capstone
MINTO MINE

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September 16, 2015

Robert Holmes
Director of Mineral Resources
Department of Energy, Mines and Resources
P.O. Box 2703
Whitehorse, YT Y1A 2C6

Dear Mr. Holmes,

Please see the attached update to Minto Mine's Underground Ground Control Plan.
This update replaces the document by the same name submitted in July 2013 (*Minto Mine Ground Control Plan—Underground* (rev. 0), Minto Explorations Ltd. July 2013.)

If you have any questions or concerns regarding the attached report, please do not hesitate to contact me at jennieg@mintomine.com / 604-759-4659, or Ron Light, General Manager.

Regards,

Jennie Gjertsen
Manager Environment, Sustainability and Community Affairs
Minto Explorations Ltd.

Attachments:
- *Minto Mine Ground Control Plan—Underground* (rev.1*)*, Minto Explorations Ltd. June 2014.

Minto Mine Ground Control Plan—Underground Operations

Minto Mine Ground Control Plan—Underground Operations

First Issue: July 2013

REVISION INFORMATION

Rev. Number	Issue Date	Description & Location of Revisions Made	Signatures		
			Originator	Checked	Approved
0	July 17, 2013	First issue	EM		
1	June, 2014	Update of rock mass characterization. Revisions to ground support standards.			

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General Statement and Corporate Message

Capstone Mining Corp. Minto Mine maintains the Health and Safety of the people involved in activities at the mine as the primary value entrenched into everything we do. We strive for “Safe Production” by ensuring people clearly understand that no one is expected to work in substandard conditions, with substandard tools or put them self at risk in any way performing their duties at the Minto Mine. We maintain a Target: ZERO philosophy that believes all incidents are preventable and that every effort must be made to eliminate significant accidents and reduce minor incidents toward ZERO.

Introduction

The purpose of this Ground Control Plan—Underground Operations (GCP) is to provide a system for the management of the ground control strategy at Capstone Minto Mine Underground Operations. The Ground Control Plan shall:

- outline systems for evaluating, designing, maintaining, and monitoring excavation stability to prevent personal injury, damage to equipment or loss to process;
- present a structure that defines core responsibilities and accountabilities;
- develop and maintain a process for hazard identification and risk management with regard to ground control and geotechnical mine design; and
- introduce methods to effectively monitor and measure compliance to legislative regulations and corporate policy through audit and review processes.

The intent of the GCP is therefore to outline the strategies aimed at eliminating or minimising the risk of falls of ground or collapse in the underground operations which may result in fatalities, injuries, equipment damage or loss of production.

The GCP is a live document that will change continuously with new standards, technology, working procedures and annual reviews and applies to all personnel at the Minto Mine.

Document Layout

The GCP has three parts:

Part One: Design

This section discusses the processes undertaken to determine the excavation design parameters, support requirements, and proposed mining methods to be applied in the various underground areas. This includes a summary of the site geology, rock mass characterization, minimum ground support standards and practices to manage the predicted ground conditions.

Part Two: Implementation

This section discusses the procedures and systems for implementing the designed ground control program. This includes Safe Work Practices for all ground support installation, a hazard recognition program, ground control communication systems, workforce training and emergency response.

Part Three: Verification

This section outlines practices and procedures for verifying the ground control design. This includes inspections and data collection, quality assurance/quality control, and audits, updates and reviews of the Ground Control Plan.

Accountability and Responsibilities

A register of all people with accountability and responsibility under this plan will lie with the Mine General Manager. Each nominated person will sign off as having read the plan and understand their accountability and responsibility.

General Manager

The General Manager has the overall responsibility for, and is the only official who may authorize the implementation, review and revision of, the GCP. The General Manager shall ensure that:

- suitably trained and qualified persons are formally appointed to the following positions:
- Mine Manager;
- Operations Superintendent;
- Chief Engineer;
- Underground Safety / Training Coordinator; and,
- Geotechnical Engineer.

Mine Manager

The Mine Manager (or delegate) shall ensure that:

- the GCP is implemented and all regulatory requirements are met;
- adequate resources are allocated and competent technical and operational personnel are appointed.

Operations Superintendent

The Operations Superintendent (or delegate) shall ensure that:

- the GCP is implemented and complied with, and all the requirements are met;
- Safe Work Practices are implemented and work practices are regularly monitored;
- adequate training is given to all underground personnel;
- suitable equipment is supplied and maintained to the specifications required for quality ground control; and
- audit, review and quality assurance programs are carried out and documented regularly.

Mine General Foremen and Shift Supervisors

The Mine General Foreman and Shift Supervisors (or delegate) shall ensure that:

- the work sites and the travel ways are adequately supported through adherence to the ground control requirements set out in the layouts;
- SWPs are implemented and monitored to ensure compliance;
- ensure any unusual ground conditions are noted and brought to the attention of the engineering group;
- all personnel receive appropriate training;
- the designed support/ reinforcement is installed to the specified standards; and
- reports on ground falls, and variations to ground support standards (issued as Ground Control Directives) are addressed and distributed as required.

Chief Engineer

The Chief Engineer (or delegate) shall ensure that:

- the GCP is implemented and updated when needed;
- competent geotechnical engineers/geologists are appointed;
- adequate training is given to the site based geotechnical engineers, geologists and mining engineers;
- training modules are developed and implemented through the site based Geotechnical Engineers/Ground Control Geologists in conjunction with the Underground Training Coordinator;
- SWPs are developed, monitored, and modified when needed, in conjunction with the Health and Safety Department.

Geotechnical Engineer

The Geotechnical Engineer (or delegate) shall ensure that:

- the GCP is implemented and updated regularly;
- major geotechnical aspects are adequately considered in relation to mine design and planning;
- monitoring, auditing, and testing systems are developed and maintained;
- on-going mapping/data collection is carried out to identify variations in ground conditions; and
- ground control directives are issued for specific conditions/excavations not covered in this plan.

All Operational Personnel

All operational personnel shall ensure that:

- no work is undertaken without a plan;
- only work in line with current competencies is undertaken;
- SWPs are followed;
- ground conditions are inspected in line with Workplace Shift Inspections at every work site;
- ground conditions are monitored during the shift for the presence of loose or unstable ground;
- if any rock noise is heard or the ground being worked is unsafe, withdraw and barricade the area, then immediately notify the Supervisor; and
- relevant information in relation to ground conditions/support is reported back to the Shift Supervisor and Geotechnical Engineer.

Mandatory Requirements

- NO PERSON IS TO ENTER UNSUPPORTED GROUND. Supported (secured) ground is deemed to be ground where a complete ground support system has been applied as per required standards.
- All excavations must conform to, or exceed the minimum ground control standards specified in this document.
- All ground control work must follow established SWPs.
- All personnel must inspect ground conditions and check the adequacy of ground control when entering an underground heading/access/work area.
- All personnel must immediately report uncontrolled falls of ground and ground control hazards to their immediate supervisor who will be responsible for follow up and documentation.
- All reports of conditions requiring actions outside of standard work will be recorded in the Ground Control Log Book and followed-up with a documented Work Place Inspection (WPI) to ensure the efficacy of the remedial action.

Part One: Design

The mine design is determined by the geological, geotechnical, and hydrogeological data collected to characterize the Minto ore bodies. Data collected for use in mine design, and the design processes are detailed in this section.

1 Description of the Mine

The Minto Mine is located in the Whitehorse Mining District in the central Yukon Territory. The property is located approximately 240 km northwest of Whitehorse, the Yukon capital. Open pit mining is currently taking place in the Area 118 Pit, scheduled to be completed in Q3, 2014. Underground mining is taking place in the Area 118 underground, accessed by the Area 118 portal; and the M-Zone (Area 2) underground, accessed by the M-Zone portal at the bottom of the Area 2 Pit.

Figure 1-1: Plan view of Minto Mine (Sept. 2013) — underground and open pit operations

2 Rockmass Characterization

2.1 Geological Overview

The Minto mine is located 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 2-1). The Belt is host to several intrusion-related Cu-Au mineralized hydrothermal systems.

Minto and the surrounding area are underlain by plutonic rocks of the Granite Mountain Batholith (Early Mesozoic Age) 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.

The hypogene copper sulphide mineralization at Minto is hosted wholly within the Minto pluton, predominantly of granodiorite composition. Hood et al. (2008) distinguish three varieties of the intrusive rocks in the pluton:

- Megacrystic K-feldspar Granodiorite - 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 metres to tens of metres thick.

- Quartzo-feldspathic Gneiss – composed of centimeter-thick compositional layering and folded by centimetre to decimetre-scale disharmonic, gentle to isoclinal folds (Hood et al., 2008).

- Biotite-rich Gneiss.

Minto geologists consider all units to be similar in origin and are variably deformed equivalents of the same intrusion; however, 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 logging/mapping separates the foliated to gneissic textured granodiorite as a distinctly unit.

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 one metre core intersections.

