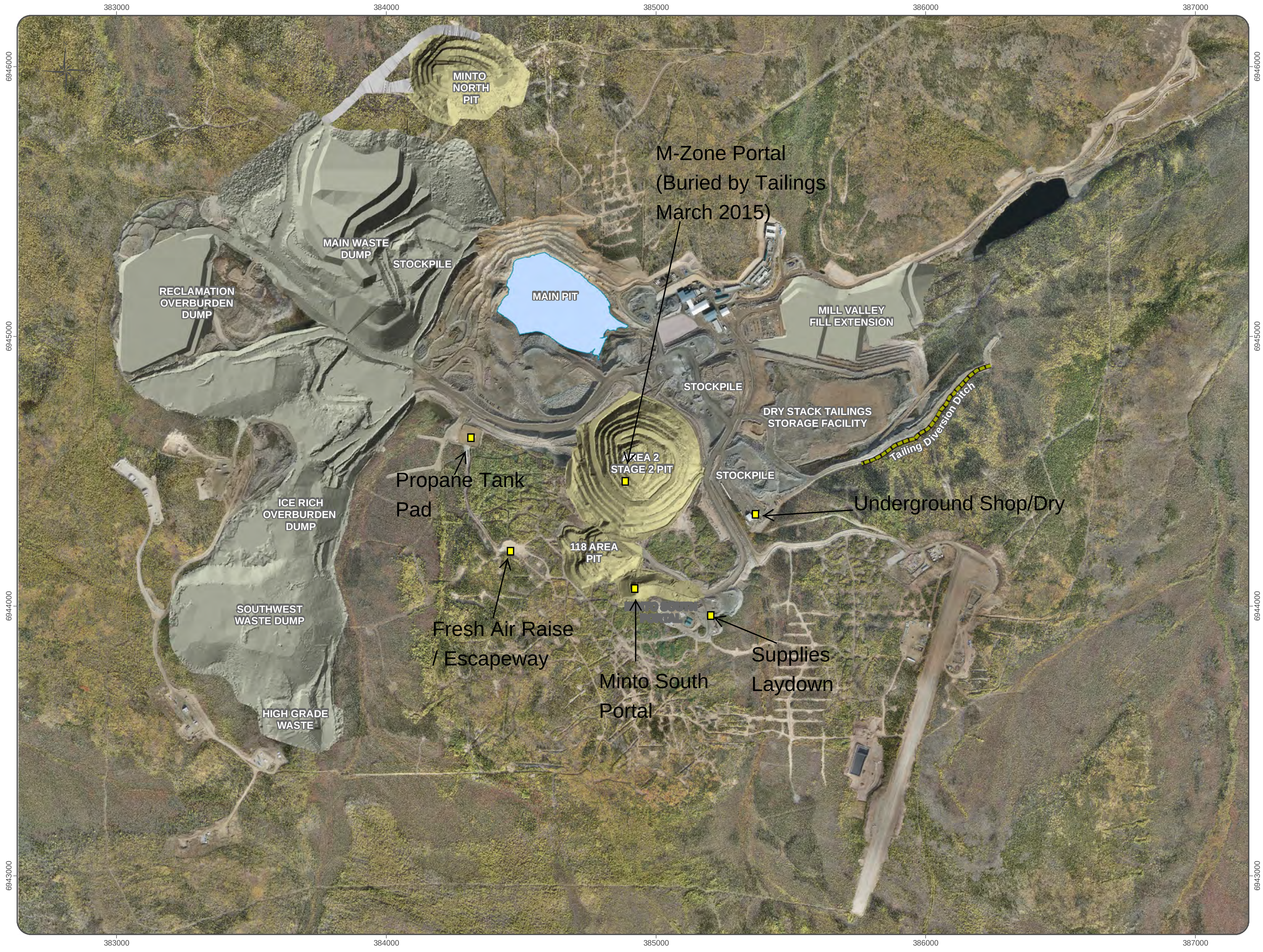
MINTO MINE

RECLAMATION AND CLOSURE PLAN
REVISION 2016-01

FIGURE 5-9

Underground Supporting Surface Infrastructure

AUGUST 2016



capstone MINTO MINE

Pit

Dump

Main Pit Lake

Minto North Access Road

Tailings Diversion Ditch

1:13,500 *when printed on 11 x 17 inch paper*

0 50 100 200 300 400 500 Meters

ALEXCO ENVIRONMENTAL GROUP

Aerial imagery obtained from Challenger Geomatics. Imagery acquired September 9[th] 2014.

Datum: NAD 83 Projection: UTM Zone 8N

D:\Project\AllProjects\Minto\gis\mxd\Closure\16-RCP_V6\V2\5-2_Overview_Year_0_20160802.mxd
(*Last edited by: amatlashevska;8/2/2016/11:07 AM*)

5.3.2.2 *Ore Zones and Portals*

The following Table 5-4 summarizes the nomenclature associated with Minto's ore zones:

Table 5-4: Nomenclature for Underground Complexes, Portals, and Zones at Minto.

Underground Complex	Access	Zones
Minto South Underground	Minto South Portal	Area 118
		Area 2
		Minto East
		Copper Keel
		Wildfire
M-zone	M-zone Portal	M-zone

A separate underground complex, known as the Wildfire Underground, was presented during the environmental assessment process. This would mine relatively shallow ore zones from a separate portal with its own dedicated infrastructure. Originally planned to be mined after the completion of the Minto South Underground, it is not currently in the mine plan and has not been included in RCP v6.

In the YESAA environmental assessment, Minto proposed that the Copper Keel and Minto East zones be accessed via their own portal. The current mine plan has been revised to access them from the Minto South Portal, reducing development expense, surface disturbance, and the number of mine openings to be secured as part of closure activities.

Figure 5-10 shows preliminary development and stoping designs for the aforementioned ore zones.

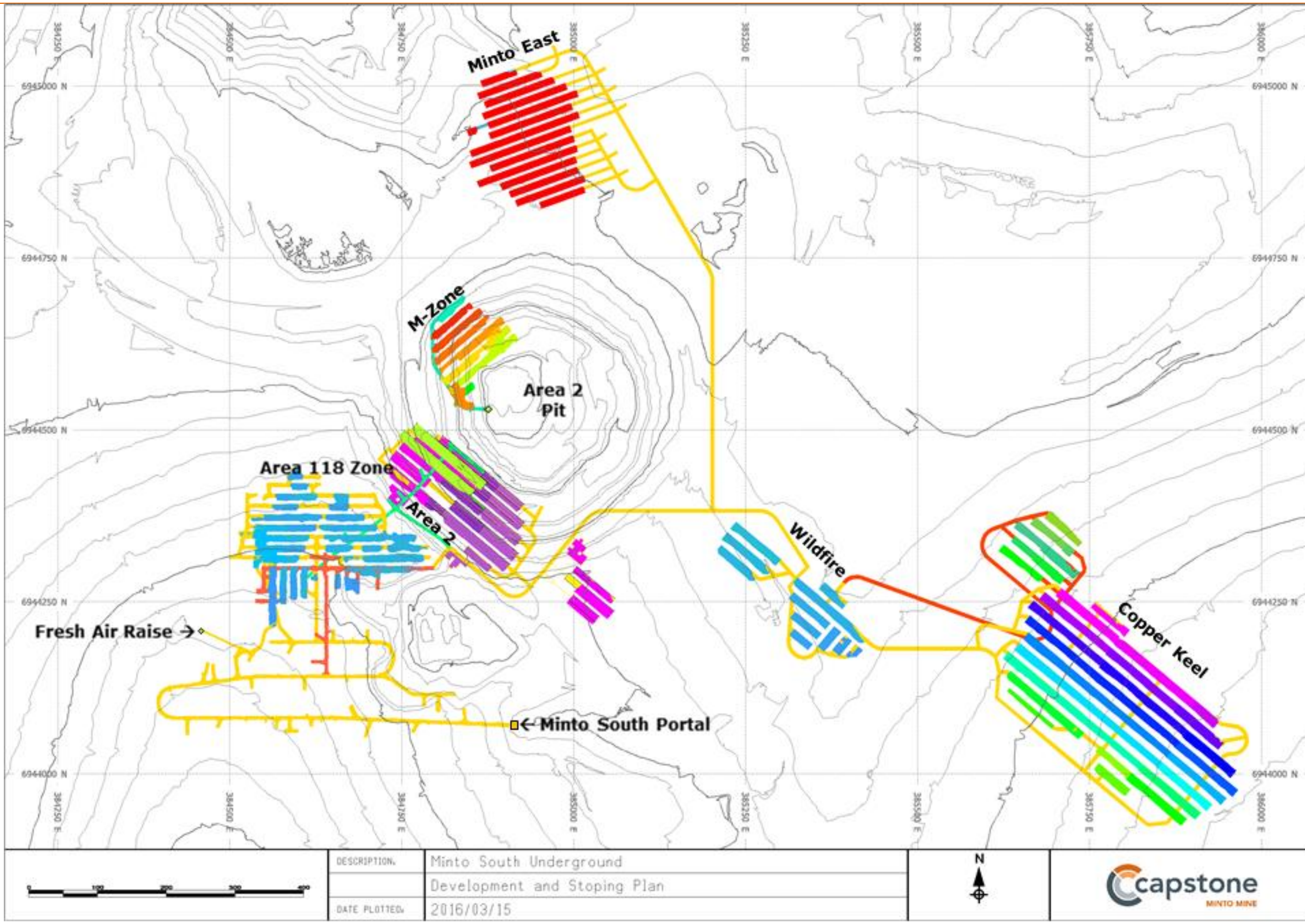


Figure 5-10: Plan View of Underground Development and Ore Zones

5.3.2.3 *Mining Methods*

Each of the areas summarized in Table 5-4 consists of many separated lenses of ore, varying considerably in size and thickness. The physical characteristics and grades of each ore zone determine which mining methods can be applied. A variant of longhole open stoping, described below, has found wide applicability at Minto, having been successfully used to mine the M-Zone and Area 118, and is currently being used in Area 2.

All three of these ore zones can be described as lenses of foliated granodiorite (fG), bounded at their hanging wall and footwall contacts by equigranular granodiorite (eG) host rock. The fG zones are typically 5-30 m thick, and the grade within them varies from 0% to approximately 6% copper. The fG zone typically dips at 20° to 35°.

To mine these zones, a series of parallel sill drifts are driven along the strike of the deposit, following the footwall contact. From these sill drifts, generally driven 6m wide and 4.5m high, a top-hammer longhole rig drills rings of 3” up-holes into the deposit above, stopping at the hanging-wall contact.

After drilling is complete, the rings are loaded, blasted, and then mucked out from the sill drift, which serves as a drawpoint. The average blast size is 3,000 tonnes. Mucking is via remote-controlled LHD; all stopes are non-entry, so no workers are exposed to the open stope. Ore is trucked to surface along the main ramp that accesses the deposit.

For the Area 118 zone and M-zone, production drift centerlines were 15 m apart. From each 6m-wide sill drift, drill holes fanned out to blast a 10m wide stope, and 5m thick rib pillars separated each stope, supporting the hanging wall. For the Area 2 zone, production drift centerlines are 20 m apart. Geotechnical analysis supports the use of 15 m-wide stopes 5m-wide pillars in Area 2. The pillar thickness is increased where stope height necessitates it. This method of varying stope and pillar widths based on the height of the deposit will also be applied to subsequent ore zones (e.g. Minto East and Copper Keel).

Significant variability in copper grades is seen within each ore zone; therefore, diamond drilling completed as part of earlier exploration is supplemented by infill drilling done from each sill using the production drilling equipment. Where additional information is needed prior to the completion of sill drifts, diamond drilling is also done from the underground workings.

The mining method does not use backfill; however, small quantities of development waste are sometimes placed in completed stopes to reduce haulage requirements.

Figure 5-11 provides a perspective view of the Area 118 zone in a nearly completed state (some stopes and development are omitted for clarity).

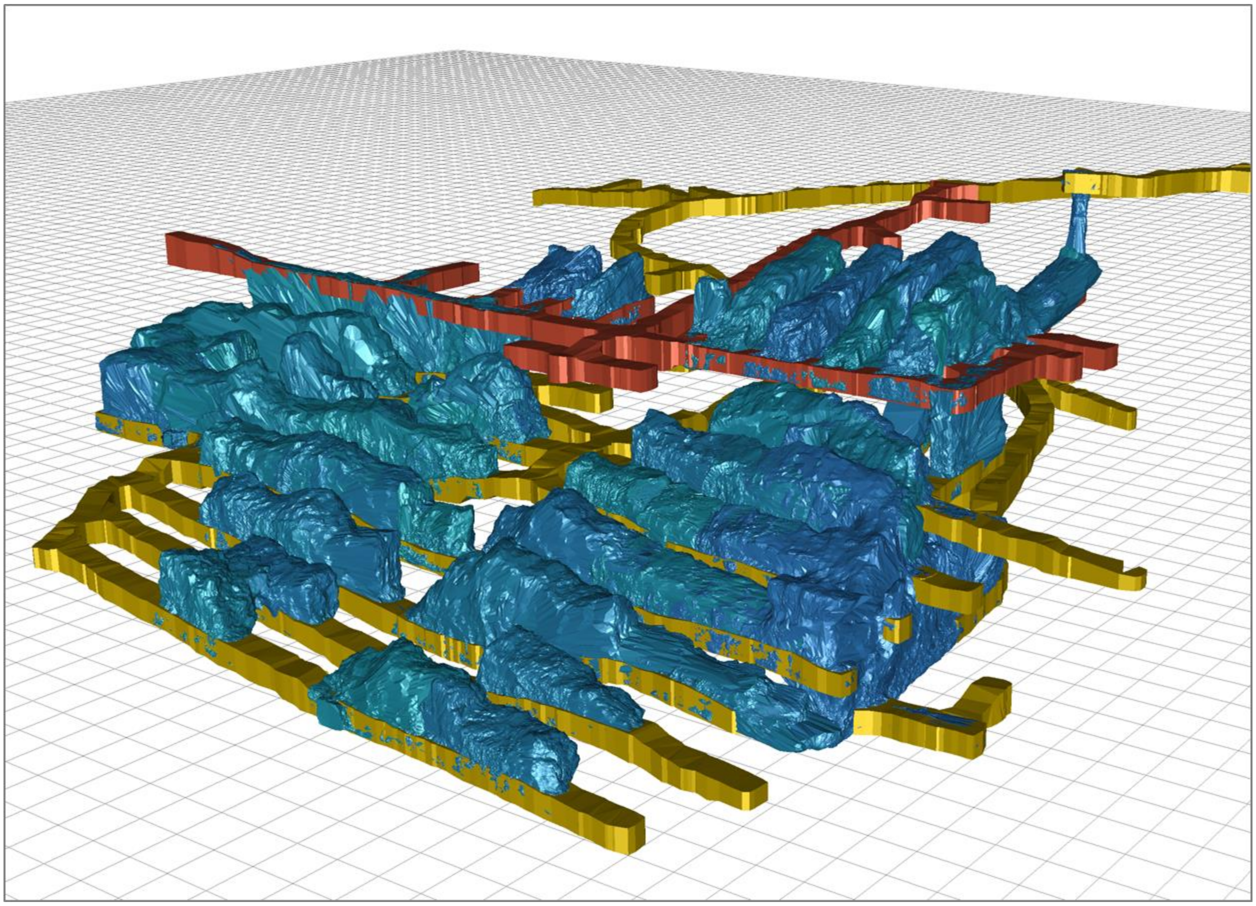


Figure 5-11: Perspective View of Area 118 Zone Looking Southeast. 740 Level Development Shown in Red. Some Development and Stoping Omitted for Clarity.

5.3.2.4 *Ground Support*

Ground support generally comprises 2.4 m-long fully grouted resin rebar bolts on a 1.5 m x 1.5 m pattern with a 1.8 m bolt in the center for the back and all 1.8m bolts for the walls. Mesh is installed to within 1.5 m from the floor. Additional support is installed in intersections.

5.3.2.5 *Ventilation*

Air is supplied to the mine by a surface installation commissioned in March 2015.

The fan is equipped with a variable frequency drive, which is used to balance the quantity of air delivered with the requirements of the diesel equipment in use at each stage of the mine life. Maximum fan power is 344hp; testing the fan at full speed during commissioning, airflow was measured at 350,000 cubic feet per minute (cfm).

Air is heated to maintain above-freezing temperatures year-round. The system comprises four burners totalling 32 million BTU/h and their ancillary infrastructure (blower motors, CO and temperature sensors, electronic controls).

Four 30,000 gallon propane tanks supply the burner with fuel. Two additional tanks will be installed in prior to the 2016 / 2017 heating season. Propane consumption averaged 4,400 L/d in December 2015.

The large lateral size of the future Minto South Underground necessitates new fresh air raises for Minto East and Copper Keel. The fan and burners are modular and designed to be movable when needed.

5.3.2.6 *Water Supply*

Inflow to the mine through faults and un-grouted diamond drill holes is generally sufficient to supply the mine with water for drilling and dust control. The mine recirculates water through a network of sumps designed to remove suspended sediment, which is dug out and hauled to surface and disposed in either the Main Pit or Area 2 Tailings Management Facilities. Occasional deliveries of water from surface have been required in the past as mining retreated out of wet areas.

5.3.2.7 *Dewatering*

Water currently collects into three sumps, from which pumps send water to the main dirty water sump at 760 L. This is a two-stage clean/dirty sump that removes most suspended solids before water is pumped to a final settling sump near the portal. This portal sump either discharges out to the permanent heat traced line on surface and on to the Area 2 Pit or returns water underground to supply the mine feed storage tank. The Area 2 pit also receives the mill’s tailings and process water.

5.3.2.8 *Explosives*

Emulsion is used for both longhole production and development. A bulk emulsion product known as Dyno Titan RU, formulated for underground use and having high viscosity, is used to load most blasts. This product is delivered via one of two dedicated mobile loading units – one for development rounds and a larger unit for longhole stope blasts.

To provide a backup in the event that the mobile loading unit is out of service, Minto stocks a product known as Dyno SL, which is a cartridge emulsion designed to be manually loaded using a portable pneumatic unit.

In development, a perimeter blasting product (Dynosplit D) is used to reduce overbreak in the back, and Dyno AP (a cartridge emulsion) is used in wet lifter holes.

The following table lists the magazines on site:

Table 5-5: Explosives Magazines

License No.	Location	Magazine Contents
YT-535	Surface	Surface detonators
YT-533	Surface	Surface explosives
YT-541	Surface	Underground detonators
YT-534	Surface	Underground explosives (perimeter control and boosters)
YT-542	Surface	Surface explosives (pre-shear)
YT-551	Surface	Underground explosives (packaged emulsion)
YT-553	Underground	Underground detonators
YT-550	Underground	Underground explosives

The Minto South Underground has two magazines, one for detonators and one for bulk and packaged explosives. Both are equipped with concrete floors and lockable gates. The powder magazine is large enough to store and handle 1.5 tonne totes of emulsion used by the development loader. The larger longhole loading unit is parked on surface at Dyno Nobel's office / shop / silo complex.

Non-electric caps are used to time and sequence blast holes in both production and development blasts. A single electric cap is used for each blast to tie the first non-electric cap into the mine's electric central blasting system.

5.4 Water Management

Management of water at the Minto Mine plays an important part in the mine planning; strategies and systems for managing water are in place for the current mining operations. The site water management plan (WMP) has been refined through extensive planning and authorization amendment processes since the inception of the original water management plan prepared and presented with the original project water licence application in 1996.

The purpose of water management at the mine is to ensure that the mine operations do not result in unacceptable impacts on surface and groundwater systems, including downstream water quality.

This section includes the following aspects of the operational Water Management Plan at the Minto Mine:

- The operational water management plan (WMP);
- The site water balance; and

- The water treatment system.

The Minto Mine Site has a positive water balance. Therefore, it is necessary to release water from site from time to time to prevent accumulation of excess water. The primary objective of the water management strategy is to control the release of water from site in a way that eliminates or minimizes potential effects to the water quality in Minto Creek.

The strategy for managing the mine water inventory during the operations phase can be summarized as follows:

- The site water balance is used to define mine water inventory targets and targets for volumes to be released to Minto Creek. Regular tracking of the mine water inventory allows the mine operations to determine if the inventory is on target and if and when water must be released from site.
- Runoff from developed mine areas (mine water) is collected and stored in the Main Pit Tailings Management Facility (MPTMF) and the Area 2 Pit Tailings Management Facility (A2PTMF). Mine water is used for ore processing and tailings deposition.
- The preferred method for controlling and limiting the inventory of mine water on site is to collect and divert discharge-compliant (clean) runoff to the Water Storage Pond (WSP) and from there to Minto Creek.
- If collection, diversion and release of clean water is not sufficient for meeting mine water inventory targets then Minto has the option of treating and releasing mine water.

The following sections will describe details of the operational water management plan, site water balance and description of operational water treatment. Planned water management for temporary closure and for the final reclamation and closure plan are described in Section 6.3.3 and 7.7, respectively.

5.4.1 Operational Water Management

The primary objective of the operational water management plan is to manage the release of water from site and, by extension, manage the inventory of mine water stored in the MPTMF and the A2PTMF. The mine operation must have sufficient water to operate but must avoid storing excess of mine water that does not meet the WL discharge quality limits.

During operations, water collected at the Minto Mine will be segregated on the basis of clean runoff and mine water. Clean runoff will be diverted around the active mining areas to the Water Storage Pond, and mine water will be contained in the MPTMF and A2PTMF. Runoff is classified as ‘clean’ if the water meets the water quality limits defined in the water licence. Runoff that does not meet water quality limits is categorized as ‘mine water’. During operations, clean runoff is intended to be released to Minto Creek from the WSP while mine water will be used for processing of ore and for sub-aqueous deposition of tailings and waste rock.

Diversion and release of clean runoff is intended to be the main method for managing the mine water inventory. However, release of treated mine water may be required if diversion of clean water is insufficient for managing the inventory of mine water.

Figure 5-12 shows a diagram of the work flow for the water management plan. The work flow includes the following steps:

Step 1. Define a mine water inventory target. The target will be set based on the available storage capacity, operational water demand, and runoff estimates. The water balance model will be used as a tool to evaluate the potential range of precipitation and runoff events that will have to be planned for.

Step 2. Track the site's mine water inventory. The inventory of mine water stored in the MPTMF and A2PTMF will be tracked on a weekly or monthly basis or as required, by surveying the water levels in the two reservoirs and by tracking the volume of waste rock and tailings solids deposited sub-aqueously in the two tailings management facilities. If the mine water inventory is increasing at a rate that would result in an exceedance of the inventory target, then steps would be taken to release additional water from site. Discharge management is described in Section 5.4.15.

Step 3. Update the water inventory target every 6 months, or as required and repeat Step 2. Operational, physical or water quality changes may change the water demand, storage requirement, availability of reservoirs or other elements that was used as a basis for defining the water inventory target. Therefore, the inventory target will be updated regularly.

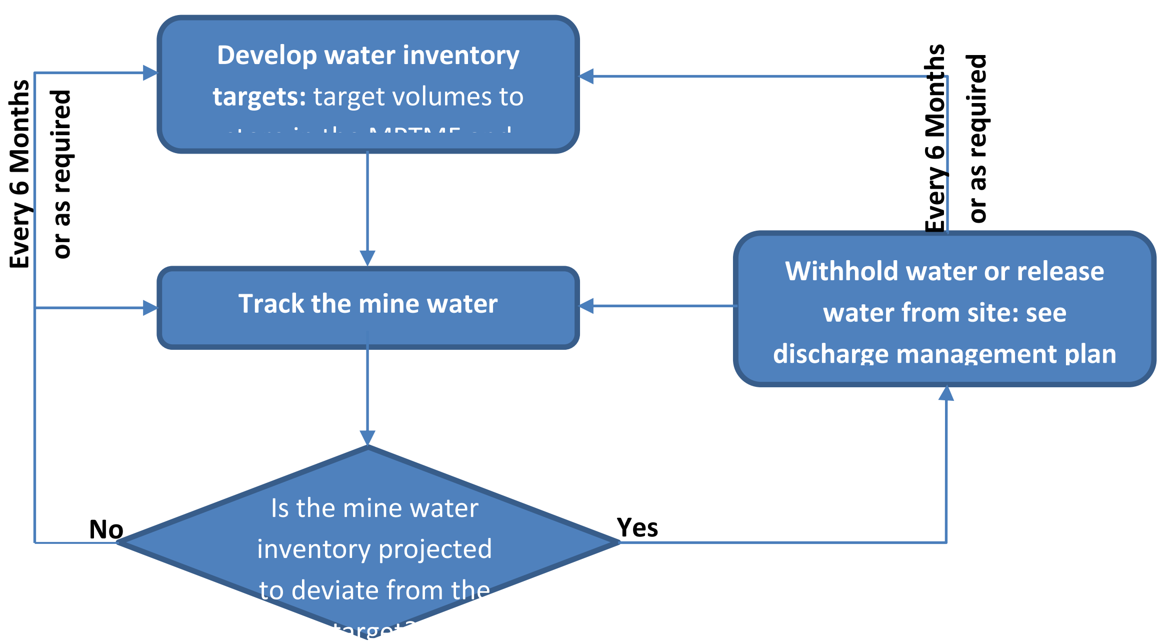


Figure 5-12: Water Management Plan Workflow

5.4.1.1 *Defining Mine Water Inventory Target*

The mine water inventory target will be defined based on the following considerations:

- As a guiding principle, a minimum of 600,000 m^3 of free water, or one year of operational water demand, should be stored on site at all times. This water inventory will ensure that the operation has adequate supply of water and that the mine water reservoir has sufficient residence time to allow for proper settling and management of suspended solids.
- Storage capacity to hold a minimum of 1,000,000 m^3 of mine water runoff must be available on March 30 each year. This storage capacity is estimated to represent water that would report to the MPTMF or the A2PTMF in a 1 in 200 wet year (approximately 1,400,000 m^3 of site-wide runoff minus approximately 400,000 m^3 diverted).
- Climatic variability. The water and load balance model developed for the Minto site will be used to evaluate the mine water inventory targets against a range of precipitation and runoff events (dry and wet years).

The inventory targets will be used by water operators as a basis for deciding whether to release additional water from site or to scale back water release. Inventory targets will be updated every 6 months or as required.

5.4.1.2 *Mine Water Inventory Tracking*

Water operators at the Minto Mine will track the mine water inventory on a weekly or monthly basis or as required. The following data will be collected and used for inventory tracking:

- Surveys of water levels in:
  - The Main Pit Tailings Management Facility (MPTMF);
  - The Area 2 Pit Tailings Management Facility (A2PTMF); and
  - The Water Storage Pond (WSP).
- Volumes of tailings solids and waste rock deposited sub-aqueously in the MPTMF and A2PTMF
- Pumped flows on site
- Precipitation and snow accumulation
- Runoff at hydrometric stations

Surveyed water levels will be converted to volumes using level-volume curves for the MPTMF and A2PTMF. The frequency of updates to the water inventory will depend on the season and operational factors. During winter months when flows are low, inventory updates may only be required every 4 to 8 weeks. However, before freshet and during periods with heavy precipitation in the summer and fall months, it may be necessary to update the inventory every 1 to 3 weeks.

5.4.1.3 *Reservoirs*

The water management plan was developed in conjunction with Minto Mine's Waste Rock and Overburden Management Plan and Tailings Management Plan. The Tailings Management plan (TMP) was developed to make use of three planned tailings management facilities planned, however only the MPTMF and A2PTMF will be used.

Main Pit Tailings Management Facility

The total storage capacity of Main Pit to its natural spill elevation is approximately 4.9 Mm^3. Additional details concerning the MPTMF are available in the TMP.

Area 2 Pit Tailings Management Facility

The final A2PTMF will consist of two intersecting pits separated by a saddle. The larger and more northerly of the intersecting pits is called Area 2 Stage 2 Pit, while the smaller and more southerly pit is referred to as Area 2 Stage 3 Pit. The total storage capacity of the final A2PTMF below the natural spill elevation of 802 m will be approximately 7.0 Mm^3. Additional details concerning the A2PTMF are available in the TMP.

Minto North

During active development and mining of the Minto North pit (2015 through 2016), mine water will be trucked or pumped to the MPTMF. There will be no surface discharge from the Minto North Pit and no spillway.

5.4.1.4 *Water Conveyance and Diversions*

Infrastructure for conveyance of water is an important element of the water management plan. Existing and planned water management infrastructure is discussed in Section 5.4.1.8.

5.4.1.5 *Discharge Management*

The discharge management actions described here provide a framework and specific procedures for diverting and releasing water from site.

Licence Effluent Quality Standards

Effluent quality limits as outlined in Water Licence QZ14-031 are included in this section. The water licence will always be referred to in conjunction with this document when making water management decisions to ensure a complete understanding and maintain compliance with the licence.

From QZ14-031:

9. All effluent discharged to Minto Creek must meet the following limits at all Effluent Points (including W16a, W17, W50 and WTP):

a)

Table 1 Effluent Standards

Parameter	Effluent Standards
pH, pH Units	6.0 – 9.0
Ammonia - N, mg/L	0.75
Nitrite - N, mg/L	0.18
Nitrate - N, mg/L	27.3
Aluminum (dissolved), mg/L	0.3
Arsenic (dissolved), mg/L	0.015
Cadmium[1] (dissolved), μg/L	$3*e^{(0.736(\ln(hardness)-4.943)}$
Chromium (dissolved), mg/L	0.003
Copper (dissolved), mg/L (when [DOC] @ W2 >10 mg/L)	0.06
Copper (dissolved), mg/L (when [DOC] @ W2 ≤10 mg/L)	0.039
Iron (dissolved), mg/L	3.3
Lead (dissolved), mg/L	0.012
Molybdenum (dissolved), mg/L	0.219
Nickel (dissolved), mg/L	0.33
Silver (dissolved), mg/L	0.0003
Selenium (dissolved), mg/L	0.006
Zinc (dissolved), mg/L	0.09
Oil and Grease	None Visible

[1] Hardness measurement at WQO Station

b) *Total Suspended Solids (TSS) of 15 mg/L except during March, April and May when the TSS limit is a maximum grab concentration of 30 mg/L and a monthly mean concentration of 15 mg/L.*

c) *A bioassay standard of a 96-hour at 100% LT50 bioassay using rainbow trout (EPS1/RM/13), pH non-adjusted and a 48-hour at 100% LT50 bioassay using Daphnia magna, pH non-adjusted (EPS 1/RM/14); and*

d) *The effluent limits set out in Schedule 4 of the MMER.*

10. All discharge from the Reverse Osmosis Plant (RO) shall meet the WQOs in Table 2.

3.4 Water Quality Objectives

11. The table below lists Water Quality Objectives. Any exceedances of these at the defined WQO[*] Station shall trigger the Operations Adaptive Management Plan.

Table 2- Water Quality Objectives

Parameter	Water Quality Objectives
pH, pH Units	6.0 - 9.0
Ammonia - N, mg/L	0.25
Nitrite - N, mg/L	0.06
Nitrate - N, mg/L	9.1
Aluminum (dissolved), mg/L	0.1
Arsenic (dissolved), mg/L	0.005
Cadmium[1] (dissolved), µg/L	$e^{(0.736(\ln(hardness)-4.943)}$
Chromium (dissolved), mg/L	0.001
Copper (dissolved), mg/L (when [DOC] @ W2 >10 mg/L)	0.02
Copper (dissolved), mg/L (when [DOC] @ W2 ≤10 mg/L)	0.013
Iron (dissolved), mg/L	1.1
Lead (dissolved), mg/L	0.004
Molybdenum (dissolved), mg/L	0.073
Nickel (dissolved), mg/L	0.11
Silver (dissolved), mg/L	0.0001
Selenium (dissolved), mg/L	0.002
Zinc (dissolved), mg/L	0.03
Bioassay (Quarterly Analyses)	30-day Early Life Stage Toxicity for rainbow trout (EPS 1/RM/28), 7-day for *Ceriodaphnia dubia* (EPS 1/RM/21), and 72-hour for algae (*Pseudokirchneriella subcapitata)* (EPS 1/RM/25).

[1] Hardness measurement at WQO Station

* WQO Station definition from QZ14-031:

"WQO Station" for the purposes of this Licence means:

- *station W2 during the period when flow is encountered at stations W15 and W35; or*
- *station W50 during the period when flow is not encountered at stations W35 and W15.*

Discharge Flow Restrictions

Flow restrictions on discharge form the Minto Mine as outlined in Water Licence QZ14-031 are included in this section. The water licence will always be referred to in conjunction with this document when making water management decisions to ensure a complete understanding and maintain compliance with the licence.

From Water Licence QZ14-031:

3.2. Discharge Rates

3) The Licensee shall cease discharging and take remedial action if there is erosion and/or alteration to the bed or bank of the water channel.

4) All discharge from the Reverse Osmosis Plant (RO) shall meet the WQOs in Table 2.

5) When W35 and W15 are frozen, discharge from the Effluent Points and/or the RO shall meet the WQOs in Table 2 at W50.

6) When W35 and W15 are not frozen, discharge from Effluent Points shall meet the EQSs in Table 1 and the rate of discharge (Q_{EFF}) shall be determined as follows:

a) Initial discharge rate: $1/3\ (Q_{MC}+Q_{RO}) \geq Q_{EFF-C}$

b) Rate after discharge has commenced: $1/3\ (Q_{MC}+Q_{RO}-Q_{EFF}\text{-}M) \geq Q_{EFF-C}$

Where:

Q_{MC} = daily flow rate in Lower Minto Creek (represented by either W1 or MC1), Q_{RO} = daily flow rate of discharged from the RO; Q_{EFF}-M = measured daily rate of discharge from mine site Q_{EFF-C} = calculated rate of water discharge from mine site

7) There shall be no discharge to McGinty Creek.

8) The flow in McGinty Creek shall remain statistically unaltered from baseline flow.

Maximum discharge flow will be calculated daily based on a manual or automated flow measurement. Automated flow measurements will consists of remote water level transmission converted to flow using a rating curve or an in-stream flow sensor that transmits a flow value to the mine.

5.4.1.6 *Water Management Decisions and Actions*

Operational water management decisions can be summarized as follows:

1) The first water management decision is whether or not water (clean runoff or treated mine water) must be released from site.

2) Secondary decisions include:

    a) The quantity of water,

    b) The preferred water source, and

    c) Timing of the release.

Water must be released from site when the mine water inventory exceeds, or is projected to exceed, the inventory target. The inventory target will regularly be compared to the mine water-tracking log to determine whether the mine is operating at a water deficit or surplus or is on target. Actions to be taken in the event of a surplus when water must be released from site are described in Section 5.4.1.7.

Water released from site must always meet effluent quality standards as prescribed in the water licence. Water treatment will be required if water destined for release does not meet these limits. Options for treating water are discussed in Section 5.4.4.

5.4.1.7 ***Surplus Water Inventory Actions***

If the mine water inventory is running a surplus, the following action will be taken in the order listed to release water from site:

1. **Divert water from W35a to WSP:** water will be diverted from the south-west catchment (collected at station W35a) to the WSP. Historically, the water at W35a has been of a similar quality to clean runoff measured in lower Minto Creek. On-going water quality monitoring will ensure that water in the WSP remains in compliance with the water licence water quality limits. The mine will maintain procedures, checklists, sample collection, and analysis that must be completed prior to diverting water from W35a to the WSP.

2. **Divert water from W15 to WSP:** if diversion of water from W35a is insufficient to meet water inventory and release targets then water collected at W15 can be diverted to the WSP. Water collection point W15 collects runoff from undisturbed areas and from waste rock. The water quality parameter concentrations have historically been elevated compared to undisturbed catchments but have generally met water quality limits in the months of May, June, July and August. On-going water quality monitoring will ensure that water diverted from W15 and water in the WSP remains in compliance with water quality limits in effect. The mine will maintain procedures, checklists, sample collection, and analysis that must be completed prior to diverting water from W15 to the WSP.

