Ridgetop North Pit

Mine Development and Operations Plan

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1 Introduction

This document supplements the Mine Development and Operations Plan (MDOP) dated June 2014 (Minto Explorations Ltd., 2014) and referenced in *Schedule C* of QML-0001. That document, submitted as part of Phase V/VI licensing, described the addition of several open pits to Minto's mine plan:

1. Minto North
2. Area 2 Stage 3
3. Ridgetop South
4. Ridgetop North

Ridgetop North has been redesigned based on current economic and operating conditions, resulting in a smaller pit that mines less ore. Ridgetop South is not currently part of the mine plan; however, it may be re-evaluated in a future revision to the MDOP. An infill diamond drilling program in the Ridgetop area was recently completed and analysis is underway. If changes are required to the design, a design change summary will be submitted.

The content of this MDOP is derived from the Plan Requirement Guidance for Quartz Mining Projects (Yukon Water Board/Yukon Energy, Mines and Resources, 2013).

2 Design Criteria – Surface Mining

The depth and extents of the four pits were determined in the Phase VI Pre-Feasibility Study (Minto Explorations Ltd., 2012) by a Lerchs-Grossman pit optimization of the mine's resource model with the following parameters:

Table 1: Input parameters used in pit optimization.

Item	Unit	Value
Metal Prices and Exchange Rate		
Copper	US$ / lb	2.50
Gold	US$ / oz	300.00
Silver	US$ / oz	3.90
Exchange rate	US$ / C$	0.90
Processing		
Copper recovery to concentrate	%	91.0
Sulphide Gold recovery to concentrate	%	70.0
Sulphide Silver recovery to concentrate	%	78.0
Copper grade in concentrate	%	40.0
Gold grade in concentrate	g/t	variable with Cu
Silver grade in concentrate	g/t	variable with Cu
Concentrate moisture content	%	8.0
Smelter Payables		
Payable copper in concentrate	%	96.75
Payable gold in concentrate	%	Per MRI contract
Silver deduction	g/t in conc.	Per MRI contract
Remaining payable silver in concentrate	%	Per MRI contract
Other Parameters		
Pit slope angles		
Minto North	°	52
Area 2 Stage 3 Rock	°	53
Area 2 Stage 3 Overburden	°	30
Ridgetop North/South	°	53
Dilution	%	6.0
Mining recovery	%	100
Mill throughput	t / year	1,370,000
Costs		
Mining cost	C$ / t mined	3.12
Processing cost	C$ / t milled	16.50
G&A cost	C$ / t milled	11.90
Royalties	%	1.0%
Conc. transportation, marketing, insurance	US$ / dmt conc.	169.54

The optimum pit shell was selected as the basis for each pit design.

A discussion of wall angles in the final pit designs is presented in Section 2.2, and haul road criteria is detailed in Section 5.1.6.

2.1 Ore Quantities

The Ridgetop North pit shares similar geology to the deposits previously mined at Minto: copper mineralization is contained in a series of sub-horizontal stacked lenses of foliated granodiorite. These lenses are characterized by sharp contacts with the surrounding host rock.

The foliated granodiorite zones are highly variable in the content of their mineralization: in the upper portions of the deposit that have been subjected to weathering, copper occurs primarily as malachite and azurite, with minor chalcocite, and in the sulfide zone as chalcopyrite with minor bornite.

The following table summarizes the Ridgetop North ore reserves at the mine's cutoff grade of 0.50% Cu.

Table 2: Open-pit reserves for Ridgetop North pit.

Ridgetop North Pit	
Ore (Tonnes)	1,018,208
Cu Grade (%)	1.02
Au Grade (g/t)	0.24
Ag Grade (g/t)	2.05
Cu Mlb, undiluted	22.86

2.2 Slope Stability and Geotechnical Assessments

Slope angles for Minto's open pits were evaluated in 2009 as part of a report authored by SRK Consulting in support of the Phase IV Pre-Feasibility Study (SRK Consulting, 2009).

The rock mass was separated into three geotechnical units; properties resulting from the 2009 drilling and laboratory testing program are summarized in Table 3 below.