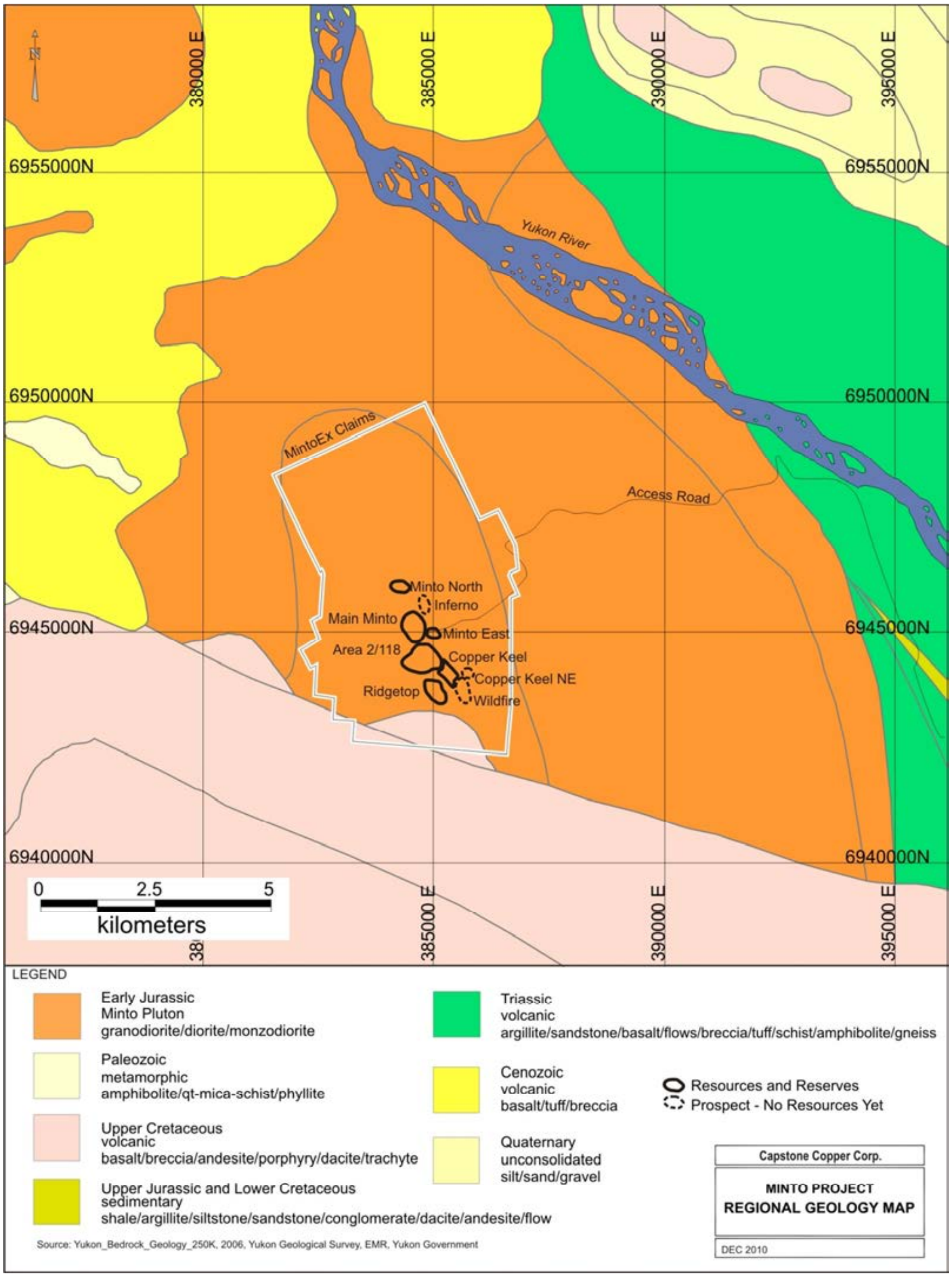


Figure 2-1: Regional Geology

2.1.1 Geologic Structure

Both ductile and brittle phases of deformation are found around the Minto deposits. As noted above, 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 zone forms sub-horizontal horizons within the more massive plutonic rocks of the region that can be traced laterally for more than 1,000 m. The horizons are often stacked in parallel to sub-parallel sequences.

Internally, the foliation exhibits highly variable orientations within individual horizons with the presence of small-scale folds. The foliation is often observed to be at a high angle to contacts with more massive textured rock units.

Late brittle fracturing and faulting is noted throughout the property. Some of these faults are significant from an economic standpoint. The Minto Creek fault (MC Fault) bisects the Minto Main deposit, dividing it into north and south areas and is modelled 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 (Figure 2-2).

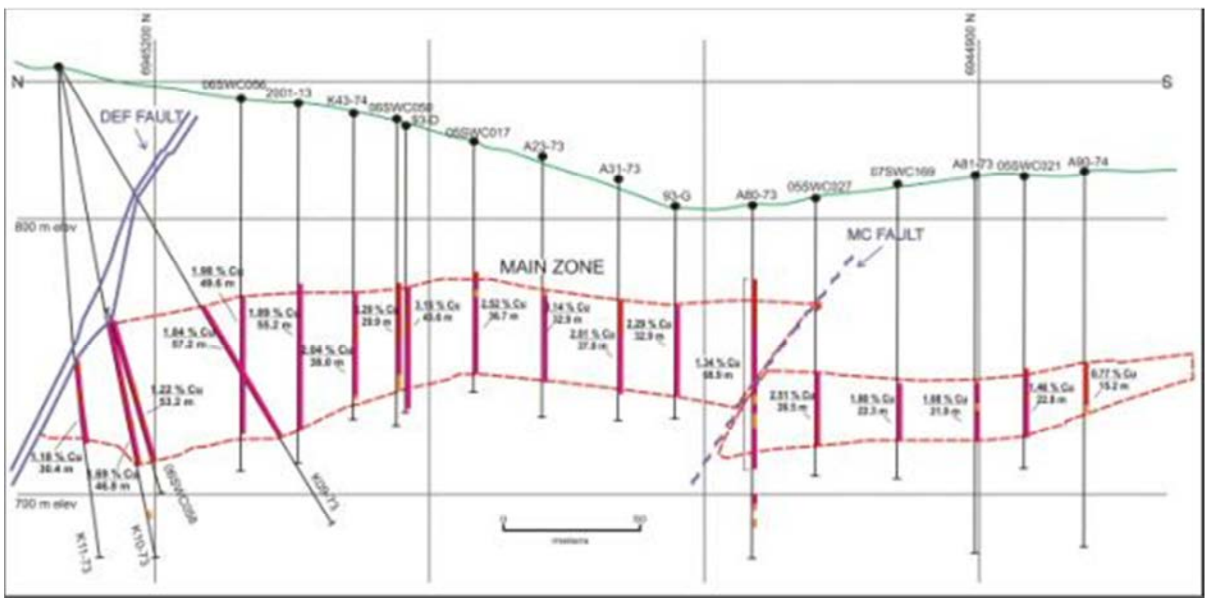


Figure 2-2: North- South Cross Section through Minto Main Deposit showing DEF Fault and MC Fault

The DEF fault defines the northern end of the Main deposit. It strikes more or less east-west and dips north-northwest and cuts off the main zone mineralization, as shown in Figure 2-2. This late block faulting is noted throughout the Granite Mountain Batholith and in some instances a rotational component is noted as well. Tafti & Mortensen (2004) found the Cretaceous Age Tantalus Formation rotated up to 60° from horizontal in areas located south of the Minto deposit.

A zone of pervasive fracturing on the west side of the deposit limits ore grades in this direction. Foliated horizons do not line up across this fracture zone. It is presumed to be one of the north-south faults that are part of the late brittle conjugate set.

The boundary between Area 2 and Area 118 is an intermediate NE dipping fault. The displacement of the mineralization is significant. The easiest zone to identify (based on mineralization and texture) is the “N” zone which has up to 66 m of vertical throw across the boundary fault. Other zones show changes in thickness and orientation, suggesting the presence of pure strain and block rotation. A similar NW striking fault zone appears to be present that defines the northeastern boundary of the Ridgetop deposit, and defines the outcrop of Cretaceous conglomerate. The dip of this structure is unknown.

At least two parallel NW striking structures are interpreted to displace mineralized domains in Area 118. Limited evidence of these has been observed in the Area 118 pit and underground development to date.

2.2 Geotechnical Model

2.2.1 Rock Types

Primary rock types at the Minto underground are listed below in decreasing order of volumetric significance:

1. Granodiorite
    a. Megacrystic K-feldspar
    b. Quartzofeldspathic gneiss
    c. Biotite-rich gneiss
2. Conglomerate
3. Dykes - simple quartz-feldspar pegmatite, aplite; and aphanitic textured intermediate composition rock

For the majority of the excavations completed at Minto, Granodiorite was the major intersected unit. As discussed in Section 1.1, mineralization typically occurs in foliated to gneissic variations of the host Granodiorite. Experience to date indicates the waste rock typically has higher intact strength but is more fractured than the ore. Conglomerate and dykes are not geotechnically significant in the underground and thus have not been characterized in this plan.

2.2.2 Discontinuities

Extensive structural mapping has been carried out in the Area 2 Pit, Area 118 underground, and M-Zone underground, summarized in Table 2.

In general the sets results in conditions underground in waste rock varying from moderately blocky to very blocky and typically wedge-prone. Discontinuities in waste rock are very continuous, extending larger than the excavation size. In ore, the sets are less persistent and more widely spaced, resulting in only occasional blocky conditions. Few wedges have been observed in ore exposures to date.

Several faults have been observed in the underground development at various orientations. Most are relatively discrete structures with limited width and minor alteration of the wall rock; however, several in the Area 118 underground are water-bearing indicating they are open and continuous. Fault orientations, summarized in Table 4, typically align with joint set J1.

Table 2: Major Joint Sets in Waste Rock

Major Joint Set	Average Dip	Average Dip Direction	Sub-sets	Average Dip	Average Dip Direction	Area Observed	Comments
J1	54	45	-	-	-	• Area 2 Pit • Area 118 Pit	Major fault orientation in A2 Pit ("320 Fault"). Observed underground as steeper dipping set J2.
J2	80	41	J2b	81	219	• Area 2 Pit • M-Zone UG • Area 118 Pit • Area 118 UG	Major set in Area 2 Pit. Moderate set underground.
J3	58	137	J3b	83	301	• Area 2 Pit • M-Zone UG • Area 118 Pit • Area 118 UG	Major set in all areas.
J4	78	163	J4b	86	333	• Area 2 Pit • M-Zone UG • Area 118 UG	Major set in all areas.
J5	40	322	-	-	-	• Area 2 Pit • Area 118 Pit	Minor set in open pits. Not observed underground.
J6	73	350	-	-	-	• Area 2 Pit and ug waste • M-Zone ug ore	Moderate set in open pits. Observed underground as steeper dipping set J4b.