3. **Release mine water stored in the MPTMF or A2PTMF to WSP.** The mine water stored on site will likely require water treatment before it can be released. Water treatment considerations are discussed in Section 5.4.4. The mine will maintain procedures, checklists, sample collection, and analysis that must be completed prior to releasing water from the MPTMF or A2PTMF. Water will only be released from the WSP to Minto Creek when the water quality complies with limits prescribed in the water licence and only

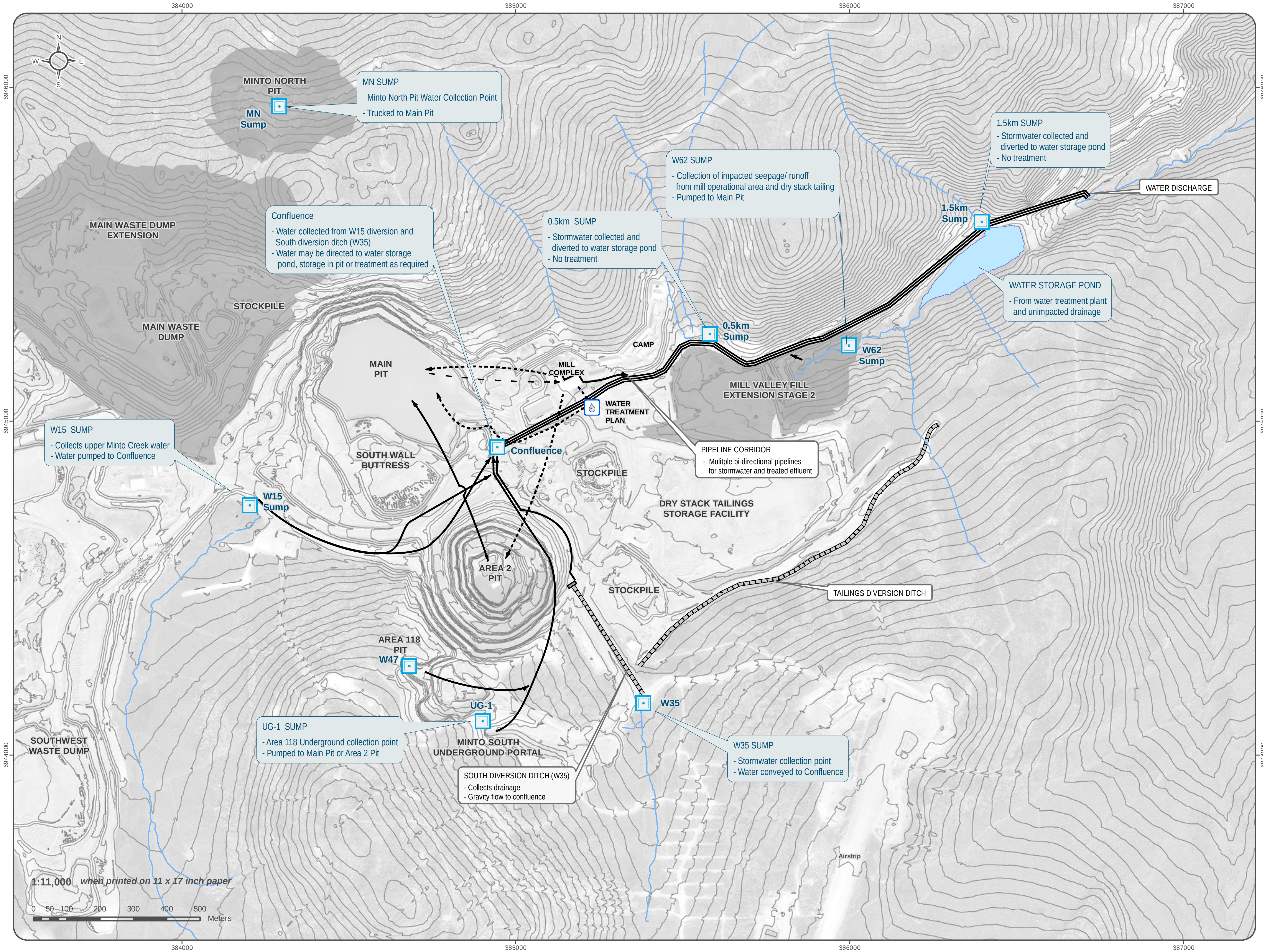
in quantities that meet the limitation in Section 5.4.1.5. In addition, the water quality, flow, and channel conditions of lower Minto Creek will be considered before a decision is made to release water from the WSP to Minto Creek.

5.4.1.8 ***Water Conveyance Network***

The Minto Mine water conveyance network consists of diversion ditches, culverts, sumps, pumps, and pipelines installed throughout the mine site. The system is designed to segregate clean runoff and mine water. Clean water is conveyed to the WSP while mine water is conveyed to the mine water storage reservoirs, which includes the MPTMF and A2PTMF.

Figure 5-13 shows the location of water conveyance infrastructure that are currently in place. Table 5-6 summarizes the current mine water infrastructure, and also includes authorized (by QZ14-031) changes that have yet to be implemented.

The conveyance network is intended to provide a high degree of operational flexibility such that appropriate water management actions can be taken based on informed management decisions.



MINTO MINE

RECLAMATION AND CLOSURE PLAN
REVISION 2016-01

FIGURE 5-13

MINTO MINE WATER CONVEYANCE NETWORK

capstone
MINTO MINE

- Collection Point
- Mill Water Reclaim Line
- Pipe Alignment
- Piping Corridor
- Tailings Slury Discharge

ALEXCO ENVIRONMENTAL GROUP

Aerial imagery obtained from Challenger Geomatics. Imagery acquired Sept 9th 2014.
Site contours derived from 2014 aerial imagery obtained from Challenger Geomatics.

Hydrology data provided by Minto Explorations Ltd, May 2009.

Datum: NAD 83 Projection: UTM Zone 8N

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(*Last edited by: amatlashevska;8/2/2016/13:21 PM*)

Table 5-6: Minto Mine Water Management Infrastructure

Infrastructure Name	Description of Current Use
Main Pit Tailings Management Facility (MPTMF)	Tailings management facility and water reservoir. Total capacity to the natural spill elevation is approximately 4.9 Mm3.
Area 2 Pit Tailings Management Facility (A2PTMF)	Tailings management facility and water reservoir.
Mill Pond	Decommissioned.
Water Storage Pond	Stores clean water destined for release to Minto Creek, or available for mill use. Total capacity is approximately 320,000 m^3.
W15 sump	Collects runoff and seepage from the western sub-catchments on the Minto Site and conveys the water via a pipeline to the Main Pit or WSP.
W35 sump	Collects runoff and seepage from the southern undisturbed sub-catchments on the Minto Site and conveys the water to the Main Pit or WSP.
Mill Valley Fill Extension Stage 2 Sump (W62)	Collects and pumps Mill Valley seepage to the Main Pit.
0.5 km and 1.5 km sumps and ditches	Collects runoff from sub-catchments north of the Minto Mine access road. Runoff collected is diverted to the WSP.
South Diversion Ditch	Collects runoff from sub-catchments located south of the dry stack tailings facility.
Tailings Diversion Ditch	Diverts water from small catchment upslope of ditch.
Area 2 Pit sump	No longer applicable.
Minto South underground dewatering	Water collected from Minto South underground dewatering will be conveyed by pipe or trucked to the MPTMF or A2PTMF.
Confluence	Hub located between the Main Pit and Area 2 Pit where water from W15 and W35 may be directed to the Main Pit or to the WSP.
WSP discharge	Pumps and pipes for releasing water from the WSP to Minto Creek.
Minto North sump	Runoff collected in the Minto North Pit will be transported to the MPTMF or A2PTMF.
Reclaim water line from the WSP to the mill	Conveys water from the WSP to the mill, if required.
Reclaim water line from the MPTMF to the mill	Conveys water from the MPTMF to the mill or A2PTMF.
Reclaim water line from the A2PTMF to the mill	Conveys water from the A2PTMF to the mill or MPTMF.
Tailings line from the mill	Conveys slurried tailings and water from the mill to the MPTMF and A2PTMF.
Water treatment plant	Accepts feed water from the MPTMF, the A2PTMF or the WSP and discharges treated water to the MPTMF, A2PTMF, WSP or Minto Creek. Sludge and brine produced in the treatment process is pumped to the MPTMF or A2PTMF.

5.4.2 Water Balance

Understanding the site water balance is integral for the development of the water management strategy. The water balance is influenced by a number of factors including the geography of the site, precipitation, evaporation and evapotranspiration, surface runoff, site water inventory, and water use.

5.4.2.1 *Water Balance Model*

The water balance includes the development of a stochastic water balance model that incorporates frequency distributions for total annual precipitation to estimate the range and probability of runoff events for the proposed development through to post-closure. These predictions contribute to the refinement of options for managing both discharge to the environment and water inventory at the mine site. Table 5-7 shows the estimated range of total site precipitation and run-off estimates.

Table 5-7: Minto Mine Site Precipitation and Runoff Estimates

		1:100 Dry Year	Average Annual Precipitation	1:200 Wet Year
Precipitation	mm	205	329	498
Estimated Site-Wide Runoff	m3/year	450,000	850,000	1,400,000

The water balance model divides the site and surrounding areas into catchments and sub-catchments within the Upper Minto Creek (Minto Mine site) catchment as well as the sub-catchment for the Minto North Pit, which is located within the adjacent McGinty Creek catchment. The area of the sub- catchments are calculated and classified as undisturbed, developed, or partially developed. Undisturbed catchments typically produce clean runoff that is of similar quality as background water quality in lower Minto Creek. Developed catchments produce mine water runoff. The mine water runoff is generally of poorer quality than the clean runoff but the quality varies over a wide range depending on season and degree and type of material contacted. Catchment delineations and classifications are described in the Water and Load Balance Model Report 2016 (SRK 2016d and included in this RCP as Appendix O).

5.4.2.2 *Groundwater*

Groundwater represents a minor component of the site's water balance. The mine is located at the headwaters of Minto Creek and therefore has limited input of regional groundwater. The tight bedrock and discontinuous permafrost limit the sub-surface movement of ground water. Some groundwater is encountered during active mining of the pits and underground. However, discharge volumes are relatively low. An evaluation of groundwater for the Minto Site is available in the Hydrogeological Characterization Report and the 2015 Groundwater Model Update Report (Appendix K1 and K3).

5.4.2.3 *Annual Operational Water Balance*

Table 5-8 shows a summary of the annual operational water balance for Minto Mine. The annual water balance shows that runoff yields approximately 950,000 m^3 of water in a year with average precipitation. Operational demand account for approximately 600,000 m^3. This leaves an excess volume of about 350,000 m^3, which must be stored on site or be released to Minto Creek.

In a 1 in 100 dry year, the runoff volume would not be sufficient to cover the operational water demand, while a 1 in 200 wet year would yield approximately 800,000 m^3 of excess runoff. The strategy for managing the excess surface runoff and mine water inventory is to divert and release clean runoff to Minto Creek to the greatest extent possible.

Table 5-8: Annual Operational Water Balance Summary for Minto Mine

Water Balance Component	Unit	1:100 Dry Year	Average Annual Precipitation	1:200 Wet Year
Water Input				
Annual site-wide runoff	m^3/year	450,000	950,000	1,400,000
Operational Water Demand				
Water to tailings pores	m^3/year	550,000	550,000	550,000
Water to waste rock pores	m^3/year	60,000	60,000	60,000
Water in Excess of Operational Demands				
Water to store on site or Released to Minto Creek	m^3/year	-160,000	340,000	790,000

5.4.2.4 *Diversion of Clean Runoff*

Table 5-9 shows a summary of sub-catchments for Minto Mine. Sub-catchments that can be considered to be largely undisturbed (i.e. consistently produce clean/discharge-compliant runoff) include the WSP and W35a catchments.

The WSP catchment accounts for approximately 22% of the total catchment area of the Minto Mine site. Runoff from the northeastern WSP catchment is collected in a ditch along the mine access road and flows through a culvert to the WSP. The eastern portion of the southern WSP catchment reports to the south diversion ditch that follows the southern boundary of the DSTSF. From there it flows to the WSP. Runoff from westernmost portion of the southern catchment reports directly to the WSP.

The W35a catchments represent approximately 16% of the total catchment area of the Minto Mine site. If the footprint for the Area 2 Stage 3 pit necessitates it, water collected at W35a will be conveyed to the tailings diversion ditch and from there flow to the WSP.

Combined, the WSP and W35a catchments account for about 38% of the total upper Minto Catchment area. The volume of runoff that can be diverted to the WSP depends on the collection and diversion efficiencies of the water management ditches, sumps, and pipes. Assuming that actual diversion efficiencies range between 60% and 80%, the average annual runoff volume that would be diverted to the WSP would range between 210,000 m^3 and 280,000 m^3, or between 25% and 33% of the total runoff from upper Minto Creek. Therefore, diverting runoff from these two catchments may be sufficient for maintaining a net zero water balance for mine operation, assuming that the precipitation on site is close to the average annual precipitation of 329 mm.

However, in the event that precipitation and runoff is much greater than average for one or more years, it may be advantageous or necessary to release additional water. If so, additional runoff may be diverted from W15 to the WSP. W15 receives runoff from both undisturbed catchments and developed mine areas. However, runoff that historically has reported to W15 has generally met water quality limits listed in WL QZ14-031 for the months of May, June, July, and August. The W15 catchment represents 36% of the total upper Minto Creek catchment and could yield another 150,000 m^3 to 200,000 m^3 of relatively clean runoff. Therefore, with diversion in place for the WSP, W35a and W15 sub-catchments, a total volume of 360,000 m^3 to 480,000 m^3 could possibly be collected and released annually from the Minto Site in a year with average precipitation and runoff.

Table 5-9: Minto Mine Sub-Catchments and Potential Runoff Volumes Diverted, Average Year

Sub-Catchment	Area	% of Minto Mine Site-Wide Catchment	Diverted Clean Runoff, 60% Diversion Efficiency		Diverted Clean Runoff, 80% Diversion Efficiency	
	ha	%	m^3/year	% of Site-Wide Runoff	m^3/year	% of Site-Wide Runoff
W35a	172	16%	120,000	14%	160,000	19%
WSP	235	22%	90,000	11%	120,000	14%
W15	374	36%	150,000	18%	200,000	24%
Diversion Options						
W35a + WSP	407	39%	210,000	25%	280,000	33%
W35a + WSP + W15	781	75%	360,000	42%	480,000	56%

If clean surface water diverted to the WSP does not meet the WL QZ14-031 effluent quality limits then water treatment may be required. Operational use of water treatment is discussed in Section 5.4.4.

5.4.3 Water Quality Modelling

Water quality predictions for the Minto site have been revised to support this version of the RCP. Methods and results are presented in the Water and Load Balance Model Report 2016 (Appendix O)). This section provides a brief summary of the approach and presents selected key results.

5.4.3.1 *Approach to Water Quality Modelling*

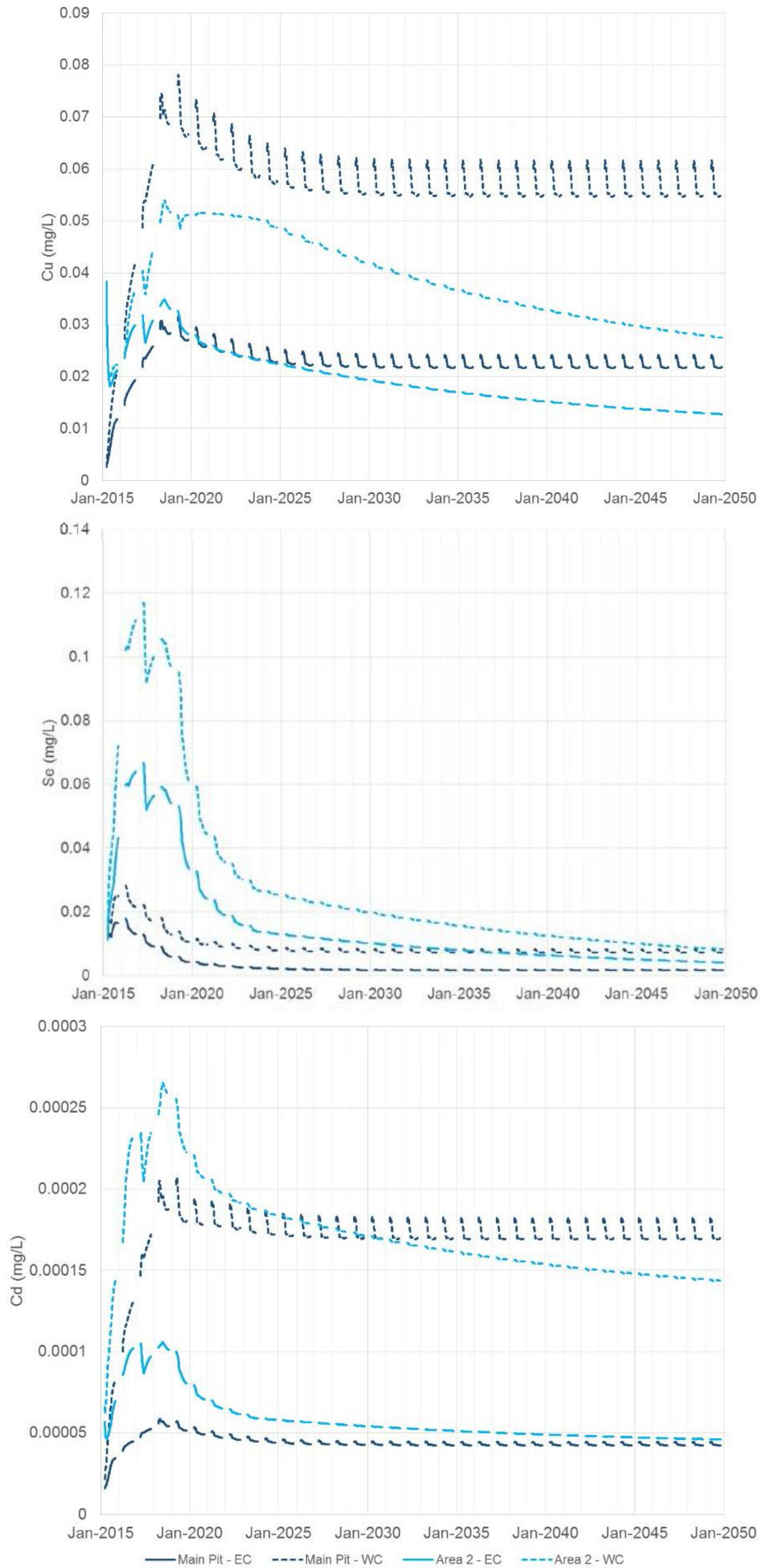
The 2016 water quality predictions were developed using the GoldSim modeling software package, using the Minto's existing model as a starting point. The existing version of the model was most recently updated in March 2016 for the water and load balance update included in the 2015 annual report (Minto 2016b). The model combines water balance inputs (summarized in the preceding section (Section 5.4.2) with geochemical loading inputs (derived largely from full-scale operational monitoring results) to produce a combined water and load balance that yields estimates of aqueous concentrations of modelled parameters at discrete points of interest relative to the mine site. The water and load balance is primarily a conservative mass balance, with no modelled removal of geochemical load except in model scenarios incorporating passive wetland treatment elements. The effect of placement of soil covers on waste rock and tailings is modelled by decreasing the rate of net percolation of water and flushing of load through those materials after placement of covers in the model scenario.

5.4.3.2 *Water Quality Model Results*

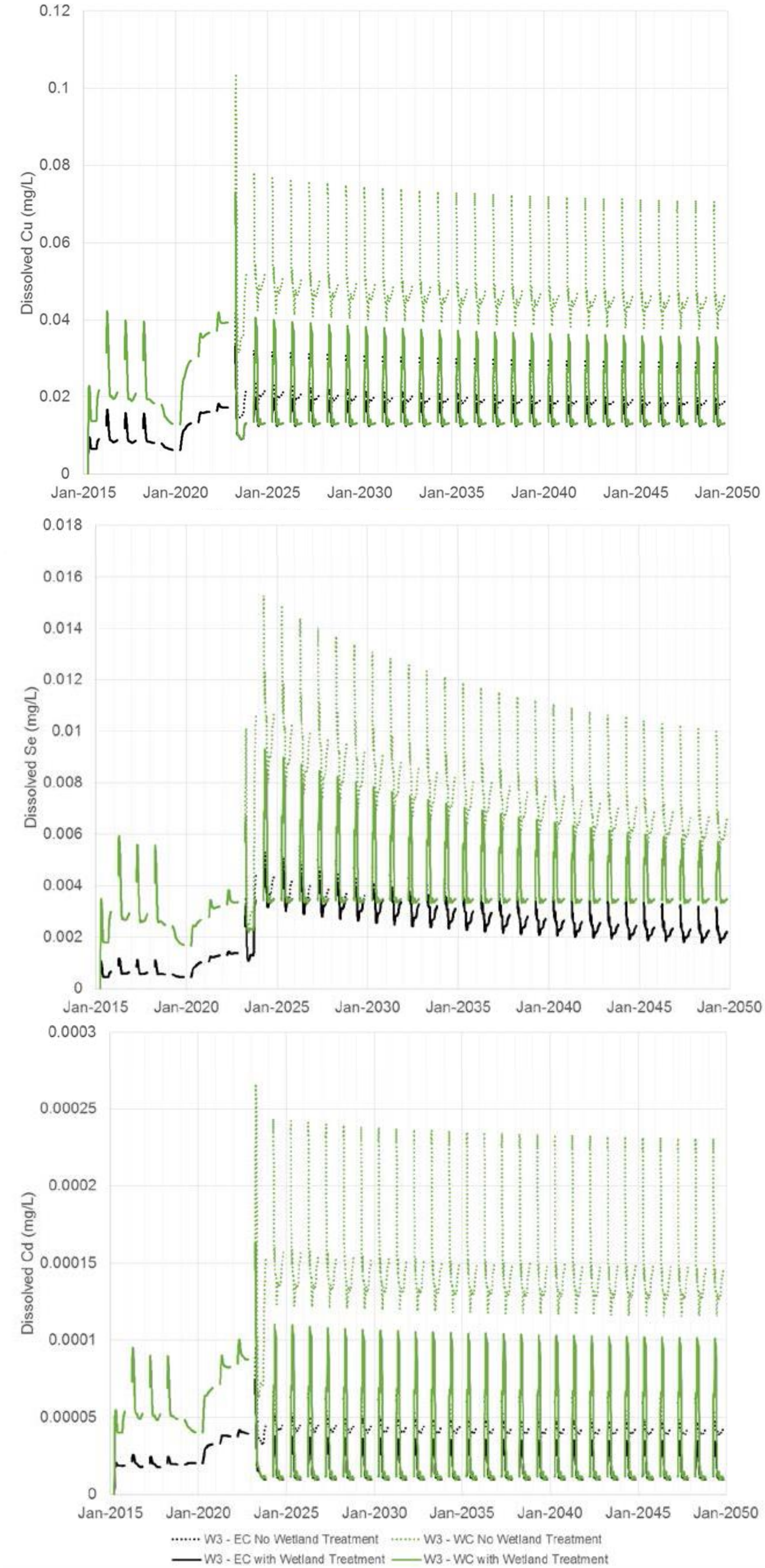
Minto Creek catchment water quality model results for dissolved copper, dissolved selenium, and dissolved cadmium are presented for the pit lakes (Figure 5-14), Minto Creek downstream of mine-related disturbances (Figure 5-15), and Minto Creek near the mouth (Figure 5-16). These three parameters have been of primary interest and provide a general representation of the overall model results (which are provided in full in Appendix O). Major aspects of the results at each location are noted in the following bullets.

- Open pits (Figure 5-14):
  - Concentrations in the Area 2 Pit are expected to increase during the operational stage when waste rock and tailings are placed in the Area 2 Pit. Selenium concentrations increase markedly during periods when tailings are deposited to the pit. After closure, copper, selenium, and cadmium concentrations are expected to eventually decline to steady-state levels that are representative of long-term post-mining geochemical loading rates.
  - Concentrations in the Main Pit remain relatively constant, again reflecting geochemical loading rates.
- Minto Creek downstream of mine-related disturbances (at station W3) (Figure 5-15):
  - Model results for W3 show relatively low concentrations during the operational period followed by a modest increase in concentrations at closure. This is due to the fact that residual mine water stored in the Area 2 Pit begins reporting to Minto Creek at that time.
  - Model results show a wide range of seasonal variability that reflects the proportion of pit discharge water to total model flows at W3.
- Minto Creek near the mouth (at station W1) (Figure 5-16):
  - Model results for W1 show relatively low concentrations during the operational period followed by a modest increase in concentrations at closure. The pattern is similar to that modelled for W3, which reflects the influence of discharge from the open pits after discharge begins.
  - Model results for dissolved copper and dissolved selenium for the high-flow period are near or above values determined to represent a concentration that has been defined as 50% assimilative capacity during the freshet period for all model scenarios. During the lower flow periods of summer and fall, model results for these same parameters are below the values defined as 50% assimilative capacity values for both Expected Case scenarios and for the Worst Case with Wetland Treatment scenario, while model results for the Expected Case-No Treatment scenario exceed the 50% assimilative capacity value for both parameters.

McGinty Creek catchment water quality model results for dissolved copper, dissolved selenium, and dissolved cadmium are presented for McGinty Creek near the mouth (Figure 5-17). The results are identical to those presented in the Phase V/VI expansion application (Minto 2014) and show that there is expected to be minimal, if any, measurable effect on the water quality in McGinty Creek from mining of the Minto North Pit. Complete modelling results for McGinty Creek are provided in Appendix O.

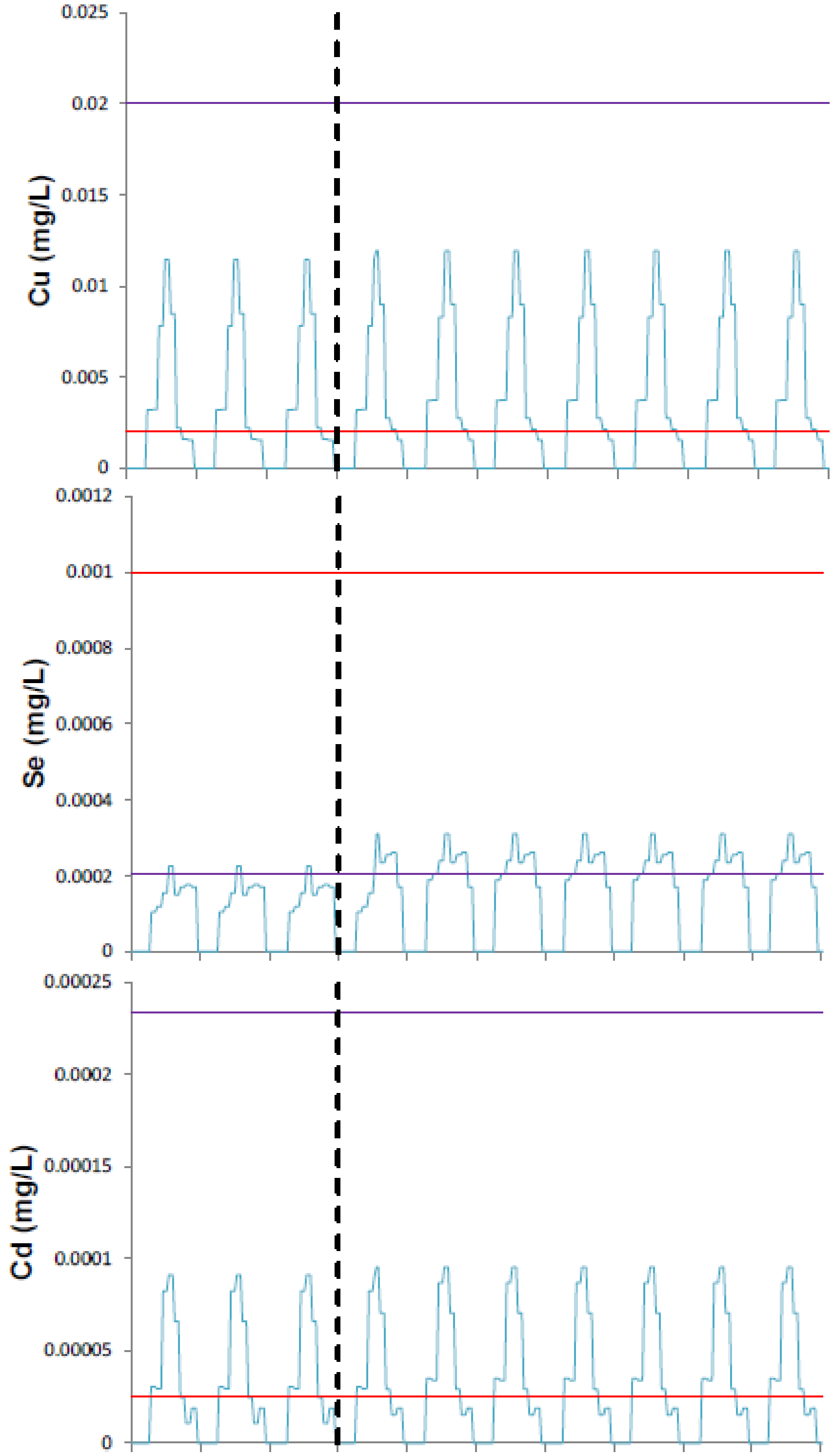


srk consulting	capstone MINTO MINE OPERATED BY MINTO EXPLORATIONS LTD.	Minto Mine RCP 2016-1 **Selected water quality modelling results for Main Pit and Area 2 Pit lakes**
Job No: 1CM002.024 Filename: Fig_5-14_MP+A2Plake_WQ.pptx	Minto Mine	Date: Aug 2016 · Approved: DBM · Figure: **5-14**



srk consulting	capstone MINTO MINE, OPERATED BY MINTO EXPLORATIONS LTD.	Minto Mine RCP 2016-1		
		Selected water quality modelling results for Minto Creek below the mine site (Station W3)		
Job No: 1CM002.024 Filename: Fig_5-15_W3_WQ.pptx	Minto Mine	Date: Aug 2016	Approved: DBM	Figure: **5-15**

srk consulting	capstone MINTO MINE OPERATED BY MINTO EXPLORATIONS LTD.	Minto Mine RCP 2016-1
		Selected water quality modelling results for Minto Creek near the mouth (Station W1)
Job No: 1CM002.024 Filename: Fig_5-16_W1_WQ.pptx	Minto Mine	Date: Aug 2016 · Approved: DBM · Figure: **5-16**



Notes: X-axis tick marks represent a 1-year timeframe

Legend	
McGinty Creek at Mouth	
CCME PAL	
95th Percentile_MN4.5_baseline	
Minto North Overflows to McGinty Ck	

srk consulting	capstone MINTO MINE OPERATED BY MINTO EXPLORATIONS LTD.	Minto Mine RCP 2016-1
		Selected water quality modelling results for McGinty Creek near the mouth (Station MN4.5)
Job No: 1CM002.024 Filename: Fig_5-17_McGinty-MN4.5_WQ.pptx	Minto Mine	Date: Aug 2016 / Approved: DBM / Figure: **5-17**

5.4.4 Water Treatment

Water treatment may be required if:

- Water stored in the WSP does not meet water quality limits prescribed in the water licence.
- Mine water stored in the MPTMF or the A2PTMF is to be released to Minto Creek and the water does not meet water quality limits prescribed in the water licence.

The WSP is intended as a clean water reservoir where discharge compliant water is stored and monitored prior to release to Minto Creek. However, storm events, seepage losses from the mill valley or other events may cause certain water quality parameter concentrations to exceed water licence water quality limits. Minto will maintain procedures that must be followed prior to treating and releasing water stored in the WSP. When treating WSP water, it may be necessary to release the treated water directly to Minto Creek from the water treatment plant rather than returning the water to the WSP.

During the operations phase, mine water stored in the MPTMF or the A2PTMF will likely require treatment before it can be released to the WSP.

The first stage of the water treatment plant at Minto was constructed in 2010. The water treatment process included a ballasted lamella clarifier unit (Actiflo®) system for removal of TSS, total metals and dissolved copper. The process relies on the addition of alumina-based coagulant (Aluminex-5), flocculant and organo-sulphide (TMT-15) reagents to facilitate removal of TSS and to precipitate dissolved copper and other metals. Yardney sand filters and Cuno polypropylene filters were installed downstream of the clarifier unit to reduce concentrations of fine particulate matter carried over with the clarifier overflow. The plant was designed for a maximum capacity of 3,600 m^3/day.

In 2012, two Reverse Osmosis (RO) trains capable of handling 2,500 m^3/day per train were added to the treatment process downstream of the existing clarification and filtration units. Treated effluent (permeate) from the RO units is also amended, when necessary, with sodium bicarbonate to adjust the pH and add salinity and alkalinity.

Feed water for the plant has historically been sourced from the MPTMF or from the WSP. A feed water line from the A2PTMF may be added in the future if required. Treated effluent can be directed to the Main Pit, the WSP or directly to Minto Creek. Sludge or RO brine can be pumped to the MPTMF for disposal.

Minto's water treatment plant can be operated in three general configurations:

1. **Clarification and filtration:** this process configuration removes suspended solids (TSS). Coagulant and flocculant solutions are added to the feed water, which is pumped to a ballasted lamella clarifier and a filter. Dissolved constituents are generally not removed. The by-product of the process is a sludge that is pumped to the MPTMF or A2PTMF. The maximum treatment capacity is approximately 4,000 m^3/day.
2. **Sulphide precipitation, clarification, and filtration:** this process configuration can remove dissolved copper, cadmium, zinc, nickel, cobalt, and lead, in addition to TSS. Dissolved metals are removed by adding

an organo-sulphide reagent that binds to dissolved metals and forms precipitates. The by-product of the process is a sludge that is pumped to the MPTMF or A2PTMF. The maximum treatment capacity is approximately 4,000 m^3/day.

3. **Reverse osmosis (RO):** this process removes 95 to 99% of all constituents in the feed water. The feed water for the RO unit is the effluent from the clarification and filtration unit, which is operated as a pre-treatment step. The RO unit produces a clean effluent stream that consists of approximately 75% of the feed water (the RO permeate). The by-product of the process is a brine stream, which consists of about 25% of the feed water and 95 to 99% of constituent loadings. The brine stream is pumped to the MPTFM or A2PTMF. Because of this brine by-product, RO cannot be considered a true water treatment process but is rather a process that concentrates mine water into a smaller volume with higher constituent concentrations. The maximum treatment capacity is approximately 2,500 m^3/day.

Table 5-10 shows a summary of water treatment options and parameters that can be removed.

Table 5-10: Summary of Water Treatment Options and Applicability

Water Treatment Process Configuration	Applicable for Removal of
Clarification and Filtration	TSS Total Metals (not dissolved metals)
Sulphide precipitation, Clarification and Filtration	TSS Total Metals Dissolved Metals, including Cu, Cd, Co, Hg, Ni, Zn
Reverse Osmosis	All other parameters, including Se, nitrate and nitrite.

Figure 5-18 shows a decision chart to guide the selection of water treatment process options when water treatment is required. The analysis of feed water quality can be based on on-site assays or off-site laboratory analysis, depending on the parameter of concern and the relative confidence in the analytical results. Discharge will not commence unless Minto has confidence in the analytical results.

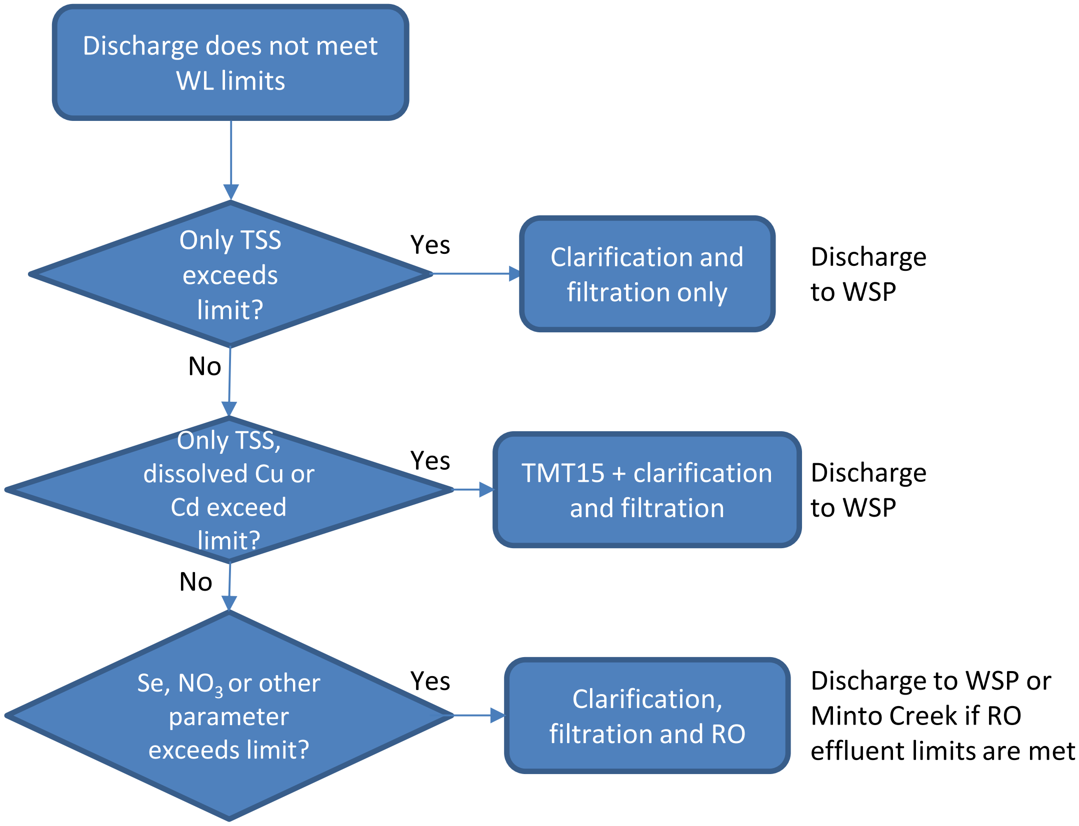


Figure 5-18: Water Treatment Selection Chart

5.4.4.1 ***Water Treatment Limitations***

Minto's water treatment plant was originally designed to remove TSS, total metals and dissolved copper from mine water. In 2011, the mine received an amended water licence that included water quality limits for nitrate and selenium, which the existing water inventory at the mine exceeded. As there was a potential need to treat and release mine water stored in the Main Pit, alternative or supplemental water treatment was identified as being required.