The western region of the Ridgetop pit is anticipated to contain 1 to 5m of soil overburden, deepening to approximately 15m on the eastern side. The maximum depth of the soil overburden is expected to be 21m at the northeast corner of the pit. This overburden layer is the same as that exposed by Stage 3 of the Area 2 pit, where its favorable orientation and the lack of major ice inclusions has resulted in a stable slope that shows neither large-scale movement nor excessive surface slumping.

Bedrock in the Ridgetop pit is expected to be weathered to a depth of 45 to 70m below the current ground surface.

Table 3: Rock Mass Parameters*

Geotechnical Unit	UCS (MPa)	RMR	a	m	s	Unit Wt. (kN/m3)	Phi	C (kPa)
Overburden Soils	-	-	-	-	-	21.7	30	20
Weathered Rock	56.6	51.8	0.507	1.66	$3.37x10^3$	26.2	-	-
Fresh Rock	100	51	0.507	1.45	$1.73x10^3$	26.2	-	-

*Mean values listed. Slope stability analysis used a probabilistic approach.

Based on the rock mass and rock structure characterization completed, two design sectors were delineated, Soil Overburden and Rock (weathered and fresh). Stability analyses included the pit slope parameters summarized in Table 4.

- Stability of soil overburden – slope designed at angle of repose, stability issues are not anticipated.
- Global wall stability; FOS of 2.3.

Table 4: Pit Slope Design Parameters

Pit Sector	Wall Dip Dir. (Az)		Interramp Slope Angle	Bench Face Angle	Bench Height (m)	Bench Width (m)
	From	To				
Rock (weathered and fresh)	000°	360°	53°	72°	18	8
Overburden	-	-	30°	-	-	-

As in all other pits mined at Minto to date, the bench configuration has been modified to develop wider benches, 10 m, with 24 m bench height, while maintaining the inter-ramp slope angle.

Six additional geotechnical diamond drill holes were drilled in 2017 to confirm rock mass and structure conditions. If conditions different to the characterization described above are discovered, slope design parameters may be revised.

3 Design and Construction

3.1 Site Preparation

The access road used to service the Area 118 Backfill Dump will be used to provide access to Ridgetop North. An additional access road to the Ridgetop Waste Dump will be established. The road alignment is shown in Figure 3 and will be built using construction-grade rock.

The organic-rich topsoil layer from Ridgetop North will be stripped using the mine's dozer fleet and stockpiled separately on existing dumps, including the Main Waste Dump Expansion, Southwest Waste Dump, and Mill Valley Fill Extension Stage 2. This approach places topsoil near the location of its final reclamation use, minimizing reclamation costs.

3.2 Construction QA/QC

No new infrastructure is planned for the site as part of the continuation of Phase V/VI mining.

Geotechnical monitoring of pit highwalls is described in Section 5.1.4, and the monitoring and quality control of waste rock dispatching is described in the site's Waste Rock and Overburden Management Plan (WROMP).

3.3 Stability Analyses

No additional stability analyses were required in addition to the slope stability analysis and monitoring practices summarized in sections 2.2 and 5.1.4, respectively. As discussed above, six geotechnical diamond drill holes were drilled in 2017 and analyses will be revised if the rock mass characterization changes from the current interpretation.

3.4 Construction Schedule

Mining of the Ridgetop North pit will start mid-February 2018 and is scheduled to be completed in December 2018. After an initial ramp-up period, a mining rate of 10,000 BCM/day is planned until mid-October, when the rates gradually decrease until the pit is completed.

Table 5: Start and completion dates for Ridgetop North open-pit mining.

Pit	Start Date	Completion Date	Duration of Mining
Ridgetop North	February 2018	December 2018	10 months

3.5 Material Release Schedule

The following figure shows the material releases for the life of Ridgetop North.