Table 3: Major Joint Sets in Ore (M-Zone)

Major Joint Set	Average Dip	Average Dip Direction	Comments
J3	68	142	Major set in M-Zone ore.
J4b	79	337	Minor set in M-Zone ore.
J7	53	87	Minor set in M-Zone ore. Minor set in waste rock.

Table 4: Major Structures

Structure Description	Average Dip	Average Dip Direction	Comments
Mapped Fault	66	34	Water bearing fault mapped in118 underground waste rock.
Mapped Fault	66-76	20-35	Water bearing fault mapped in118 underground waste rock.
Mapped Fault	64-74	40-50	Major fault zone in Area 2 Pit (“320 Fault).
Mapped Fault	60	160	Gouge filled fault in M-Zone underground.
Interpreted Fault	54	47	Interpreted to offset 118 ore lenses.
Interpreted Fault	57	64	Interpreted to offset 118 ore lenses.
Interpreted Fault	51	51	Interpreted to offset 118 ore lenses.

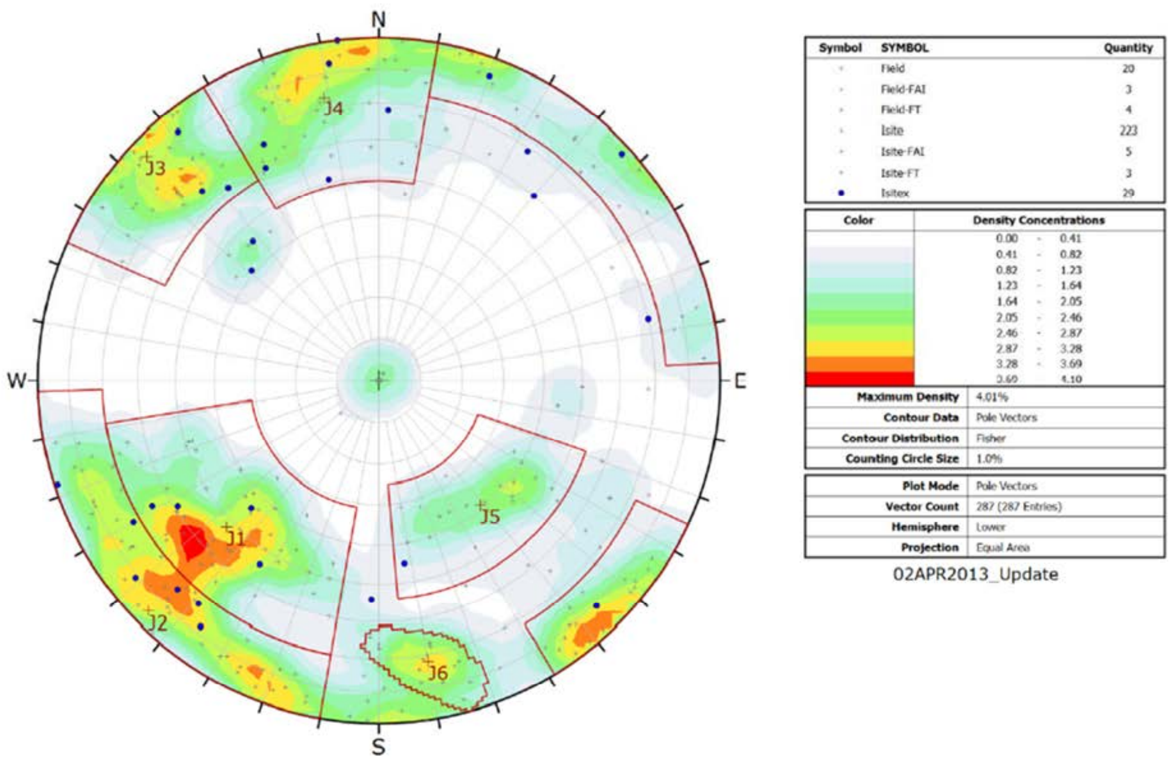


Figure 2-3: Area 2 Pit Waste Rock Mapping Data (SRK, 2013)

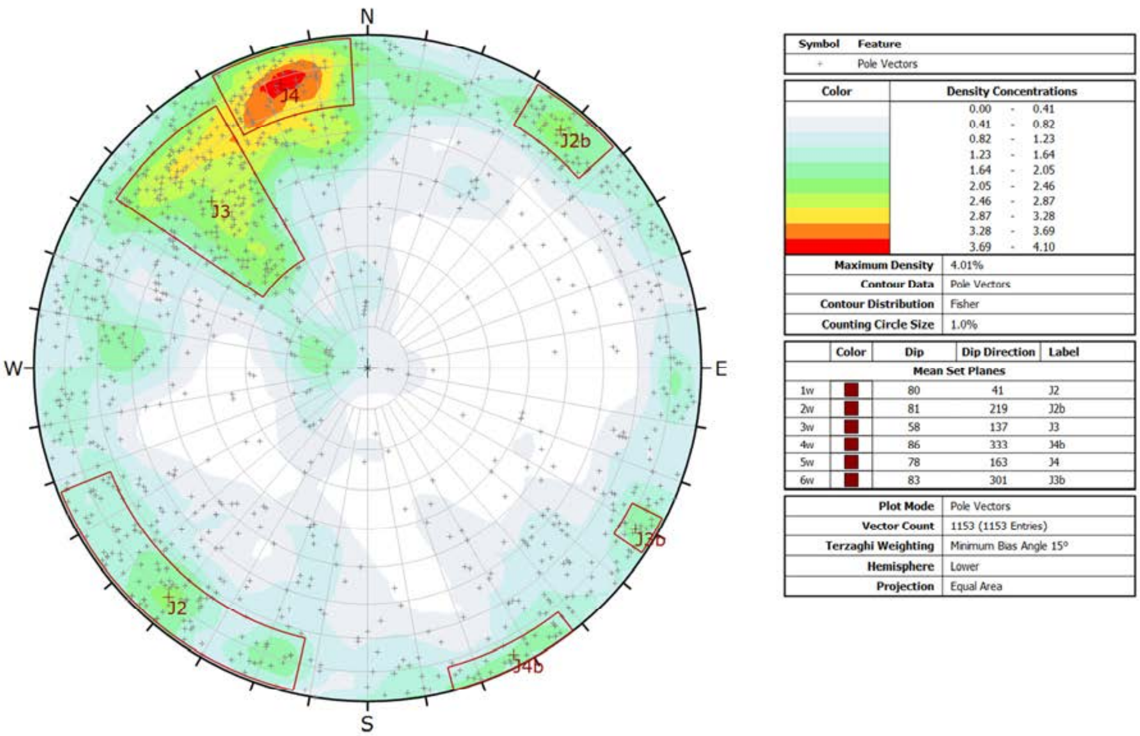


Figure 2-4: Underground Waste Rock Mapping Data (118 and M-Zone)

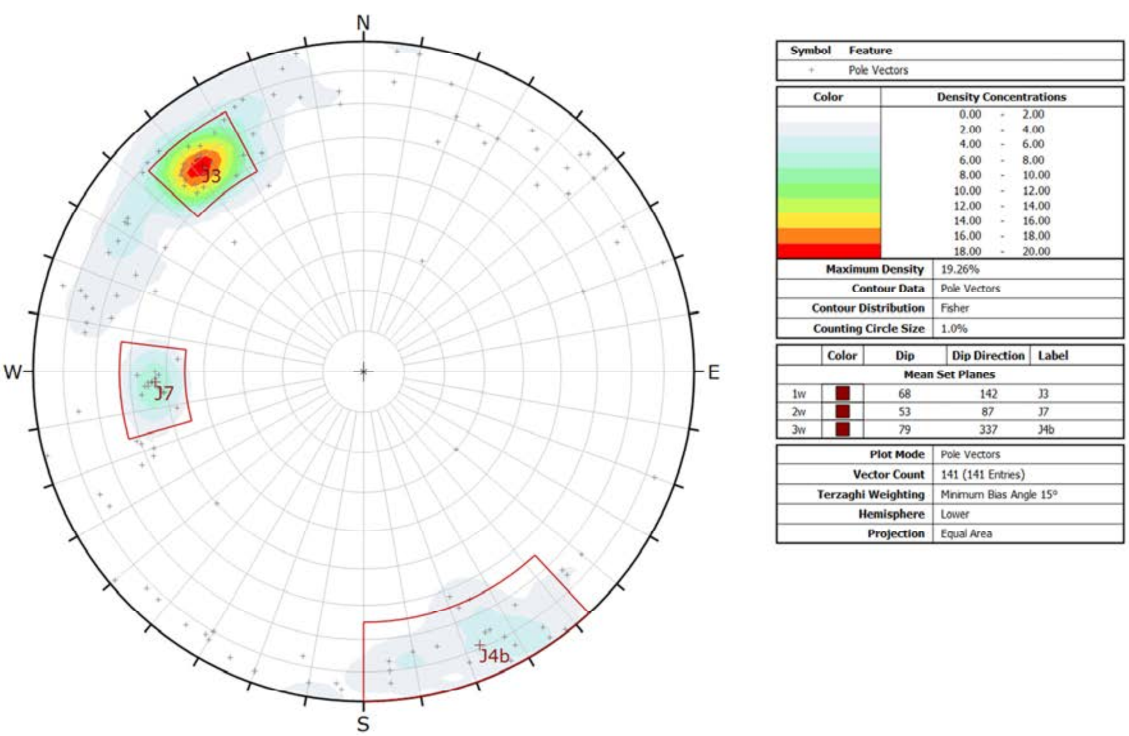


Figure 2-5: M-Zone Underground Ore Mapping Data

Direct shear testing on discontinuities was carried out in 2009 by SRK at the University of Arizona, summarized in Table 5.