A review of conventional water treatment methods for removal of nitrate and selenium concluded that nitrate could likely be removed using anaerobic biological treatment but removal of selenium to concentrations below the water quality limit of 2.0 µg/L would not be possible/reliable using biological treatment alone. Rather, TSS removal and RO would be required as pre-treatment steps ahead of anaerobic biological treatment. In this treatment process, RO brine would be pumped to an anaerobic biological treatment process and the clean RO permeate would be released to the environment. Selenium present in the RO brine would be removed as sludge in the anaerobic water treatment process. The anaerobic process would be followed by an aerobic biological treatment process that would remove residual dissolved carbon and other nutrients carried over from the anaerobic treatment. Finally, effluent from the aerobic biological water treatment would be settled and filtered prior to release.

Although RO is considered to be a conventional technology, the treatment process described above for removal of selenium to ultra-low concentrations of 2.0 µg/L is outside the realm of conventional technology. However, the use of RO alone for removal of selenium or any other constituents is, in effect, a mine water concentration process than a true water treatment process. As described, 95 to 98% of water quality parameter loadings in the mine water report to the RO brine. If RO alone is used for "treatment" of mine water, the brine would be pumped back to the MPTMF or the A2PTFM where the loadings removed would mix with the untreated mine water. This would result in a gradual increase in all parameter concentrations over time. If RO is used for an extended period of time, the parameter concentrations in the mine water reservoir may increase to a point where RO is no longer effective. In other words, long-term use of RO alone simply causes a gradual worsening of the mine water quality and therefore is not a sustainable water treatment method, particularly in the transition to closure and in the post-closure period.

5.5 Operational Monitoring

Environmental monitoring at the Minto mine is key to confirming that the operational plans implemented on site are protective of the environment and remain in compliance with applicable licences and permits. The monitoring on site is guided by Minto's Environmental Monitoring, Surveillance and Reporting Plan (EMSRP). The EMSRP includes numerous monitoring programs that cover a wide variety of environmental topics. The programs included in the EMSRP are the Water Monitoring Program, Geochemical Monitoring Program, Meteorological Monitoring Program, Physical Monitoring Program, Aquatic Environmental Monitoring Program, Terrestrial Environment Monitoring Program and the Progressive Reclamation Effectiveness Monitoring Program. This section is intended to provide a brief summary of the operational monitoring programs- refer to the EMSRP (Minto, 2016) if more detail is required.

5.5.1 Operational Water Monitoring Program

The Water Monitoring Program is made up of three components, Surface Water Surveillance Program, Groundwater Monitoring Program and the Seepage Monitoring Program.

The objective of the Surface Water Surveillance Program is to monitor surface water quality and hydrological conditions at stations within the operational mine area, downstream stations which are influenced by mine effluent discharge, and downstream reference stations which are not exposed to effluent. Water quality and hydrology monitoring is conducted in accordance with the requirements outlined in the WUL and reflected in Table 5-11. Monitoring areas can generally be characterized as sites at or near the active mine site and associated facilities, and on Minto Creek, the Yukon River, McGinty Creek and non-impacted drainages.

Table 5-11: Water Quality and Hydrology Monitoring Program Requirements

Station	Flow	Water Level	Field Parameters Frequency	External Analytical Suite		Internal Suite	96-Hr LT50	48-Hr LT50	Chronic Toxicity Testing	
				Frequency	Analytical Suite	Frequency			Frequency	Test
W1	C	-	-	-	-	-	-	-		
W2	-	-	W/Wd	W/Wd	A,N,DOC	Wd	-	-	Md	CD-7d
									Q	CD-7d, CT-30d, CA-72hr
W3	C	-	W/Wd	W/Wd	A,N,DOC	Wd	Md	Md	-	-
W4	-	-	Q	Q	A,N, DOC	-	-	-	-	-
W5	-	-	Q	Q	A,N, DOC	-	-	-	-	-
W6	M	-	M	M	A,N, DOC	-	-	-	-	-
W7	C	-	M	M	A,N,DOC	-	-	-	-	-
W8	-	-	W	W	A,N	W	-	-	-	-
W8A	-	-	W	W	A,N	W	-	-	-	-
W10	-	-	M	M	A,N	-	-	-	-	-
W12	-	W-WL, TV	M	M	A,N	-	-	-	-	-
W12A	Wd		Wd	Wd	A,N					
W14	-	-	M	M	B	-	-	-	-	-
W15	C	-	M	M	A,N, DOC	Wd	-	-	-	-
W16	-	W-WL	Mnf/Wd	Mnf/Wd	A,N, DOC	Wnf	-	-	-	-
W16A	Wd	-	Wd	Wd	A,N,DOC	Wd	Md	Md	-	-
W17	C	-	W/Wd	W/Wd	A,N, DOC	Wd	-	-	-	-
W30	M	-	M	M	A,N	-	-	-	-	-
W33	M	-	M	M	A,N	-	-	-	-	-
W35	C	-	M	M	A,N, DOC	Wd			-	-
W36	C	-	M	M	A,N	-	-	-	-	-
W37	M	-	M	M	A,N	-	-	-	-	-
W45	Cdw	W-WL, TV	M	M	A,N	-	-	-	-	-
W46	M	-	M	M	A,N,DOC	-	-	-	-	-
W47	Cdw	W-WL	M	M	A,N	-	-	-	-	-
W50	M/Wd	-	M/Wd	M/Wd	A,N,DOC	Wd	M	M	M	CD-7d
MC-1	C	-	M/Wd	M/Wd	A,N,DOC	-	-	-	-	-
WTP	Wd	-	Wd	Wd	A,N,DOC	Wd	-	-	-	-
RO	Wd	-	Wd	Wd	A,N,DOC	Wd	-	-	-	-
W51	Cdw	W-WL	M	M	A,N	-	-	-	-	-

Station	Flow	Water Level	Field Parameters Frequency	External Analytical Suite		Internal Suite	96-Hr LT50	48-Hr LT50	Chronic Toxicity Testing	
				Frequency	Analytical Suite	Frequency			Frequency	Test
W52	Cdw	W-WL, TV	M	M	A,N	-	-	-	-	-
W53	Cdw	W-WL	M	M	A,N	-	-	-	-	-
W54	C	-	M	M	A,N	-	-	-	-	-
W55	M	-	M	M	A,N	-	-	-	-	-
W62	C		M	M	A,N					
C4	M	-	M	M	A,N,DOC	-	-	-	-	-
C10	M	-	M	M	A,N,DOC	-	-	-	-	-
MN	Cdw	W-WL	M	M	A,N	-	-	-	-	-
MN-0.2	M	-	M	M	A,N,DOC	-	-	-	-	-
MN-0.5	M	-	M	M	A,N,DOC	-	-	-	-	-
MN-1.5	C	-	M	M	A,N,DOC	-	-	-	-	-
MN-2.5	C	-	M	M	A,N,DOC	-	-	-	-	-
MN-4.5	C	-	M	M	A,N,DOC	-	-	-	-	-
UG 1	Cdw	-	M	M	A,N	-	-	-	-	-
UG 2	Cdw	-	M	M	A,N	-	-	-	-	-
UG 3	Cdw	-	M	M	A,N	-	-	-	-	-
UG 4	Cdw	-	M	M	A,N	-	-	-	-	-

C: Continuously	**A**: Physical parameters, conductivity, total suspended solids, total dissolved solids, hardness, alkalinity, sulphate, ICP scan- total metals, ICP – dissolved metals
W: Weekly	**B:** Physical parameters, conductivity, total dissolved solids, alkalinity, sulphate, ICP – dissolved metals
Wd: Weekly while discharging	**N**: Nutrients: Ammonia-N, Nitrate-N, Nitrite-N
Wnf: Weekly, when not frozen	**Field parameters:** In-situ pH, Conductivity, Temperature, Dissolved Oxygen
M: Monthly	**Internal lab parameters:** dissolved metals: copper, aluminum, cadmium, selenium; ammonia, nitrite, nitrate and total suspended solids
Md: Monthly while discharging	**DOC**: Dissolved organic carbon
Mnf: Monthly, when not frozen	**96 hr LT50**: LT50 Rainbow trout static bioassay, 96 hrs at 100%, pH non-adjusted
Cdw: Continuous when dewatering	**48 hr LT50**: LT50 *Daphnia magna* static bioassay, 48 hrs at 100%, pH non-adjusted
WL: Surface Water Level Elevation	**CD-7d**: Chronic Toxicity – *Ceriodaphnia dubi*a 7 day test (EPS 1/RM/21)
TV: Track Tailings Volume	**CT-30-d:** Chronic toxicity – 30 day Early Stage Toxicity for Rainbow Trout (EPS 1/RM/28)
	CA-72hr: Chronic Toxicity – 72-hour for Algae (EPS 1/RM/25)

The objective of the Groundwater Monitoring Program is to monitor potential impacts on groundwater from the mine project components. Groundwater-related monitoring at Minto is accomplished through monitoring groundwater wells, vibrating wire piezometers and thermistors. The Groundwater Monitoring Program includes several components including groundwater water quality, aquifer characterization, evaluation of longitudinal flow paths, leaching tests, and the monitoring of long-term phreatic levels in tailing management facilities.

Monitoring areas are both up-gradient and down-gradient of mine activities and include, but are not limited to, the DSTSF, mill area, Main Pit Tailings Management Facility, Area 2 Pit Tailings Management Facility, Minto North Pit, mill valley fill, waste rock dumps, water storage pond (WSP), and areas where future mine components are planned. The purpose of the monitoring wells is to provide information to better understand the potential for off-site migration of contamination and to better understand and define source terms and conditions of waste emplacement, for comparison to source terms used in the Water Balance and Water Quality model. All wells are monitored on a quarterly basis as presented in Table 5-12.

Table 5-12: Operational Groundwater Monitoring

Mine Project Component	Monitoring Installation	Westbay Zone Depth or description	Quality	Level	Monitoring Frequency
Up-gradient of Mine Activities	MW16-08	TBD (Zones not defined)	X	X	Quarterly
Southwest Waste Dump	MW12-DP1	NA	X	X	Quarterly
	MW12-DP2	NA	X	X	Quarterly
	MW12-DP3	NA	X	X	Quarterly
	MW16-09	TBD (Zones not defined)	X	X	Quarterly
Main Waste Dump	MW09-01	Zone 1 (44 mbgs)	X	X	Quarterly
	MW09-01	Zone 2 (34 mbgs)	X	X	Quarterly
	MW09-01	Zone 3 (26 mbgs)	X	X	Quarterly
	MW16-10	TBD (Zones not defined)	X	X	Quarterly
Dry Stack Tailings Storage Facility and Mill Valley Fill Expansion	MW12-06	Zone 1 (142 mbgs)		X	Quarterly
		Zone 2 (123 mbgs)	X	X	Quarterly
		Zone 3 (93 mbgs)		X	Quarterly
		Zone 4 (66 mbgs)	X	X	Quarterly
		Zone 5 (35 mbgs)		X	Quarterly
		Zone 6 (18 mbgs)	X	X	Quarterly
Main Pit	MW12-07	Zone 1 (115 mbgs)	X	X	Quarterly
		Zone 2 (88 mbgs)	X	X	Quarterly
		Zone 3 (66 mbgs)		X	Quarterly
Minto North Pit	MW09-03	Zone 1 (38 mbgs)	X	X	Quarterly
		Zone 2 (24 mbgs)	X	X	Quarterly
		Zone 3 (11 mbgs)	X	X	Quarterly
	MW16-11	TBD (Zones not defined)	X	X	Quarterly
Water Storage Pond	MW12-05	Zone 1 (132 mbgs)	X	X	Quarterly
		Zone 2 (110 mbgs)	X	X	Quarterly
		Zone 3 (94 mbgs)	X	X	Quarterly
		Zone 4 (69 mbgs)	X	X	Quarterly
		Zone 5 (52 mbgs)	X	X	Quarterly
		Zone 6 (26 mbgs)	X	X	Quarterly
		Zone 7 (15 mbgs)	X	X	Quarterly
	MW16-12	TBD (Zones not defined)	X	X	Quarterly

The objective of the Seepage Monitoring Program is to assess and monitor potential acid rock drainage and metal leaching conditions at the Minto Mine. The program includes a survey for seepage of all project components including pit wall seepage; ore stockpile areas; overburden dumps; waste rock dumps including low grade, medium grade and high grade waste storage areas; DSTSF; mill valley fill (MVF) area (extension 1 and 2); mill area; and other known seepage locations. The monitoring locations and monitoring frequency are summarized in Table 5-13, along with the analytical parameters required for seepage samples.

Table 5-13: Seepage Monitoring Survey Locations and Sampling Frequency

Sur ey ocations	Monitoring requency	Analytical Parameters
Ore stockpile areas	Twice yearly; once in spring runoff conditions (typically May) and once in early fall conditions (typically September). Note that Pit walls can only be surveyed if safe conditions are present.	Physical parameters, Conductivity, Total Dissolved Solids, Alkalinity, Sulphate, ICP Scan- Dissolved Metals Ammonia-N, Nitrate-N, Nitrite-N and Phosphorous In-situ parameters- pH, Conductivity and Temperature
Overburden dumps		
Waste rock dumps		
Dry Stack Tailings Storage Facility		
Mill Area		
Mill Valley Fill Extension (Stage 1 and 2)		
Water Storage Dam Seepage		
Pit Walls		

5.5.2 Operational Geochemical Monitoring Program

The Geochemical Monitoring Program is made up of three components, Acid Base Accounting (ABA) Monitoring Program, Waste Rock Verification Program and the Low Grade and Oxide Ore Metal Leaching Characterization Program.

The ABA program is comprised of two parts, one is the internal monitoring which is completed onsite and the other external verification which is completed offsite.

On-site ABA monitoring is carried out on drill cuttings from every blast hole. Samples are collected for grade control purposes, and a portion of each sample is sent for total sulphur (S(T)) and total carbon (C(T)) analyses at the on-site laboratory.

Following analysis, S(T) and C(T) results are converted into equivalent acid potential (AP-S(T)) and neutralization potential (NP-C(T)) values, and NP-C(T):AP-S(T) ratios are calculated for each sample. The NP-C(T):AP-S(T) values are plotted for each drill hole in a given blast pattern (along with other assay results), and mine geologists use the mine's grade control software to define polygons outlining contiguous zones of waste rock types- either bulk waste or waste with an NP-C(T):AP-S(T) ratio less than 3.0.

The external verification is executed by composite samples from each waste class for each blast are formed from the individual samples that are subject to on-site monitoring for S(T) and C(T). These composite samples are both tested on-site and sent off-site to a commercial laboratory to provide external verification for quality control purposes. The external verification samples will be analysed for a broader range of parameters, including paste pH, total sulphur, sulphate sulphur, total inorganic carbon, modified neutralization potential (Modified NP) and metals by aqua regia digestion with ICP finish. Modified NP will be analysed using the MEND (1991) method to allow direct comparison with pre-production characterization.

ABA sample frequency, sample type and analysis requirements are summarized in Table 5-14

Table 5-14: Acid Base Accounting Monitoring Program Requirements

Material	Sample Frequency	Sampling Type	Analytical Requirement
Overburden	Sampled when overburden is mined	Representative sampling whenever overburden is mined	Internal Laboratory: S(T) and C(T) External Laboratory: ABA and trace element analyses
Open Pit Waste Rock	Each blast hole	Split of grade control sample (single hole composite of blast hole cuttings)	Internal Laboratory: S(T) and C(T)
	Pre-selected based on the drill pattern, the ABA sampling occurs every 4-5 drill holes equilaterally in a drill pattern which is typically 20-25 m apart. The aim is to ensure even coverage for ABA analysis throughout the drill pattern.	Composite ABA samples are created based on the waste zone polygons. The number of ABA samples that go into the composite sample will depend on the size of the waste zone polygon and number of ABA samples taken within that polygon.	Internal Laboratory: S(T) and C(T) External Laboratory: ABA and trace element analyses
Underground Waste Rock	One sample for every 50m of development (represents ~ 3300 tonnes of waste rock)	Representative composite grab sample from transfer pad pile	Internal Laboratory: S(T) and C(T) External Laboratory: ABA and trace element analyses
Tailings Solids	Monthly	One composite sample per month comprised of weekly final tailings sample	External Laboratory: ABA and trace element analyses

The Waste Rock Management Verification Program supports the waste rock management procedures at the mine. The results of this program will be detailed in the WUL and QML Annual Report.

The program includes detailed record-keeping on the types and quantity of waste rock placed at each location, and monitoring and verification of the characteristics of the waste rock stored at each location as per the WROMP.

Minto tracks all material dispatched between sources and destinations generated using the mine's production tracking database system. This data is based on load count sheets compiled by the mining contractor.

A monthly dump sampling program takes place at Minto. The procedure is as follows:

1. At monthly intervals, mine personnel will visit every dump crest that was active over the preceding month, as determined by an analysis of the production tracking database system.
2. At 25 m intervals along each active dump crest, the waste rock will be manually sampled.
   For each sample, one shovel-full of material will be collected and labelled. Particles greater than fist size will be manually rejected at the time of sampling.

3. The resulting samples will be crushed, pulverized, and split in Minto's assay lab such that a representative sample is obtained.
4. Each sample will be analyzed at site for copper, total sulphur (S(T)), and total carbon (C(T)) content using an Eltra CS-800 induction furnace with infrared detectors.
5. S(T) and C(T) values are converted into equivalent acid potential (AP-S(T)) and neutralization potential (NP-C(T)) values, and NP-C(T):AP-S(T) ratios are calculated for each sample.
6. Resulting NP-C(T):AP-S(T) ratio values are compared to the segregation criteria and assigned 'Pass' or 'Fail' verification designations.

If two or more adjacent failures occur, the crest will be resampled at 5 m intervals over each 25 m crest section represented by the failed samples. Sampling and analysis will follow steps 3 through 6 in the procedure described above. The average copper grade and NP-C(T) and AP-S(T) for the suspect zone will be calculated, and then the (Average NP-C(T)) : (Average AP-S(T)) ratio value for the zone will be calculated. Isolated failures will be accepted with no further action.

Low Grade and Oxide Ore Metal Leaching Characterization Program has not been approved at the time of writing this plan, however, the proposed program will consist of one large scale on-site leaching test for each material type (Blue Ore and POX), paired with static laboratory tests to define the geochemical characteristics of the materials being tested.

The on-site leaching tests will consist of large leach pads (nominally 5m x 5m, with actual size dependent on location details once a suitable location is identified following plan approval) lined with a geosynthetic liner and loaded to a depth of 1 to 2 m with run-of-stockpile test material (POX or Blue Ore). The leach pads would be subject to ambient site temperature and precipitation conditions, with collection of leachate accomplished by appropriate grading of the leach pad base and installation of a drain pipe through the liner to allow collection of leachate samples.

Static laboratory testing would consist of sampling and analysis of test materials during the initial construction of the test in the manner described for both internal and external laboratory analysis of waste rock under the ABA Monitoring Program.

The Meteorological Monitoring Program results will provide companion meteorological data to complement the leaching tests.

5.5.3 Meteorological Monitoring Program

The Water Monitoring Program is made up of two components, Climate Monitoring Program and Snow Survey Program.

The objective of the Climate Monitoring Program is to collect climatic data specifically for the Minto Mine site. The monitoring areas consist of a meteorology station located north east of the Minto Mine airstrip. The meteorological station logs parameters at hourly intervals. The loggers are downloaded twice per month. During the download process, staff inspect the meteorological station for inoperative equipment.

The meteorology station is a research grade Campbell Scientific station that records the following parameters: maximum wind speed, minimum wind speed, average wind speed, wind direction, precipitation (rain and snow), temperature, relative humidity, pan evaporation, barometric pressure, solar radiation, outgoing radiation and calculated evapotranspiration.

The objective of the Snow Survey Program is to collect snow data used for calculating the snow water equivalent specifically at the Minto Mine. Snow water equivalents are inputs to the Minto Mine Site Water Balance models. Three courses are surveyed during the first week of February, March & April each year. If conditions permit, Minto will additionally survey the snow courses in May. These courses are East-facing (near the Dyno compound), North-facing (near the airstrip) and South-facing (above the Tank Farm).

5.5.4 Operational Physical Monitoring Program

The Physical Monitoring Program consists of two main components: instrumentation to measure ground conditions and deformation; and, regular geotechnical inspections. Instrumentation to measure ground conditions and deformation include the following:

- Survey hubs;
- Inclinometers;
- Thermistors; and
- Vibrating Wire Piezometers.

Instrumentation (new or replaced) is installed in accordance with design reports / recommendations of third-party engineer, including those from past geotechnical inspections.

The objective of the Physical Monitoring Program is to monitor the performance of key mine infrastructure and workings. Outlined in Table 5-15 is the mine infrastructure that requires monitoring under the Physical Monitoring Program; the table also includes the infrastructure descriptions and instrumentation that is in place.

Table 5-15: Physical Monitoring Program: Mine Structures and Instrumentation

Structure	Description	Instrumentation
Area 2 Pit and Area 2 Pit Tailings Management Facility (A2PTMF)	The Area 2 Pit was completed in 2015 to the extents licensed under Phase IV (Stages 1 and 2); the pit will be extended to the south as part of Phase V/VI (Stage 3). Tailings deposition into the pit began in March, 2015 and the pit is now maintained as a tailings management facility.	Survey hubs Piezometer (proposed)
Area 118 Pit	Mining of the Area 118 Pit was carried out in 2014. The pit is currently inactive and the access is barricaded.	Survey hubs
Area 118 Underground	The Area 118 underground began development in 2013 and is accessed by a portal and decline south of the Area 2 and Area 118 Pits. Production mining is currently taking place using a longhole stoping method and is expected to be completed in 2016.	None
Big Creek Bridge	Bridge on the Minto access road crossing Big Creek, located at Km 19. Licenced under Type B water licence MS04-227.	None
Camp	The camp consists of several connected bunkhouse buildings (Sherwood, Minto, Selkirk), a kitchen building, and several separate buildings including the gym and Site Services offices.	None
Dry Stack Tailings Storage Facility (DSTSF)	Construction of the DSTSF with filtered tailings placement was carried out from 2007 to November 2011. As part of progressive reclamation activities in 2012-2013, the DSTSF was covered with a layer of overburden approximately one to four meters thick. The DSTSF began showing deformation in 2009, interpreted as primarily horizontal sliding towards the north/northeast on an ice-rich layer in the underlying overburden, several meters above bedrock. The movement has continued since then but at a decreasing rate in response to construction of the Mill Valley Fill waste rock buttress.	Survey hubs Thermistors Inclinometers Piezometers
Ice Rich Overburden Dump (IROD)	Originally constructed as a free-standing rockfill structure to contain ice-rich overburden. The IROD is no longer active and is now entirely surrounded by the SWD rockfill.	None
Main Pit (Area 1 Pit) and Main Pit Tailings Management Facility (MPTMF)	Mining in the Main Pit was completed in 2011. Instability in the south wall of the pit occurred in 2009 during mining of Stage 3 of the pit, and subsequently a larger failure occurred in 2011 after completion of Stage 5. Continued sloughing and creep movement of the south wall led to the design and construction of a waste rock buttress, known as the South Wall Buttress, completed in 2013. Slurry tailings deposition into the pit began in 2012 and the pit is now maintained as a tailings management facility. Dumping of NP: AP<3 waste rock (SAT), intended to be below the final water table at closure, continues into the pit, forming several benches of “in-pit dumps”. Tension cracking on the west in-pit dump is monitored with a series of survey hubs installed in 2015 as recommended in previous inspection reports.	Survey hubs Inclinometer Piezometer (proposed)
Main Pit Dump	The Main Pit Dump is included in the Phase V/VI licence- construction of this facility has not yet commenced. The dump will be located on the south side of the Main Pit, partially on top of the South Wall Buttress.	N/A
Main Waste Dump (MWD)	The Main Waste Dump stores waste rock released during the mining of the first three stages of the Main Pit. The dump is no longer active however dumping is taking place on the overlapping Main Waste Dump Expansion.	Inclinometers

Structure	Description	Instrumentation
Main Waste Dump Expansion (MWDE)	This dump is an extension of the MWD and is currently the main active waste rock dump storing waste rock released from the Minto North Pit.	Inclinometers (same instruments as for MWD)
Mill Site	The mill site consists of the mill building, crusher and crusher stockpile pad.	None
Mill Valley Fill Extension (MFVE)	A waste rock buttress to the north of the DSTSF, constructed from January 2012 to March 2013 to prevent or decrease further movement of the DSTSF.	Survey hubs
Mill Valley Fill Extension 2 (MVFE2)	An extension of the MVFE waste rock buttress (completed August 2016) to further decrease movement of the DSTSF.	Inclinometers Piezometers Survey hubs
Mill Valley Fill Extension 2 Collection Sump	A replacement sump for the MCDS (constructed in Q4 2015). It will detain surface water considered impacted from upstream sub-catchment areas and will direct it to the MPTMF or water treatment plant.	None
Minto Access Road	Road from the Yukon River barge crossing to the mine site. Licenced under Type B water licence MS04-227.	None
Minto East, Area 2, Copper Keel, Wildfire Underground	The Area 2, Minto East, Copper Keel and Wildfire underground are in the phase V/VI mining plan and have not commenced yet.	N/A
Minto North Pit	Mining of the Minto North Pit commenced in August 2015 and is scheduled to be completed in 2016.	Radar
Ore Stockpiles	There are two primary ore stockpiles on site – North and South stockpile. These are located south of the crusher and east of the Area 2 pit.	None
Reclamation Overburden Dump (ROD)	Received the bulk of the overburden released as part of Phase IV and earlier mining of the Main Pit. The material in the ROD is available for use in reclamation of the mine at closure.	None
South Diversion Ditch (SDD)	A diversion ditch located southeast of the Area 2 Pit to divert unaffected surface water around the mine workings.	None
South Wall Buttress (SWB)	Waste rock buttress constructed against the Main Pit south wall from 2009-2011 as a result of instability in the south wall of the pit.	Survey hubs[1]
Southwest Waste Dump (SWD)	SWD stores waste rock released during Main Pit and Phase IV mining. Dumping at the SWD is now complete and bulk re-sloping was carried out in 2015.	Survey hubs Inclinometers Thermistors Piezometers
Tailings Diversion Ditch (TDD)	A diversion ditch located south of the DSTSF to divert unaffected water around the tailings facility.	None
Water Storage Dam (WSD	The Water Storage Pond and Dam are located east of the mine along Minto Creek. The dam was constructed in 2006 as a clay-core water retention dam for collecting precipitation and surface water runoff at the site. Maximum depth of water at the face of the dam is approximately 15 m.	Survey hubs Thermistors Piezometers

1. As per Clause 97 (e) of QZ14-031, in-situ monitoring devices were installed in 2015 and are presented in the survey hub section of Physical Monitoring Plan as M82, M83, M84, and M87.

5.5.5 Aquatic Environmental Monitoring Program

The Aquatic Environmental Monitoring Program is made up of four components, Metal Mine Effluent Regulations (MMER) Monitoring Program, Sediment Quality and Toxicity Monitoring, Periphyton and Benthic Invertebrate Tissue Monitoring and the Fish Monitoring Program.

The Metal Mine Effluent Regulations (MMER) outline requirements for monitoring and reporting of discharged effluent volume and quality under the MMER to Environment Canada. The Metal Mine Effluent Program aims to maintain compliance with the MMER and the program will be revised should regulation amendments occur. Specifically, the Metal Mine Effluent Program requires effluent monitoring with sampling at station W3, downstream of the end of pipe discharge. Effluent monitoring requirements are outlined in Table 5-16. Effluent monitoring samples are collected when there is a deposit of water at W3; testing occurs weekly for deleterious substances. Radium 226 and acute lethality tests are conducted quarterly due to the reduced frequency guidelines outlined in the MMER. The MMER specifies requirements for increased testing frequencies if the Radium 226 or acute lethality tests do not meet the prescribed standards as detailed in the MMER.

Weekly effluent monitoring samples are tested for the deleterious substances as described in the MMER including the total metals arsenic, copper, lead, nickel and zinc; total suspended solids (TSS) and pH. As a general practice, weekly samples are collected on the same day each week.

Reporting of the effluent monitoring results, and discharge volumes is required quarterly and annually to Environment Canada, under the Regulatory Information Submission System (RISS).

Environmental Effects Monitoring under the MMER includes four components: Site Characterization, Effluent Characterization, Effluent Sublethal Toxicity and Supporting Water Quality Monitoring.

Table 5-16: Metal Mine Effluent Monitoring Program Requirements and Frequency

Water uality Monitoring Stations	Monitoring requency	Analytical Parameters
W3 – Compliance Point	Weekly	1. Effluent Volume 2. Water Quality: in-situ field parameters, physical parameters, nutrients, and total metals
	Quarterly	3. Water Quality: Radium 226 and acute lethality tests on both Daphnia magna and Rainbow trout (*Oncorhynchus mykiss*).

The objective of sediment quality monitoring is to determine if the Minto Mine has influenced the sediment quality of Minto Creek. Sediment quality monitoring is completed annually in September in both upper and lower Minto Creek. Sediment quality of upper Minto Creek (immediately downstream of Station W3) is monitored and compared to the reference area located at upper McGinty Creek. Sediment quality of lower Minto Creek is monitored and compared to the reference area lower Wolverine Creek. Depositional areas, quiescent pools and wetted backwater locations are targeted as these areas contain more fine sediment (silt and clay) and the most recently deposited sediment.

The objective of periphyton monitoring is to evaluate chlorophyll α (productivity), community composition and tissue chemistry of periphyton in Minto Creek. Periphyton is made up of an assemblage of algae, bacteria, fungi and meiofauna attached to submerged substrates. The periphyton monitoring program is conducted on an annual basis.

The objective of the fish monitoring program is to monitor, assess and characterize fish usage of Minto Creek and to determine if the Minto Mine influences the health of a sentinel fish species of Minto Creek. Based on previous findings of fish use of Minto Creek, fish monitoring includes two elements: 1) ongoing characterization of fish use of lower Minto Creek; and 2) a mobile laboratory-based evaluation of the effects of exposure of juvenile Chinook salmon (*Oncorhynchus tshawytshca*) to Minto Mine effluent.

5.5.6 Terrestrial Environment Monitoring Program

The Terrestrial Environment Monitoring Program is made up of four components, Invasive Plant Species Monitoring Program, Wildlife Monitoring Program, Erosion and Sedimentation Monitoring Program and Vegetation Metal Uptake Program.

Invasive plant monitoring at Minto includes detailed vegetation surveys in areas of reclamation and coarse vegetation surveys in areas where there are invasive species pathways.

Detailed vegetation surveys were established in September 2012 on the Main Waste Dump (MWD). The detailed vegetation surveys identify vegetative cover and species types (within the dry land seed mix) and should invasive species be detected, the following information will be included in the survey:

- Location;
- Species Name;
- Health and size of the plant;
- Photos (for verification of plant and location); and
- Percent coverage in the area.

Coarse vegetation surveys typically take place in areas where there are invasive species pathways such as roads with high visitor traffic, recently exposed areas and areas that have been recently reclaimed. The meander or roadside method may be utilized to inventory invasive plants in pathways with high visitor traffic. High priority species as determined by the Yukon Invasive Species Council (YISC) will be identified, and the distribution and location of the plant will be recorded. Incidental surveys may also take place as field staff are routinely collecting data for various programs within the EMSRP; should an invasive plant be located the field staff will record its distribution and location. Data from the coarse vegetation surveys is entered into an invasive plant tracking record.

High priority plant species in the Yukon, as defined by YISC, are summarized in Table 5-17.

Table 5-17: Common and Scientific Names of High Priority Yukon Invasive Plant Species, as defined by YISC

Common Name	Latin Name
Bird vetch	*Vicia cracca*
Common tansy	*Tanacetum vulgare*
Creeping thistle	*Cirsium arvense*
Hawkweeds	*Crepis tectorum*
Leafy spurge	*Euphorbia esula*
Oxeye daisy	*Leucanthemum vulgare*
Perennial sow-thistle	*Sonchus arvensis*
Scentless chamomile	*Tripleurospermum perforata*
Spotted knapweed	*Centaurea stoebe*

The activities under the Wildlife Monitoring Program are summarized in Table 5-18, including the area monitored and the frequency of monitoring. Wildlife sightings around site are entered into a *Wildlife and Hazing Tracking Form*. Wildlife sightings from site personnel are collected either via a *Wildlife Sighting Log* form or through communication with the Environmental and Safety Departments. Any direct sighting by the Environmental Department are additionally entered into the *Wildlife and Hazing Tracking Form*.

Table 5-18: Wildlife Monitoring Activities

Area Monitored	Monitoring Activities	Frequency
Wildlife Monitoring	Wildlife monitoring consists of maintaining a wildlife observation log onsite and reporting wildlife encounters as per the Wildlife Act. Environmental personnel on site will monitor project activities and modify operations to address wildlife concerns.	Ongoing
Migratory Birds	Monitoring to determine if waterfowl and shorebirds settle on impacted water bodies, such as the Main or Area 2 Pits. Environmental personnel on site will monitor project activities and modify operations to address wildlife concerns.	Seasonal during migratory periods
Species at Risk/of Concern	Any caribou observations will be reported to the Conservation Officer in Carmacks. Bank swallows have been observed to nest in residuum piles in the summer months, in which case these piles are cordoned off and left undisturbed until after the late summer migration, or resloped prior to nesting season to deter nesting.	As necessary

The Erosion and Sedimentation Monitoring Program monitoring activities are summarized in Table 5-19.

Table 5-19: Erosion and Sediment Monitoring Schedule

Activity	Location	Frequency
Visual inspections	Bottoms of slopes and depressions of large structures.	As needed following heavy rain events, and during freshet.
	Road routes: ditches and outlets of culverts and pipes.	As needed following heavy rain events, and during freshet.
Water quality monitoring for total suspended solids (TSS)	Water quality monitoring stations W2, W50 and W17	Weekly and during heavy runoff periods.
Physical inspection of surface facilities by a Yukon registered Engineer	Water Storage Dam, all waste rock and overburden dumps, all water diversion and conveyance structures and the Dry Stack Tailings Storage Facility.	After the spring thaw period in May/June of each year.

The main objective of the Vegetation Metal Uptake Program is to monitor and measure metal uptake in vegetation on the mine site and surrounding areas.

The Vegetation Monitoring Uptake program consists of a monitoring network of site (exposure) or control stations. Progression of the mine plan and analysis of the monitoring results may result in the creation of additional monitoring locations. For example, progressive reclamation of waste dumps may allow for areas that have been revegetated to be included into the monitoring network. Site sampling stations are located in areas anticipated to accumulate the most dust based on meteorological data collected at site. Plant species selection is subject to change based on discussions with SFN which also drive the sample stations.

The following procedures are performed at each monitoring network site:

- Selection of an appropriate microsite in the vicinity of the station;
- Generation of a station ID and documentation of relevant ecological attributes of the station area;
- Soil sampling; and
- Vegetation sampling.

Soil and vegetation samples will be sent to an accredited laboratory for the following analysis: metals, pH, texture and cation exchange capacity. The initial study will take place in July or August any given year before seasonal desiccation of vegetative material occurs. Continued monitoring should occur every three years after initial study, to determine any changes in dust dispersal and vegetation metal uptake.

5.5.7 Progressive Reclamation Effectiveness Monitoring Program

The Progressive Reclamation Effectiveness Monitoring Program is used to support the progressive reclamation activities that occur during mine operation; while post-closure monitoring is described in the RCP. The objective of the Progressive Reclamation Effectiveness Monitoring Program is to identify and evaluate reclamation and remediation technologies that are considered both promising and feasible for incorporation into the evolving mine RCP.

5.6 Operational Risk Assessment, Contingency Planning and Adaptive Management

Minto uses adaptive management to address uncertainty or conditions beyond those anticipated in mining operations. Mining activities are highly managed operations, with very prescriptive and detailed management plans required for both operational control and regulatory approval. More mature mines such as Minto have management plans which benefit from the operational experience at the site, and uncertainty in the range of conditions expected is reduced through this operational experience. The operational AMP is intended to provide a framework for responses to conditions beyond those expected and identified in their decision-based management plans. Consequently, this AMP addresses a limited range of components.