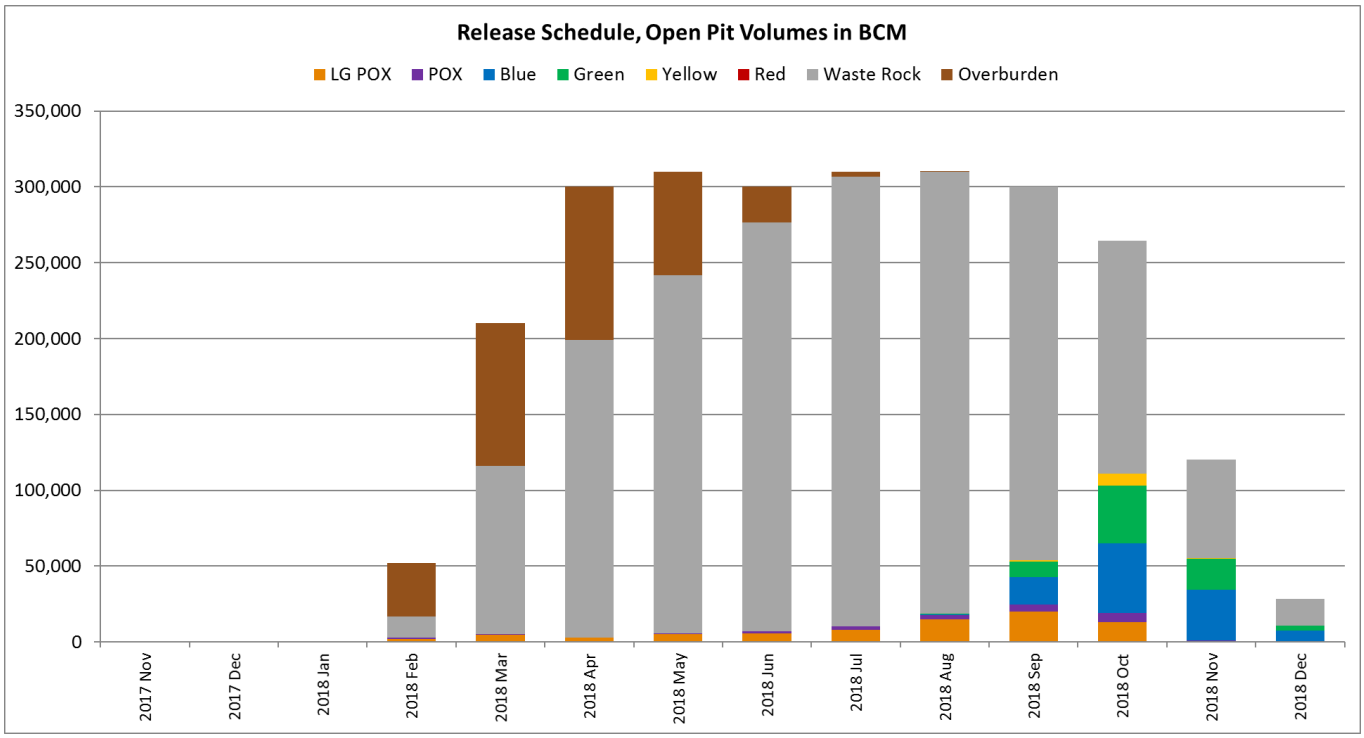

Figure 1: Material release by month.

3.6 Ore Handling Procedures

Ore will be classified, based on copper grade, into the material types presented in the table below.

Table 6: Classification of ore by copper grade.

Material Type	Copper Grade Range	Soluble Copper
Blue Sulfide Ore	0.50 – 1.00% Cu	<15.0%
Green Sulfide Ore	1.00 – 2.00% Cu	<15.0%
Yellow Sulfide Ore	>2.00% Cu	<15.0%
Partially Oxidized Ore (POX)	>1.50% Cu	>15.0%
Medium Grade Partially Oxidized Ore (MG POX)	0.80 – 1.50% Cu	>15.0%
Low Grade Partially Oxidized Ore (LG POX)	0.50 – 0.80% Cu	>15.0%

Classification of material as one of the six types of ore (or as waste) is based on blast hole assays. The following is a description of the process.

1. Drill cuttings from every blast hole are sampled, tagged, and sent for assay at the on-site lab prior to blasting;
2. Representative samples of the cuttings are assayed using atomic absorption (AA) to determine the copper and silver content. A separate sample is acid-leached and assayed for copper grade, allowing for a determination of soluble copper;
3. The environmental assay lab tests representative samples for total sulfur and total carbon content, which are used to calculate an NP/AP ratio;

4. The assay results are sent to the geology department for interpretation;
5. 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);
6. 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;
7. 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.