Table 5: Direct Shear Strength Testing on Discontinuities

Area	Drillhole ID	Depth	Lithology	Friction Angle	Cohesion (kPa)
Area 2	C09-03	162.55	Foliated Granodiorite (fG)	33.7	10.0
Area 118	C09-01	49.87	Porphyroblastic Granodiorite (pG)	40.7	21.6
Area 118	C09-01	103.00	Porphyroblastic Granodiorite (pG)	35.0	20.5
Area 118	C09-01	212.15	Porphyroblastic Granodiorite (pG)	33.4	1.3
Area 118	C09-02	211.14	Porphyroblastic Granodiorite (pG)	32.9	5.7
			Average	35.1	11.8

2.2.3 Intact Rock Strength

Intact rock strength properties, summarized in the following tables, are based on the results of a 2009 testing program by SRK.

Table 6: Summary of Testing for Intact Strength Properties

Area	Lithology	Condition	UCS (MPa) (excluding invalid tests)				Young's Modulus (E) (GPa)	Poisson's Ration	Brazilian Tensile Strength (MPa)	Density (kN/m^3)
			tests	min	max	mean				
Area 2	Equigranular Granodiorite (eG)	Fresh	1	103	103	103	-	-	-	26.3
		Weathered	1	72	72	72	-	-	-	24.9
	Foliated Granodiorite (fG)	Fresh	1	104	104	104	47	0.23	7.6	26.5
	Porphyroblastic Granodiorite (pG)	Fresh	1	150	150	150	15	0.08	-	25.8
		Weathered	1	49	49	49	-	-	-	26.6
Area 118	Equigranular Granodiorite (eG)	Fresh	1	150	150	150	-	-	-	26.3
	Foliated Granodiorite (fG)	Fresh	3	120	165	138	67	0.30	-	26.5
	Porphyroblastic Granodiorite (pG)	Fresh	4	72	156	126	49	0.21	10.1	26.3
		Weathered	1	88	88	88	51	0.22	-	26.1

Table 7: Summary of Triaxial Testing

Area	Drill hole ID	Sample Depth (m)	Unit Weight (kN/m3)	Lithology	σ3 (MPa)	σ1 (MPa)
Area 2	07SWC201	28.9	25.6	Porphyroblastic Granodiorite (pG)	9.65	112.7
Area 2	07SWC201	180.00	26.6	Foliated Granodiorite (fG)	15.9	253.9
Area 2	07SWC196	126.40	26.2	Porphyroblastic Granodiorite (pG)	6.2	189.7
Area 2	07SWC196	210.30	26.3	Foliated Granodiorite (fG)	21.4	180.5
Area 118	09SWC424	59.88	26.4	Porphyroblastic Granodiorite (pG)	6.9	222.1
Area 118	09SWC424	153.30	26.2	Equigranular Granodiorite (eG)	17.2	276.8
Area 118	09SWC422	150.10	26.4	Porphyroblastic Granodiorite (pG)	10.3	213.8
Area 118	09SWC422	209.69	26.4	Porphyroblastic Granodiorite (pG)	13.8	294.1
Area 118	09SWC420	250.17	26.5	Equigranular Granodiorite (eG)	13.8	288.2

2.2.4 Rock Mass Properties

Rock mass properties, summarized in Table 8, are estimated from diamond drillhole data and geotechnical mapping.

Table 8: Rock mass parameter summary for underground mining areas

Area	Source	Type	Condition	Number of Samples	RMR(89)			Q' Range		
					min	max	avg	min	max	avg
Area 2	Core Logging (SRK)	eG,pG,fG	Fresh	409 runs	29	82	60	-	-	-
			Weathered	162 runs	18	68	46	-	-	-
Area 118	Core Logging (SRK)	eG,pG,fG	Fresh	334 runs	22	81	58	-	-	-
			Weathered	59 runs	21	72	51	-	-	-
Area 2 (M-Zone)	Underground mapping	fG	Fresh	92 m	55	92	77	0.8	50.0	9.6

2.2.5 In-Situ Stress

Based on the world stress map (Figure 2-6; http://dc-app3-14.gfz-potsdam.de/index.html), the major stress orientation is likely to be in a north-east—south-west direction. An estimate of stress magnitude is not available, but based on the currently planned shallow depth of mining stress is not likely to be an issue. No indications of overstress have been observed in the underground excavations to date.

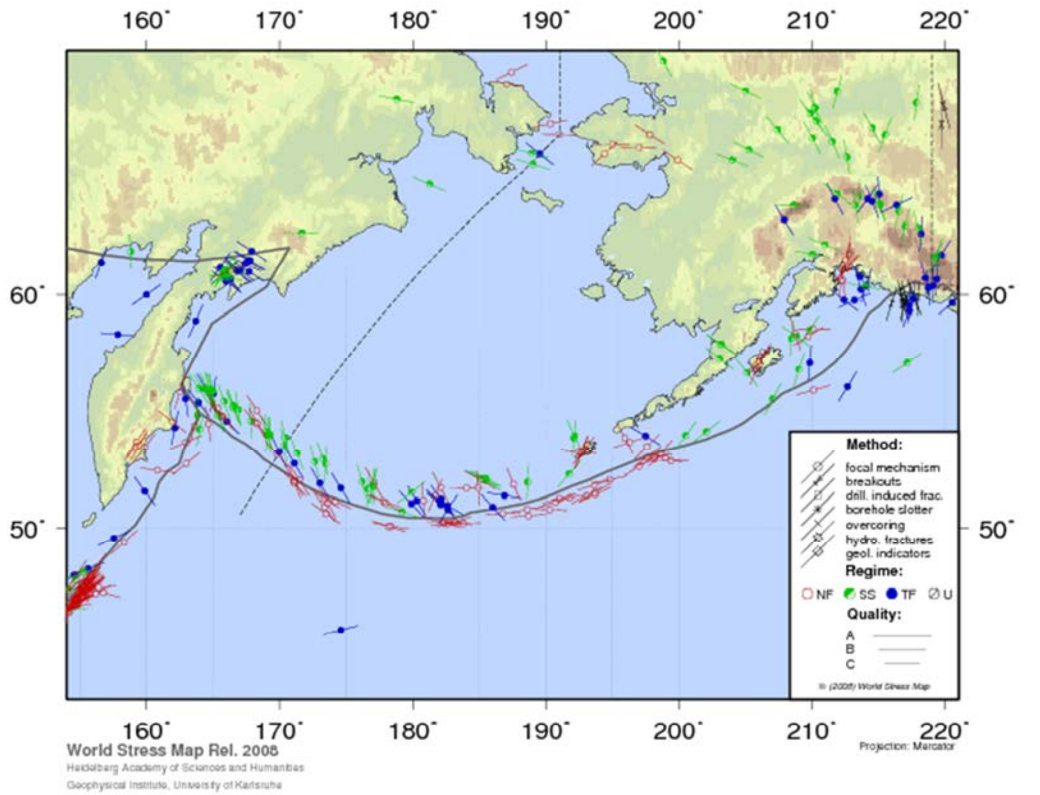


Figure 2-6: World Stress Map for Aleutian Arc

2.3 Hydrogeology

Based on underground development to date, groundwater flow rates have been observed to be moderate with no grouting or dewatering completed. Seeps and inflows (up to approximately 20 GPM) have been encountered in the main ramp and 740 level access in Area 118, and the crosscuts in Area 2 M-Zone. The main inflows have been encountered in fault/fractured zones, in particular near the footwall of the orebodies. Underground development has not been completed yet into the hanging wall.

Several ungrouted diamond drill holes have been encountered in Area 118 which have produced inflows, typically draining and then drying up quickly from the back but flowing continuously from the floor at up to 20 GPM.

Based on experience in the underground to date and the Area 2 Pit, inflows into the remaining planned underground are expected to be manageable with the designed sump and pumping system. The lowest planned elevation in the Area 118 underground is approximately the same as the planned Area 2 Pit bottom elevation at 676m.

Table 9 presents the rock mass permeability measurements completed by Golder (1974).

Table 9: Rock mass permeability values (Hatch, 2006 after Golder, 1974)

Lithology	Range (cm/sec)		Design Values (cm/s)
	Lower	Upper	
Highly weathered—near surface	9.0x10^6	1.5x10^4	5.0x10^6
Highly weathered—fault associated	5.3x10^6	7.0x10^6	6.0x10^6
Moderately weathered	4.7x10^6	8.4x10^6 (1)	6.0x10^6
Fresh rock	1.5x10^6	8.3x10^6 (1)	3.5x10^6

Note 1: Excludes results from shattered zones

3 Design Criteria

3.1 Design References

Underground design parameters were developed based on analyses outlined in the following documents:

- Prefeasibility Geotechnical Evaluation, Phase IV (SRK, 2009)
- Minto Phase VI Underground Geotech Evaluation –Draft (SRK, 2012)
- Report on the Itasca Site Visit of 16-19 October 2012 at Minto Mine (Itasca, 2012)
- Report on the Itasca Site Visit of 26-28 February 2013 at Minto Mine (Itasca, 2013)
- Itasca June 2013 Site Visit at Minto Mine (Itasca, 2013)
- Itasca Site Visit of October 2013 at Mine Mine (Itasca, 2013)
- Three-Dimensional Numerical Simulation of the M-Zone at Mine Mine (Itasca, 2014)
- Structural Stability Analyses at Minto Mine (Itasca, 2014)
- M-Zone Updated Geotechnical Assessment (Internal, 2014)
- Itasca Site Visit of April 2014 at Mine Mine (Itasca, 2014)
- Kinematic Analysis-Underground Excavations (Internal, 2014)

3.2 Underground Mining Methods

Underground mining methods, described in the following sections, were selected based on orebody geometries, grades and geotechnical conditions. All underground mining is currently being carried out by an independent mining contractor, Dumas.