The following AMP components have been identified as having the potential for unexpected conditions during the operational period for which the Operational Management Plans may not provide adequate mitigation against potential effects to the environment or human health and safety:

- Surface water quality;
- Groundwater quality;
- Water Management, and
- Physical Stability

5.6.1 Operational Adaptive Management Plan Framework

The AMPs for each component are laid out using a common element approach to create consistency in implementation of the AMP protocol for all components as illustrated in Figure 5-19. The common elements are:

1. Description of the component

   - *Description* - description and understanding of the component leads to risk narrative and specific performance thresholds.
   - *Risk Narrative* describe the possible environmental impacts and environmental conditions that implementation of the AMP will prevent.

2. Monitoring the component

   - *Specific Indicators* are the environmental or physical parameters to be monitored and assessed. Specific indicators are measurable or observable, and are indicative of changes from the designed or expected condition.
   - *Monitoring Requirements* describes the monitoring regime for the component including frequency, type of data required and interpretation of results.
   - *Specific Performance Thresholds* define the conditions, in terms of specific indicators, when action is triggered. Performance thresholds are staged to accommodate levels of concern and a diversity of actions. To the extent possible, specific performance thresholds will include early warning thresholds.

3. Responding to unexpected conditions of the component

Specific Responses are staged according to specific performance thresholds describes the actions to be implemented if specific performance thresholds are crossed. They are provided in the following categories:

a) Notification

b) Review

c) Evaluation

d) Action

4. Annual Reporting and Review

Annual Reporting reflects annual changes made to the AMP as the site conditions change. The AMP should be modified whenever unexpected circumstances are encountered and the protocol is implemented or when additional proven science or technology becomes available. The annual review will include a review of the relevant monitored data and AMP elements. Updates, amendments, performance thresholds crossed, and trigger(s) activated will be provided to the appropriate governmental (including SFN) organizations as required and will be part of the annual report.

Additional reporting is described further in Appendix P1 (Operational AMP).

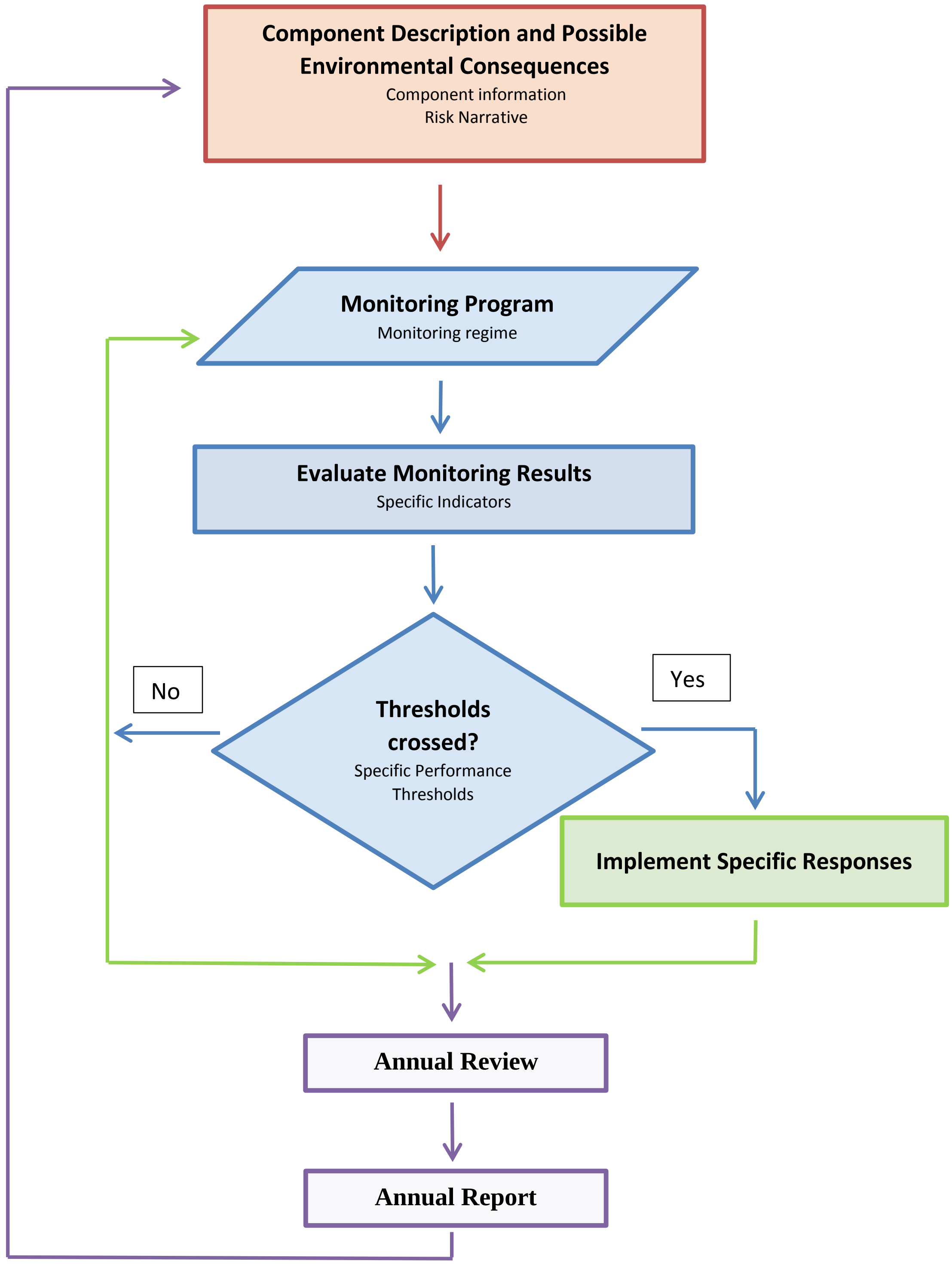


Figure 5-19: Sequential Components of the AMP (Adapted from AECOM 2010)

5.6.2 Adaptive Management Plans for Mine Components

There are a total of 6 mine components included in the operational adaptive management plan and they include:

- Minto Creek Surface Water Quality
- McGinty Creek Surface Water Quality
- Groundwater Quality in Minto Creek Watershed
- Groundwater Quality in McGinty Creek Watershed
- Water Management
- Physical Stability

A detailed adaptive management plan for each of the above mine components can be found in Section 2 of Appendix P1 (Operational AMP).

6 Temporary Closure

This section intends to describe the following aspects of Temporary Closure at the Minto Mine:

- Temporary closure objectives (Section 6.1)
- Temporary closure preparations (Section 6.2) and;
- Temporary closure activities, including (Section 6.3);
  - Site security;
  - Physical and geochemical stability;
  - Water management;
  - Monitoring and reporting;
  - Maintenance and
  - Resources.

The temporary closure approach at the Minto Mine is to maintain the site in a state such that it can resume operations in a timely manner, while continuing to monitor and protect the environment, physical assets and human health and safety.

6.1 Temporary Closure Objectives

The primary temporary closure objectives at Minto include the following:

- Protection of public health and safety;
- Environmental protection; and
- Management of company assets.

This section describes the objectives that will guide the activities undertaken at Minto in the event of a temporary closure. The specific measures regarding protection of public health and safety, environment and company assets are detailed in Sections 6.2 and 6.3. For purposes of this temporary closure plan, temporary closure refers to a suspension of mining and/or milling activities for more than two consecutive months but less than five years.

The primary objective of temporary closure preparations are to secure company assets, and reduce environmental, public health and safety risks. Additionally, temporary closure preparations will be completed to reduce the resources required to maintain the site during temporary closure. The primary activities with regards to preparation for temporary closure are protection of physical assets, securing infrastructure and unused facilities, and potential demobilization of major contractors. Initial preparation will include securing all facilities not required during temporary closure.

The majority of activities that occur during temporary closure will be driven by approved operating plans which include, but are not limited to, the following: managing water as per the approved Water Management Plan (WMP); monitoring and reporting as per the approved Environmental Monitoring, Surveillance and Reporting Plan (EMSRP); managing solid waste as per the approved Waste Management Plan; and adhering to the Adaptive Management Plan (AMP) as required.

Maintenance of site components will also be a key activity to meeting temporary closure objectives and will include, but not be limited to, maintaining access to site, security, water conveyance infrastructure and any facilities required in the event of a temporary closure as per this plan, applicable licences, permits and regulations. Temporary closure will continue until production recommences or full closure is implemented.

6.2 Temporary Closure Preparations

At the beginning of the temporary closure period, preparations will be undertaken to; secure assets not required in temporary closure; reduce environmental liability and demobilize major contractors. During this phase of temporary closure, mining, camp and process facilities not required for temporary closure will be temporarily decommissioned; hazardous material not required for temporary closure will be removed from site and equipment and facilities belonging to contractors not required for temporary closure may be removed.

Mining facilities not utilized will be de-energized, winterized and secured to ensure entry by authorized personnel only. Camp facilities that will not be utilized during temporary closure will be de-energized, winterized and secured to ensure entry by authorized personnel only. Components of processing facilities not utilized in temporary closure will be drained/emptied, cleaned and secured while the overall facilities will be de-energized, winterized and secured to ensure entry by authorized personnel only.

Hazardous materials including, but not limited to, remaining processing reagents, oils, and glycols that are not required for activities in temporary closure will be removed from site. All hazardous wastes, including waste hydrocarbons, glycols, lubricants, mill reagents, and process chemicals will be removed from site. All explosives inventories will be removed and any remaining explosives facilities will be secured to ensure entry by authorized personnel only.

Depending on the expected length of temporary closure, all major contractors may be required to demobilize from site. This demobilization may include all equipment and facilities belonging to contractors that are not required in the event of a temporary closure.

During temporary closure preparations all environmental monitoring will continue in accordance to all applicable licences, permits and approved environmental protection plans. The environmental monitoring will be parallel to that of the operational period. During temporary closure preparation it is expected that the underground workings will remain dewatered and the underground infrastructure will remain intact. Preparations for temporary closure are expected to take up to three months. Routine care and maintenance activities will take place after the initial preparations have been completed.

6.3 Temporary Closure

Site security, stability, water management, monitoring and maintenance are key to meeting the critical temporary closure objectives of protecting public health and safety, the environment and company assets. Full-time staff will be housed onsite in the main camp throughout the entire temporary closure period to provide security, control site access, monitor site activities, manage water and perform maintenance as required. This section details the specific measures regarding: site security, physical and geochemical stability, water management, monitoring and reporting, maintenance and resources as they pertain to meeting the objectives of temporary closure.

Site Security

Access to the site will be restricted and enforced on a 24 hour per day, year round basis. Site security is expected to be comparable to the operational period with access to the site controlled by the tug and barge crew in the summer and ice bridge attendants in winter. In the event that an attendant or tug and barge is not required, a gate will be installed along the access road that will not allow passage. During the spring thaw and fall freeze-up or other river access limiting circumstances, the site will only be accessible from the maintained air strip. Personnel accessing the site will be required to be on an approved site manifest which will ensure that site management has oversight over the personnel accessing the mine site. All visitors will be required to check in with the camp administrator upon arrival. Similar to the operational period, Selkirk First Nation will be provided access to their land during the barge and ice bridge seasons.

In addition to site access restrictions, further security measures may be implemented for mine workings, mine and processing facilities not required during temporary closure, equipment and hazardous material. These additional security measures are discussed in Sections 6.3.1.1 to 6.3.1.3.

6.3.1.1 *Mine Workings*

Open pit mining operations will be ceased in the event of a temporary closure and therefore access control is a key temporary closure measure to protect public health and safety. Pit ramp entrances will be barricaded and signage will be posted warning of potential hazards related to entering a closed facility. While access to open pits will be restricted they will remain accessible as authorized personnel will require access on a regular basis to complete tasks related to water management activities.

Underground mining operations will be ceased in the event of a temporary closure and therefore access control is a key temporary closure measure to protect public health and safety. Similar to the open pits, portal entrances and vent raise shafts will be barricaded and signage will be posted warning of potential hazards related to entering a closed facility. Also comparable to the open pits, the portals will have to remain accessible as authorized personnel will require access on a regular basis to maintain equipment involved in dewatering the underground workings.

6.3.1.2 *Mine and Processing Facilities*

Not all mine and processing facilities will be required in the event of a temporary closure and therefore access control is a key temporary closure measure to protect public health and safety as well as company assets. As such, all facilities not required to operate in the event of a temporary closure will be secured and locked. Regular visual inspection will be conducted to ensure that all closed facilities remain secured.

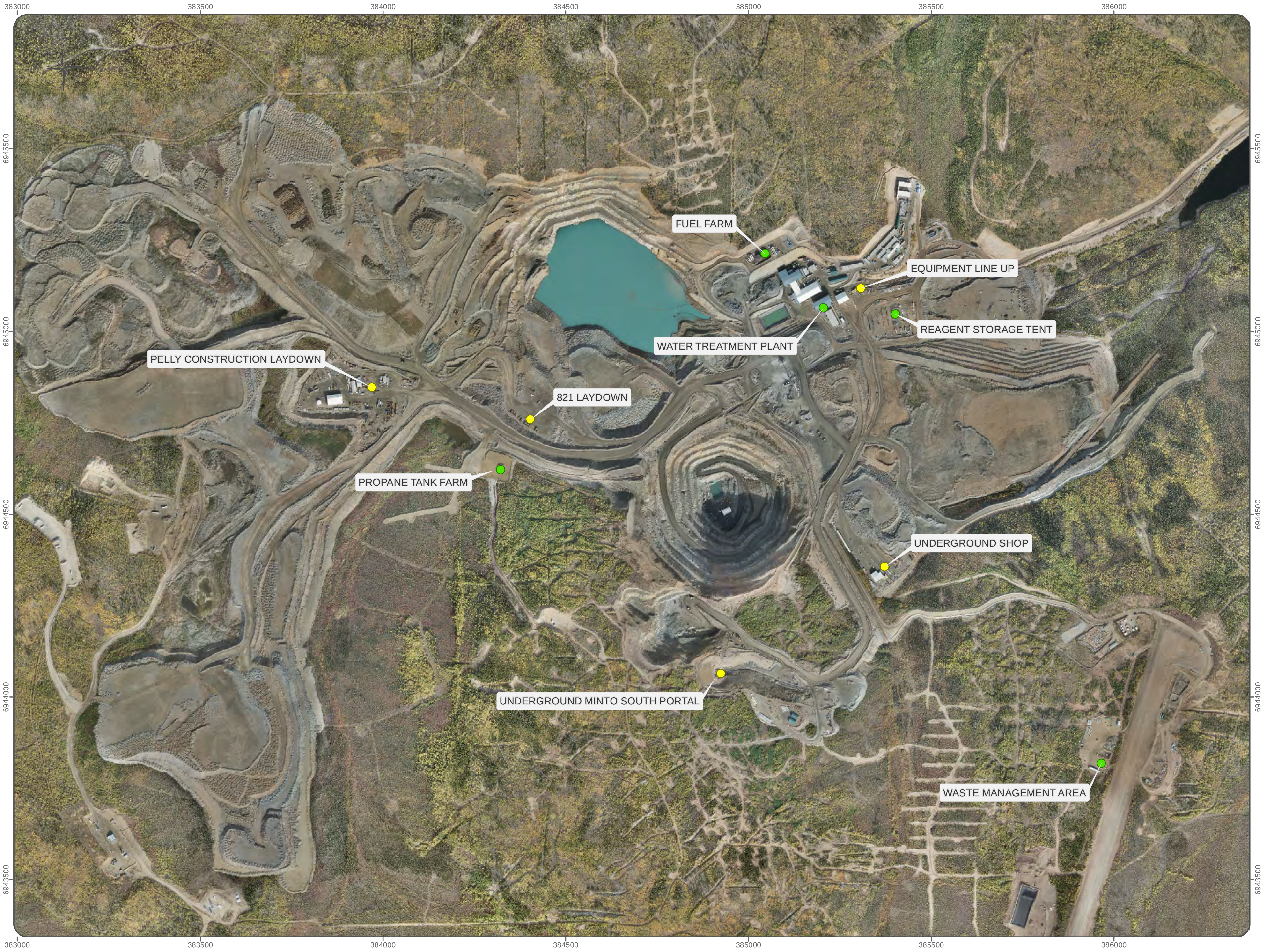
6.3.1.3 *Equipment*

In the event of a temporary closure, Minto will maintain the equipment necessary to complete maintenance of onsite facilities and infrastructure. However, not all remaining equipment may be required for temporary closure activities and therefore security of that equipment is a key temporary closure measures to protect public health and safety, the environment and company assets. As such, equipment that is on site and not utilized during temporary closure will be stored and secured on lined areas, inside shops or underground as shown in Figure 6-1.

6.3.1.4 *Hazardous Materials*

Removal of all hazardous materials not required in the event of a temporary closure is a key temporary closure measure to protect public health and safety and the environment. All hazardous materials that remain onsite in the event of a temporary closure will be stored in the Reagent Storage Tent, Water Treatment Plant, Fuel Farm, Propane Tank Farm, and Waste Management Area as shown in Figure 6-1.

Reagents required for the treatment of water will be secured in the Reagent Storage Tent and/or Water Treatment Plant. The Fuel Farm will be utilized in a reduced capacity during temporary closure and therefore will be secured and serviced by care and maintenance staff. The Propane Tank Farm will be utilized during the winter months while dewatering activities are ongoing underground and will be secured and serviced by care and maintenance staff. Special waste will be stored in the lined special waste pole barn in the Waste Management Area as per the Waste Management Plan.



MINTO MINE
PHASE V/VI EXPANSION
TEMPORARY CLOSURE

FIGURE 6-1

EQUIPEMENT AND HAZARDOUS WASTE STORAGE LOCATIONS

FEBRUARY 2016

capstone
MINTO MINE

- Equipment Laydown/ Storage Area
- Hazardous Materials Storage Area

1:10,000 *when printed on 11 x 17 inch paper*

0 100 200 400
Meters

ALEXCO ENVIRONMENTAL GROUP

Aerial imagery obtained from Challenger Geomatics. Imagery acquired September 9th 2014.

Datum: NAD 83 Projection: UTM Zone 8N

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6.3.2 Physical and Geochemical Stability

Physical and geochemical stability are key to meeting the critical temporary closure objectives of protecting public health and safety and the environment. This section will address the approach taken to managing physical and geochemical stability of various components on site in the event of a temporary closure. Components discussed in this section include landfill and waste management areas, tailings facilities, ore stockpiles, Water Storage Pond (WSP) and waste rock facilities.

As per the Minto Mine Waste Management Plan, only inert waste is placed into the landfill. Given the chemical nature of the landfill materials, there is no need to take additional measures beyond continuing the activities as described in the Waste Management Plan. Similarly, given the physical nature of the materials stored on site and the nature of the designs for the hazardous storage areas and landfills, the continued adherence to the site's management plans will ensure these materials remain stable and protected.

Tailings at Minto are currently located in the covered Dry Stack Tailings Storage Facility and within the Main Pit and Area 2 Pit Tailings Management Facilities. During temporary closure, monitoring of the tailings facilities will continue to take place as per the site's management plans. Given the physical and chemical nature of the tailings facilities and the contained tailings at Minto, there is no need to take additional measures beyond the monitoring programs and adaptive management protocols already in place.

Similarly to the tailings at Minto, given the physical and chemical nature of the ore stockpiles at Minto, there is no need to take additional measures beyond the monitoring programs and adaptive management protocols already in place.

The Water Storage Pond is part of the mine's water management system. As such, it will be required for use in the event of temporary closure. The site Water Management Plan, Adaptive Management Plan and Operation, Maintenance and Surveillance (OMS) manual includes routine operations and adaptive management of the Water Storage Pond and the Water Storage Dam. It is noted that there is nothing related to the impoundment that requires chemical stabilization.

Acid Rock Drainage /Metal Leaching (ARD/ML) predictions for ore and waste materials will not be subjected to modification due to increased durations of exposure possible under temporary closure. The great majority of mined materials at Minto are not potentially acid generating, and those that have uncertain potential to generate acidic weathering conditions are not expected to do so for several decades (if at all). As such, there are no materials that require exposure to be minimized.

6.3.3 Temporary Closure Water Management

The appropriate management of site water is critical to meeting the objective of environmental protection in the event of a temporary closure. All water management facilities, including the use of the Water

Treatment Plant, will be managed as if operations were continuing. Specifically, the facilities will be maintained and operated according to the approved Water Management Plan.

This section will summarize the details of the approved Water Management Plan as it pertains to temporary closure. Areas of focus for water management in temporary closure include the following: water management strategy, water treatment and water management infrastructure.

6.3.4 Temporary Closure Water Management Strategy

The current Water Management Plan utilizes a water management strategy and it is expected that this strategy will carry forward in the event of temporary closure. The current water management strategy includes the following key principles:

- The site water balance is used to define mine water inventory targets and targets for volumes to be released to Minto Creek. Regular tracking of the mine water inventory allows the mine operations to determine if the inventory is on target and if, and when, water must be released from site. Consideration will be given to the likely duration of temporary closure as well as required and available water storage capacity for operation restart when defining water inventory targets.

- Runoff from developed mine areas (mine water) is collected and stored in the Main Pit Tailings Management Facility (MPTMF) and the Area 2 Pit Tailings Management Facility (A2PTMF).

- The preferred method for controlling and limiting the inventory of mine water on site is to collect and divert discharge-compliant (clean) runoff to the WSP which then can be discharged to Minto Creek, as required.

- If collection, diversion and release of clean water is not sufficient for meeting mine water inventory targets, then Minto has the option of treating and discharging compliant (clean) water that originated as mine water.

In order to fulfill the water management strategy, the water balance will be updated every 6 months or more often as required. The annual water balance update will help inform the mine water inventory targets and targets for volumes to be released to Minto Creek. In the event of a temporary closure there will be limited, if any, consumption of water and therefore it is expected that the site will have a surplus in water inventory. Due to the expectation of surplus water, the following actions will be undertaken in temporary closure to ensure sufficient storage volumes for water remains in the tailings management facilities:

1. **Divert water from W35 to WSP:** water will be diverted from the south-west catchment of site (collected at station W35) to the WSP. Historically, the water at W35 has been of a similar quality to discharge-compliant (clean) runoff measured in lower Minto Creek. On-going water quality monitoring will ensure that water in the WSP remains in compliance with the water licence

effluent quality standards. Minto will maintain procedures, checklists, sample collection, and analysis that must be completed prior to diverting water from W35 to the WSP.

2. **Divert water from W15 to WSP:** if diversion of water from W35 is insufficient to meet water inventory and release targets then water collected at W15 can be diverted to the WSP. Water collection point W15 collects runoff from undisturbed areas and from waste rock. The water quality parameter concentrations have historically been elevated compared to undisturbed catchments but have generally met effluent quality standards in the months of May, June, July and August. On-going water quality monitoring will ensure that water diverted from W15 and water in the WSP remains in compliance with effluent quality standards in effect. Minto will maintain procedures, checklists, sample collection, and analysis that must be completed prior to diverting water from W15 to the WSP.

3. **Release mine water stored in the MPTMF or A2PTMF to WSP.** The mine water stored on site will likely require water treatment before it can be released. Water treatment considerations are discussed in Section 6.3.4.1 of this plan including the water treatment plant configuration to use for specific water conditions that may be present in temporary closure. Minto will maintain procedures, checklists, sample collection, and analysis that must be completed prior to releasing water from the MPTMF or A2PTMF.

In temporary closure, water inventory targets will be updated every 6 months, or more often as required. Water inventory in the tailings management facilities and licensed water storage facilities will be tracked through routine monitoring.

The Minto South underground workings will initially remain dewatered during temporary closure; however, as temporary closure proceeds other options may be considered. Underground dewatering will utilize operational dewatering infrastructure. Minto North will remain dewatered for the duration of temporary closure utilizing methods described in the Water Management Plan.

6.3.4.1 *Water Treatment*

Water treatment will be a key component to maintaining safe water storage capacity onsite in the event of a temporary closure. The Water Treatment Plant can be operated in three general configurations depending on the constituents that require treatment. The three general configurations are as follows:

1. **Clarification and filtration:** this process configuration removes suspended solids (TSS). Coagulant and flocculant solutions are added to the feed water, which is pumped to a ballasted lamella clarifier and a filter. Dissolved constituents are generally not removed. The by-product of the process is a sludge that is pumped to the MPTMF or A2PTMF. The maximum treatment capacity is approximately 4,000 m^3/day.

2. **Sulphide precipitation, clarification, and filtration:** this process configuration can remove dissolved copper, cadmium, zinc, nickel, cobalt, and lead, in addition to TSS. Dissolved metals are

removed by adding an organo-sulphide reagent that binds to dissolved metals and forms precipitates. The by-product of the process is a sludge that is pumped to the MPTMF or A2PTMF. The maximum treatment capacity is approximately 4,000 m^3/day.

3. **Reverse osmosis (RO):** this process removes 95 to 99% of all constituents in the feed water. The feed water for the RO unit is the effluent from the clarification and filtration unit, which is operated as a pre-treatment step. The RO unit produces a clean effluent stream that consists of approximately 75% of the feed water (the RO permeate). The by-product of the process is a brine stream, which consists of about 25% of the feed water and 95 to 99% of constituent loadings. The brine stream is pumped to the MPTMF or A2PTMF. Because of this brine by-product, RO cannot be considered a true water treatment process but is rather a process that concentrates mine water into a smaller volume with higher constituent concentrations. The maximum treatment capacity is approximately 2,500 m^3/day.

As stated in the WUL, a capacity of 1,000,000 m^3 is required to ensure enough storage capacity for freshet and therefore a bypass protocol is not required in the event that the Water Treatment Plant is damaged or unable to keep up with demand for a short to intermediate time period. It is expected that the Water Treatment Plant could be run throughout the year if necessary to maintain the 1,000,000 m^3 capacity.

6.3.4.2 *Water Management Infrastructure*

The Minto Mine water conveyance network consists of diversion ditches, culverts, sumps, pumps, and pipelines installed throughout the mine site. The system is designed to segregate clean runoff and mine water. Clean water is conveyed to the WSP while mine water is conveyed to the mine water storage reservoirs, which include the MPTMF and A2PTMF.

Figure 6-2 shows the location of water conveyance infrastructure that is currently installed onsite. Table 6-1, below, lists the equipment that is currently utilized at Minto for dewatering and water conveyance. Table 6-2 summarizes the current mine water infrastructure, and further includes the expected status of the infrastructure in the event of temporary closure.

The conveyance network is intended to provide a high degree of operational flexibility such that appropriate water management actions can be taken based on informed management decisions.

Table 6-1: Water Conveyance Equipment Inventory

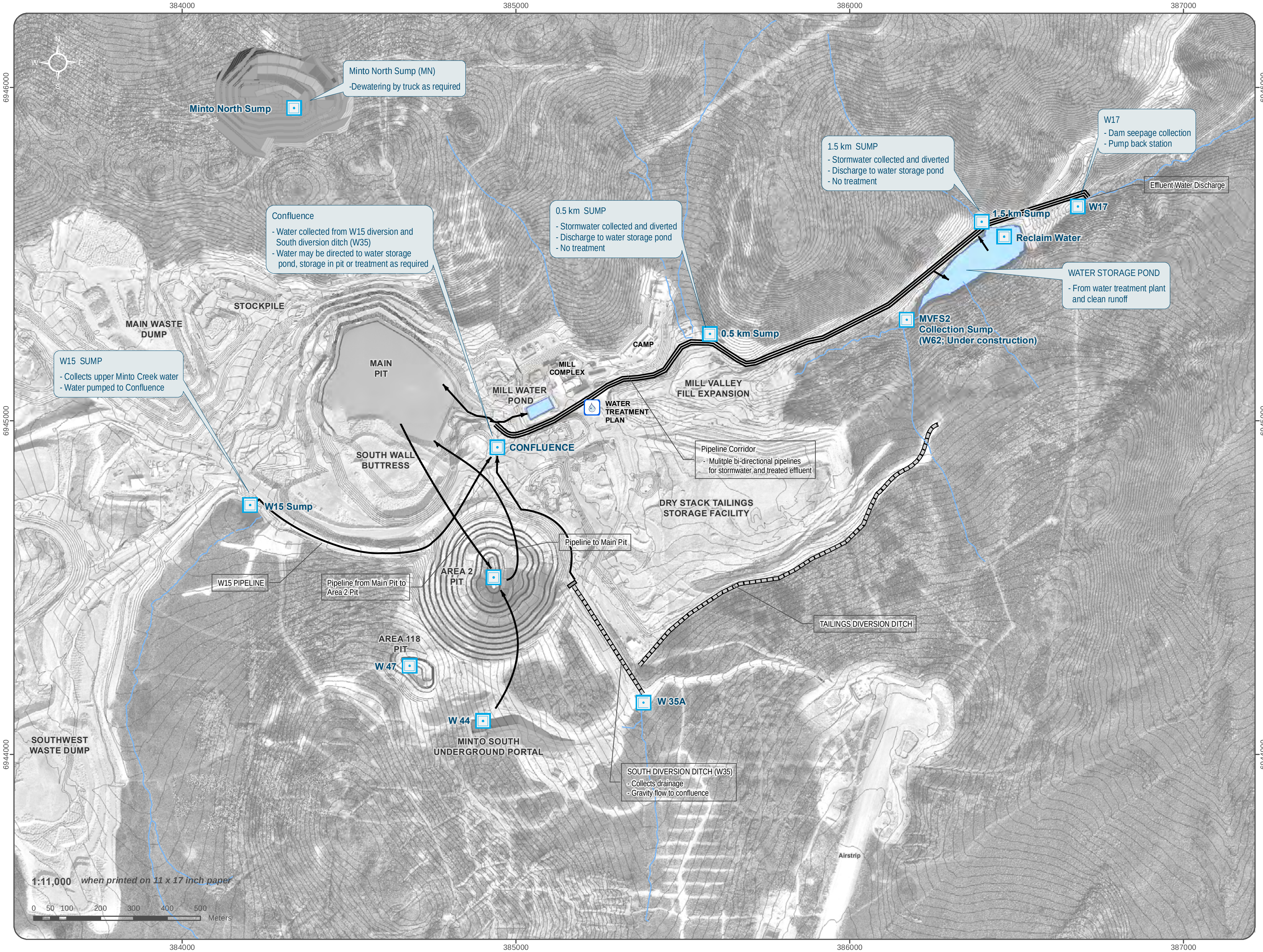
Pump Size	Pump Type	Quantity	Power Type
150hp	Tsurumi	5	Electrical
140hp	Flyght	1	Electrical
100hp	Tsurumi	2	Electrical
60hp	Tsurumi	4	Electrical
HL250M	Godwin	2	Diesel
HL4M	Godwin	2	Diesel
Pipe Size	**Pipe Type**	**Quantity (m)**	**Additional Information**
24"	HDPE	885	
16"	HDPE	1500	
10"	Steel	240	Heat traced
8"	HDPE	1400	
8"	HDPE	2600	Insulated
4"	HDPE	2800	
4"	HDPE	1400	Insulated
4"	Steel	450	Heat traced
3"	HDPE	600	

MINTO MINE

RECLAMATION AND CLOSURE PLAN
REVISION 2016-01

FIGURE 6-2
WATER CONVEYANCE NETWORK

AUGUST 2016



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- Collection Point
- Water Treatment Plant
- Pipe Alignment
- Piping Corridor
- Tailings Slury Discharge
- Diversion Ditch

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Aerial imagery obtained from Challenger Geomatics. Imagery acquired Sept 9th 2014. Site contours derived from 2014 aerial imagery obtained from Challenger Geomatics.

Hydrology data provided by Minto Explorations Ltd, May 2009.

Datum: NAD 83 Projection: UTM Zone 8N

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Table 6-2: Water Conveyance System Details

Infrastructure Name	Description of Current Use	Temporary Closure Use
Reservoirs		
Main Pit Tailings Management Facility (MPTMF)	Tailings management facility and water reservoir. Total capacity to the natural spill elevation is approximately 4.9 Mm3.	Ongoing use.
Area 2 Pit Tailings Management Facility (A2PTMF)	Tailings management facility and water reservoir.	Ongoing use.
Mill Pond	Facility has been decommissioned	N/A
Water Storage Pond (WSP)	Stores clean water destined for release to Minto Creek, or available for mill use. Total capacity is approximately 320,000 m3.	Ongoing use.
Water Conveyance		
W15 sump	Collects runoff and seepage from the western sub-catchments on the Minto Site and conveys the water via a pipeline to the Main Pit or WSP.	Ongoing use.
W35 sump	Collects runoff and seepage from the southern undisturbed sub-catchments on the Minto Site and conveys the water to the Main Pit or WSP.	Ongoing use.
Minto Creek Detention Structure	Decommissioned and functionally replaced by MVFES2 Collection sump (W62)	N/A
0.5 km and 1.5 km sumps and ditches	Collects runoff from sub-catchments north of the Minto Mine access road. Runoff collected is diverted to the WSP.	Ongoing use.
South diversion ditch	Collects runoff from sub-catchments located south of the dry stack tailings facility.	If design of Area 2 Stage 3 pit necessitates it, the south diversion ditch will be decommissioned and flow diverted via the tailings diversion ditch.
Tailings diversion ditch	Diverts water from small catchment upslope of ditch.	If required by Area 2 Stage 3 pit development, this ditch will be modified to lengthen the ditch at the eastern end to convey water from the south diversion ditch to the WSP or A2PTMF or MPTMF.
Area 2 Pit sump	No longer applicable.	
Minto South underground dewatering	Water collected from Minto South underground dewatering will be conveyed by pipe or trucked to the MPTMF or A2PTMF.	Expected ongoing use.
Confluence	Hub located between the Main Pit and Area 2 Pit where water from W15 and W35 may be directed to the Main Pit or to the WSP.	Ongoing use.
WSP discharge	Pumps and pipes for releasing water from the WSP to Minto Creek.	Ongoing use.
Minto North sump	Runoff collected in the Minto North Pit will be transported to the MPTMF or A2PTMF.	Ongoing use.
MVFES2 Collection sump	Collects and pumps Mill Valley seepage to the Main Pit.	Collects and pumps Mill Valley seepage to the Main Pit.
Reclaim Water		
Reclaim water line from the WSP to the mill	Conveys water from the WSP to the mill, if required.	Ongoing use.
Reclaim water line from the MPTMF to the mill	Conveys water from the MPTMF to the mill or A2PTMF.	Ongoing use.
Reclaim water line from the A2PTMF to the mill	Conveys water from the A2PTMF to the mill or MPTMF.	Ongoing use.
Tailings		
Tailings line from the mill	Conveys slurried tailings and water from the mill to the MPTMF and A2PTMF.	Temporarily decommissioned.
Water Treatment		
Water treatment plant	Accepts feed water from the MPTMF, the A2PTMF or the WSP and discharges treated water to the MPTMF, A2PTMF, WSP or Minto Creek. Sludge and brine produced in the treatment process is pumped to the MPTMF or A2PTMF.	Ongoing use.

6.3.5 Monitoring and Reporting

In the event of a temporary closure, monitoring and reporting will be critical to determining the success of the implemented temporary closure measures. In general, the monitoring strategy for environmental protection monitoring will be to monitor as per an approved EMSRP. The EMSRP commits Minto to all regulatory required monitoring and reporting under the approved WUL and Quartz Mining License. It is expected that Minto will develop and submit an updated EMSRP for review and approval as it pertains to temporary closure. The temporary closure EMSRP will focus on reduced frequency of monitoring as appropriate from the operational EMSRP. For clarity, the EMSRP that is referenced in this plan will be whichever approved EMSRP is current at the time (Operational or Temporary Closure EMSRP).

Monitoring and reporting requirements from other regulations, permits and licences that do not fall under the requirements of the EMSRP will be adhered to and followed as required.

Site components and infrastructure will be visually inspected on a regular basis. The visual inspections will document unexpected conditions as they relate to protection of public health and safety, the environment, physical stability and security. Management will be notified of all unexpected conditions and the conditions will be investigated and addressed as required.

In general the monitoring activities will include but not be limited to the following:

- All environmental protection monitoring and reporting will be completed as per approved EMSRP.
- Regular inspections of mine and processing facilities will be completed to ensure the facilities remain in good repair.
- Regular inspections of the water conveyance systems will be completed to ensure the facilities remain in good repair.
- Reports of changes to the physical status of any part of the site may warrant a follow-up investigation by the appropriate personnel.
- Subject matter experts will be utilized as required to remain in compliance with approved plans.
- Water storage capacity in licensed facilities will be monitored regularly and data analyzed to ensure compliance with water storage capacity.
- All monitoring, reporting and inspections not covered by the EMSRP and required by the environment act permits will be adhered to.
- All inspections and monitoring activities will be recorded and filed onsite.