Material containing more than 15% soluble copper content is classified as partially oxidized.

Waste rock having an NP:AP ratio greater than 3.0 is classified as bulk waste and deposited to one of several rock dumps, while material with a ratio less than 3.0 is deposited in one of the tailings management facilities below the final flooded levels.

Stockpile inventory will be drawn down until the Area 2 Stage 3 Expansion starts producing ore in December 2017. Stockpile volumes will then increase until March 2018 when Area 2 Stage 3 Expansion will be complete. Stockpiles will be drawn down over the next 4 months while stripping activities occur in Ridgetop North. Stockpile inventory begins to increase in July 2018 as Ridgetop North releases ore, peaking in December 2018 when Ridgetop North mining is completed. The stockpile inventory will then be drawn down until the end of the mine life, supplemented by ongoing feed from underground operations.

Stockpiles will be placed on the stockpile footprints established as part of previous mining and presented as part of Phase V/VI licensing. No new stockpile pads will be created as part of Ridgetop North mining.

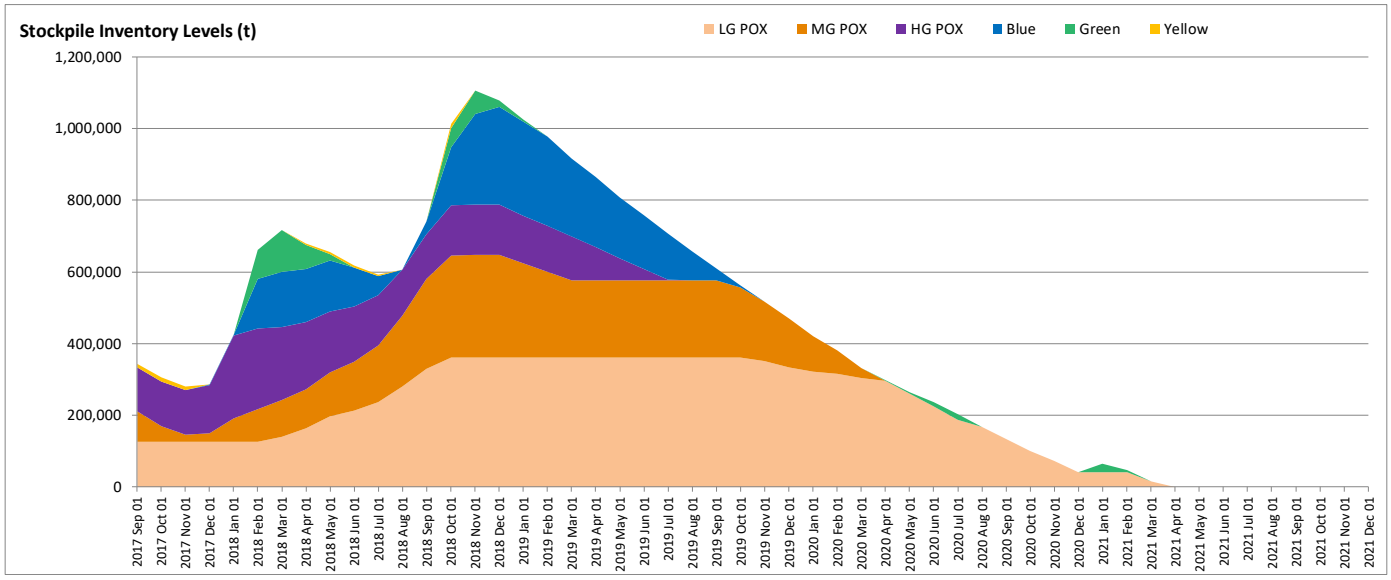

Figure 2: Life-of-mine stockpile inventory levels.

4 Associated Mine Services and Infrastructure

4.1 Ancillary Infrastructure

The surface mining fleet will continue to be diesel-powered. No new electrical infrastructure will be created for the open pit mine.