3.2.1 Area 118

The Area 118 ore body is planned to be mined using a combination of room and pillar (RAP) and post-pillar cut and fill (PPCF). Area 118 geometry is summarized in Table 9, and shown in Figures 3-1 and 3-2, and planned excavation sizes are summarized in Table 10.

Table 10: Summary of Area 118 Geometry

Dimension	Minimum	Maximum	Average
Dip (degrees)	18	45	25
Elevation (m)	652	757	-
Depth (m)	150	220	-
Length along strike (m)	30	255	145
Thickness (m) (estimated)	15	35	22
Cut Height (m)	-	-	5
Number of Cuts	-	-	22

Table 11: Summary of Area 118 Excavation Dimensions

Excavation	Dimensions	Comment
Development headings	5.0m W x 5.0m H	Includes decline, level access, remucks
Rooms	≤10m	Further analysis into production rooms/pillars is currently underway.
Pillars	5.0m W x 5.0m H – typical 5.0m W x 15.0 m H – max	Pillars >5m high will be mined in multiple cuts with backfill. Further analysis into production rooms/pillars is currently underway.
Ventilation Raises and Escapeways	3.0m x 3.0m 3.0m x 5.0m	>70° dip

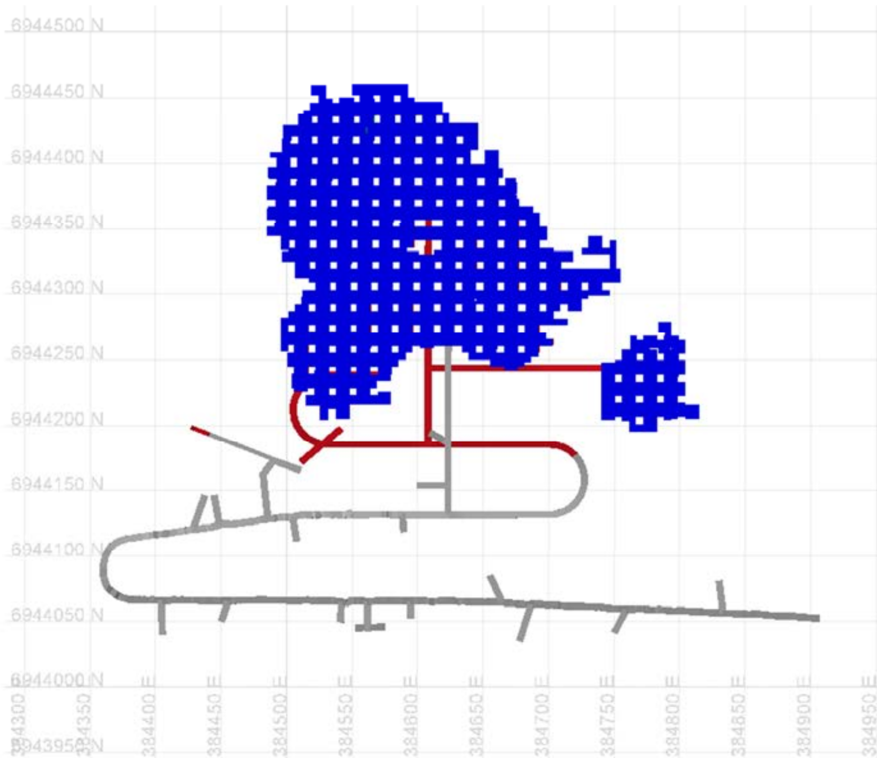


Figure 3-1: Area 118 Underground Plan View

(Grey = as-built development, Red = Planned Development, Blue = Planned Production Rooms)

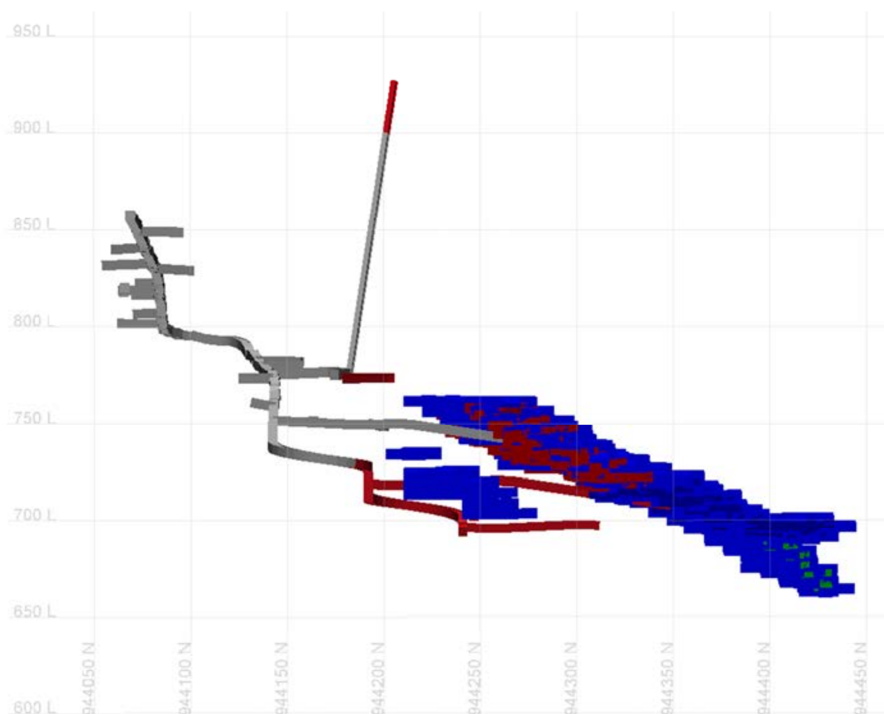


Figure 3-2: Area 118 Underground Looking West

(Grey = as-built development, Red = Planned Development, Blue = Planned Production Rooms).

3.2.2 Area 2 (M-Zone)

The Area 2 ore lens (M-Zone) is planned to be mined using a longhole open stope method, accessed through a portal at the Area 2 pit bottom. M-Zone geometry is summarized in Table 12, and shown in Figures 3-3 and 3-2, and planned excavation sizes are summarized in Table 13.

Table 12: Summary of Area 2 (M-Zone) Geometry

Dimension	Minimum	Maximum	Average
Dip (degrees) (estimated)	0	8	5
Elevation (m)	668	703	-
Depth (m)	12	111	-
Length along strike (m)	25	115	-
Thickness (m) (estimated)	8	23	18
Number of Stopes	-	-	8

Table 13: Summary of Area 2 (M-Zone) Excavation Dimensions

Excavation	Dimensions	Comment
Development headings	5.0m W x 5.0m H	Includes decline, sumps
Production Crosscuts	6.0m W x 4.5m H	-
Open Stopes	10.0m W x <23.0m H	-
Rib Pillars	5.0m W x <23.0m H	-
Escapeway Raise	1.8m W x 2.1 m H	49° dip

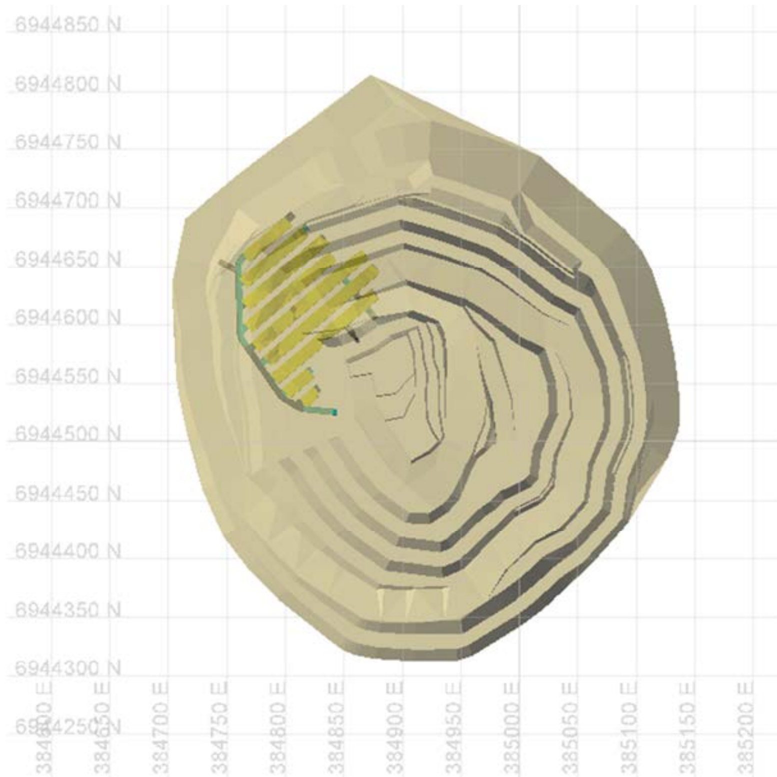


Figure 3-3: Area 2 Pit and Underground Plan View

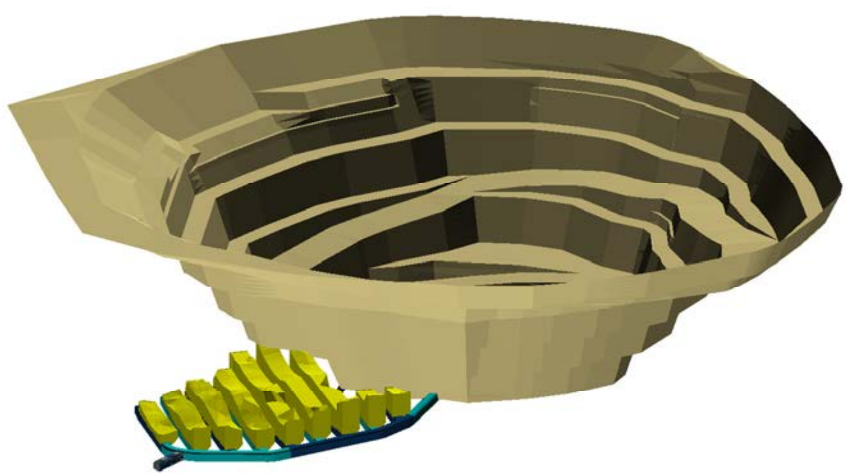


Figure 3-4: Area 2 Pit and Underground Isometric View looking Northeast

3.3 Ground Support Design

Ground support design was carried out using a combination of empirical and kinematic analyses, and experience to date at the Minto site.