Reporting will be completed as per the EMSRP or as required by applicable permits and licences.

If a temporary closure is triggered, a notice will be provided within seven days (or as the authorizations dictate) to the appropriate authorities stating the following:

- The nature and reason for the temporary closure;
- The anticipated duration of the temporary closure;
- Actions planned to maintain compliance with project permits and plan approvals; and
- Any event which would reasonably be anticipated to result in the resumption of mining or the permanent closure of the mine.

Table 6-3 presents a summary of the temporary closure activities and applicable monitoring of the various project components which would occur in temporary closure.

6.3.6 Maintenance

In the event of temporary closure, site components such as infrastructure and facilities will require maintenance to successfully meet the temporary closure objectives of protecting public health and safety, the environment and company assets. During the temporary closure preparation phase, the facilities not required will be temporarily decommissioned and secured. For facilities that are required in the event of temporary closure, they will be maintained on a preventative maintenance program similar to the program administered during the operational phase. The current preventative maintenance program relies on the outcomes of routine inspections; monitoring; and adherence to site management plans and facility operations, maintenance and surveillance manuals. In temporary closure, it is expected that the same outcomes will be the driving factors for maintenance of site infrastructure and facilities. In general, all facilities, equipment and infrastructure necessary in the event of a temporary closure will require ongoing maintenance; further discussion on this maintenance is provided in this section

In the event of temporary closure it will be critical to maintain the physical stability and functionality of the diversion channels. Water conveyance equipment will require regular maintenance to ensure reliable operation and performance of the water conveyance system. Monitoring, repairs and maintenance will be carried out by the care and maintenance crew.

The access road system will require periodic visual inspections. The care and maintenance crew will be responsible to complete maintenance of surface drainage infrastructure, culvert repair or road grading as required.

In the event of a temporary closure, maintaining the waste rock dumps will be critical to reduce the risk of physical instability. The care and maintenance crew will maintain the sloped grading of bench surfaces to minimize surface water infiltration and erosion of downstream slopes. Furthermore, the crew will maintain the surface water collection ditches to control surface drainage. Any repairs or maintenance of the facility; or improvements to runoff, erosion and sediment control will be undertaken as required.

Equipment that will be utilized in the event of temporary closure will be maintained as required and will be included as part of the preventative maintenance system. Preventative maintenance will aid in the reduction of environmental contamination by preventing spills. Additionally, preventative maintenance will benefit Minto by maintaining the company assets. Maintenance crews will be responsible for the maintenance of equipment similar to the operational period.

Actively managing and maintaining the Waste Management Area will be important to securing the facility in the event of temporary closure. The Waste Management Area will be maintained as per the Waste Management Plan and associated permits, including but not limited to segregation of waste based on waste type.

The reduced inventory of special waste associated with the limited site activities as well as, the structure and management of the Waste Management Area will ensure hazards contained within the facility are stable and secured.

The physical stability of the fuel and propane tank farms will be maintained by the maintenance crew similar to the operational period. Regular inspections and preventative maintenance will drive the requirement for maintenance of these facilities.

The water treatment plant will be maintained as required including preventative maintenance. To preserve physical stability of the all facilities the care and maintenance crew will conduct quarterly structural inspections of the facilities and will complete proactive repairs as required.

6.3.7 Resources

In temporary closure a care and maintenance crew will be onsite at all times. The staffing numbers onsite at a given time will fluctuate from six to ten people. Two to three environmental personnel will be onsite at all times to complete all of the environmental monitoring and inspection requirements. Appropriate trades personnel will be retained for routine maintenance of components required in temporary closure. Water Treatment Plant operators will be employed part time, as required, to meet the expectations of managing water onsite.

The equipment expected to be utilized during care and maintenance will include, but not be limited to, the following: a front end loader, excavator, rock truck, water truck, vacuum truck, grader, forklift, flat deck truck, fuel truck, tug, barge and necessary light duty trucks.

The care and maintenance staff will consist of a variety of expertise, and roles and responsibilities will include, but not be limited to the following:

- Site management for continued direction and management of all activities;
- Safety personnel to support site inspections, security controls, first aid, emergency response and overall administration of the health and safety management systems;

- Water Treatment Plant Operators to support water management including WTP operations;
- Environmental personnel to coordinate site and environmental monitoring and ensure compliance to ongoing regulatory requirements;
- Adequate maintenance staff to ensure critical process equipment such as pumps and generators, and mobile equipment are maintained in operating condition;
- Equipment operators to support required maintenance, provide site access and maintain infrastructure;
- Some care and maintenance personnel may be trained in operating equipment required for snow removal and road access; and
- Additional support from Capstone's corporate office for IT and administration.

In temporary closure energy consumption will be significantly reduced. The estimated amount of electric power required in temporary closure is approximately 5,640 kilovolt ampere per month. The estimated diesel required in temporary closure is approximately 40,000 litres while gasoline is estimated at 2,500 litres per month. Propane will fluctuate depending on the season and underground activity and is expected to range from 1,200 to 12,000 litres per month.

Table 6-3: Summary of Care and Maintenance Activities and Monitoring during Temporary Closure

Project Component		Area of Interest	Care/Maintenance Activities	Monitoring Activities	Monitoring Responsibility	Monitoring Timing/Frequency
Open Pits		-Water Management/Treatment -Physical Stability	-Maintain creek diversions around pits	Physical Monitoring Program	Environment Monitor/Coordinator	As per EMSRP
			-Treat excess pit water and transfer to WSP if required	Water Quality Monitoring for Treatment	Water Treatment Plant Operator	As per EMSRP when treating water
			-Restrict access to hazardous areas with physical barriers	Geotechnical Inspection of Creek diversion	Engineer	Annual
Ore Stockpiles	**High Grade**	Physical Stability	Reduce High Grade Stockpile Inventory	n/a	n/a	n/a
		Geochemical Stability	Monitor for seepage	Water Quality Surveillance Program, Seepage Monitoring Program	Environment Monitor/Coordinator	As per EMSRP
	Low Grade	Physical Stability	Monitor for stability	Physical Monitoring Program and Annual Geotechnical Inspection	Engineer, Environment Monitor/Coordinator	Annual, As per EMSRP
		Geochemical Stability	Monitor for seepage	Water Quality Surveillance Program, Seepage Monitoring Program	Environment Monitor/Coordinator	As per EMSRP
Waste Rock and Overburden Dumps		Physical stability	Runoff/Erosion/Sediment control, as required.	Physical Monitoring Program	Environment Monitor/Coordinator	As per EMSRP
				Geotechnical Inspection	Engineer	Annual
		Geochemical Stability	Monitor for seepage	Water Quality Surveillance Program, Seepage Monitoring Program	Environment Monitor/Coordinator	As per EMSRP
Dry Stack Tailings Storage Facility		Physical stability	-Surface water diversion structure repair/maintenance, as required -Runoff/Erosion/Sediment control, as required.	Visual inspection elements of Monitoring Program from Tailings Management Plan (TMP) Physical Monitoring Program	Environment Monitor/Coordinator	As per TMP and EMSRP
			-Stability Monitoring as required	Geotechnical Inspection from WUL and TMP	Engineer	Annual
		Geochemical Stability	Monitor for seepage and water quality	Water Quality Surveillance Program and TMP Monitoring Elements	Environment Monitor/Coordinator	As per EMSRP
Mill and Camp Site		-Buildings, Equipment, and Infrastructure -Physical Stability	Concentrate removed from site Secure buildings and maintain necessary equipment onsite for resumption of milling	Visual inspection periodically for signs of instability	Maintenance	Monthly
			Inspect for site stability	Structural and Physical Inspection	Engineer	As required
		-Physical Stability	-Maintain culverts.	Physical Monitoring Program	Environment Monitor/Coordinator	As per EMSRP
Water Storage Dam		-Water Management -Physical Stability	-Maintain spillway and structure as required based on geotechnical inspections. -Monitor pond levels and water quality, where applicable.	Physical Monitoring Program	Environment Monitor/Coordinator	As per EMSRP and WSPD OMS Manual
			-Maintain spring/early summer pumping drawdown equipment.	Geotechnical Inspection	Engineer	Annual
		Geochemical Stability	Monitor for seepage water quality	Water Quality Surveillance Program	Environment Monitor/Coordinator	As per EMSRP
Explosives Facility		Physical stability	-Remove bulk explosives from site. -As required, repair and replace infrastructure	Visual inspection periodically for signs of instability.	Maintenance	Monthly
Barge Landing		Access to Yukon River	As required, granular upgrade to landing site.	Visual inspection periodically for signs of instability.	Environment Monitor/Coordinator	Weekly
Access Road and Surface Drainage		Entire Route	As required, surface grading and granular amendments, ditch and culvert maintenance.	Visual inspection periodically for signs of instability/erosion	Environment Monitor/Coordinator, Maintenance	Weekly and after heavy precipitation events

Project Component	Area of Interest	Care/Maintenance Activities	Monitoring Activities	Monitoring Responsibility	Monitoring Timing/Frequency
Entire Site	Physical stability	-Runoff/Erosion/Sediment control, as required.	Physical Monitoring Program	Environment Monitor/Coordinator	As per EMSRP
		-Road/culvert maintenance as required.	Geotechnical Inspection	Engineer	Annual
	Water Quality/Management	-Retain Water Treatment Plant and Operators -Maintain storm water diversion systems -Continue seasonal water treatment as required for excess pit and site water	-Complete required monitoring as per the company's Environment Monitoring, Surveillance and Reporting Plan -Continue required monitoring under Metal Mining Effluent Regulations (MMER)	Environment Monitor/Coordinator	As per EMSRP and MMER
	Security	Full time site staff will check, repair and replace as required: □ precautionary signage □ barricades at mine entry ways □ secured door ways of temporarily closure facilities	Site Inspection and Security Monitoring of all infrastructure and site elements	Care and Maintenance Staff	Regularly
	Miscellaneous Infrastructure	Shut down and winterize camp, except for caretaker facilities Inspect power line	Site Inspection and Security Monitoring of all infrastructure and site elements – report any changes to stability/condition of miscellaneous infrastructure.	Care and Maintenance Staff	Regularly
	Reporting	-Prepare and submit reports to the Yukon Water Board pursuant to the approved Environment Monitoring, Surveillance and Reporting Plan, including details of temporary closure activities and monitoring. - Prepare and submit reports to the Energy Mines and Resources branch of the Yukon Government pursuant to the approved Environment Monitoring, Surveillance and Reporting Plan, including details of temporary closure activities and monitoring. -Prepare and submit quarterly monitoring reports to Environment Canada under MMER. -Prepare and submit reports to other regulatory bodies as required by permits and licences not included in the Company's Environment Monitoring, Surveillance and Reporting Plan.		Environment Coordinator, Site Management	As per the EMSRP Quarterly, Online RISS Registry As per applicable permits and licences

7 Final Reclamation and Closure Measures

The site configuration at the end of mining (and beginning of the Active Closure period) is shown in Figure 7-1, and the site configuration after completion of construction of the final reclamation and closure measures (at the end of the Active Closure period) is shown in Figure 7-2. The following subsections describe the final reclamation and closure measures that are planned for the various components of the Minto Mine site.

7.1 Underground Workings and Openings to Surface

Underground mining schematics and plans are presented in Minto's Underground Mine Development and Operations Plan. An updated mine plan showing the final layouts and extents of the workings will be completed at time of final closure. An overview of the underground deposits under consideration for this plan are shown in Figure 5-10.

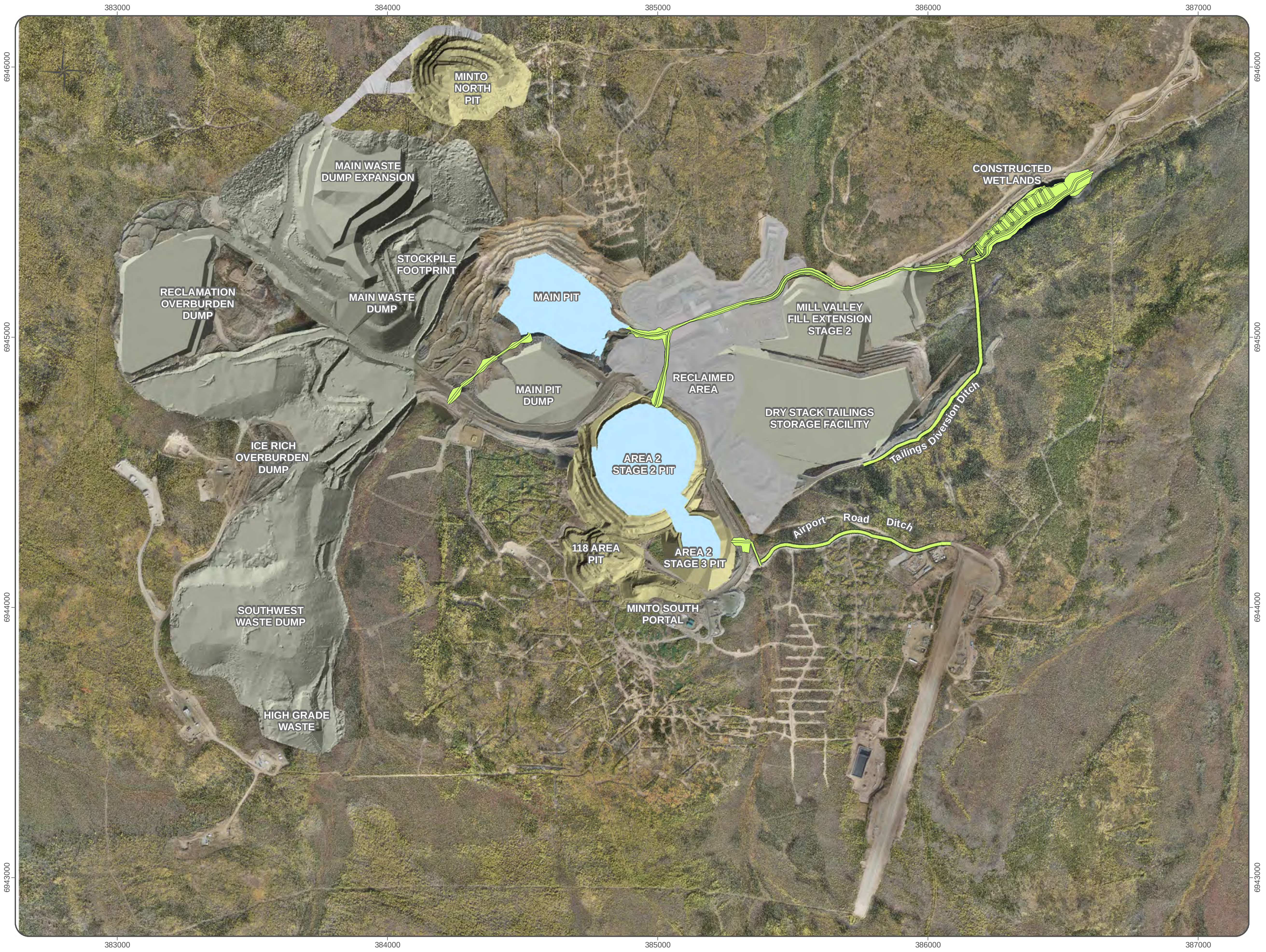
Two portals were completed to date, the Minto South and the M-Zone Portal respectively. The M-Zone portal was collared from the bottom of the Area 2 Stage 2 pit. The two areas accessed through these portals were the Minto South and the M-Zone respectively.

The mining methods employed (room-and-pillar, and longhole stoping) resulted in workings with a typical span and vertical height of 10 m and 18 m respectively, confined by rib pillars. Stability analysis of the openings completed as part of the Underground Mine Development and Operations Plan (Minto 2014) indicated that this opening geometry is stable and additional support is not required.

The shortest distance from the top of a mined out stope to the surface is 154m. This was realized in the upper level mining of the 118 zone (the 740 level). The thickest ore and hence the highest void realized for the stopes closest to surface is 24m. Given the dimensions and the general high strength of rock at Minto, surface expression of subsidence due to mine workings collapse is not expected.

7.1.1 Minto South

Upon completion of underground mining, underground workings will be allowed to flood. Hydrogeological investigations indicate that in the post-closure period the groundwater table will not rise sufficiently to result in water discharging at the surface. The Minto South Portal (elevation 851 m) is about 52 m above the final level of the Area 2 Pit lake (elevation 799 m), representing a significant groundwater gradient that would have to be overcome for water to discharge through the portal opening. In the unlikely event that groundwater would be discharging through the Minto South portal, it would be confined within the catchment of the Area 2 Pit and would be captured under the general closure water management system.



MINTO MINE

RECLAMATION AND CLOSURE PLAN
REVISION 2016-01

FIGURE 7-2

SITE CONFIGURATION-END OF ACTIVE CLOSURE

AUGUST 2016

capstone MINTO MINE

- Water Conveyance System
- Pit
- Dump
- Reclaimed Area
- Pit Lake
- Minto North Access Road

1:13,500 *when printed on 11 x 17 inch paper*

0 50 100 200 300 400 500 Meters

ALEXCO ENVIRONMENTAL GROUP

Aerial imagery obtained from Challenger Geomatics. Imagery acquired September 9th 2014.

Datum: NAD 83 Projection: UTM Zone 8N

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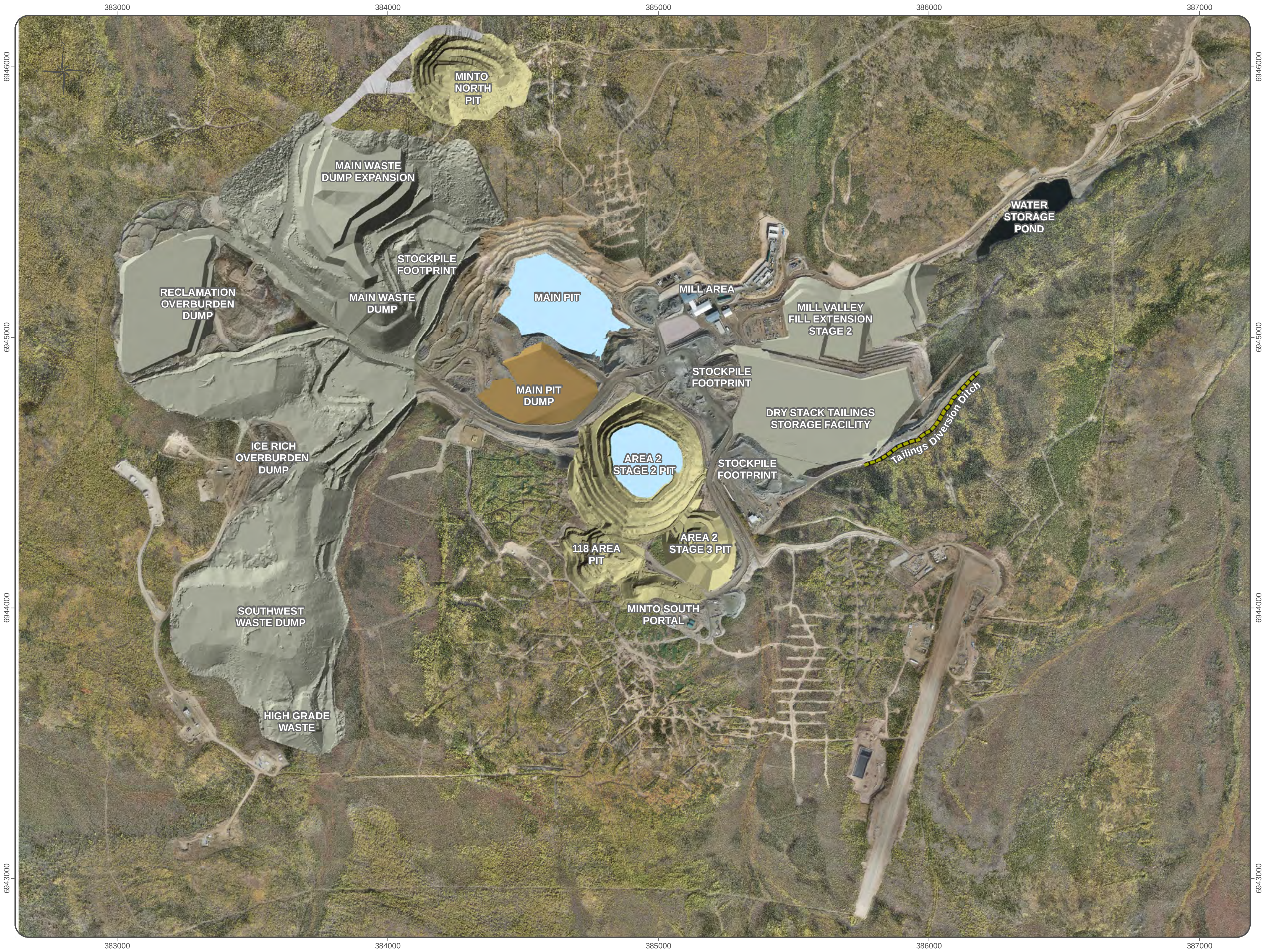

MINTO MINE

RECLAMATION AND CLOSURE PLAN
REVISION 2016-01

FIGURE 7-1

SITE CONFIGURATION-BEGINNING OF ACTIVE CLOSURE

AUGUST 2016

capstone MINTO MINE

- Pit
- Dump Covered
- Dump Not Covered
- Pit Lake
- Minto North Access Road
- Tailings Diversion Ditch

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0 50 100 200 300 400 500 Meters

ALEXCO ENVIRONMENTAL GROUP

Aerial imagery obtained from Challenger Geomatics. Imagery acquired September 9 th 2014.

Datum: NAD 83 Projection: UTM Zone 8N

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Underground fixtures, equipment, and systems (compressed air pipes, ventilation ducts, electrical cables, etc.) will be decommissioned, decontaminated of hydrocarbons and other hazardous waste, and disposed of as appropriate. All fuels, lubricants, and hydraulic fluids will be drained and disposed of as appropriate. Mobile equipment will be removed from underground and disposed of as described in Section 7.8.10.

The portal to the underground workings will be blocked to eliminate access by people and wildlife. The blockage will be achieved by placing rockfill to at least 2 m above the top of the opening and will occupy the entire section of the portal. Side slopes of the rockfill will be graded adequately to allow overburden to be placed as a growth medium. This will be followed by revegetation using techniques applied elsewhere on site.

7.1.2 M-Zone

The M-zone portal was excavated from the bottom of the Area 2 Pit. This portal is currently completely flooded with tailings slurry and water and no further closure measures will be required.

7.1.3 Vent Raises

All ventilation raises will be sealed to prevent access by construction of a reinforced concrete cap capable of supporting a minimum uniformly distributed load of 12kPa, as per the requirements of the Occupational Health and Safety Regulations. Loose overburden will be excavated from around the vent raise collar and the cap will be anchored in competent bedrock to prevent subsidence or any other movement.

7.2 Heap Leach Pads and Process Ponds

No heap leach pads exist at Minto. Ore beneficiation was done using conventional milling and flotation techniques. This section is therefore not applicable to this Plan but has been included to maintain parallelism with the headings prescribed by YG (2013).

7.3 Open Pits

7.3.1 Restricting Access

Inadvertent access to all pits will be prevented by constructing berm structures along pit perimeters (including across haul roads and other access points), offset from the pit crest by 5 to 10 m. The berm structure will incorporate regular breaks to prevent any significant impoundment or diversion of surface water. Nominally the berm structures will consist of 1.5m high and 4 to 7 m long sections with angle of repose side slopes and 1 m gaps between adjacent sections. Construction of the berm structures will be done by pushing local material into the berm sections using a dozer or equivalent, with the 4 to 7 m dimension corresponding to common dozer blade widths. The gaps will be planted with trees to discourage their use as passage points. Although placement of signage around pit rims is a common feature of closure plans for open pit mines, in practice signs commonly deteriorate over the course of time under exposure to site conditions and are thereafter ineffective. Although a program of sign replacement could be undertaken, Minto proposes to rely on berms alone to prevent inadvertent access.

7.3.2 Main Pit

The Main Pit was exhausted in April 2011. A description of the pit layout and operations is provided in Section 5 (Figure 5-4, Figure 5-5). Details of the pit design, including the slope and bench stability assessment, can be found in the SRK report "Pit Slope Evaluation for Area 1 Open Pit, Minto Mine, YT" dated July 2007.

An area of instability in the ice-rich overburden in the south wall of the pit failed in 2011, and a stabilization buttress (South Wall Buttress) for the area was constructed between 2011 and 2013. Stability monitoring conducted since 2013 observed that the buttress has largely stabilized by 2015, with average movement of about of 0.2 mm/day.

A significant proportion of the highwall will remain exposed after flooding the pit, however acid-base accounting indicates that the rock is not potentially acid generating. No reclamation work is required on the high walls. Perimeter berms will be constructed as described in Section 7.3.1.

The mined-out pit is used for tailings and waste rock deposition. Currently the pit lake is also used as a source of processing water for the mill, as well as a surge reservoir in the overall mine (contact) water management system. The final pit lake elevation is expected be 786 masl. An engineered spillway will be constructed to connect the pit lake to Conveyance Channel C (Section 7.7).

Surface runoff from up-gradient of the Main Pit will be routed through the Main Pit via Conveyance Channel A. The pit also collects water from local catchment and highwall runoff. As a component of closure conveyance system flows, the Main Pit discharge will be routed through the Constructed Wetland Treatment System that is planned for the Water Storage Pond area. See Section 7.7 for discussion on how Main Pit lake discharge will be managed along with other site flows.

7.3.3 Area 2 Pit

The Area 2 Pit is located south of the Main Pit and west of the Dry Stack Tailings Storage Facility as described in Section 5 (Figure 5-6). The final pit will be the product of merging of the Area 2 Stage 2 and Area 2 Stage 3 pits (Section 5.2.1).

The mined-out Area 2 Pit is used for tailings, waste rock and water storage. Following the cessation of operations it will be flooded until it overflows into the engineered drainage channel exiting the pit to the north at elevation 799 m. An engineered spillway will be constructed to connect the pit lake to Conveyance Channel D (Section 7.7) and onward to the post-closure water conveyance system.

Pit flooding will occur over a period of 1 to 4 years following cessation of milling, with inflows from local catchment and highwall runoff as well as from the larger catchment area to the south via the construction of Conveyance Channel B. As a component of post-closure water conveyance system flows, the Area 2 Pit discharge will be routed through the Constructed Wetland Treatment System that is planned for the Water Storage Pond area. See Section 7.7 for discussion on how Area 2 Pit lake discharge will be managed along with other site flows.

The Area 2 Pit was mined using standard drill and blast techniques with the excavation occurring primarily in competent bedrock. Due to the steep topography it is estimated that approximately 20% of the open pit walls will remain exposed following flooding of the pit; however acid-base accounting indicates that the open pit wall rocks are not potentially acid generating. No reclamation activity is required for these high walls.

Some of the upper benches excavated in overburden have experienced slumping (likely due to thawing of permafrost), particularly along the eastern and northern portions of the pit perimeter where overburden exposures are thickest. These areas are naturally revegetating and no additional work will be done to avoid disturbing the vegetation that has established. Prior to flooding, any safely accessible overburden benches that have not slumped or naturally begun to revegetate will be scarified to encourage natural revegetation.

Inadvertent access to the pit will be prevented by construction of perimeter berms (Section 7.3.1).

7.3.4 Area 118 Pit

The Area 118 Pit was excavated to the southwest of the Area 2 Pit (Figure 5-6) and will be backfilled during stripping of Area 2 Stage 3 Pit. At closure the pit will be completely buried by the Area 118 Backfill Dump, and no further closure measures related to the Area 118 Pit itself will be required. Closure of Area 118 Backfill Dump is outlined in Section 7.5.7.

7.3.5 Minto North Pit

The Minto North Pit is located in the extreme upper elevation of the McGinty Creek catchment area, directly north of the Main Pit. Pit layout and operations were described in Section 5 (Figure 5-7).

At closure, the pit will be allowed to flood; however, groundwater observations and preliminary water balance modeling under most scenarios indicate that the Minto North Pit is not likely to fill to the point where it would spill. Monitoring of pit water levels and quality will be included in the post-closure monitoring program along with down-gradient groundwater quality. The need for an engineered spillway will be assessed based on the monitoring results during a subsequent Closure Plan update. Whether the Minto North pit discharges via surface or groundwater, water quality modelling indicates that no negative downstream effects are anticipated and therefore no treatment will be necessary.

The Minto North Pit is being mined using standard drill and blast techniques with the excavation occurring primarily in competent bedrock. At closure some or all of the highwalls will remain exposed; however acid-base accounting indicates that the open pit wall rocks are not potentially acid generating. No reclamation activity is required for these high walls. Inadvertent access to the pit will be prevented by construction of perimeter berms (Section 7.3.1).

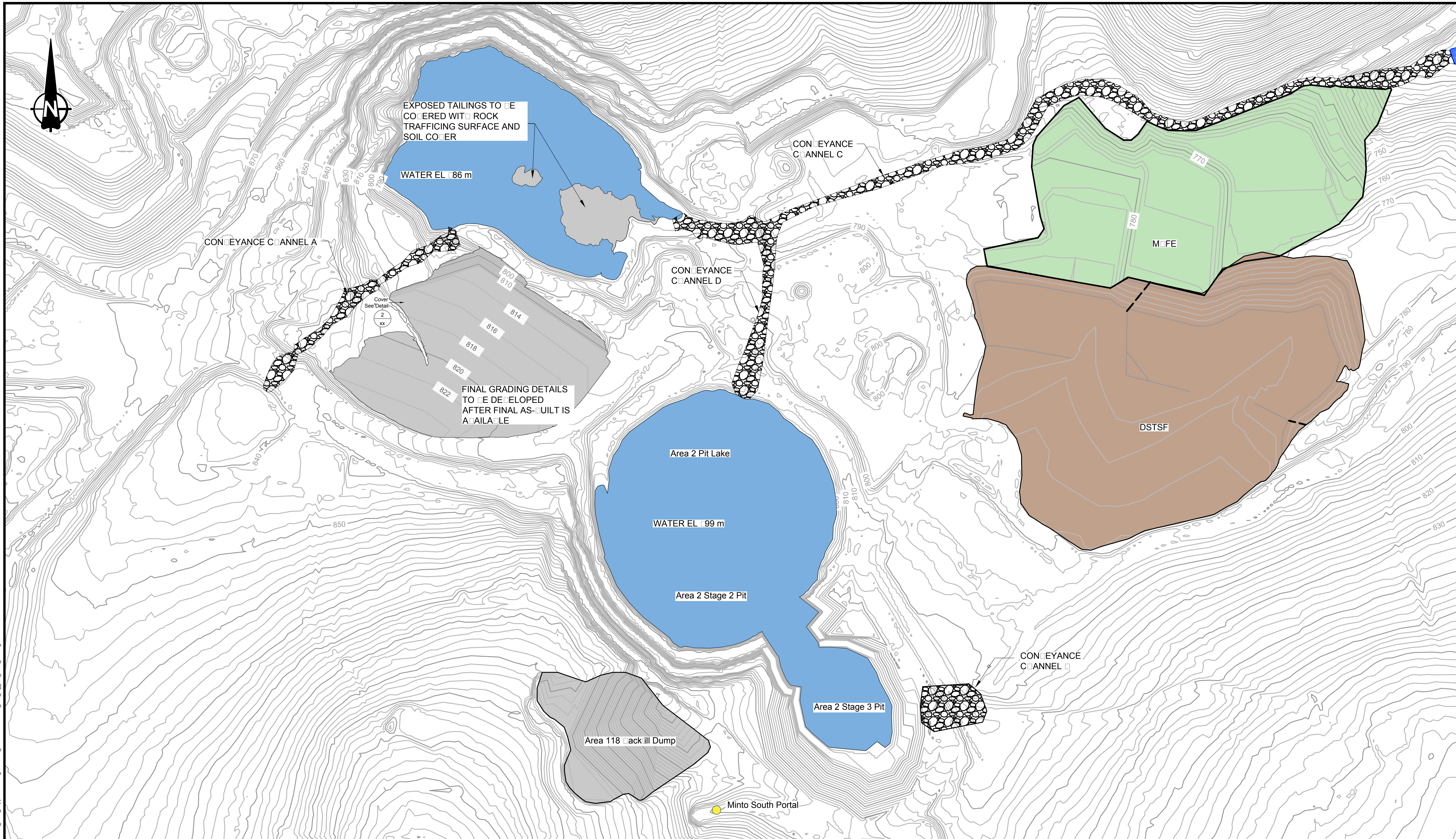
7.4 Tailings Facility Areas

Tailings management strategy for the project initially relied on filtered tailings placed in a dry stack facility until the first pit became available for slurry deposition. Tailings were therefore placed on the DSTSF until the end of October 2012, after which the tailings management strategy was changed to slurry deposition in the Main Pit and in the Area 2 Pit. Facilities layout is shown in Figure 7-3.

Two physical tailings laboratory programs have been previously completed to characterize the tailings performance as it relates to tailings deposition at the site (EBA 2007 and Klohn Crippen Berger 2013). The available test data included indicator properties (grain size distributions and Atterberg Limits), consolidation tests, settling tests, specific gravity, direct shear tests, and hydraulic conductivity tests.

Tailings density achieved in the DSTSF was about 1.8 to 2.2 tonnes/m^3, confirmed by sampling during a post-DSTSF construction subsurface investigation program conducted in 2013 (SRK 2014a). Slurry-deposited tailings density in the Main Pit was estimated to be 1.44 tonnes/m^3, based on bathymetry and tailings production data collected by Minto (Capstone 2015).

The tailings are typically a well graded sand and silt (59% sand, 35% silt and 6% clay) with a Specific Gravity of 2.72. The coefficient of consolidation for a change in effective stresses between 50 kPa and 100 kPa was estimated to be 5.6x10-6 m^2/s. The compression index of 0.1 (in log scale) indicates stiffness behavior typical of sands. An exhaustive summary of physical and mechanical properties of the tailings can be found in an SRK memo - SAT Dump on Tailings (SRK 2016b).



LEGEND

— — — Drainage Channel

NOTES

1. Contours provided by Client□May 2016.
2. Contours shown at a 2.0m interval.

0 40 80 120 160 200

Scale in Metres

srk consulting

capstone MINTO MINE

OPERATED BY MINTO EXPLORATIONS LTD.

Reclamation and Closure Plan

Plan View of Post-closure Arrangement of Main Pit, Area 2 Pit, DSTSF and MVFE Stage 2

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FILE NAME:	1CM002_044_Fig_□-1_Main_A2.dwg

MINTO MINE

DATE:	APPRO□ED:	FIGURE:
July 2016	IM	7-3

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7.4.1 Dry Stack Tailings Storage Facility

Placement of tailings on the DSTSF was completed between 2007 and 2012 and progressive reclamation activities (in the form of interim cover placement) were carried out. The maximum thickness of tailings is about 25 m. The north and east sides were constructed at an overall slope of approximately 2H:1V and clad with not potentially acid generating waste rock to an overall slope of approximately 4H:1V. This rock shell provides erosion protection to the stacked tailings.

Instability of the DSTSF was first observed in 2009. A detailed study of the causes of instability (SRK 2012) indicated that the area of movement appears to be limited to within or near the edges of the DSTSF itself. The movement was occurring at depth within the relatively deep permafrost soil foundation. The available data indicates that a deep shear zone acting as a sliding surface is relatively well defined at depths of 28 to 64 m below the original ground surface and approximately 7 m above the bedrock contact (SRK 2012). Monitoring of the movement will continue in the closure and post-closure periods as described in Section 7.12.

Clean run-off water from upstream of the DSTSF will be diverted by the Tailings Diversion Ditch (initially completed in 2008 and upgraded in 2014, with a future addition remaining to be constructed), conveyed to east into the High Flow Discharge Bypass Channel. The top surface of the DSTSF will be graded to shed run-off toward the north, south, and west, where secondary channels and swales will direct the water to the primary conveyance network (Conveyance Channel C and Channel E).

The low permeability and partially frozen nature of the compacted tailings results in little seepage being expected, and operational seepage monitoring results support this prediction. The low volumes of seepage that do occur mix with other seepage water before reporting to the operational sump. After sump decommissioning, seepage water will report to the closure water conveyance system at or upgradient of the Primary Head Pond (itself upstream of the Constructed Wetland Treatment System) where it will mix with the water from Conveyance Channel E and be directed to treatment in the wetlands or to the High Flow Bypass Channel, according to flow conditions. During bypass conditions, seepage flows will be a very small proportion of the overall total volume.

An interim overburden cover was completed on the DSTSF in 2014, with overburden thickness up to 5 m (SRK 2016a) consisting of zones of residuum, fine grained soils, and mixed residuum and fine-grained soils. However, this interim cover does not meet the cover design criteria (Section 3.2.4) in some areas. These areas will be amended with soil with appropriate fines content to support vegetation and limit infiltration. The surface will be revegetated using appropriate revegetation techniques (Appendix E3) as refined through the ongoing reclamation research program.