Two-way VHF radios will continue to be used for communication with the mining fleet. Sixteen channels are available on site, with three available everywhere on the property: one channel dedicated to routine pit traffic, one for extended conversations or other uses, and the site emergency channel.

4.2 Waste Management

4.2.1 Overburden Management

Ridgetop North overburden release is expected to be 325,000 BCM. Material suitable for use in covers will be placed adjacent to the Ridgetop Waste Dump to be used for reclamation of that dump. A portion of the overburden release will be dispatched to other waste dumps constructed in previous stages of mining, including the Main Pit Dump and Main Waste Dump.

Mine operations will continue to visually classify overburden at the dig face; acceptable soil cover material will be loaded and direct-hauled to waste rock dump covers, while off-spec material will be sent to the Area 118 Backfill Dump. Off-spec cover material includes material containing coarse sand, weathered rock, or massive ice.

4.2.2 Waste Rock Management

The waste rock, totaling 1.8M BCM, will be placed at the Ridgetop Waste Dump within the permitted Phase V/VI design. The fraction of the waste rock projected to have an NP:AP ratio less than 3.0 will be co-disposed with tailings in either the Area 2 Pit Tailings Management Facility or the Main Pit Tailings Management Facility.

Figure 3: Waste Dumps for Ridgetop North

4.3 Tailings Management

No changes are required to tailings management, described in the Tailings Management Plan, for Ridgetop North. All tailings will continue to be deposited in either the Area 2 Pit Tailings Management Facility or the Main Pit Tailings Management Facility.

The completed Ridgetop North pit will be backfilled with tailings as described in the Phase V/VI Tailings Management Plan.

4.4 Industrial Complex

Minto's site infrastructure consists of a primary crusher, secondary crusher, coarse ore stacker/conveyor, mill, concentrate storage shed, tailings filtration building, water treatment plant, propane tanks, camp complex, warehouse, and laydown area. No changes to the locations of these structures were planned as part of Phase V/VI, and no further changes are expected as part of remaining mining.

4.5 Fuel Storage

Diesel fuel is stored in a diesel storage facility located north of the process plant. Six large diesel tanks have a combined storage capacity of approximately 3.2 million litres (L). These tanks were sized to store sufficient fuel for two months of operation, under generator power, during the Yukon River freeze and thaw periods when vehicle access to the site is not possible. The mine's connection to the electrical grid has reduced fuel use and the tanks, if filled, now represent a four-month fuel supply. A fuel tank inventory, including the types of products and volumes is presented in the table that follows.

Table 7: Fuel storage capacity.

Number of Storage Tanks (#)	Product Type	Volume (L)
6	Diesel	3,268,000
1	Gasoline	8,000
6	Propane	911,000

5 Mine Design and Methods

5.1 Mine Design

5.1.1 Volumes

Figure 3 and **Error! Reference source not found. Error! Reference source not found.**show the redesigned Ridgetop North pit. Table 8 outlines the mined volumes for Ridgetop North.

Table 8: Ridgetop North Volumes

Overburden (BCM)	Waste Rock (BCM)	Partially Oxidized Ore (BCM)	Sulfide Ore (BCM)	Total (BCM)
325,000	1,800,000	186,000	193,000	2,504,000

Figure 4: Ridgetop North

5.1.2 Access

The access road used to service the Area 118 Backfill Dump will be used to provide access to Ridgetop North; all ore and SAT haulage will utilize this existing road. The northern access to the Ridgetop Waste Dump will be used to haul waste contained on or above the 868m bench, the remaining waste material will take the southern access to the Ridgetop Waste Dump.

5.1.3 Wall Design and Overburden Stability

Wall design and stability assessments are summarized in Section 0.

5.1.4 Ground Movement Monitoring

Minto uses a radar-based slope monitoring device manufactured and supported by GroundProbe. This provides continuous monitoring of highwalls with sub-millimeter accuracy. The device is limited to scanning the portions of the wall visible from its setup point; therefore, it is typically placed such that it monitors the highest or most critical wall under which personnel are actively working.