3.3.1 Ground Support Elements

Details and specifications of ground support elements used in standard support patterns at Minto are listed below in Table 14.

Table 14: Ground Support Elements

Support Element	Description	Minimum Breaking (tensile) Strength	Plate	Comment
Bolts	#6 (20mm) (3/4") threaded rebar bolt w/ full column resin	12 tonnes	Domed - 12 x 12 cm domed (5" x 5"), 6 mm (1/4")	-
	#6 (20mm) (3/4") forged head rebar bolt w/ full column resin	12 tonnes	Domed - 12 x 12 cm (5" x 5"), 6 mm (1/4")	Used for raise development.
	Super Swellex/Python (36 mm)	24 tonnes	Domed - 15 x 15 cm (6" x 6"), 6 mm (1/4")	-
	Standard Swellex/Python (27 mm)	13 tonnes	Domed - 12 x 12 cm domed (5" x 5"), 6 mm (1/4")	Used for face bolting only.
Resin	J-Lok Resin 30mm x 610mm cartridge 30 second (fast) 180 second (slow)	-	-	-
Mesh	7 gauge welded wire mesh	~ 2-3 tonnes bag strength	-	Galvanized for permanent excavations. Bright for short-term excavations.
Straps	0 gauge welded wire mesh straps	-	-	Galvanized for permanent excavations. Bright for short-term excavations.

3.3.2 Ground Support Standards

Support standards for development and production headings have been developed for two types of ground, as summarized in Table 15 below. Detailed ground support drawings are provided in Appendix A. Ground support for ventilation and escapeway raises will be developed on a case by case basis and issued by the Geotechnical Engineer.

The ground support types outlined below are minimum standards - supervisors and workers installing the ground support should assess the conditions and place additional ground support over and above the stated minimums if conditions warrant.

Table 15: Minimum Ground Support for Development and Production Headings

Type		**Span (m)**	**Primary Support (minimum)**	**Comment**
1	**Development Drifts (typical ground conditions)** Figure A.1	5.0	2.4 m (8 ft.) rebar in back around perimeter of mesh sheets 1.8 m (6 ft.) rebar in back and walls to pin mesh at center 1.8 m (6 ft.) rebar in walls to 1.5 m above floor 1.5 x 1.5 m bolt spacing diamond pattern Galvanized welded wire mesh to 1.5 m above floor	Life of mine infrastructure in typical ground conditions.
2	**Production Drifts (typical ground conditions)** Figure A.2	6.0	2.4 m (8 ft.) rebar in back around perimeter of mesh sheets 1.8 m (6 ft.) rebar in back and walls to pin mesh at center 1.8 m (6 ft.) rebar in walls to 1.5 m above floor 1.5 x 1.5 m bolt spacing diamond pattern Bright welded wire mesh to 1.5 m above floor	Non-permanent development (e.g. stope/production room crosscuts) in typical ground conditions.
3	**Poor ground – fault zones** Figure A.3	≤6.0	2.4 m (8 ft.) rebar in back around perimeter of mesh sheets 4.0 m (12 ft.) Super Swellex/Python to pin mesh at center 1.8 m (6 ft.) rebar in walls to 1.5 m above floor 1.5 x 1.5 m bolt spacing diamond pattern Bright/Galvanized welded wire mesh to 1.5 m above floor	Poor ground, typically consisting of discrete faults (generally <0.3m thick).
Intersection Secondary Support				
1,2,3	**Intersections** Figures A.1-A.3	≤9.5	2.4 m (8 ft.) rebar in back around perimeter of mesh sheets 1.8 m (6 ft.) rebar in back and walls to pin mesh at center 1.8 m (6 ft.) rebar in walls to 1.5 m above floor 1.5 x 1.5 m bolt spacing diamond pattern 4 m (12 ft.) Super Swellex/Python in back and shoulders 1.8 x 1.8 m bolt spacing - Installed at least two rows past the intersection in each direction. Bright/Galvanized welded wire mesh to 1.5 m above floor	To be installed in addition to primary support pattern outlined above. Intersection support to be installed prior to taking wall slash, as per SWP (Appendix B).

Intersections are preferentially located in areas of good ground conditions. If an intersection must be developed in an area of poor ground, a specific ground support design will be completed by the Geotechnical Engineer and issued as a Ground Control Directive.

Longhole stopes will be pre-supported at the stope brows with long support in addition to the standard development support. Two types of brow support are outlined in Table 16. Typically the Geotechnical Engineer will specify which support type to install; however, supervisors and workers installing the ground support should assess the conditions and place additional ground support over and above the stated minimums if conditions warrant.

Table 16: Minimum Ground Support Standards for Open Stope Brow Pre-Support

Type		**Drift Span (m)**	**Brow Pre-Support (minimum)**	**Comment**
A	**Open Stope Brow in Normal Conditions** Figure A.4	≤6.0	4.0 m (12 ft.) Super Swellex/Python - 1 row at 1 m spacing 0-gauge welded wire mesh straps	Used in normal ground conditions.
B	**Open Stope Brow in Fractured/Fault Zone** Figure A.5	≤6.0	4.0 m (12 ft.) Super Swellex/Python - 2 rows at 1 m spacing 0-gauge welded wire mesh straps on the brow row only	Used where continuous fractures, faults or highly fractured ground is encountered at the planned stope brow.

Part Two: Implementation

4 Ground Support Installation

All operators must be trained, qualified and authorized to use the ground support installation equipment. Ground support will be installed according the following procedures, attached in Appendix B:

- Resin/Rebar Installation Procedures (Jennmar, 2014)
- Swellex Bolt Installation (Dumas, 2012)
- Screening with Mechanized Rock Bolter (Dumas, 2011)
- SWP - Underground Intersection Development and Ground Support Installation (Minto, 2013)

Ground support installation specifications are summarized in Table 14.

Table 17: Ground Support Installation Specifications

Support Element	Hole Diameter	Inflation Pressure	Comment
#6 (20mm) (3/4") threaded rebar	26 – 33 mm	-	Hole length 10cm (4") shorter than bolt length. Rebar are installed with torque tension (TT) shear pin nut to allow resin mixing and torqueing in the same direction.
Super Swellex/Python	43 – 52 mm	4350 psi (300 bar)	-
Welded wire mesh	-	-	Screen overlapped by 3 squares, with bolt placed in second square from the edge.

5 Scaling

Scaling will only be undertaken by individuals that have undertaken hazard recognition training and who have been trained and certified in scaling procedures.

Scaling is to be carried out in accordance with the following procedure, attached in Appendix B:

- "Procedure for Scaling" (Dumas, 2011)

Appropriate length scaling bars are available on specified machines and located where required.

5.1 Check Scaling Program

A formal check-scaling program is conducted to ensure all accessible areas underground are check scaled at least annually for all major travel ways.

Where it is found that an area contains considerable amounts of loose, the Geotechnical Engineer or designate is to inspect the area and ascertain if more frequent check scaling or rehabilitation is required.

6 Risk Assessment and Management

6.1 Hazard Recognition Training Program

Hazard recognition training is to be conducted on an annual basis for every person working underground at Minto. This training is mandatory and applies to new employees as a condition of employment. Specific training modules for scaling and ground support are presented at these sessions.

6.2 Hazard Recognition Responsibilities

The following sections are quoted directly from the Yukon Regulations Occupational Health and Safety Act (in effect from November 1, 2006).

Notice of hazards 15.12

(1) Where there is a non-continuous shift operation at a mine or project, the on-coming shift shall be warned of any abnormal condition affecting the safety of workers.

(2) The warning referenced in subsection (1) shall consist of a written record in a log book under the signature of the person in charge of the off-going shift and be read and countersigned by the person in charge of the on-coming shift before the workers are permitted to assume operations in the area indicated in the record.

(3) The log book referred to in subsection (2) shall be available on request to a joint health and safety committee representative, if any, and to a safety officer.

Underground Support 15.48

(1) Every adit, tunnel, stope, or other underground opening, where a worker may be exposed to the danger of rock fall or rock burst while working or passing through, shall be supported by wooden or steel support structures, casing, lining, rock-bolts or combination of any of these to make the openings secure and safe.

Potential rock burst

(2) Where ground condition indicates that a rock burst or uncontrolled fall of ground may occur, the condition and the corrective action taken shall be recorded in writing in the daily log book and signed by the shift supervisor.

Work areas examined

(3) A competent person shall examine all working sections of an underground mine or project at least once during each shift.

Non-work areas examined

(4) Non-working sections of an underground mine or project that are not barricaded or to which access is not prevented shall be examined at least once a month.

Scaling tools

(5) An adequate quantity of properly dressed scaling bars, gads, and other equipment necessary for scaling shall be provided in working sections.

6.3 Ground Control Communication

Communication of ground control issues and concerns among technical, operational and management staff, and between shifts takes place at several levels and includes:

- Shift boss log book;
- Ground control log book;
- Face to face meeting of the shift supervisors between shifts;
- Verbal communication by the crews at shift change;
- Daily production meetings attended by Underground Superintendent and Minto Engineering and Management staff; and,
- Ground control directives issued by the Geotechnical Engineer.