7.4.2 In-Pit Tailings Management Facilities

The tailings management system for the in-pit tailings disposal integrated disposal of slurry tailings within the Main Pit and the Area 2 Pit (Figure 7-3) on a schedule that benefited operations and the immediate mine water management needs. As a result, tailings volumes disposed of in each of the pits are approximate. Detailed descriptions of the in-pit tailings disposal operations were provided in Section 5 and the Tailings Management Plan (Minto 2014b).

Main Pit Tailings Management Facility

Tailings deposition into the Main Pit TMF resulted in the east portion of the tailings being beached, while the west portion remaining permanently submerged under the Main Pit lake.

An engineered spillway will be created at the east side of the facility, with an invert at elevation 786 masl, to connect the pit lake with Conveyance Channel C (Appendix G2 – closure conveyance design) and from there to Minto Creek via the post-closure water conveyance system. During low flow periods all flow will undergo passive treatment through the Constructed Wetland Treatment System to be constructed in the Water Storage Pond area, while during high flow a portion will report to the High Flow Bypass Channel (along with other site flows). Water quality will be monitored in the closure and post-closure period as part of the site-wide water monitoring program (Section 7.12).

The tailings lines and the water reclaim system (barge, pumps, reclaim lines) will be decommissioned and removed. Equipment will be salvaged or disposed of, as appropriate. HDPE pipe will be cut into manageable pieces and disposed of in the site landfill.

The area of tailings permanently submerged will not require any further closure activity. Exposed beach areas will be reclaimed with a cover system including a waste rock traffic layer and an isolation/vegetation supporting layer (Figure 7-4; Appendix E1).

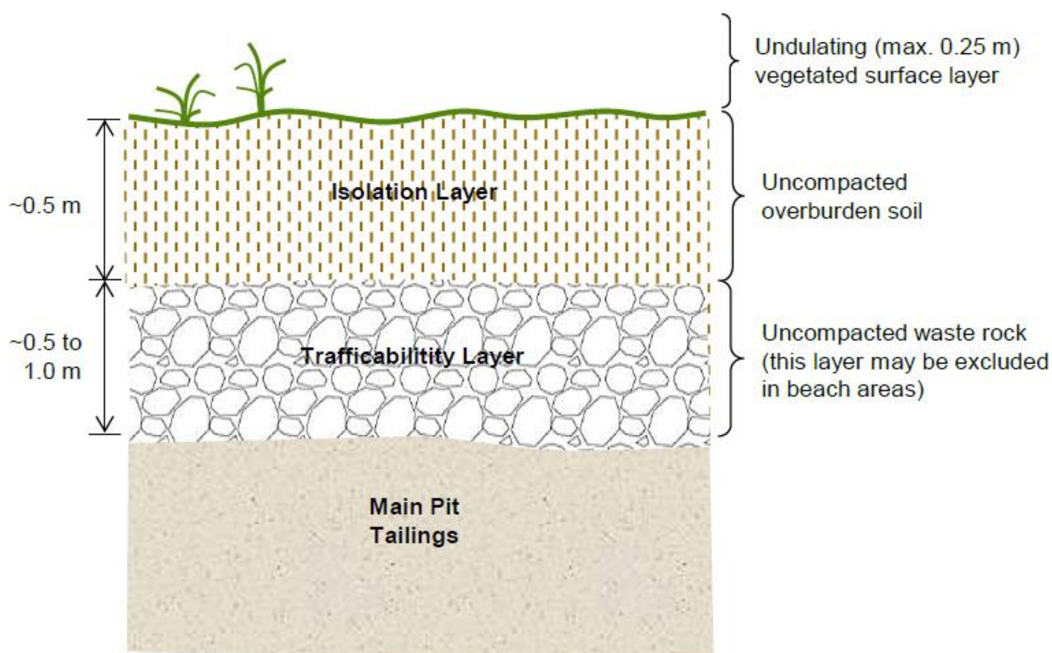


Figure 7-4: Conceptual Isolation Cover for Main Pit Tailings

Area 2 Pit Tailings Management Facility

Tailings were deposited in the Area 2 Pit in accordance with the Tailings Management Plan (Minto 2014). The Area 2 Stage 3 Pit was not yet mined at the time of this update (August 2016), however it is expected that some tailings will be deposited in this area once the Stage 3 pit has been mined out.

Tailings in this facility will be permanently flooded and will require no further reclamation activities. An engineered spillway with the invert elevation of 799 masl will be built to connect the pit lake to Conveyance Channel D (Appendix G2).

During low flow periods all flow will undergo passive treatment through the Constructed Wetland Treatment System to be constructed in the Water Storage Pond area, while during high flow a portion will report to the High Flow Bypass Channel (along with other site flows). Water quality will be monitored in the closure and post-closure period as part of the site-wide water monitoring program (Section 7.12).

7.5 Waste Rock and Overburden and Dumps

This section addresses the reclamation of the waste rock and overburden dumps at the site which include the following reclamation units:

- Main Waste Dump and Main Waste Dump Expansion;
- Southwest Waste Dump;
- Main Pit Dump;
- Mill Valley Fill Extension;
- Reclamation Overburden Dump;
- Ice-Rich Overburden Dump; and
- Area 118 Backfill Dump.

7.5.1 Main Waste Dump and Main Waste Dump Expansion

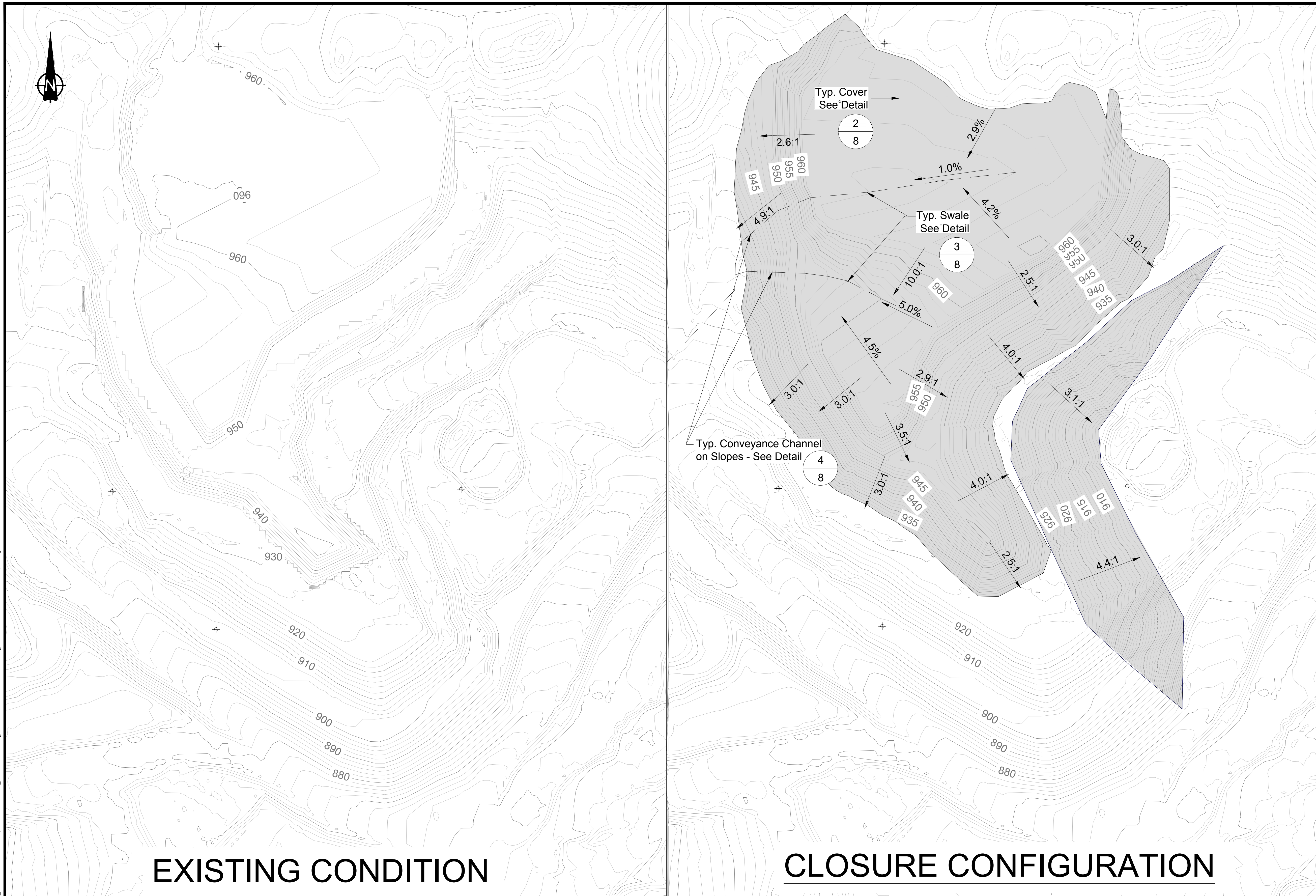
The Main Waste Dump (MWD) is located immediately northwest of the open pit as described in Section 5 (Figure 7-5). The dump was expanded uphill and to the northwest in 2015/2016 with waste materials excavated from the Minto North Pit- this latest construction forms the Main Waste Dump Expansion (MWDE). The design of the MWDE was developed with closure in mind, through incorporation of landform design concepts that grade the flatter top portion of the dump away from the crest and develop broad drainage paths that, when covered, will direct surface runoff to the ultimate water conveyance system while limiting the potential for erosion.

The MWD has been constructed according to EBA's Geotechnical Evaluation – Proposed Main Waste Dump, Minto Project, Yukon (EBA, 1998) which addresses physical stability design considerations, such as maximum credible earthquake criteria so the likelihood of major failure of the facility is deemed to be low. The stability of the expansion was analysed in a report completed in 2013 - Phase V/VI Main Pit Dump Physical Stability Assessment (SRK 2013d).

Annual inspections of the MWD have taken place and no physical stability issues have been identified to date.

Waste materials placed in the facility currently contain copper concentrations ranging from 0 to 0.64% since the majority of the MWD was constructed prior to the development of specific material handling plans based on the copper content which were employed in placement of the majority of waste rock stored in the SWD. Geochemical characterization of the materials, as part of licence requirements, has shown that the materials currently in the facility are not potentially acid generating (SRK 2010). Neutral pH metal leaching has been identified as being a potential chemical concern associated with closure of this facility based on operational monitoring for the mine (e.g. seepage monitoring results in Minto 2016b). Section 2.2.2 discusses reclamation that has been conducted on the south face of the Main Waste Dump as part of the ongoing Reclamation Research Program. Results from this program will assist in optimizing dump face reclamation strategies for site waste dumps. A trial reclamation plot was established on a slope of the MWD. Direct application of seed onto a trial plot on the first lift of the MWD already graded to final slope was attempted in fall 2008. The amount of fine material and acceptable nutrient levels allowed the establishment of a vegetative cover (80%) suggesting that direct seeding onto parts of the final dump will meet the final revegetation objectives for the facility. Further seeding of additionally reclaimed slopes in 2012 showed variable results, with significant growth and coverage observed on the sections that were applied with the highest fertilizer rates.

At closure, the slope of each lift will be reclaimed with standard techniques. A specific landform design for the MWD will be developed prior to final closure and the dump faces will be recontoured and/or regraded according to this plan. The entire dump will be capped with a 0.5 m thick isolation soil cover constructed from reclamation soil materials available on-site. A preliminary design of the cover was completed (Appendix E3) detailing the cover design criteria and performance expectations.



LEGEND

- – – – Drainage Channel
- Areas to be covered

NOTES

1. Contour data set provided by Minto in May 2016.
2. Contours shown at a 2.0m interval.

0m 40 80 120 160

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srk consulting

SRK JOB NO.: 1CM002.049

FILE NAME: 1CM002.049 – Main Waste Dump-2.dwg

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Reclamation and Closure Plan- 2016-01

Main Waste Dump Plan View of Closure Configuration

DATE:	APPROVED:	FIGURE:
JULY 2016	EPK	7-5

7.5.2 Southwest Waste Dump

The SWD is located to the south of the MWD (Figure 7-6). It was started in 2008 in order to optimize operations and provide additional storage areas for waste rock and non-ice-rich overburden material, in accordance with the Waste Management Plan (EBA, 2010a). Details of the design can be found in a report entitled Geotechnical Design, Proposed SWD (EBA, 2008a).

The SWD is estimated to contain a total of approximately 6.44 Mm3 of waste materials with copper content ranging from less than 0.1% to 0.5% from the Phase IV development. Geochemical characterization of the waste materials scheduled for placement in the SWD has shown that the materials do not present an acid rock drainage concern. Neutral pH metal leaching has been however identified as being a potential geochemical concern (SRK, 2010).

Waste rock placed in the SWD was segregated based on copper content and the high grade waste (HGW- 0.36 to 0.5% copper) was placed in the southern-most zone of the dump. The HGW was originally destined for a Grade Bin Disposal Area (GBDA) south of the Main Pit but due to the instability and south wall failure of the Main Pit it was necessary to place it in the SWD instead. Medium grade waste (MGW- 0.1 to 0.36% copper) was also placed in an area separate from the rest of the low grade waste (LGW- up to 0.1% copper) in the dump. Some of the original portions of the SWD constructed from Main Pit waste rock were overdumped as a result of the continued construction with Phase IV waste rock. The portions of the SWD that were built from Main Pit waste rock were constructed of bulk waste with copper content ranging from <0.01% up to 0.64% copper. The proposed closure covers will help reduce the potential metal loadings from the SWD materials. The SWD was constructed in progressive lifts and ongoing geotechnical monitoring conducted throughout the construction period indicate slow foundation movement (average of 0.5 mm/day in 2016) observed in east direction. This movement however was not deemed as being a safety hazard and no remediation is proposed at this time. Monitoring of the movement will continue in the closure and post-closure period.

Significant regrading and recontouring work was completed on the SWD starting in 2014, based on a collaborative and interactive design-build workflow between Minto and SRK engineers and implemented using the mining contractor’s equipment and staff. Most of the SWD will be covered with a 0.5 m thick single layer soil cover constructed of locally available soils sourced from mining of Area 2 Stage 3 Pit or from overburden stockpiles. The exception is the HGW area which will be covered with a very low infiltration cover system incorporating a geosynthetic membrane. Details regarding the design and installation of the cover system will be refined leading up to its placement. As mentioned in Section 2.1 additional options will be considered for the HGW area and will potentially be incorporated into future plans. Both cover types will be revegetated using appropriate revegetation techniques refined through the ongoing reclamation research program.

LEGEND

- Drainage Channel
- Areas to be covered

NOTES

1. Contours data set provided by Minto in May 2016.
2. Contours shown at a 2.0m interval.

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Reclamation and Closure Plan- 2016-01

Plan View of Southwest Waste Dump

SRK JOB NO.: 1CM002.049	Minto Explorations Ltd.	DATE: July 2016	APPROVED: EPK	FIGURE: 7-6
FILE NAME: 1CM002.049-SW-WRD-2.dwg				

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7.5.3 Main Pit Dump and South Wall Buttress

The South Wall Buttress construction started in June 2011 and was essentially complete by November 2013. The purpose of the buttress was to contain the slide debris and stabilize the South Wall against further instability. The Main Pit Dump is an upwards expansion of the South Wall Buttress, and it will be built wholly within the Main Pit footprint.

The Main Pit Dump has been designed for closure, with intermediate bench slopes of 2.5H:1V and overall slope of approximately 3H:1V. At closure, the dump will therefore not require substantial regrading. The dump has also been designed to accommodate closure conveyance channel A (Figure 7-3). The haul road ramp on the dump will accommodate haul trucks during operations (primarily for progressive reclamation activities.)

The Main Pit Dump will be covered with a 0.5 m thick single layer soil cover constructed from reclamation soil materials from the Reclamation Overburden Dump or other local sources, and revegetated using appropriate revegetation techniques refined through the ongoing reclamation research program.

7.5.3.1 ***SAT Dump***

The SAT dump is located in the southwest corner of the Main Pit and was designed to receive the SAT waste rock (NP:AP <3) from mining of Minto North Pit- construction began in Q1 2016 and remains in progress. The storage of this type of waste in an environment that is eventually saturated is a condition of the WUL. The concept was to dump the SAT waste as a single lift (about 16 m thick) in the southwest corner of the Main Pit, on top of the existing tailings and lapping onto the existing in-pit dump. A detailed stability assessment was completed, confirming the feasibility of this concept (SRK 2016b). The crest of this dump will have a target elevation of 786 masl, which coincides with the spill elevation of the Main Pit lake. To comply with the requirement for saturated deposition some of the SAT waste may have to be relocated. As mentioned in Section 2.1 additional closure options for this facility may be considered for future iterations of this plan.

Other than for safety reasons during construction, failure of the SAT dump foundation or slopes is not a concern, it being entirely below the water level of the Main Pit lake. No additional reclamation activities are required for this dump.

7.5.4 Mill Valley Fill Extension

The Mill Valley Fill is located east of the Main Pit and north of the DSTSF, with its extension occupying the Minto Creek valley downstream further to the east, as described in Section 5 (Figure 7-3). The MVFE was constructed in two stages, for the purpose of buttressing the DSTSF. Monitoring of the DSTSF had shown rates of movement slowing down since the Mill Valley Fill Extension Stage 1 but the movement had not ceased completely, and in 2013 additional investigations and engineering design was undertaken to support the design of an additional stage of buttress construction. The Mill Valley Fill Extension Stage 2 (MVFES2) added more rockfill to the existing buttress both vertically and to the east, and is expected to improve the long-term stability of the DSTSF. Construction of the bulk material placement of the MVFES2 was completed in July 2016 and grading of the final surface has begun.

The top surface of each tier will be graded in roughly a north-south direction to create roughly a 2% grade toward the north (towards Conveyance Channel E). An access road will be built into the final surface of the MVFE Stage 2 to allow for site access post-closure.

Stability monitoring of this dump is ongoing and results reported in the Annual Reports. Monitoring will continue in the closure and post-closure stages (Section 7.12), until a risk assessment or some other approach determines that monitoring is no longer required.

The entire surface of the MVFE will be covered with a 0.5 m thick single layer soil cover. Surface runoff will be directed primarily to the west and north and will report in Conveyance Channel E.

The surface of the soil cover will be revegetated using appropriate revegetation techniques refined through the ongoing reclamation research program.

7.5.5 Reclamation Overburden Dump

The reclamation overburden dump (ROD) is located to the west of the MWD and north of the SWD. The ROD is not expected to be expanded during the Phase V/VI Expansion activities. The existing portions of the ROD have been constructed in accordance with EBA's Geotechnical Design, Proposed Reclamation Overburden Dump, Minto Mine, Yukon (EBA 2008a), and subsequent revisions.

The overburden materials stockpiled in the ROD will be used as a source for growth media during reclamation of other facilities at the site. Any overburden remaining in the ROD after closure and reclamation has been completed will be resloped to minimize erosion and revegetated using appropriate revegetation techniques refined through the ongoing reclamation research program.

7.5.6 Ice-Rich Overburden Dump

The ice-rich overburden dump (IROD) is located south of the ROD and has been constructed immediately upgradient of the SWD. A toe berm has been constructed from waste rock to retain the ice-rich overburden and prevent migration of the material downslope as ice in the stockpiled materials melts. The IROD has been constructed according to EBA's Geotechnical Design, Ice-Rich Overburden Dump, Minto Mine, Minto YT (EBA 2006) and has been inspected since as per the Quartz Mining Licence with no stability issues identified to date. The IROD has received no new frozen material since 2011. Given the period since frozen material was last placed and the physical performance to date, physical stability of the IROD is not a significant closure concern.

Materials from the IROD may be used as a source for growth media during reclamation of the SWD. Reclamation of the IROD will involve the placement of a nominal 0.25 m layer of overburden on the toe berm to support vegetation, as this facility is not deemed to require source control.

Any overburden remaining in the dump after closure and reclamation has been completed will be resloped to minimize erosion and revegetated using appropriate revegetation techniques refined through the ongoing reclamation research program.

7.5.7 Area 118 Backfill Dump

Construction of the Area 118 Backfill Dump will be constructed by backfilling of Area 118 Pit with overburden during mining of Area 2 Stage 3 Pit beginning in early 2017 (Figure 7-3). A mix of thaw stable and ice rich overburden will be dumped below the pit rim while only thaw stable overburden will be dumped above the pit rim.

The Area 118 Backfill Dump may be used as a source for overburden for cover materials during reclamation if needed. Reclamation of the Area 118 Backfill Dump itself after completion of any closure borrow activities will include grading of the remaining overburden to leave final slopes flatter than 3H:1V, followed by revegetation using appropriate revegetation techniques refined through the ongoing reclamation research program.

7.6 Ore Stockpiles and Pads

The Phase V/VI mine plan includes the milling of all stockpiled ore prior to final closure. The following stockpiles at the site (Figure 5-2) will be treated in this fashion and therefore are not deemed to be an issue at closure:

- High and medium grade sulphide ore stockpiles and pads (located south of the mill); and
- Low grade sulphide ore stockpile and partially-oxidized ore pad (located between the Main Pit and the MWD).

Both the high and low-grade sulphide stockpile pads were constructed from waste rock according to design criteria set out in EBA’s Waste Rock Stability Evaluation, Minto Project, Yukon (EBA 1996). The ore stockpiles have been inspected annually and there are no issues identified to date that suggest long-term stability concerns for these units.

Reclamation of the stockpile pads will be conducted after removal and milling of all stockpiled ore materials. Geochemical characterization will be conducted to determine the need for removal of stockpile base materials to limit long term metal leaching. If indicated by the geochemical characterization results, material will be removed and disposed of in pits or in waste dumps prior to cover placement. The remaining footprint would be graded as required to fit in to the closure surface water management system. Revegetation of the remaining footprint will be carried out through placement of appropriate overburden material as growth medium and seeding or direct planting as per similar reclamation land units on site.

For costing purposes, we have assumed that the following reclamation activities will be done in areas of existing and former ore stockpiles:

- Relocation of all existing ore inventory to the in-pit tailings management facilities;
- Characterization of stockpile base material through test pitting and laboratory analyses;
- Assume removal of 0.5 m of material from the entire footprint, and disposal of this material in the Main Pit as a traffic surface on subaerial tailings prior to cover placement;
- Grading of stockpile area footprints to achieve surface water management objectives;
- Placement of 0.5m of overburden material to support revegetation;
- Revegetate using the same techniques as used for other reclaimed areas of the site.

7.7 Water Management Structures and Systems

7.7.1 Closure Water Management Concept

The closure water management concept is based on developing a post-closure closure conveyance network that routes water from the mine site to lower Minto Creek (Figure 7-7) for the range of possible flow conditions, with passive wetland water treatment for flows below a volume limit of 3,000 m^3/day.

In addition to the conveyance system, three reservoirs will be present into active closure and post closure periods. Two of the reservoirs, the Main Pit Lake and the Area 2 Pit Lake will remain in perpetuity while the third one, the Water Storage Pond, will be decommissioned and the dam deconstructed in the post-closure period.

The following points summarize the planned sequence of management activities beginning with the end of the operational period and extending to Post-Closure II.

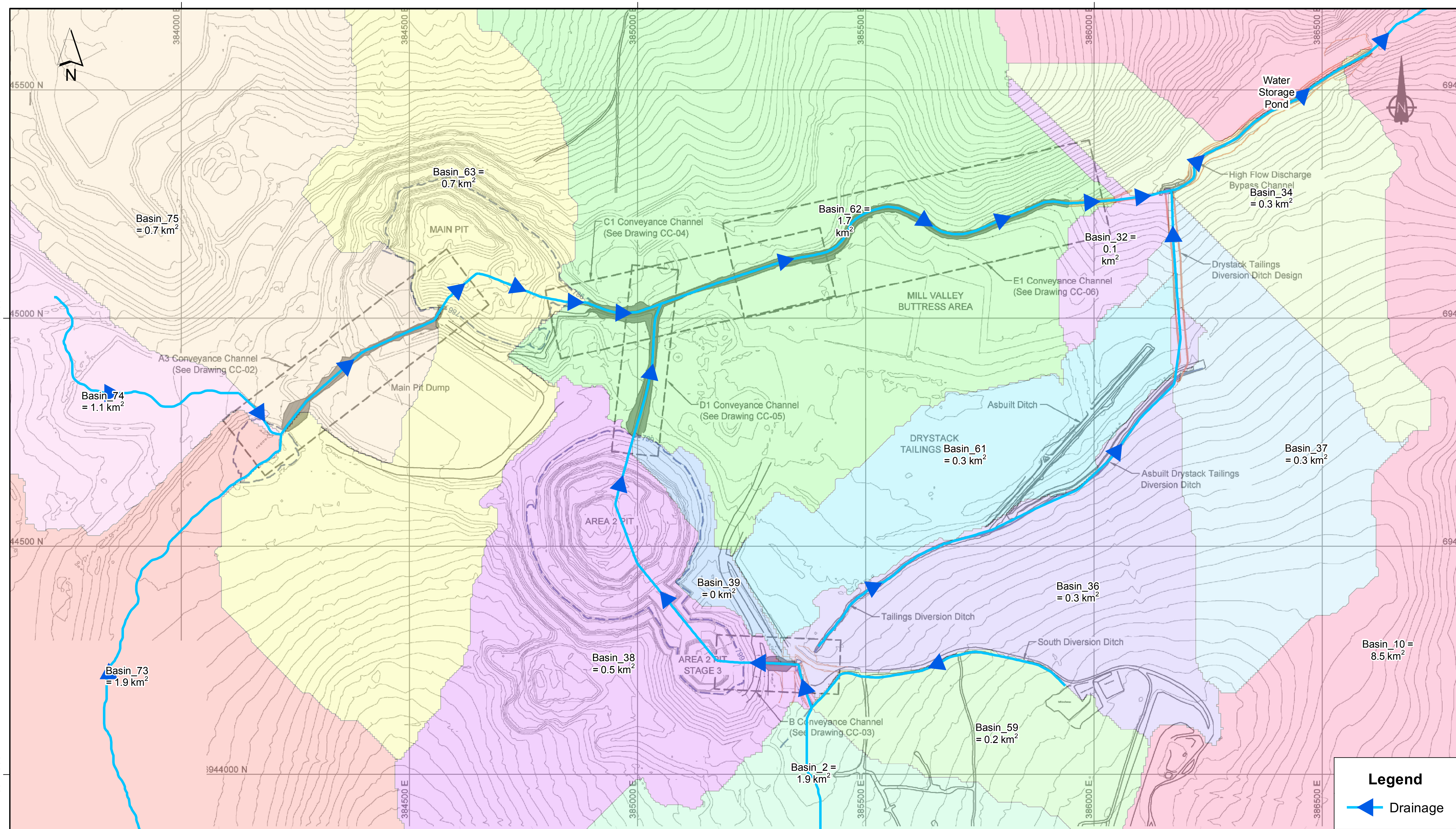
- Active Closure (Closure years 1 through 3): construction of closure conveyance network and wetland treatment systems, and filling of open pits as water reservoirs. The Water Storage Dam will be lowered, with excavated materials used in construction of the Minto Creek Constructed Wetland Treatment System (CWTS). A reservoir will be retained behind the lowered Water Storage Dam for control of water during commissioning of the CWTS. Operational Water Quality Objectives and Effluent Standards will apply and active water treatment capability will be retained and is expected to be the primary source of discharge.
- Post-Closure I (Closure years 4 through 8): According to water balance active water management during a period of commissioning of the water conveyance network and the CWTS. The CWTS will treat typical summer flows (up to 3,000 m^3/day) with discharge of the CWTS effluent monitored and managed by pumping, either as pumped discharge if effluent standards are met or as pumped water return to the inlet to the wetland or to water storage in pits if effluent standards are not met. High flows in excess of 3,000 m^3/day will report to a High Flow Bypass Channel that reports to lower Minto Creek below the lowered Water Storage Dam. Operational Water Quality

Objectives and Effluent Standards will apply during the Post-Closure I commissioning period, and active water treatment capability will be retained and is expected to be available for use as required to manage on-site water inventory. Transition to Post-Closure II will occur when commissioning monitoring shows that the conveyance system and the CWTS are performing as expected.

It should be noted that the estimated schedule for filling the Area 2 Pit Lake does not define the end of the Post-Closure I. The water and load balance model for developed for the RCP indicated that the Area 2 Pit Lake would reach its overflow level by 2025, or around closure year 7, assuming that water from W35a and outflow from the Main Pit Lake would be routed to the Area 2 Pit. If the water quality and water balance reviews during Active Closure or Post-Closure I determines that it is prudent or useful to delay the filling of the Area 2 Pit then diversions (or treatment) and discharge of water that meet water quality licence limits will be considered.

- Post-Closure II (Closure years 9 through 18): passive water management with verification monitoring of the water conveyance network and the CWTS. Post-closure Water Quality Objectives and Effluent Standards will apply during the Post-Closure II verification monitoring period, and active water treatment capability will be retained as a contingency for use as required to manage on-site water inventory.

  The Area 2 and Main Pit Lake water levels are both expected to have reach the spillway invert levels around the time of transition from Post-Closure I to Post-Closure II. In Post-Closure II, water from the two reservoirs will be allowed to flow freely via the water conveyance network.



250 125 0 250 Meters

1:8,000

Notes:
1. Data presented in NAD 1983 UTM Zone 8N.
2. Contours in 1 m intervals.

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Minto Mine Reclamation and Closure Plan 2016-01

Water Management Catchments and Layouts

Job No: 1CM002.042

Filename: 1CM002.042_Fig_7-7_PostClosure_WaterManagement.mxd

Minto Explorations Ltd.

Date: August 2016 | Approved: VM | Figure: 7-7

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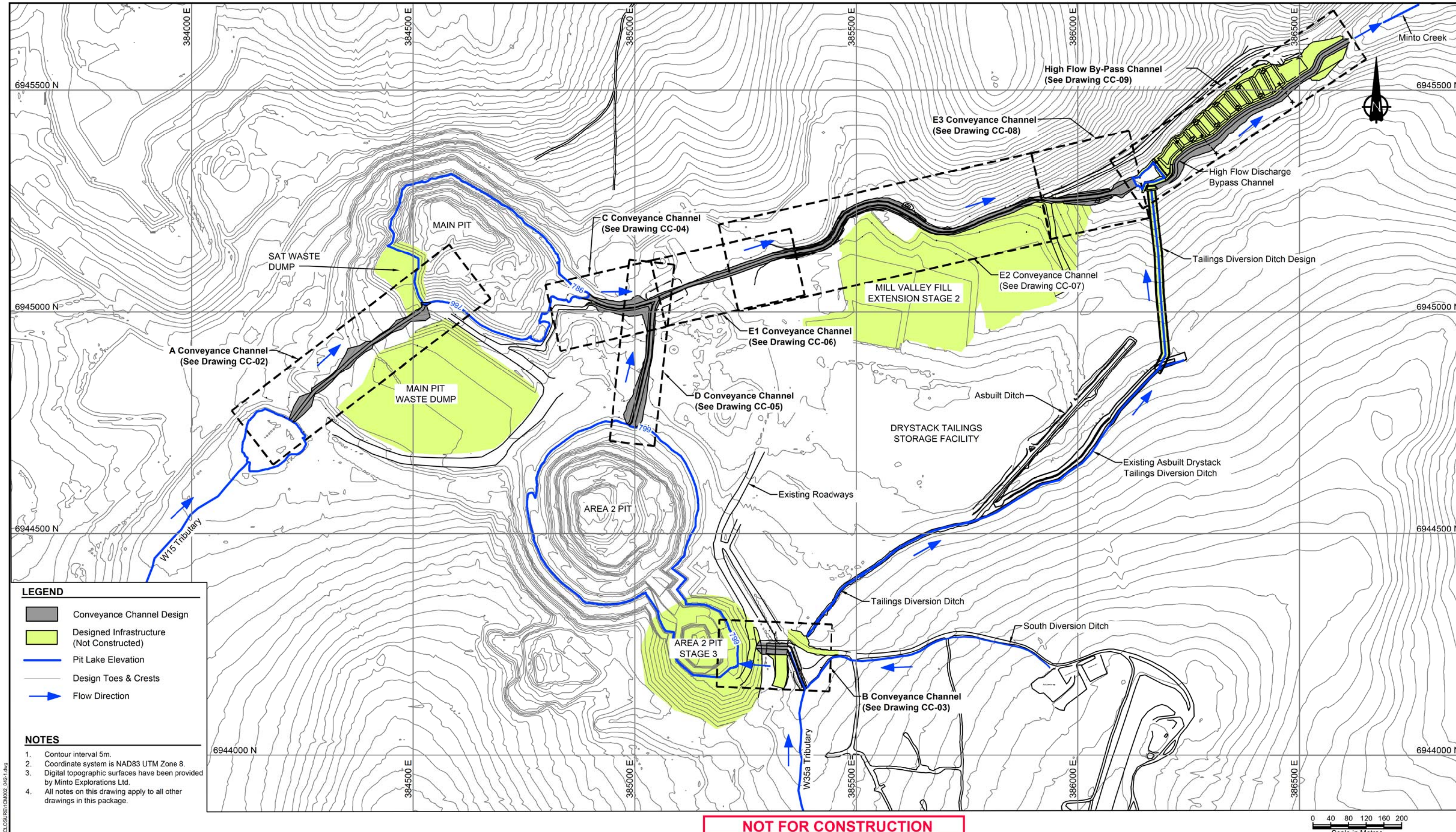
7.7.2 Water Conveyance Channels

The general arrangement of the network of primary closure conveyance channels and respective watersheds are shown on Figure 7-8. The network comprises the following:

- Conveyance Channel A: located Southwest of the Main Pit, between the Main Pit Waste Dump and the SWD. This channel conveys surface water from the W15 tributary over the Main Pit Waste Dump to the Main Pit.
- Conveyance Channel B: located East of the Area 2 Stage 3 Pit (A2S3). This channel collects flow from the South Diversion Ditch and surface water that reports to the W35A tributary and conveys the flow to the A2S3 pit.
- Conveyance Channel C: begins at the discharge of the Main Pit. Channel C conveys the discharge from the Main Pit, and is combined with flow from Channel D, to the confluence with Channel E1.
- Conveyance Channel D: begins ate the spill point of Area 2 Pit and conveys the discharge water to the confluence with Channel C.
- Conveyance Channel E: commences at the confluence between channel C and D and is essentially a realignment of the former Minto Creek; it consists of three sequential channels: E1, E2, and E3 (from upstream to downstream). Channel E ultimately conveys water from the Main Pit and the Area 2 Pit to the Constructed Wetland Treatment System in the current Water Storage Pond area.
- High Flow Bypass Channel: commences at the north end of the Tailings Diversion Ditch and runs east-northeast along the south side of the Minto Creek valley, through the footprint of the Water Storage Dam, and discharges to lower Minto Creek. During high flow events, it will receive bypass water from Conveyance Channel E to the extent that flows exceed the inlet controls for the Constructed Wetland Treatment System.
- South Diversion Ditch (SDD): running along the south side of the Airport Access Road this channel was constructed to divert surface runoff from the areas south of the mine disturbance and safely convey it around the Area 2 Pit. At closure it will be redirected into the Area 2 Pit.
- Tailings Diversion Ditch (TDD): was constructed in 2008 and upgraded in 2014 to divert surface water south of the DSTSF to a wooded area east of the facility (SRK 2014b). A further extension has been designed to convey water from the end of the current ditch down to the High Flow Bypass Channel and subsequently to lower Minto Creek, and it will be constructed during Active Closure.



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CHECKED: SM	APPROVED: DM	DATE: July 2016
FILE NAME: 1CM002_042-1.dwg		

MINTO EXPLORATIONS Ltd.

SRK JOB NO.: 1CM002.042

Reclamation and Closure Plan- 2016-01

DRAWING TITLE:
Post-closure Primary Water Conveyance System

Figure 7-8

7.7.3 Water Reservoirs

Three water reservoirs will exist on site at closure: the Main Pit Lake, the Area 2 Pit Lake, and the Water Storage Pond. The two pit lakes will remain in perpetuity and will act as flow-through systems, providing sediment settling and retention capacity. During Active Closure and Post-Closure I, water flowing from the Min Pit Lake will be pumped to the Area 2 Pit Lake or conveyed to the CWTS via channel C and E. No further closure activities are anticipated in relations to these reservoirs.

The location of the Water Storage Pond relative to other site developments is shown in Figure 5-2. The dam on Minto Creek provides water retention for site-wide contact water and is considered to be the furthest downstream point for discharge control at the site. During Active Closure, the dam will be lowered to allow construction of the Constructed Wetland Treatment System and the High Flow Bypass Channel, but will continue to store a limited volume of water to facilitate the Post-Closure I water management strategy described in Section 7.7.1. At the end of Post-Closure I, the dam will be fully decommissioned. Physical stability of the Water Storage Dam will be ensured during post closure by regular geotechnical inspections until such time as the dam is declassified.