In the event of a movement rate increase, the radar issues automated alarms to the mill control room operator, as this position is staffed continuously. The control room operator will communicate with the pit foreman, operations supervisor, and geotechnical engineer/EIT, as outlined in the safe work practice, to address the alarm or cease work in the affected area.

All pit walls are inspected weekly by the geotechnical engineer or EIT, accompanied by geology and engineering personnel. These inspections check all exposed walls for signs of instability or changing conditions such as raveling, crack formation, overhangs, and major or unfavorably oriented structures. The reports issue guidelines for safe work and can order corrective actions, if required. These can include:

- More frequent inspections;
- Rockfill berms at bench-level to arrest raveling material;
- Delineators at bench level restricting access to areas;
- Instrumentation such as prisms or survey hubs;
- Mandatory use of a spotter for work underneath certain areas;
- Work restrictions for adverse weather conditions;
- Completion of a Job Hazard Analysis (JHA) process prior to commencing work; and/or
- Highwall redesign and blasting / excavation of structural units that present a risk of failure.

An inspection by an external consulting geotechnical engineer is also performed annually.

5.1.5 Blasting and Wall Control

Wall control is achieved by means of trim blasting and pre-shear.

Trim blasting is the practice of firing dedicated wall control blasts along the perimeter of the pit, no more than five rows deep. This allows material to move freely away from the wall, minimizing the amount of energy transferred into the wall itself. Trim blasts are always fired independently of production blasts and are always shot to free faces; that is, all previously blasted material is mined out along the perimeter of a trim blast. To further minimize the amount of energy transferred into the wall, blasts are tied in such that the direction of movement is parallel to the wall instead of perpendicular to it.

Minto uses pre-shear drilling to further enhance wall control. This is a technique in which closely-spaced small-diameter holes, drilled to follow the final contour of the wall, are loaded with decoupled charges. Groups of holes are fired simultaneously, encouraging the formation of a fracture plane between them. Much of the strain energy from production / buffer blast holes, upon meeting this discontinuity, will be reflected back, instead of continuing into the wall where it would result in back-break.

5.1.5.1 Explosives

For production blasts, the mine uses mini-prill ANFO with a bulk density of 1050 kg/m^3 as its default product; it is used wherever ground conditions are dry or holes can be dewatered and lined. In wet conditions, a water-resistant 70/30 emulsion/prill product is used. The decision to switch to an emulsion blend is at the blaster's discretion in the field.

Dry product is preferred; however, groundwater conditions are variable and, when high influx of water is encountered, emulsion use can increase to 100% of total bulk product.

5.1.5.2 Typical Wall Design Parameters

The following figure shows Minto's wall drilling standards for 6.0m and 12.0m benches. All of Minto's pit designs have catch benches at 24m intervals. Every fourth bench is therefore shot above a catch bench, and the standards are modified to prevent damage to the crest by eliminating subgrade and laying out the holes such that they do not fall directly over the crest.