6.3.1 Review of Design Guidelines

Mine plans, including week plans, are reviewed by the Geotechnical Engineer (or designate) to assess expected geotechnical conditions and ground control aspects in the planned excavations, considering the geotechnical data and inspections/mapping carried out. Driving layouts of planned excavations with prescribed ground support are signed off on by the Geotechnical Engineer (or designate) prior to mining of the heading. Where significant geotechnical conditions are expected, e.g. fault zones, contacts, water-bearing zones, they will be shown on the driving layouts.

6.3.2 Unusual Ground Conditions

The intent of the current Ground Control Standards as outlined in this document is that all potential ground conditions are addressed. In the event that conditions beyond those covered in the current version of the Ground Control Standards are encountered by an operator or anyone doing a routine inspection, the area shall be roped off immediately and brought to the attention of the Shift Supervisor. The Shift Supervisor shall notify the Geotechnical Engineer who will inspect the area and develop a path forward. The condition shall be noted in the Ground Control Log Book.

6.4 Incident Response and Emergency Preparedness

Minto Mine Emergency Response Plan documents the incident response and emergency preparedness procedure. This plan is updated annually by the Minto Health and Safety Department and is stored at the following location: X:\Health & Safety\Safety Public\ERP.

6.4.1 Falls of Ground

All rock fall incidents are documented in the Ground Control Log Book. Reportable rock falls are considered unexpected falls greater than 50 tonnes and are fully investigated and archived as per Minto incident response procedures.

Details of all reported falls of ground are recorded electronically in the Rock Fall database, which can be found at the following location: X:\Mine Technical\33 - Ground Control Program\1 Underground - Ground Control Program\8 Incident Response, Emergency Preparedness\8.1 Ground Falls, Inquiry Procedure\Rock Fall Database. The following items are recorded:

- General information: location, date and time, injuries, damage
- Location: depth below surface, excavation type, distance from active face
- Excavation details: age of excavation, dimensions, excavation shape
- Geotechnical conditions: rock quality, structure, water inflows
- Ground support details: implemented support standard, rehabilitation, surface support
- Failure details: dimensions, failure mechanism, types of ground support failure
- Potential contributing factors: ground support, blasting, stress, ground condition, human factor
- Personnel exposure: time of occurrence, activity in area
- Possible preventative actions.

7 Workforce Training

Underground mining is currently being carried out by the mining contractor Dumas. As such, workforce training consists of a combination of Minto and Dumas safety training and Safe Work Procedures (SWPs).

7.1.1 Safe Work Procedures (SWP)

It is a requirement that employees and contractors be trained in the use of relevant safe work procedures (SWPs) that apply to their work environment. All SWPs required for the work are reviewed and signed off by the employees upon induction to the Minto mine site. SWPs are linked to and used in competency-based training programs. Employees are assessed in the workplace periodically on their understanding and compliance with SWPs through the use of random Job Observations performed by the supervisor. These are performed a minimum of once per week.

All SWPs relevant to the work must be reviewed annually at a minimum by all employees.

7.1.2 Training of Workforce

Geotechnical specific training will be presented to the general underground workforce in formal sessions lead by the Underground Safety/Training Coordinator. This training will be site specific and will include identification of ground types, structural features such as wedges and blocks, recognition of loose, scaling, minimum support standards and reporting unusual conditions.

7.1.3 Training of Supervision

Geotechnical specific training will be presented to underground supervisors in formal sessions lead by the Geotechnical Engineer or designate. This training will be site specific and cover all areas pertinent from a supervisory point of view such as: selection of support types, dealing with unusual ground conditions and supervisory reporting requirements in addition to the general training to be provided to the mining workforce.

Part Three: Monitoring and Verification

8 General Practices and Procedures

8.1 Ground Inspections

All underground workers will inspect the ground conditions each time the workplace is entered as per the Minto 5 point safety card system. Unusual conditions such as falls of ground, excessive loose, adverse structures, signs of high stress, or ground support damage should be noted and reported to the supervisor.

Routine ground inspections will be conducted by the Geotechnical Engineer and Chief Engineer to assess the stability of mine openings, ground support performance and the quality of ground support installation.

8.2 Ground Control Log Book

The Ground Control Log Book is maintained as a live record of ground control related issues such as unusual conditions, falls of ground, incidents or accidents, remedial measures, etc. to ensure the transfer of information between shifts and Engineering/Technical staff. The Ground Control Log Book is to be updated and signed by both the finishing and oncoming shifter at each shift change and reviewed regularly by the Geotechnical Engineer.

8.3 Geotechnical Mapping

Geotechnical mapping for rock quality and rock structure are carried out to verify rock mass characterization assumptions (summarized in Section 2) used in the geotechnical design. This data is reviewed regularly to identify significant geotechnical features and is summarized and analyzed annually as part of the Ground Control Plan update.

8.4 Excavation Surveys

Regular surveys of all workings are carried out and transferred to as-built drawings in a timely manner. This provides an estimate of overbreak which may indicate poor ground conditions or poor drilling/blasting practices.

Cavity monitor surveys (CMS) will be performed on all open stopes. Back-analysis will carried out to develop a correlation between rock quality, structure, excavation size and excavation performance.

9 Instrumentation

9.1 Multi-Point Borehole Extensometers (MPBX)

Multi-point boreholes extensometers (MPBX) are instruments installed in drillholes to measure movement at various point downhole relative to the collar. MPBX's are planned to be installed in the M-Zone crown pillar/pit wall to monitor ground movement during longhole stoping in the M-Zone underground below. Data is collected and recorded regularly (typically hourly) and can be downloaded and interpreted remotely.

9.2 Blast Vibration Monitor

An Instantel Series III Minimate Plus seismograph is used to measure blast vibrations caused by underground blasts. It is typically set up to record for larger, production blasts. Data is used to correlate drilling/loading designs and resulting vibrations to damage in the surrounding rockmass. Data is stored in the following directory:

X:\Mine Technical\33 - Ground Control Program\1 Underground - Ground Control Program\7 Geotechnical Mapping, Drilling and Monitoring\7.2 Monitoring and Instrumentation\Vibration Monitoring

9.3 Stressmeters

Geokon vibrating wire stressmeters are planned to be installed in the Area 118 underground production areas once pillars are developed. The stressmeters will record changes to the rock stress in the pillars which can then be used to verify numerical models, identify overloaded or yielded pillars, and understand changing stresses as mining on a level takes place.

10 Quality Assurance/Quality Control

10.1 Ground Support Testing

Testing of ground support elements will be carried out according to Table 8.1.

Table 1: Recommended ground support testing frequency and specifications

Element	Ultimate Strength (tonnes)	Yield Strength (tonnes)	Estimated Bond Strength (tonnes/m)	Testing Method	Number of bolts to be tested per month	Test Load (tonnes)
20mm threaded Rebar w/ J-LOK resin	12	9	40	Pull test—full column	3	9
				Pull test—short encapsulation	3	Until bolt slippage
Super Swellex/ Python	24	-	18	Pull test—full inflation	2	21
				Pull test—short inflation	2	Until bolt slippage

10.1.1 Test Bolt Installation

Bolts for pull-testing should be installed by the bolter according to the following guidelines:

- Installed and marked specifically for testing purposes and are not part of the regular ground support pattern.
- Installed in the lower wall to allow pull testing to be carried out from the floor.
- Installation locations will be specified on the driving layouts and will be preferentially located in safety bays or cutouts to allow testing to be carried out safely away from equipment traffic.
- Installations will be in both ore and waste, and in varying rock type/quality.
- For bond strength tests (short encapsulation/inflation), the following specifications should be used:
  - Rebar – resin encapsulation length must be less than approximately 30 cm, installed at the toe of the hole. This requires only ½ stick of resin to be installed.
  - Python (Super) – inflation length must be less than approximately 1m, inflated at the toe of the hole. The remaining length at the collar of the hole is sleeved to prevent inflation.

10.1.2 Pull Test Procedure

The following procedure is for the DSI 30 ton pull test unit, shown in Figure 1 attached, currently used on site:

1. Place the pull test collar over the bolt and secure with the appropriate size of nut.
2. Place the pull test claw over the collar and tighten the pull rod against the bolt.
3. Place the hollow ram and loading frame assembly over the pull rod and secure with the two nuts.

4. Tighten the pull rod nuts to ensure the loading frame is tight against the plate and rock.
5. Steel shims may be required at this point to correct for any misalignment. Make sure the pull claw and loading frame will be parallel with the bolt once the load is applied.
6. Connect the hydraulic hose to the hollow ram, gauge and hand pump.
7. Position the hand pump well away from the bolt being tested. Do not allow anyone to stand directly in front or below the bolt while the test is in progress.
8. Turn the knob on the hand pump to the forward position.
9. Begin pumping the gauge until it reads 1 ton.
10. Inspect the ram and loading frame to ensure everything is secure. Pay particular attention to any shims that may be in use as they can occasionally pop out as the load is increased.
11. Continue pumping the hand pump while monitoring the gauge. When the pressure gauge reaches the test load listed in Table 1, hold the load for about 10 seconds to ensure the bolt does not slip (pressure will remain constant). If performing a short encapsulation/inflation test, continue pumping until the bolt begins to slip.
12. Be aware that the pull test claw can bottom out on the inside of the loading frame. The pull claw needs several inches of room to move inside the loading frame when the bolt is being pulled. If the needle on the gauge suddenly spikes it is most likely because the claw has bottomed out on the loading frame.
13. Release the load by turning back the knob on the hand pump. When releasing the load, be aware that any shims you have used may fall.

If the bolt being pull tested fails to meet the set criteria, further tests will be conducted to verify that the problem is not widespread. If the problem is widespread, the area will be shut down and an investigation will be carried out by Minto Mine Technical to ascertain the causes of the failures and develop corrective actions.