7.7.4 Closure of Water Retention and Conveyance Structures

The water detention structures are limited to the two former pits, i.e. MPTMF and A2PTMF. As such, no additional closure activities are required in relation to the closure of these facilities. The conveyance channels were designed with robustness and low maintenance in mind, so it is expected they will function as intended into the post-closure period. Regular inspection after construction and throughout the closure period will be completed, with maintenance completed on an as-needed basis following the recommendations of the qualified inspector. Once stable conditions were achieved, time between inspections will be gradually extended and eventually inspections will be suspended.

7.7.5 Wetland Treatment Systems

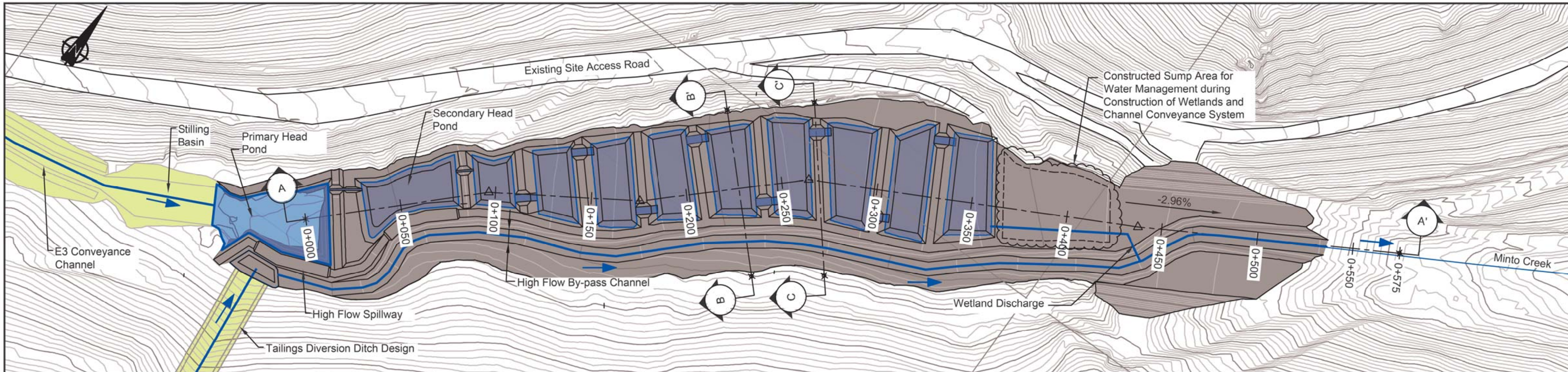
7.7.5.1 *Minto Creek Constructed Wetland Treatment System*

Passive water treatment is planned for post-closure at the Minto Mine, with a focus on the constituents of cadmium (Cd), copper (Cu), and selenium (Se). Minto has commissioned the development of a constructed wetland treatment system (CWTS), which is being designed through a phased approach.

The Preliminary Design Report for Treatment Wetlands (Appendix G1) outlines the basis for the technology selection and conceptual design, and presents preliminary design of the CWTS based on findings from information gathering, site assessment, off-site pilot-scale, and on-site demonstration-scale phases.

The design report (Appendix G1) specifically considers water treatment by a CWTS within the footprint of the water storage pond. The preliminary design of the CWTS described in the design report is a surface flow wetland, designed to maintain anaerobic conditions in the sediment to sequester cadmium and copper in sulphide mineral form, and selenium in a low bioavailable elemental form. The phased plan for site-specific design and optimization has demonstrated that these elements can be successfully and sustainably treated using this apporach at the Minto Mine. Rigorous monitoring and adjustments to the operation of the CWTS is expected during an initial commissioning period. Requirement for monitoring and maintenance are expected to diminish as the CWTS matures through early- and long-term operation.

Figure 7-9 shows the treatment wetland configuration and preliminary design. Further information on the engineering design for the treatment wetland can be found in Appendix G1.



CONSTRUCTED WETLANDS PLAN VIEW

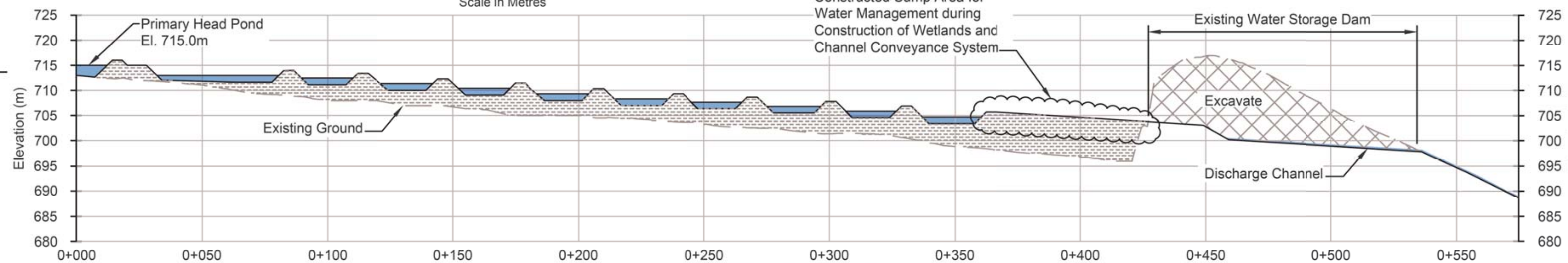
0 20 40 60 80 100
Scale in Metres

LEGEND

- Wetland Foundation Fill Material
- Rip Rap
- Constructed Wetlands Design
- Designed Infrastructure (Not Constructed)
- Geomembrane
- Flow Direction

NOTES

1. During the decommissioning of the dam the segregated materials are repurposed in the construction of the wetland system
2. Road access within WSP footprint will be required for construction.
3. Material stockpiles, load and haul routes within the wetland area should be constructed as dam decommissioning advances.
4. Decommissioning of the WSP dam will include the construction of the High Flow By-pass Channel that will convey flow around the wetlands as per SRK Closure Conveyance Channel Design 2016.
5. Supporting features: E3 Stilling Basin, Energy dissipation pond, and the High Flow By-pass Channel are designed by SRK in the Closure Conveyance Design Report 2016.
6. Notes on this drawing apply to all other drawings within this drawing package unless otherwise advised.



A SECTION A - A'

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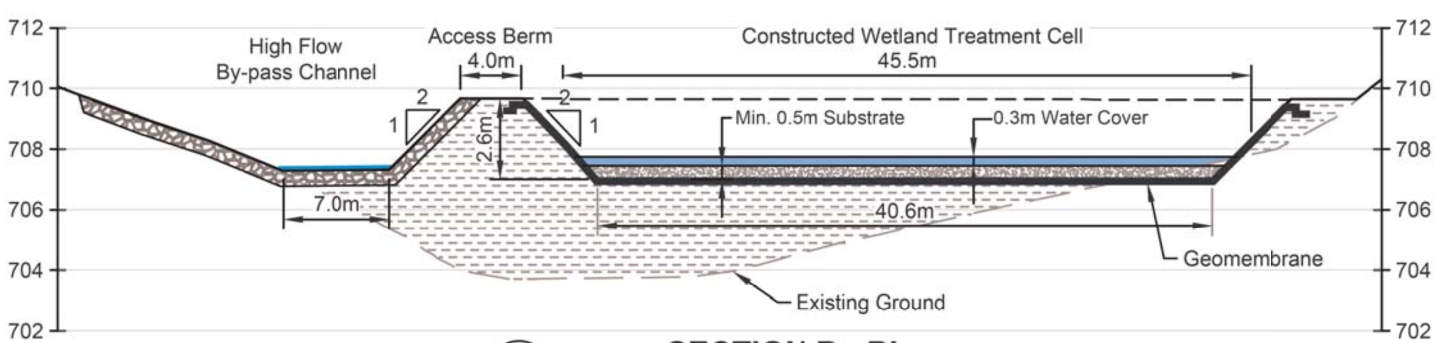
Horizontal Scale in Metres
Vertical Exaggeration 2X



B SECTION B - B'

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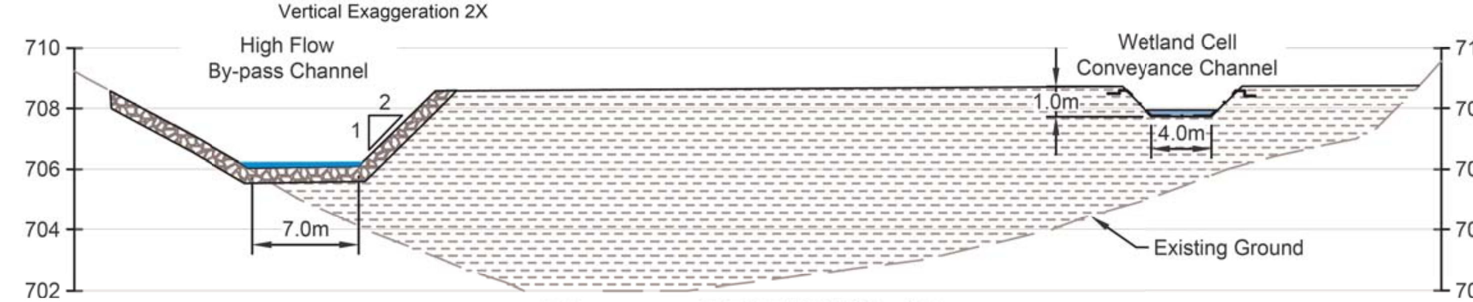
Horizontal Scale in Metres
Vertical Exaggeration 2X



C SECTION C - C'

0 5 10 15 20 25
Horizontal Scale in Metres
Vertical Exaggeration 2X

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srk consulting	capstone MINTO MINE	Reclamation and Closure Plan-2016-01
DESIGN: SM / DRAWN: NV / REVIEWED: SM		DRAWING TITLE: Minto Creek Constructed Wetland Configuration
CHECKED: SM / APPROVED: DM / DATE: July 2016	MINTO EXPLORATIONS Ltd.	
FILE NAME: 1CM002_044—Wetland—1.dwg	SRK JOB NO.: 1CM002.042	Figure 7-9

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7.7.5.2 *Southwest Terraced Wetland*

As noted in Section 2.2 (Reclamation Research), planning and baseline characterization for a full-scale trial of a terraced wetland system in the area downgradient of the SWD and upgradient of routine monitoring station W15 is underway, with construction tentatively planned for the 2017 construction season. Following construction, monitoring will be carried out to allow evaluation of the performance of the terraced wetland treatment system relative to baseline conditions. At the conclusion of the trial period, the monitoring program will be reduced to a confirmation frequency and the terraced wetland system will remain as a long term component of the reclaimed site.

7.8 Mine Infrastructure and Equipment

This section addresses the decommissioning and closure measures for miscellaneous mine support facilities and sites around the property. These facilities include:

- Mine camp and related infrastructure;
- Mill building and related infrastructure;
- Fuel Farm area;
- Sewage treatment plant;
- Water treatment plant;
- Exploration sites and trails;
- Land treatment facility;
- Solid waste facility;
- Explosives plant site; and
- Mobile equipment.

Environmental concerns for these areas will arise primarily from contamination of surrounding soils by fuel, chemicals or other wastes. Such occurrences will be documented through an environmental audit, conducted upon the completion of milling activities. Any contaminated soils identified will be remediated on site at the site's approved land treatment facility, and any recyclables and/or special wastes will be removed from the solid waste facility. Decommissioning plans will be submitted to YG Environment prior to the final decommissioning of the land treatment facility and the solid waste facility.

A salvage program has been implemented onsite to reduce the volume of scrap that will require disposal in the on-site landfill. The salvage program will continue until the mine end of mine life.

Buried services such as piping and wiring will remain buried. Concrete footings will be broken down to slightly below grade, where required, and covered with fill. Recontouring of areas will also be conducted as required in order to establish final drainage runoff patterns and blending the area in with the natural topography as much as possible. Culverts will be removed and natural drainage will be restored where appropriate. Pertinent areas will be covered in a nominal 0.25 metres of overburden as growth media prior to application of seed and fertilizer.

All equipment, furnishings, materials, and residual supplies will be divided into three categories to be treated as follows:

- Salvage: reusable items that retain a value equal to or higher than the cost of decommissioning and delivery to the point of sale;
- Recycle: items that can be disposed of at recycling depos at no costs related to the disposal, but hauling costs must be borne by Minto; and
- Landfill: non-hazardous waste items that require a tipping fee for disposal and it is more practical to dispose of in the on-site landfill;

All controlled substances and hazardous waste are excluded from these categories and will be disposed of in licensed facilities as appropriate (Section 7.9). An overview of the Mill and Camp area are shown in Figure 7-10 below.

7.8.1 Mine Camp and Related Infrastructure

Closure measures for the camp include disassembly of the camp trailers and related infrastructure. All materials will be salvaged, recycled, or landfilled, as appropriate. The remaining campsite landing will be scarified and recontoured, as required, to establish drainage patterns and then covered with a nominal 0.25 m of growth media (if required, pending outcome of revegetation studies) and revegetated. Seed mixtures and fertilization specifications will be based on both revegetation trials and natural revegetation observations and success.

7.8.2 Mill Building and Related Infrastructure

The Mill Complex is located east of the Main Pit and is comprised of several buildings and facilities, including:

- Mill Building;
- Process Building;
- Filter Plant building;
- Concentrate storage shed;
- Crusher and crusher conveyor;
- Mill warehouse;
- Assay lab;
- Mechanics shop; and
- Electricians shop;

Each of these facilities and buildings will be decommissioned and any hazardous waste removed and handled as described in Section 7.9. Equipment will be removed and separated for salvage, recycling, or landfilling. The buildings and structures will be demolished with the resulting scrap steel being recycled or landfilled (depending on market conditions) while the other non-hazardous demolition debris being placed into the on-site landfill. Concrete foundations will be demolished to just below ground level while concrete pads will be broken up to allow water infiltration but otherwise will be left in place. Any sumps or below-grade voids will be backfilled with waste rock or other suitable fill. The footprint of each building will be covered with suitable fill or overburden soils and revegetated as part of the larger disturbed area.

7.8.3 Fuel Farm Area

The fuel farm area was constructed on a bench above the mill complex. The tanks will be decommissioned, drained of any residual fuel and removed from site for salvage or recycling, as appropriate. The liner will be pressure washed, and then cut into manageable pieces and disposed of in the permitted landfill area. A field sampling program will be conducted to determine if any residual fuel contamination areas and estimate the extent of contamination. Affected soils will be excavated and taken to the Land Treatment Facility for treatment. The area will be regraded to conform to the original topography as much as possible and limit permanent ponding and then it will be revegetated.

7.8.4 Sewage Treatment Plant

The Sewage Treatment Plant will be decommissioned, and the treatment tanks and piping will be flushed with clean water to remove residual treatment sludge. The residual sludge and treated effluent will be disposed of in the Main Pit. The plant will be disassembled and removed from site for salvage.

7.8.5 Water Treatment Plant

The Water Treatment Plant is an integral part of the environmental compliance system with respect to water quality. It will remain operational throughout the Active Closure and Post-Closure I periods, until it is demonstrated that water quality objectives can be generally achieved without the need for active water treatment.

The Water Treatment Plant will eventually be decommissioned, the modules disconnected, and removed from site for salvage or recycling. The WTP building will be demolished- if the permitted site landfill is capped and reclaimed at that time, the resulting demolition debris will be shipped off-site for disposal into a permitted landfill.

7.8.6 Exploration Sites and Trails

Current exploration activities being conducted on the site operate under a Class III Mining Land Use Authorization are subject to specific closure measures as identified in the Class III Authorization. These measures will be implemented as required by the exploration crew, and are not subject to this plan.

7.8.7 Land Treatment Facility

Minto currently has two permitted land treatment facilities, the first is located near the airstrip in an area originally excavated on bedrock for an equipment laydown area. This facility is permitted by YG, Department of Environment, Environmental Programs Branch under Permit #24-204 to treat a maximum volume of 700 m³ of hydrocarbon contaminated soil. Contaminated soils from fuel/oil spills during operations will be treated in this facility to appropriate levels of remediation before being used as industrial fill as per permit requirements. This facility is currently slated for decommissioning in late 2016.

The second LTF was constructed in 2014 near the landfill area and was built using a cut/fill technique and is lined with a plastic geosynthetic liner. This facility is permitted by YG, Department of Environment, Environmental Programs Brach under Permit #24-041 to treat a maximum volume of approximately 1,800 m^3 of hydrocarbon contaminated soil. Contaminated soils from fuel/oil spills during operation s will be treated in this facility to appropriate levels of remediation before being used as industrial fill as per permit requirements.

The closure of both of these facilities is subject to the submission of a formal Decommissioning Plan to YG, along with sampling results which demonstrate the final concentrations of contaminants in the soil being treated. As mentioned previously LTF #24-204 is scheduled for decommissioning in late 2016.

LTF #24-041 is expected that upon final closure of the entire site, dismantling and decommissioning activities may reveal or result in soil contamination requiring the relocation of contaminated soil to the LTF and an undetermined number of months of treatment to achieve desired remediation levels. As such, the LTF Decommission Plan and final sampling results will be prepared and submitted in due time after final closure of the mine site has begun. Generally, once the desired contaminant levels have been reached in the final volumes of treated soil, and the Decommission Plan has been approved by YG, the soils will be spread at approved locations at the site and revegetated. If required, additional overburden may be hauled and be used as cover material and growth media for revegetation. The liner will be cleaned by pressure washing, cut into manageable pieces, and disposed of in the on-site landfill (if still operational) or shipped off-site for disposal in a permitted landfill. The LTF footprint will be regraded and the area will be revegetated using appropriate revegetation techniques refined through the ongoing reclamation research program.

7.8.8 Solid Waste Facility

Under Commercial Dump Permit # 81-005, issued to Minto Explorations Ltd. by YG, Department of Environment, Environmental Programs Branch, Minto has established a Solid Waste Facility near the airstrip that includes:

- A burning pit for wood and paper waste;
- Construction waste disposal area (landfill);
- Special Waste storage;
- Metal and rubber tire disposal areas; and

- Incinerator for camp waste.

The solid waste facility will receive construction debris and operational waste throughout the operation of the mine, as permitted. At closure the area will be covered by fill and compacted in 'lifts' as per common landfill practice.

Following site closure the equipment and materials that have no scrap value will be disposed of in the solid waste facility. Rubber tires and recyclable scrap metal will be hauled off site for salvage/recycling. All special waste and hazardous material will be removed from site and disposed of at licensed facility.

Prior to disposal in the landfill, all equipment will be examined to ensure that all hazardous materials are removed. Any hazardous materials identified will be collected in suitable containers and shipped off site to a licenced waste disposal facility.

The submission of a formal Decommissioning Plan to YG for the solid waste facility will be required at final closure. The formal Decommissioning Plan will document the conditions and materials at final closure. Once the Decommissioning Plan is approved by YG, the facility will be covered by a soil cover system. The cover will be graded to prevent pooling of precipitation runoff and to encourage the shedding of water.

The entire site will then be revegetated using appropriate revegetation techniques refined through the ongoing reclamation research program.

7.8.9 Explosives Plant Site

The ANFO explosives (ammonium nitrate – fuel oil) production area is comprised of the production plant and AN bag storage and powder magazine storage areas, located near the drainage boundary southwest of the mine site.

At closure all unused explosives, the explosives magazines, and other equipment will be returned to the explosives supplier. The septic system at the site will be emptied, broken down, and backfilled. Any fuel-contaminated soils will be excavated and hauled to the land treatment facility for remediation. Disturbed areas will be recontoured to blend in with local topography and scarified or covered with 0.25 m of overburden, as appropriate. The entire area will be revegetated using appropriate revegetation techniques refined through the ongoing reclamation research program.

7.8.10 Mobile Equipment

Mobile equipment includes vehicles, production equipment, light plants, compressors, mobile electricity generators, self-contained storage tanks, etc.

All contractor-owned equipment will be removed by the owners. The remaining equipment will be decommissioned and removed from site for salvage or recycling, as appropriate.

Storage tanks will be decommissioned and the residual fuel or other stored liquids will be drained and placed into suitable drums. The tanks will then be removed from site for salvage or recycling, while the drums will be shipped off-site for salvage or disposal.

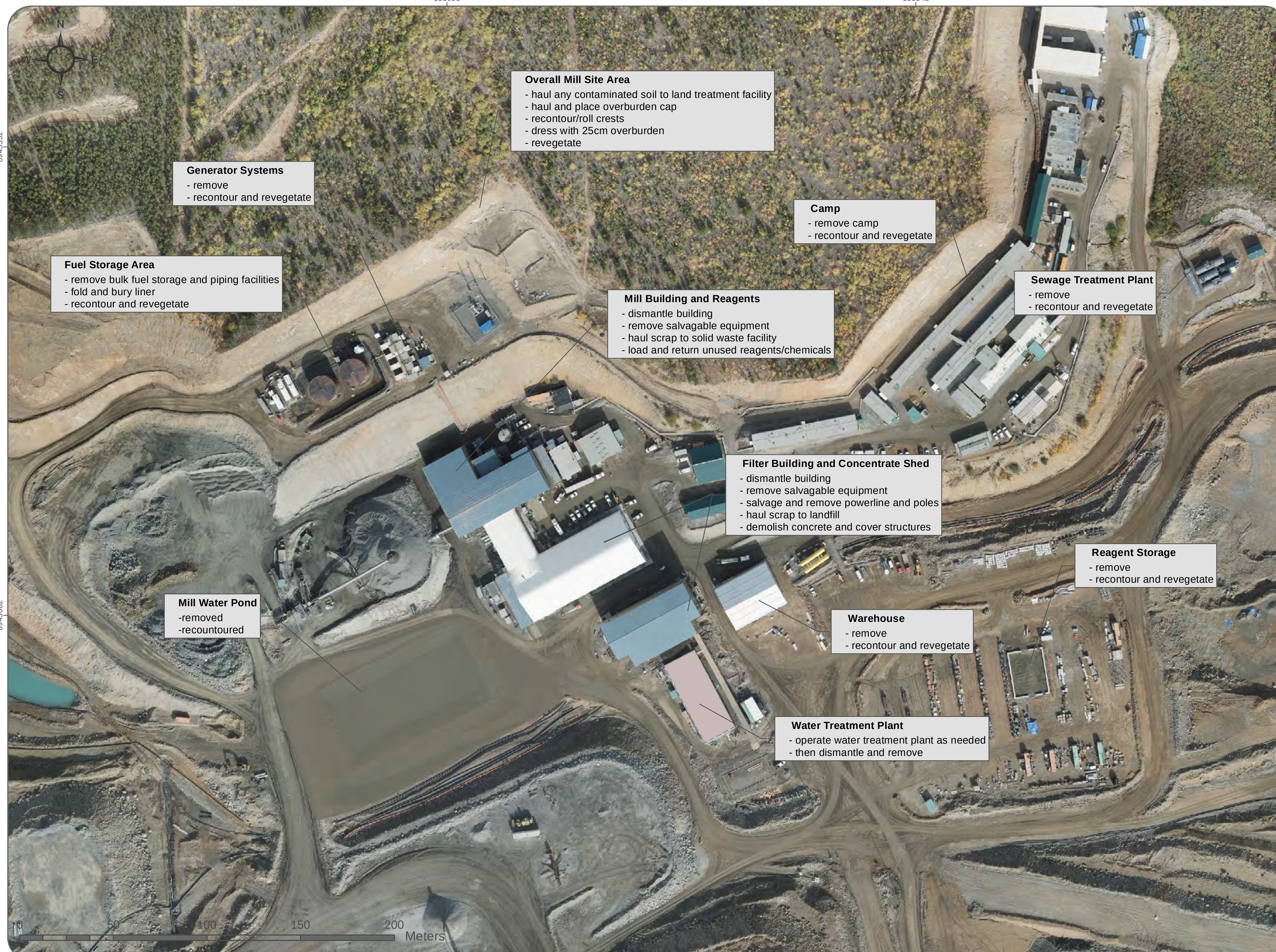
MINTO MINE

RECLAMATION AND CLOSURE PLAN
REVISION 2016-01

FIGURE 7-10

MILL AND ANCILLARY FACILITIES RECLAMATION MEASURES

JULY 2016



capstone MINTO MINE

1:2,000 *when printed on 11 x 17 inch paper*

0 10 20 40 60 Meters

ALEXCO ENVIRONMENTAL GROUP

Aerial imagery obtained from Challenger Geomatics. Imagery acquired September 9th 2014.

Datum: NAD 83 Projection: UTM Zone 8N

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7.9 Hazardous Materials

Hazardous materials will be removed from all buildings and facilities as part of the decommissioning. A comprehensive list of hazardous materials present on site will be compiled based on a review of operating procedures for the various areas and facilities, as well as warehouse inventory sheets. Such wastes may include mill reagents, hydrocarbons, cleaning and household products, automotive fluids, etc. Explosives are discussed in Section 7.8.9 and will be treated as a separate stream.

An estimate of quantities of hazardous materials would be irrelevant at this time as stocks change continuously based on operational requirements; this estimate will be completed once the site begins transition to closure. For closure cost estimate purposes however a total of 27,000 kg was allowed for.

All hazardous materials will be collected and stored in appropriately labeled containers suitable for each type of waste, as recommended by the manufacturers and suppliers of these materials. These containers will then be transported to commercial facilities licensed to dispose of such waste materials. Strict adherence to the specifications of the material safety data sheets (MSDS) will be imposed when handling and transporting these materials.

7.10 Roads and Other Access

7.10.1 Main Access Road

The main access road to the property was constructed in 1996 and 1997. This road was constructed to facilitate 26-ton ore concentrate truck traffic. The road was constructed by cut and fill methods with a road width of 8 meters and associated ditch drainage and culvert installations. Figure 5-1 shows the alignment of the main access road.

The Main Access Road will remain open throughout the active closure and into post-closure period to provide access for inspections, sampling, and maintenance and repair work. The schedule for the road decommissioning will be determined once the final closure criteria have been achieved. This decision will also be made in conjunction with SFN as the access road lays within SFN Category “A” settlement lands. Closure of the main access road is expected to be consistent with the RCP’s closure philosophy; however, it is recognized that the performance of the reclamation and closure of the site must be assured before a final determination of the main access road closure is made. Government regulators and the local trapper will also be consulted regarding decommissioning plans for the road.

7.10.2 Haul Roads

The haul roads on the site radiate out from the open pits to the mill, the ore stockpiles, the waste rock dumps and the ice-rich overburden dump. Haul roads, site roads and the main access road will be subject to standard road decommissioning and reclamation measures at closure, including culvert excavation, drainage recontouring, slope stabilization and surface scarification. Regrading/contouring of the roads will ensure that runoff sheds off the road surface and does not become ponded. Site reclamation experience indicates that road surfaces are not expected to require seeding, only surface scarification in order to encourage natural revegetation. Sediment management measures will be installed where drainage channels have been re-established in order to prevent sediment from entering streams while revegetation occurs. Short term sediment management measures may include installation of silt fencing and enviro-matting at select sites until vegetation becomes established. In the long term establishment of vegetation will provide the primary sediment control.

7.10.3 Airstrip

The airstrip will remain operational into the Active Closure and Post-Closure periods as part of the Yukon emergency landing aerodromes network. No closure activities are required.

7.11 Borrow Materials Planning

7.11.1 Overburden

Overburden for the isolation covers will be obtained from the Reclamation Overburden Dump (Figure 5-2) and from overburden stripped during the development of Area 2 Stage 3 pit mining operations (Figure 5-6). Overburden from the ROD has been extensively characterized (Appendix E3 and demonstrated to be suitable for use in revegetated isolating soil covers. The site has significantly more overburden available for reclamation than required, with the ROD alone estimated to contain on the order of 4.3 Mm3, available for soil cover construction (refer to Section 5.2.2).

7.11.2 Rip-Rap

The reclamation planning calls for about 42,000 m^3 of durable, geochemically benign rip-rap for lining water conveyance ditches and protecting slopes from erosion due to surface runoff. Rip-rap material will be required at closure ranging in size from D50 of 200mm to D50 >1000 mm.

Geochemically acceptable rock will be sourced from suitable waste rock areas and operations will be set up for screening. Large boulders for use in energy dissipation structures are being opportunistically sourced during operations from the MWDE and Minto North Pit and stockpiled for later use.

7.11.3 Filter/Bedding Layers

The reclamation planning requires on the order of 20,000 m^3 of granular fill for filter and bedding layers associated with rip-rapped and/or lined water conveyance ditches. Pit-run sand and gravel is not readily available onsite; therefore, it is anticipated that this material will be obtained primarily as a by-product of screening and/or crushing of rip-rap stockpiles. In the event that insufficient quantities are produced as a by-product of crushing, either additional dedicated crushing and screening operations will be required or an alternate source will need to be identified. The filter/bedding layer will be well-graded with a D50 of about 25mm and less than 5% fines. It is anticipated that some washing of the crushed, screening filter/bedding layer may be required to control the amount of fines.

7.11.4 Organics

There are limited readily available sources of organics on-site. Potential sources for incorporation in passive treatment systems are currently being evaluated in connection with ongoing reclamation research. One option currently under consideration includes mulching of locally available trees for incorporation into CWTSs.

7.12 Monitoring and Maintenance

7.12.1 Compliance Monitoring and Reporting

Environmental compliance monitoring, internal monitoring of earthworks and independent geotechnical inspections are presently ongoing at the property. The environmental monitoring at the Minto mine includes several types of scheduled periodic inspections to ensure that the facility is meeting environmental performance objectives and is complying with appropriate regulatory standards. These inspections entail:

- Scheduled inspections of the waste rock and overburden storage areas, tailings management facility, water retaining structures and mine components to monitor environmental and physical stability performance;
- Scheduled water quality sampling and flow measurements of effluent streams and local receiving water streams;
- Scheduled receiving water programs for benthic invertebrates, stream sediments and fish to monitor downstream environmental quality;
- Scheduled piezometric monitoring of water levels in wells and the spillway structure at the Main Water Pond Dam (if still in place);
- Monitoring of other instrumentation installed in the DSTSF as per the Physical Monitoring Plan (thermistors, survey hubs, etc.);
- Annual inspections of the TMF, diversion channel, waste rock and overburden storage areas, and Main Water Pond Dam for structural stability by a qualified geotechnical engineer; and
- Scheduled environmental tours and audits of the property by Minto staff to look for environmental hazards and site stability. Minto will endeavour to invite various Government agencies’ representatives as part of the environmental inspections.

At present, site personnel undertake the scheduled environmental monitoring and inspection programs with the exception of annual geotechnical inspections and the benthic invertebrates, and stream sediment, which are conducted by qualified professionals. All results are reported to the YWB, and YG EMR as monthly or annual reports.

During the active closure period environmental and physical compliance monitoring and inspections will continue as required by the approved EMSRP at the time, utilizing site-based personnel. Prior to entering into Active Closure, Minto intends to refine the monitoring requirements which could include a reduction of monitoring. Also, it is expected that the amount of environmental and physical monitoring and inspection (frequency and quantity) will decline once all closure measures are implemented. The approach to closure monitoring will be to continue with the monitoring and inspection programs detailed in an approved EMSRP until decommissioning and reclamation measures have been completed and then reduce the frequency of site monitoring and the number of monitoring stations over time as satisfactory closure performance is confirmed.

The schedule for monitoring programs planned for the 18-year period (20 years including a 2 year interim period) immediately following cessation of active mining and milling operations are presented in Tables 7-1 through 7-4. For the first 3 years following the cessation of mining/milling, and during active closure and decommissioning, routine operational environmental monitoring will be completed. As noted in the Yukon Government Reclamation and Closure Guidance document an interim period for monitoring, maintenance, permitting and closure planning must be costed. An additional 2 years was added to the active closure period for monitoring to account for the interim period. The Year 4 to 8 period (Post-Closure I) is expected to demonstrate the effectiveness of closure measures and includes monitoring of their performance, but monitoring frequencies would be reduced to periodic inspections. The period spanning years 9 to 18 (Post-Closure II) is considered as the confirmatory period, during which performance monitoring on a further reduced frequency will confirm that closure measures are performing as intended and that closure objectives were successfully achieved (Table 7-1).

During the Post-Closure I period monitoring data from the geotechnical instrumentation will be collected semi-annually, as allowed by site presence for water monitoring activities, while visual inspections by a qualified geotechnical engineer will be completed on an yearly basis. In the Post Closure II period monitoring data collection and visual inspections will coincide, on a 5 year frequency.

The purpose of these periodic inspections would be to ensure that water discharging from site remain compliant, closure and water quality objectives are being consistently met, and physical structures are performing as designed. Should these inspections or monitoring initiatives identify issues of concern, then plans would be developed to address the concerns, as per the AMP. For each elements of concern threshold values will be developed to trigger increased monitoring if performance is not satisfactory or decrease data collection and inspection frequency if closure objectives have been achieved. These threshold values will be determined in consultation with SFN and regulatory stakeholder following completion of the planned closure activities and prior to the post-closure period.

Based on the results of site monitoring for the 18-year post-closure monitoring period and discussions with SFN and the appropriate regulators the need for and the frequency of additional site monitoring will be determined. If the results from monitoring indicate that the site is stable with acceptable geotechnical and environmental performance, then Minto would propose to decrease the frequency of monitoring further. If the results from monitoring indicate there are concerns with either geotechnical conditions or environmental issues, then the site would continue to require more frequent monitoring than otherwise proposed and possibly additional remedial work would be proposed.

As previously mentioned, Minto is interested in having the SFN participate actively in both the closure activities and in post-closure monitoring. Minto will work directly with SFN in this regard.

Environmental and geotechnical monitoring, inspections and treatment wetland monitoring conducted during the post-closure periods (years 4-18 after cessation of mining) will be undertaken by site-based staff or during periodic visits to the site. Water sample collection and data downloads from geotechnical monitoring instrumentation will be completed as per Tables 7-1 and 7-2, while geotechnical inspections and reporting will be completed as per Table 7-3. Treatment wetland monitoring will be completed as per Table 7-4. Access to the property for post-closure monitoring would be by road while the Main Access Road is maintained or via ATV, snowmobile, and/or helicopter after the road is decommissioned.

During the post-closure period, reporting on all environmental and inspection programs carried out on the property will continue (Table 7-3). These reports will be filed with the YWB, and EMR in accordance with conditions contained in the Water Use Licence, Quartz Mining Licence and other operating permits and approvals as they are.

Company personnel responsible for the management of the Minto mine would continue to meet with regulatory agencies, SFN, and the community (Pelly Crossing) on an as-needed basis to keep interested parties appraised of decommissioning activities and the results of post-closure monitoring.

It is expected that a review of the environmental performance of the mine following closure would be made with EMR and other interested parties. Once this review is completed, Minto would consider applying to the Minister of EMR for a Certificate of Closure for the Minto mine under the Yukon Quartz Mining Act Mine Production Regulations. The Certificate of Closure will confirm that Minto has fulfilled its closure obligations for the site.

Table 7-1: Post Closure Water Monitoring Program

		YEAR 1-5 FREQUENCY (Interim and Active Closure)				YEAR 6 - 10 FREQUENCY (Post Closure I)				YEAR 11 -20 FREQUENCY (Post Closure II)		
SITE	**DESCRIPTION**	**Water Quality**	**Sediment**	**Benthos**	**Flows**	**Water Quality**	**Sediment**	**Benthos**	**Flows**	**Water Quality**	**Sediment**	**Benthos**
	Receiving/Background Water Stations											
W-2	Mainstem Minto Creek directly u/s Access Road Crossing	Monitoring to be carried as per an approved Environmental Surveillance and Reporting Plan				Wd/M	BA	BA	Wd/M	SSF	BA	BA
W-3	Mainstem Minto Creek - MMER Compliance Point					M	BA	BA	M	SSF	BA	BA
W-7	Tributary to Minto Creek					SSF			SSF	A		
MN-0.5	Lower west arm of McGinty Creek - Reference Station					SSF			SSF	A		
MN-1.5	Upper east are of McGinty Creek - downstream of Minto North Pit					SSF			SSF	A		
MN-4.5	McGinty Creek at confluence with Yukon River					SSF			SSF	SSF		
W-50	50m downstream of end of pipe discharge (WUL Compliance Point)					Wd			Wd	A		
	Mine Site Stations											
W-12	Discharge from Main Pit	Monitoring to be carried as per an approved Environmental Surveillance and Reporting Plan				SA			SA	A		
W-45	Discharge from Area 2 Pit					SA			SA	A		
W-55	Minto North Pit					SA			SA	A		
W-15	Minto Creek, downstream of the SWD					SA			SA	A		
W-16	Main Water Storage Pond Discharge (or Main Water Storage Pond if not discharging)					NLA			NLA	NLA		
W-17	Main Water Storage Dam Seepage					NLA			NLA	NLA		
W-62	Seepage from toe of MVFES2					SA				A		

Table 7-1: Continued.