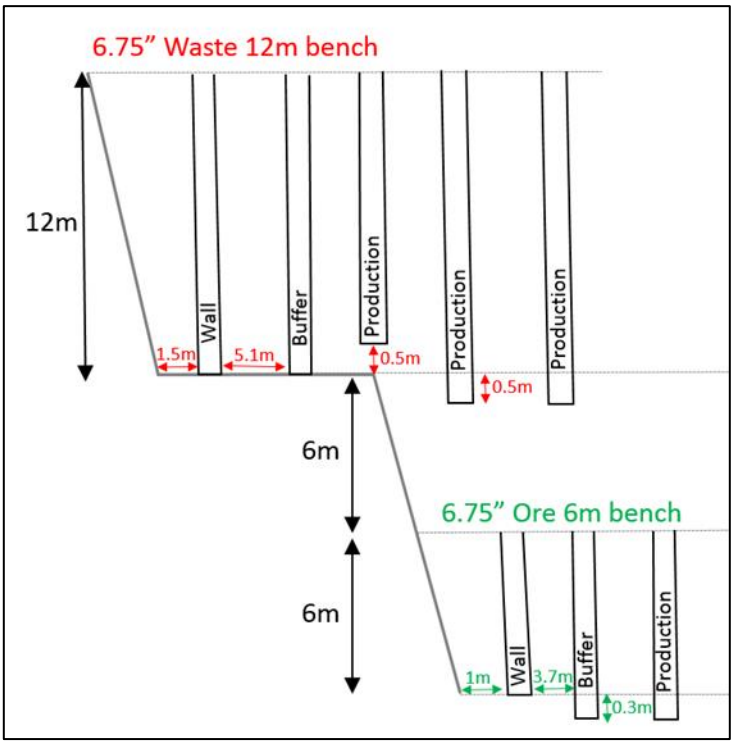

Figure 5: Design constraints for wall shots – 12.0m and 6.0m.

5.1.6 Haul Roads

Haul roads at Minto are typically designed to accommodate Cat 777 haul trucks in dual or single lane configurations. Road widths are based on the requirements of Yukon WCB regulation 15.43(1)(a):

i. not less than three times the widest haulage vehicle used where dual lane traffic exists, or
ii. not less than two times the widest haulage vehicle used where only single lane traffic exists.

Berms are designed to be 75% of the trucks' tire height, as per Yukon WCB regulation 15.43(1)(b).

Allowance is typically made for an approximately one meter wide ditch on one side of the road.

These factors yield the following road design characteristics:

Table 9: Haul road design parameters.

Parameter	Dual Lane Width	Single Lane Width
Truck width	6.5 m	6.5 m
Road surface width	19.5 m	13.0 m
Tire height	2.7 m	2.7 m
Berm height	2.0 m	2.0 m
Berm width	5.0 m	5.0 m
Total road width, against highwall (one berm, one ditch)	25.5 m	19.0 m
Total road width, two berms, one ditch	30.5 m	24 m

Design grade is 10%. Grade limits are applied to the inside corner of a turn.

A speed limit of 50 km/h is in effect on mine roads. Minto has a light-vehicle training and sign-off program intended to ensure that personnel are familiarized with the mine site prior to driving. All personnel and all types of vehicles are required to announce their presence at call points, which are marked with roadside signs: these are typically busy intersections or areas with limited visibility.

Minto's Safe Work Procedure for vehicle operation specifies the following priorities for right-of-way:

1. Emergency vehicles;
2. Explosive trucks;
3. Crew busses;
4. Loaded haul trucks;
5. Empty haul trucks;
6. Service equipment (fuel, water, and heavy maintenance trucks);
7. Light vehicles.

Passing of haul trucks is not permitted.

5.2 Fleet

Minto's fleet is largely contractor-owned and operated, with the exception of the blast hole drills used for both production and pre-shear drilling. The following table summarizes the available equipment.

Table 10: Open-pit equipment fleet for Phase V/VI mining

Equipment Type	No. of units
Hitachi EX2500 front shovel	1
Hydraulic Excavators, Hitachi EX1200 or similar	3
100-ton Haul Trucks, Cat 777	10
60-ton Haul Trucks, Cat 773	2
Front-end loaders, Cat 990 / Cat 992	2
Small Hydraulic Excavators, Cat 330 or similar	2
D11-class dozer	2
D10-class dozers	3
Graders, 16' blade	3
Contractor blast hole drills	3
Blast hole Drill, Sandvik DR560, 4 to 8" hole diameter	2

6 Closure

This document presents the mine development and operations plan for Ridgetop North open pit mining at Minto Mine. This plan will be updated as required based on ongoing mine planning and optimization.

7 References

Minto Explorations Ltd. (2012) *Phase VI Preliminary Feasibility Report, Minto Mine.*

Minto Explorations Ltd. (2014) *Mine Development and Operations Plan.*

Minto Explorations Ltd. (2016) *Underground Mine Development and Operations Plan.*

SRK Consulting Inc. (2009) *Pre-Feasibility Geotechnical Evaluation, Phase IV, Minto Mine.*

SRK Consulting Inc. (2015) *Pit Slope Evaluation, Minto Mine, Area 2 Pit – Stage 3.*

Yukon Water Board/Yukon Energy, Mines and Resources (2013) *Plan Requirement Guidance for Quartz Mining Projects.*