		YEAR 1-5 FREQUENCY (Interim and Active Closure)				YEAR 6 - 10 FREQUENCY (Post Closure I)				YEAR 11 -20 FREQUENCY (Post Closure II)		
SITE	DESCRIPTION	Water Quality	Sediment	Benthos	Flows	Water Quality	Sediment	Benthos	Flows	Water Quality	Sediment	Benthos
	Groundwater Wells											
MW16-08	Upgradient of Mine Activities - TBD (Zones not defined)	A - F				NRM				Monitoring program to be recommended by a qualified professional based on an analysis of trends		
MW12-DP1	Southwest Waste Dump - Drive Point Wells	SA - SF				NRM						
MW12-DP2	Southwest Waste Dump - Drive Point Wells	SA - SF				NRM						
MW12-DP3	Southwest Waste Dump - Drive Point Wells	SA - SF				NRM						
MW16-09	Down gradient of SWD - TBD (Zones not defined)	SA - SF				A - F						
MW09-01	Down gradient of MWD - TBD (Select zones as recommended by a qualified professional)	SA - SF				NRM						
MW16-10	Down gradient of MWD - TBD (Zones not defined)	SA - SF				A - F						
MW12-06	Down gradient of DSTSF - TBD (Select zones as recommended by a qualified professional)	SA - SF				A - F						
MW12-07	Down gradient of Main Pit - TBD (Select zones as recommended by a qualified professional)	SA - SF				A - F						
MW09-03	Down gradient of Minto North Pit - TBD (Select zones as recommended by a qualified professional)	SA - SF				NRM						
MW16-11	Down gradient of Minto North Pit - TBD (Zones not defined)	SA - SF				A - F						
MW16-12	Down gradient of Water Storage Pond - TBD (Zones not defined)	SA - SF				A - F						

*** Unless structure has been decommissioned/reclaimed**

Frequency Description

W	Weekly	BA	Bi-annually
Wd	Weekly when discharging	NLA	No longer active
W2	Every 2 Weeks	DCR	Daily Continuous Record during open season
M	Monthly	SSF	Spring, Summer, Fall (May, July/August
Md	Monthly when discharging	SF	Spring and Fall
Q	Quarterly	F	Fall
SA	Semi-annually	NA	Not Applicable
A	Annually	NRM	No routine monitoirng

Table 7-2: Geotechnical Monitoring and Instrumentation Download Frequency

		YEAR 1-5 FREQUENCY (Interim and Active Closure)		YEAR 4-8 FREQUENCY (Post Closure I)		YEAR 9-18 FREQUENCY (Post Closure II)	
AREA	**STURCTURE**	**Instrumentation**	**Data Download Frequency**	**Description**	**Data Download Frequency**	**Description**	**Data Download Frequency**
UNDERGROUND	Vent Raises	Visual Inspection	Semi-annually	Visual Inspection	Annually	Visual Inspection	Every 5 years
OPEN PITS	Area 118 Pit	SH	Semi-annually	SH	Annually	SH	Every 5 years
	Area 2 Pit	SH	Weekly during mining, quarterly thereafter	SH	Annually	SH	Every 5 years
	Main Pit	SH I	Quarterly Quarterly	SH I	Annually	SH I	Every 5 years
	Minto North Pit	NA	NA	NA	NA	NA	NA
TAILINGS FACILITIES	Area 2 Pit Tailings Management Facility	Visual Inspection	Quarterly	Visual Inspection	Annually	Visual Inspection	Every 5 years
	Dry Stack Tailings Storage Facility	I P SH T	Quarterly Monthly Monthly/Weekly Quarterly	I P SH T	Semi-annually	I P SH T	Annually
	Main Pit Tailings Management Facility	Visual Inspection	Quarterly	Visual Inspection	Annually	Visual Inspection	Every 5 years
WASTE ROCK AND OVERBURDEN DUMPS	Area 118 Backfill Dump	Visual Inspection	Semi-annually	Visual Inspection	Annually	Visual Inspection	Every 5 years
	Ice-rich Overburden Dump	Visual Inspection	Semi-annually	Visual Inspection	Annually	Visual Inspection	Every 5 years
	Main Pit Dump	SH	Semi-annually	SH	Annually	SH	Every 5 years
	Main Waste Dump Main Waste Dump Expansion	I	NA	I	NA	I	NA
	Mill Valley Fill Extension	P SH	Monthly Weekly	P SH	Semi-annually	P SH	Annually
	Reclamation Overburden Dump	Visual Inspection	Semi-annually	Visual Inspection	Annually	Visual Inspection	Every 5 years
	Southwest Waste Dump	I P SH T	Quarterly Monthly Monthly Quarterly	I P SH T	Semi-annually	I P SH T	Every 5 years
MINE INFRASTRUCTURE	Includes all reclaimed camp, mill, warehousing and fuel storage facilities	Visual Inspection	Annually	Visual Inspection	Biannually	Visual Inspection	Every 5 years
ROADS AND ACCESS	Includes main access road, site access roads, and airstrip	Visual Inspection	Annually	Visual Inspection	Biannually	Visual Inspection	Every 5 years
WATER MANAGEMENT	Conveyance Channels	Visual Inspection	Semi-annually	Visual Inspection	Annually	Visual Inspection	Every 5 years
	Water Storage Dam	P SH T	Monthly Monthly Monthly	P SH T	Semi-annually	Visual Inspection	Every 5 years

I Inclinometers
P Piezometers
T Thermistors
SH Survey Hubs
NA Not Applicable

Table 7-3: Post Closure Geotechnical Inspection Program

		YEAR 1-3 FREQUENCY (Interim and Active Closure)		YEAR 4-8 FREQUENCY (Post Closure I)		YEAR 9-18 FREQUENCY (Post Closure II)	
AREA	**STURCTURE**	**Description**	**Inspection Frequency**	**Description**	**Inspection Frequency**	**Description**	**Inspection Frequency**
UNDERGROUND	Vent Raises	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year	Semi-Annually –May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection	Annually	Included in site-wide geotechnical inspection	Every 5 years
OPEN PITS	Area 118 Pit	Backfilled; inspection no longer required and not possible	N/A		N/A		N/A
	Area 2 Pit	Visual inspection by Geotechnical Engineer and review of monitoring data	Quarterly	Included in site-wide geotechnical inspection	Annually	Included in site-wide geotechnical inspection	Every 5 years
	Main Pit	Visual inspection by Geotechnical Engineer and review of monitoring data	Quarterly	Included in site-wide geotechnical inspection	Annually	Included in site-wide geotechnical inspection	Every 5 years
	Minto North Pit	Visual inspection by Geotechnical Engineer and review of monitoring data	Quarterly	Included in site-wide geotechnical inspection	Annually	Included in site-wide geotechnical inspection	Every 5 years
TAILINGS FACILITIES	Area 2 Pit Tailings Management Facility	Visual inspection by Geotechnical Engineer as per OMS manual	Quarterly; in conjunction with pit inspection	Included in site-wide geotechnical inspection	Annually	Included in site-wide geotechnical inspection	Every 5 years
	Dry Stack Tailings Storage Facility	Visual inspection by Geotechnical Engineer and review of monitoring data as per OMS Manual	Monthly	Included in site-wide geotechnical inspection	Annually	Included in site-wide geotechnical inspection	Every 5 years
	Main Pit Tailings Management Facility	Visual inspection by Geotechnical Engineer as per OMS Manual	Quarterly; in conjunction with pit inspection	Included in site-wide geotechnical inspection	Annually	Included in site-wide geotechnical inspection	Every 5 years
WASTE ROCK AND OVERBURDEN DUMPS	Area 118 Backfill Dump	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year	Semi-Annually –May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection	Annually	Included in site-wide geotechnical inspection	Every 5 years
	Ice-rich Overburden Dump	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year	Semi-Annually –May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection	Annually	Included in site-wide geotechnical inspection	Every 5 years
	Main Pit Dump	Seepage from toe of MVFE	Semi-Annually –May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection	Annually	Included in site-wide geotechnical inspection	Every 5 years
	Main Waste Dump Main Waste Dump Expansion	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year	Semi-Annually –May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection	Annually	Included in site-wide geotechnical inspection	Every 5 years
	Mill Valley Fill Extension	Visual inspection by Geotechnical Engineer and review of monitoring data	Monthly; in conjunction with the DSTSF inspection	Included in site-wide geotechnical inspection	Annually	Included in site-wide geotechnical inspection	Every 5 years
	Reclamation Overburden Dump	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year	Semi-Annually –May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection	Annually	Included in site-wide geotechnical inspection	Every 5 years
	Southwest Waste Dump	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year	Semi-Annually –May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection	Annually	Included in site-wide geotechnical inspection	Every 5 years
MINE INFRASTRUCTURE	Includes all reclaimed camp, mill, warehousing and fuel storage facilities	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year	Annually	Included in site-wide geotechnical inspection	Biannually	Included in site-wide geotechnical inspection	Every 5 years

ROADS AND ACCESS	Includes main access road, site access roads, and airstrip	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year	Annually	Included in site-wide geotechnical inspection	Biannually	Included in site-wide geotechnical inspection	Every 5 years
WATER MANAGEMENT	Conveyance Channels	Included in site-wide geotechnical inspection - Inspection and data review by Professional Engineer as per QZ14-031 (Clause 100) and QML-0001 (Clause 13.2). Q2 inspection must be completed by an independent engineer by June 30 each year	Semi-Annually – May/June post thaw, and September pre freeze-up	Included in site-wide geotechnical inspection	Annually	Included in site-wide geotechnical inspection	Every 5 years
	Water Storage Dam	Visual inspection by Geotechnical Engineer as per OMS Manual. Dam Safety Reviews (DSR) to be completed by an independent engineer as per CDA requirements for a dam with a 'Significant' dam hazard classification.	Monthly Visual inspection; next DSR required in 2020	Visual inspection by Geotechnical Engineer as per OMS Manual	Monthly	No longer required; Dam decommissioned	N/A

Table 7-4: Wetland Monitoring Schedule and Frequency

		YEAR 1 - 5 FREQUENCY (Interim and Active Closure)	**YEAR 6 - 10 FREQUENCY (Post Closure I)**								**YEAR 11 -20 FREQUENCY** (Post Closure II)			
		Construction	**Com**missioning (year 6-7)				**Early Operation (year 8-10)**				**Long-term Operation (year 11-20)**			
SITE	**DESCRIPTION**	**No Monitoring Required**	**Water Quality**	**Substrate/Sediment**	**Flows**	**Vegetation**	**Water Quality**	**Substrate/Sediment**	**Flows**	**Vegetation**	**Water Quality**	**Substrate/Sediment**	**Flows**	**Vegetation**
CWTS IN	Inflow to the CWTS system	NA	W,M	NA	W,M	NA	M	NA	M	NA	SSF	NA	SSF	NA
CWTS MID	Mid points within the CWTS system, for water, between the cells, and for soils, within the cells	NA	W,M	M,SSF,A	W,M	W,M,A	M	M,A	NA	SSF,A	A	A	A	A
CWTS OUT	Outflow of constructed wetland treatment system	NA	W,M	NA	W,M	NA	M	NA	M	NA	SSF	NA	SSF	NA

Frequency Description

W	Weekly	BA	Bi-annually
Wd	Weekly when discharging	NLA	No longer active
W2	Every 2 Weeks	DCR	Daily Continuous Record during open season
M	Monthly	SSF	Spring, Summer, Fall (May, July/August
Md	Monthly when discharging	SF	Spring and Fall
Q	Quarterly	F	Fall
SA	Semi-annually	NA	Not Applicable
A	Annually	NRM	No routine monitoirng

7.12.2 Maintenance

Provisions for reclamation maintenance tasks such as erosion control and maintenance seeding have been included as part of the long-term closure requirements. Based on physical inspections and monitoring, maintenance works will be planned for and conducted as required to meet closure performance standards and objectives. Maintenance will be completed on an as-needed basis, following inspections and recommendations of a qualified inspector. For costing purposes however, a major maintenance campaign was included every 10 years.

It is a reasonable expectation that site features will require ongoing or periodic maintenance in the closure period. Examples include:

Water conveyance structures:

- Ditches will require cleaning of debris, fines accumulation, sediments and periodic fixing of ditch sides/liners;
- Settling basins will require periodic cleaning of sediments; and
- Ditches and settling basins may require rip rap or boulder replacement or fixing.

Soil Covers:

- Covers will require periodic attention for erosion; and
- Covered areas may require additional cover material and/or armouring in areas where continued erosion is occurring.

7.13 Performance Uncertainty and Risk Management

7.13.1 Adaptive Management Plan

An adaptive management plan (AMP) has been developed as part of this closure planning. This plan has benefited from reviews and comments from both YG EMR and the Yukon Water Board, and the update to the Minto Mine Closure AMP has been structured to meet requirements of both regulatory bodies. The entire AMP is attached in Appendix P2 and a summary is provided here.

AMPs are tools used to address the inherent uncertainty in closure planning. AMPs outline a range of possible, unexpected outcomes and the responses that will be undertaken to curb possible negative impacts associated with these unexpected situations.

An AMP is a flexible, iterative process that emphasises learning while doing. This implies that an AMP is never complete in nature, but in a continuous state of refinement in response to feedback from monitoring, analysis of data and changing conditions. The ideas presented within this document build on information gathered through operations and environmental monitoring at Minto. Any future developments that occur at the Minto mine site will necessitate updates to the AMP. Thus the AMP is considered a "living document". Subsequent iterations of the closure AMP will take these changes into account.

7.13.1.1 *Adaptive Management Planning*

Adaptive management is an approach to environmental management that, according to the Canadian Environmental Assessment Agency, is appropriate when a mitigation measure may not function as intended or when broad-scale environmental change is possible. Mine closure planning includes both of these potentialities due to the long term planning horizon and associated uncertainty. Adaptive management plans are precautionary in nature, and provide a level of security in long term environmental planning. Adaptive management plans also allow for the inclusion of improved science into mitigation measures as they are continually revised.

Adaptive management has been evolving since its emergence in the 1970s. Adaptive approaches include an ability to incorporate knowledge into the management plan as the knowledge is gleaned and circumstances change. Eberhard et al. described the categories of knowledge that may trigger changes to water quality management plans; system understanding, measuring progress and anticipating changes. These categories allow for the inclusion of knowledge and adaptation of management to changed conditions. Embedding adaptation into environmental plans involves thinking about how the results of monitoring will change management actions. AMPs are a way to accept uncertainties and build a structured framework to respond to changing conditions.

Adaptive management conducts a flexible path with actions to take when specific triggers occur. AMPs are a formalization of a plan for performance monitoring and project re-evaluation in the future. The general structure of adaptive management can be described by the following steps:

1. Identify risk triggers associated with vulnerabilities or uncertainties;
2. Quantify impacts and uncertainties;
3. Evaluate strategies and define implementation path that allows for multiple options at specific triggers;
4. Monitor the performance and critical variables in the system; and
5. Implement or re-evaluate strategies when triggers are reached.

Although there are no widely used AMP terms, the steps listed above are representative of typical AMP processes. Within AMPs, triggers provide decision points in a stepwise decision-making framework that identifies how and when management action should be taken. A key characteristic of adaptive management is monitoring, which is used to advance scientific understanding and to adjust management policies in an iterative process. Adaptive management is a rigorous method for addressing uncertainties in ecosystem management.

Minto has used the general steps listed above to establish a set of adaptive management terms and apply them to the ongoing Minto closure planning process.

7.13.1.2 *AMP Approach*

An AMP is a management tool wherein a framework is provided to make quick and effective decisions to guide responses to unforeseen events. This document identifies areas of uncertainty within this RCP and its predictive elements and provides an AMP framework for each. For each component the AMP describes monitoring commitments, thresholds, triggers and responses to underperforming elements or emerging risks within the component. The steps laid out in the AMP framework are precautionary, and therefore they provide the confidence that action will be taken before adverse environmental impacts are observed.

Response planning, and results for anticipated events are contained within site management plans while AMPs guide responses to unforeseen or contingency events. This AMP provides a framework to guide responses to unanticipated monitoring results and to potential but low probability events where uncertainty exists.

It is difficult to predict the specific environmental condition that may arise which requires a response from management and, therefore, the AMP does not provide specific detailed descriptions of responses to a situation. The AMP provides a range of possible responses to use as a guide to respond to specific environmental conditions encountered. The AMP responses also rely on the engagement of qualified professionals to evaluate the particulars of the situation and to make recommendations for further investigation, evaluation or action. Management should use the information provided in the AMP and undertake the appropriate response.

7.13.1.3 *AMP Components*

This iteration of the Minto Mine Closure AMP has been expanded to cover additional mine components with identified areas of performance uncertainty at closure. The AMP now includes frameworks for the adaptive management of changing conditions related to:

- Surface water quality;
- Groundwater quality;
- Physical Stability of Mine Components;
- Water Management Infrastructure; and
- General Reclamation Measures, including Revegetation and Cover Systems.

The specific AMP framework for each of these components are described in detail in the attached AMP (Appendix P2).

7.13.1.4 *AMP Framework*

The AMPs for each component are laid out using a common element approach to create consistency in implementation of the AMP protocol for all components. The common elements are:

1. Description of the component - this includes, where applicable, the engineering design associated with the component. Thorough description and understanding of the component leads to narrative risk triggers and specific performance thresholds.

2. Risk narrative - describes the possible environmental impacts and environmental conditions that implementation of the AMP will prevent. The risk narrative is used to establish early warning indicators.

3. Monitoring the component

    - Specific Indicators are the environmental or physical parameters to be monitored and assessed. Specific indicators are measurable or observable, and are indicative of changes from the designed or expected condition.
    - Specific Performance Thresholds define the conditions, in terms of specific indicators, when action is triggered. Performance thresholds are staged to accommodate levels of concern and a diversity of actions. To the extent possible, specific performance thresholds will include early warning thresholds.

4. Responding to unexpected conditions of the component

    - Specific Responses are staged according to specific performance thresholds and they describe the actions to be implemented if specific performance thresholds are crossed. Specific responses were developed through various means including, consultation with SFN and their agents, site operations such as monitoring and management, and input from ACG as well as other consultants.

5. Annual Reporting and Review

    - Annual Report reflects annual changes made to the AMP as the site conditions change. The AMP should be modified whenever unexpected circumstances are encountered and the protocol is implemented or when additional proven science or technology becomes available.

7.13.1.5 *AMP Risk Narrative, Specific Indicators and Specific Performance Thresholds*

In concept, it is Minto's position that risk narrative, specific indicators, and specific performance thresholds have been selected in order to maintain closure objectives in the event of emergence of unanticipated conditions at and surrounding the project site during operations and post-closure. The risk narratives include those identified in the FMEA workshop (see sections 2.4.2 and 7.13.2) for which mitigations identified included addressing in adaptive management planning. The specific performance thresholds are numeric values against which measurements and sampling from the closure monitoring programs (Section 7.12) can be compared.

7.13.1.6 *General Approach to AMP Specific Responses*

The following general steps may be taken if any AMP performance thresholds(s) have been exceeded:

1. Internal notification to management, followed by timely notification to SFN and the Water Inspector that a performance threshold has been exceeded;

2. Investigation of the root cause of the exceedance;

3. If a root cause of the exceedance can be readily identified and remedied, the remedy will be implemented in a timely manner, and the water inspector will be notified of the remedy and the implementation according to permit requirements;

4. If a root cause cannot be readily identified, a study plan will be outlined and communicated to involve qualified professionals to assist in the identification of the root cause(s);

5. An action plan will be devised for the mitigation of the problem;

6. Increased monitoring/sampling frequencies to monitor the situation and see if prescribed mitigation is appropriate and effective;

7. Inspect and monitor any modification to infrastructure; and

8. Review, report and make changes to the AMP.

7.13.1.7 *Annual Review and Annual Reporting*

An annual review of the AMP will be performed and any necessary amendments or updates to the AMP elements will be made. The annual review will include a review of the relevant monitored data and AMP elements.

Updates, amendments, performance thresholds crossed, and trigger(s) activated will be provided to the appropriate governmental (including SFN) organizations as required and will be part of the annual report.

7.13.2 Risk Assessment (FMEA)

Minto hosted a multi-stakeholder FMEA workshop (in two parts) for the Phase V/VI RCP. The first session in Vancouver on August 27 and 28, 2014. A second, supplementary FMEA workshop was held in

Whitehorse on October 9 and 10 with a subset of the original workshop group to address outstanding mine components and closure aspects that had not been addressed in the first workshop.

The first FMEA workshop was held at SRK's office in Vancouver, BC on August 27 and 28, 2014. The workshop was facilitated by Dr. Dirk Van Zyl (Chair of Mining and the Environment at the Norman B. Keevil Institute of Mining Engineering, University of British Columbia). The two-day workshop included participation by representatives of Minto, SFN, and YG EMR. Representatives from Norwest Corporation (in its third party review capacity on geotechnical subjects at Minto Mine, on behalf of Minto and SFN jointly) participated on the second day only (August 28).

The supplementary FMEA workshop was conducted over two half-day sessions in October 2014. The workshop was jointly facilitated by Dylan MacGregor and Scott Keesey and was attended by representatives of Minto, SFN, and Steve Januszewski, an independent consultant attending on behalf of YG EMR.

The FMEA used predefined consequence categories, severity descriptors and likelihood terminology to determine where the residual risk associated with the various mine components ranked on the risk matrix (from Low to Very High). The risk rating tools used in the FMEA workshops are presented within the final Report in Appendix D2. Scenarios of potential failure modes were proposed by members of the group. For each scenario that was rated, potential risks were identified, recorded, and taken through a facilitated procedure using the consequence-severity and likelihood tools to reach a consensus risk rating. The risk ratings were recorded in a risk register spreadsheet that was projected on a screen for participants to refer to and provide feedback on during the meeting, and the resultant risk IDs were placed on a wall matrix and photographed once the topic was complete.

The highest overall risks (i.e., High and Very High) identified during the FMEA workshops were associated with Administration, Water Conveyance, and Waste Rock Dumps, with Administrative Failures representing the largest perceived residual closure risk. A recurring theme for mitigating residual risk included the implementation of an effective AMP and long-term care and maintenance program. The complete final Report and Risk Register are located in Appendix D2.

8 Reclamation and Closure Schedule and Execution Strategy

8.1 Reclamation and Closure Schedule

The conceptual schedule for reclamation and closure is presented in Figure 8-1. A breakdown of the percentage of each activity completed in each closure year is shown in the cash flow calculations in Appendix Q (Worksheets 2 and 7). The activity sequencing during closure has been balanced to some degree in terms of cost, in order to also balance the workforce during active closure; however, the actual construction sequencing will be determined by the construction manager during implementation.

The closure period will begin once all mineable ore and stockpile reserves have been processed. Active closure implementation has an estimated duration of 3 years starting in 2018. The post closure period has an overall duration of 15 years, with the Post-Closure I period having a duration of five years, and Post-Closure II period having a duration of 10 years.

Construction during closure implementation is expected to occur between April and October (7 months) of each year. Annual on-site care and maintenance activities during Post-Closure I is estimated to occur over 5 months. Maintenance during Post-Closure II is estimated to occur once every 5 years for 1 month.

Active water treatment is to continue throughout the closure period with the passive wetland treatment system expected to begin operations in Year 1 of post-closure. The active treatment system is assumed be dismantled and removed from site during final demobilization at the end of Post-Closure I.

Phase	P A NS		C S			P S C S 1					P S C S 2											
Year	2 16	2 17	2 1	2 1	2 2	2 21	2 22	2 23	2 24	2 25	2 26	2 27	2 2	2 2	2 3	2 31	2 32	2 33	2 34	2 35	2 36	
Closure Year	-2	-1	1	2	3	4	5	6	7			1	11	12	13	14	15	16	17	1	1	
Planning and Permitting																						
Reclamation Research and Planning	■	■																				
Technical Studies and Investigations	■	■																				
Engineering, Design, and Construction Plans	■	■	■	■	■																	
Monitoring and Management Plans	■	■																				
Permitting	■	■																				
Monitoring																						
Water Quality Monitoring (surface and groundwater)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
Sediment Monitoring	■	■	■	■	■	■		■		■					■					■		
Biological Monitoring	■	■	■	■	■	■		■		■					■					■		
Geotechnical Monitoring	■	■	■	■	■	■		■		■					■					■		
Revegetation Monitoring	■	■	■	■	■	■		■		■					■					■		
Annual Inspection Reporting	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
Closure Implementation and Reclamation																						
Waste Dumps	■	■	■	■																		
Overburden Dumps					■																	
Ore Stockpiles			■																			
Open Pits				■	■																	
Underground Openings			■																			
External Tailings Facilities		■	■																			
Roads					■																	
Demolition			■	■	■																	
Surface Infrastructure			■	■	■																	
Water Detention Structures				■	■																	
Yards/Laydown Areas			■	■	■																	
Waste Disposal					■	■	■	■	■													
Surface Water Conveyance			■	■	■																	
Passive Treatment System Construction					■																	
Mob-Demob			■		■															■		
Care and Maintenance																						
Active Water Treatment Operation	■	■	■	■	■	■	■	■	■	■												
Passive Water Treatment Operation						■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Reclamation Maintenance						■	■	■	■	■												
Site Maintenance	■	■	■	■	■	■	■	■	■	■					■					■		

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Minto Mine

Reclamation and Closure Plan

Conce tual eclamation and Closure Schedule

Date: August 2016
Prepared by: PHM
Figure: .1

8.2 Execution Strategy

During active closure, the existing camp and offices will be used to support the closure workforce, with unused facilities and site trailers, demolished or dismantled as required. A limited number of facilities are to be maintained on site to support post-closure activities and will remain on site. These facilities are expected to consist of: a camp and kitchen trailer, an office trailer, the active treatment system facility, and mechanic/equipment warehouse to store supplies and equipment. A limited equipment fleet will also expected be maintained on site through to the end of Post-Closure I to allow for as needed repairs and maintenance, as well as to maintain the main site access road and airstrip.

The work-force during closure will vary depending on activities that are in progress at a particular point in time. Based on the 3 year, 7 month per year closure duration, and the total estimated man-hours calculated by the closure cost estimate, the average operational workforce (equipment operators and labourers) during closure is estimated to be approximately 15 to 20 workers. A similar number of personnel is estimated to be required for support (project management, field support staff, and camp support staff.

The post-closure periods will require significantly less personnel. The post-closure workforce will be consist of water treatment and environmental staff, and a limited number of equipment operators to complete reclamation repairs and site maintenance. Details of the estimated required workforce during each post-closure period is provided in Worksheet 5 of Appendix Q. The actual workforce will depend on the work to be completed within a given year.

In addition to the personnel listed in the tables, additional camp staff would be required for cooking and housekeeping. This results in a total estimated workforce of approximately 9 to 12 during Post-Closure I and approximately 5 during Post-Closure II.

9 Reclamation and Closure Liability

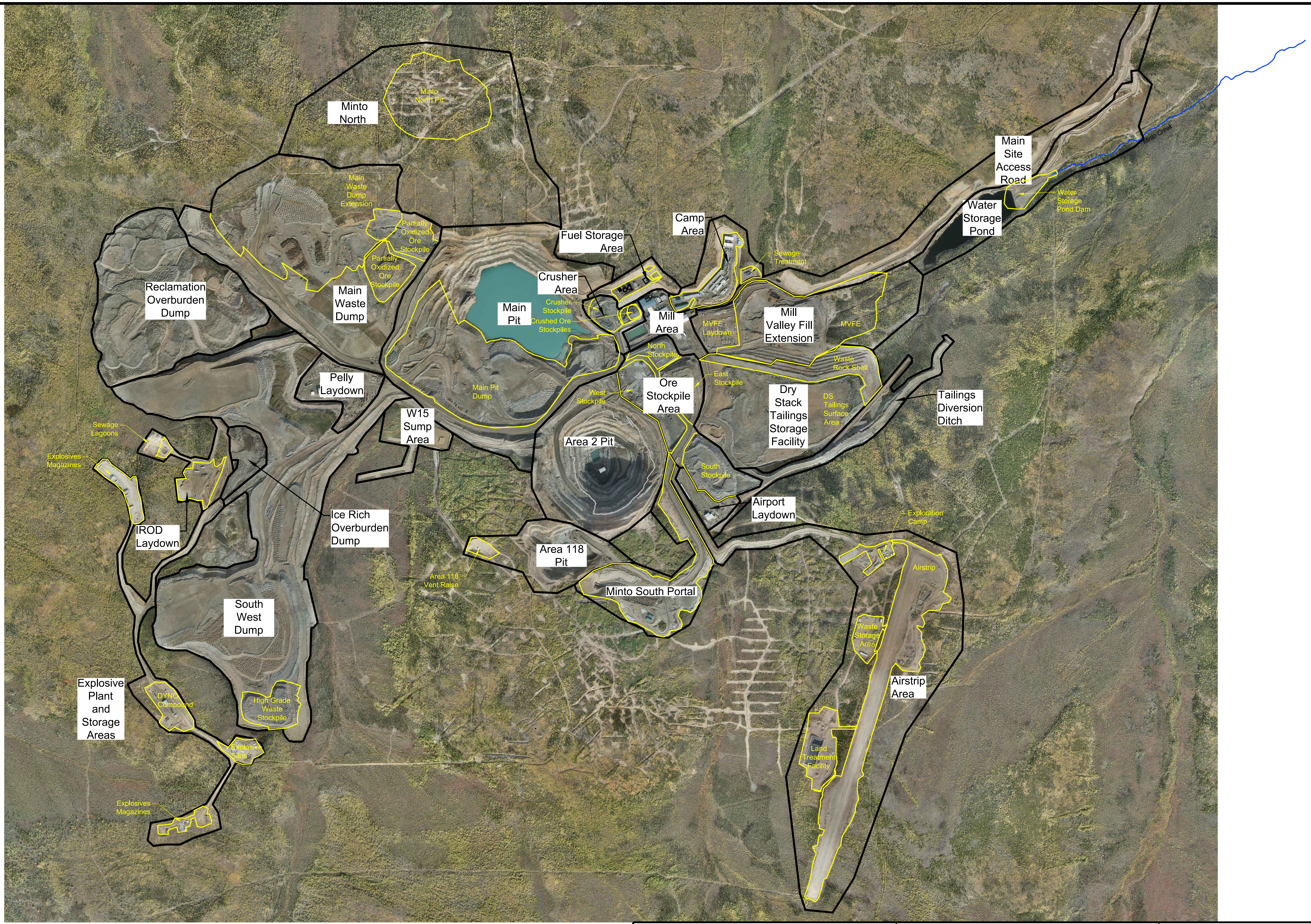
The estimates for reclamation and closure liability have been prepared in accordance with the costing guidance from YG EMR in the document Reclamation and Closure Planning for Quartz Mining Projects: Plan Requirements and Closure Costing Guidance (YG, 2013). The closure liability estimates including the cost estimate basis, sources, and assumptions are provided in Appendix Q. Figure 9-1 illustrates the reclamation units and where areas of the site were costed within the cost estimate.

The YG (2013) guidance document requires liability estimates for three separate conditions:

1. Current status (i.e. Year 0);
2. Peak Liability within the next two-year period; and,
3. End-of-mine (EOM) Life.

For the Minto Mine, the peak liability is the same as the Year 0 liability estimate and as a result, two estimates are presented. The Year 0 liability estimate assumes that mining at Minto North is complete, and that mining of the Area 2 Stage 3 Pit has yet to begin. This point of time is the peak liability as the closure cost is expected to be reduced as overburden stripped from the Area 2 Stage 3 Pit will be placed as covers over completed waste dump facilities. The end-of-mine life closure liability occurs following completion of mining in the Area 2 Stage 3 Pit in 2018.

Closure implementation is estimated to take 3 years for both liability estimates with construction occurring between April and September each year. The site is estimated to be access by air during the spring, and by barge following spring break-up. Two years of interim care and maintenance is assumed to be required after mining ceases and prior to implementation of the final closure plan for the Year 0 liability estimate. These costs are not included in the EOM estimate as the closure plan would be finalized at the end-of-mining.



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MINTO CLOSURE PLAN

Cost Estimate Reclamation Areas

SRK JOB NO.: 1CM002.044

FILE NAME: 1CM002-45_ClosureQuantities_rev03-ForFigure.dwg

MINTO

DATE: July 2016

APPROVED:

FIGURE: 9.1

As noted in Section 8, the Post-Closure I and Post-Closure II periods have durations of 5 years and 10 years, respectively. During Post-Closure I, site access is maintained by air during the spring, and by barge following spring break-up. During Post-Closure II, site maintenance is assumed to be required every 5 years with the site accessed by barge and work completed in one month. Site access for monitoring events and geotechnical inspections when no barge is in place are assumed to be completed by helicopter. During Post-Closure II, the geotechnical inspection completed by helicopter will also be used to determine the maintenance requirements to be completed during the next summer.

Costs have also been allocated for on-going site maintenance past the Post-Closure II period into perpetuity. Routine site inspections and maintenance were assumed to be completed every 10 years, with access to the site established by barge. During these 10 year maintenance events, costs were allocated for passive treatment maintenance, site grading, as well as maintenance of the access road (including Big Creek Bridge).

Table 9-3 summarizes the reclamation and closure liability for the Year 0[4] (and peak two-year liability) scenario, and the End-of-Mine (EOM) scenario. The costs are presented in 2016 Canadian Dollars.

Table 9-1: Reclamation and Closure Liability Cost Summary

Description of Cost	Year 0	EOM
Closure Implementation		
Direct Costs	$16,660,000	$9,759,000
Care & Maintenance Costs to end of implementation	$9,502,000	$4,356,000
Indirect Costs	$18,925,000	$14,843,000
Cost Inflation	*$2,330,000*	*$1,769,000*
Sub-total - Implementation Costs	**$47,417,000**	**$30,727,000**
Post-Closure NPV	$13,645,000	$13,252,000
TOTAL FINANCIAL SECURITY	**$61,062,000**	**$43,979,000**

[4] The Year 0 liability is also the peak 2 year liability due to the amount of reclamation that is planned over the next 2 years, and the lack of incremental liability created over that period.

10 References

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Personal Communication

Hegel, Troy. Environment Yukon, Caribou, Sheep, & Goat Biologist

Appendix A1
Minto Mine Site Assessment

Appendix A2
Wetland Treatment Research Program - Pilot Scale

Appendix A3
Minto Mine Constructed Wetland Treatment Research Program - Demonstration CWTS

Appendix A4
Minto Mine Constructed Wetland Treatment Research Program - Demonstration Scale 2015 Update

Appendix B
SFN Stakeholder & Regulator Engagement Table

Appendix C
Memo - Re-evaluation of Candidate Passive Treatment Technologies for Minto Mine Closure

Appendix D1
2013 FMEA Risk Register

Appendix D2
Minto Mine Closure - Failure Modes and Effects Assessment 2014 Workshop Report

Appendix E1
Scoping Level Cover Assessment for Minto Closure Covers

Appendix E2
Memo - Minto Mine Closure Covers: Results of Numerical Modelling to Bracket Percolation Predictions

Appendix E3
Updated Closure Cover Design for the Minto Mine
2016 Reclamation and Closure Plan

Appendix E4
Closure Landform Design and Reclamation Landform Units for the Minto Mine

Appendix F
Background Water Quality of Lower Minto Creek for Application in the Derivation of Post-Closure Water Quality Objectives

Appendix G1
Minto Mine Reclamation and Closure Plan – Preliminary Design Report for Treatment Wetland

Appendix G2
Closure Water Conveyance System Design Update Report, Minto Mine

Appendix H
Minto Climate Baseline Report

Appendix I1
Memo - Minto Copper Project - Surface Water Hydrology Conditions – Final

Appendix I2
Surface Water Hydrology Baseline Conditions

Appendix I3
Memo - Minto and McGinty Creek 2014 Hydrology Update

Appendix I4
Memo - Minto and McGinty Creek 2015 Surface Hydrology Update

Appendix J1
Minto Creek Water Quality Characterization
January 2005 – December 2015

Appendix J2
McGinty Creek Water Quality Characterization
May 2009 – December 2015

Appendix K1
Minto Mine Phase V/VI Expansion: Hydrogeological Characterization Report

Appendix K2
Memo - Minto Mine: Groundwater Baseline Conditions

Appendix K3
Minto 2015 Groundwater Model Update

Appendix L
Summary of Baseline Wildlife Surveys Conducted 1994 to 2012

Appendix M
Aquatic Resources Baseline Report

Appendix N
Minto Ecosystems and Vegetation Baseline Report

Appendix O
Water and Load Balance Model Report 2016

Appendix P1
Minto Mine - Operations Adaptive Management Plan

Appendix P2
Closure Adaptive Management Plan

Appendix Q
Minto Mine Closure Cost Estimates – RCP Revision 2016-01