10.1.3 Documentation

Records of all tests are documented in a master Excel spreadsheet, stored here: X:\Mine Technical\33 - Ground Control Program\1 Underground - Ground Control Program\7 Underground Monitoring, Geologic Mapping, Reporting\11.2 Underground Monitoring\Pull Testing. Information recorded includes bolt type, location, age, rock type, test result and description. A memorandum will be issued monthly communicating test results and pertinent information to Minto Mine Technical and underground operations staff.

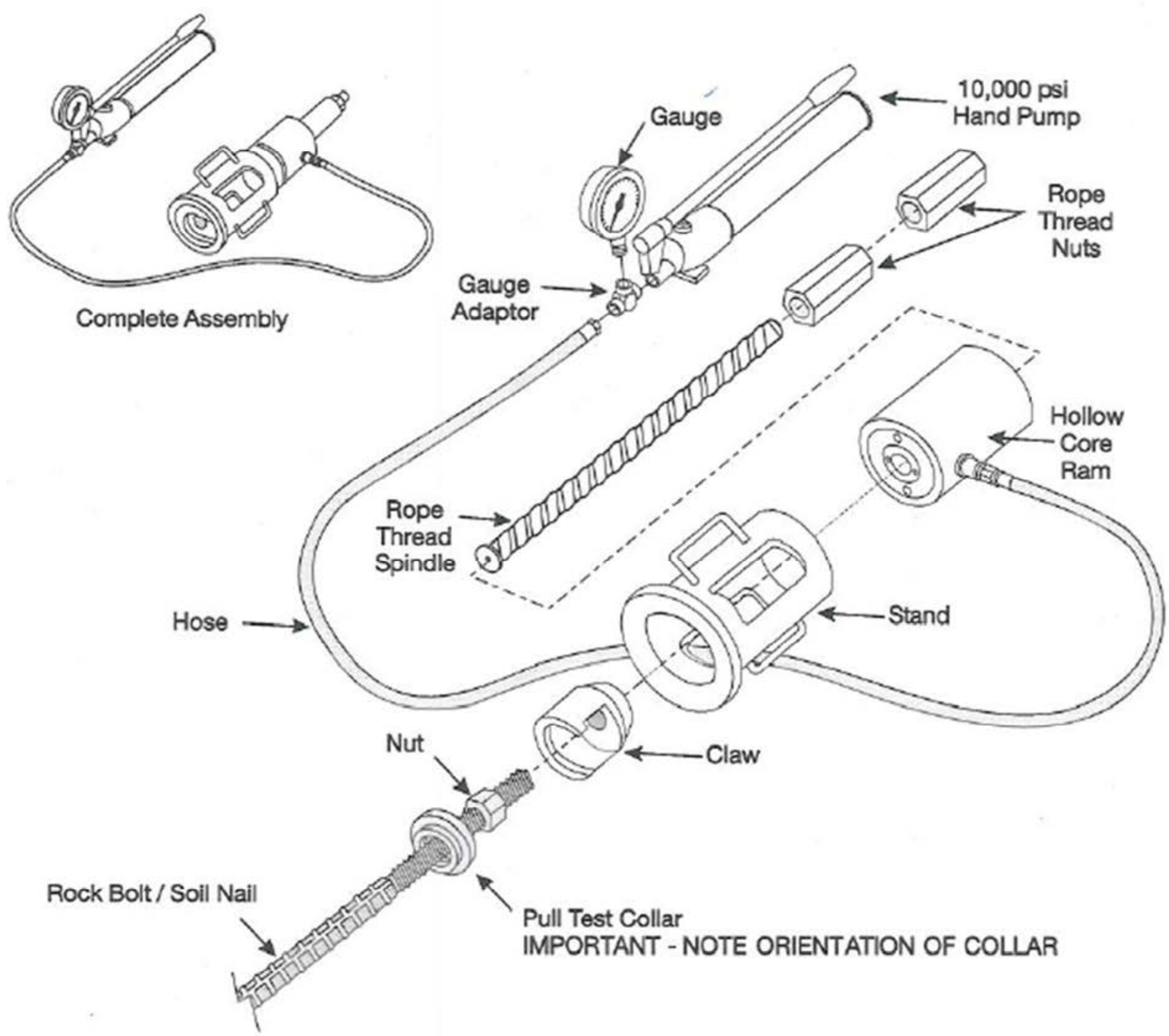


Figure 5: DSI 30 ton Pull Test Unit

10.2 Ground Support Quality Assurance / Quality Control

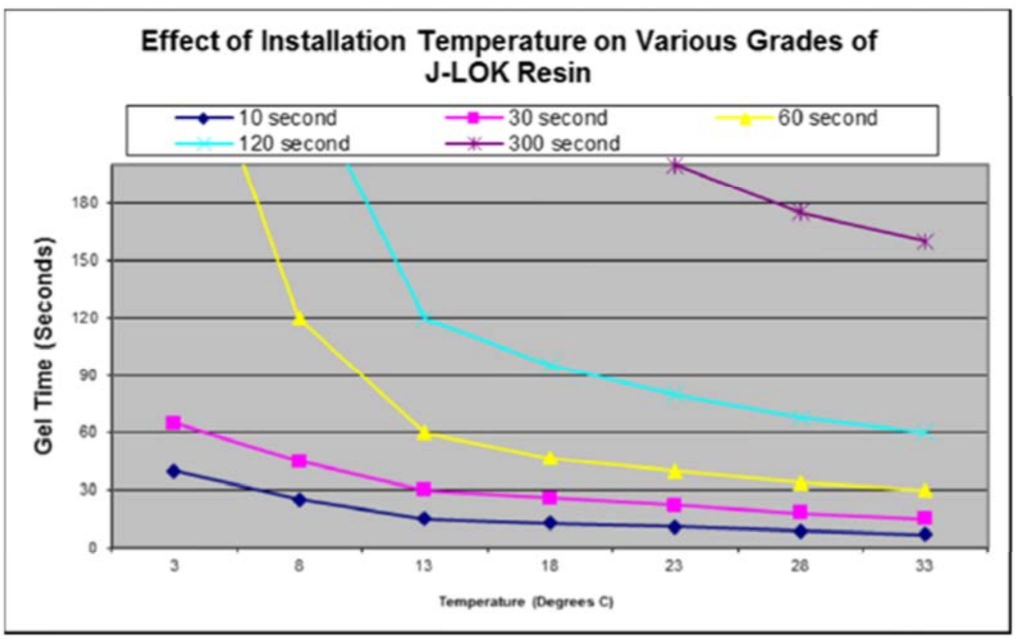
10.2.1 Materials Management

Regular checks are required to ensure that all ground support materials are of a suitable standard and quality, fit for intended purpose, and are stored in accordance with manufacturers' recommendations.

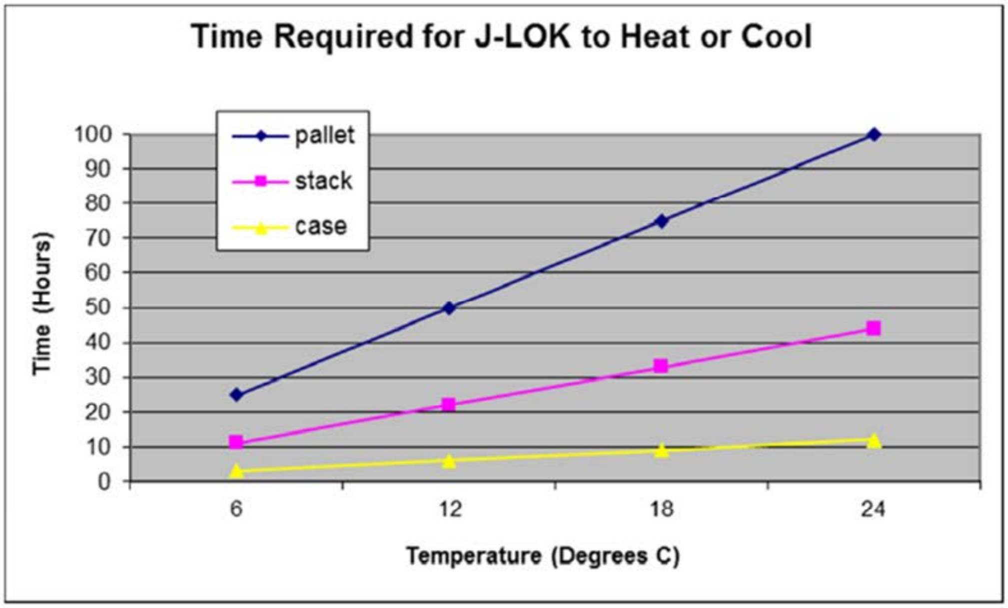
Resin Storage and Handling

The most sensitive ground support element is resin, which should be stored and handled with the following guidelines:

- Resin should be stored in a cool and dry location, avoiding direct sunlight and rain. Excessive heat reduces the shelf life of the resin.
- Stock must be rotated. The resin that is first in should be first out. Out-dated resin should not be used. Resin typically has a one year shelf life, but 1-2 month inventories are the best way to manage resin.
- Resin performance is highly sensitive to installation temperature.



- Underground, resin boxes should be laid flat, not stood on end. The resin should be moved from storage directly to the machine.
- Frozen cartridges must be thawed before being used. Freezing and thawing does not affect the performance of the resin. Resin boxes should not be left on top of hot locations for extended periods.



- Wear gloves and glasses when working with resin products. Upon contact with skin, wash exposed area immediately. If there is contact with the eyes, flush thoroughly and seek immediate medical counsel and treatment.

10.2.2 Task Observation

Task observations will be carried out by the Engineering group on ground support installation on a regular basis (minimum one per month). When warranted, findings will be communicated through Ground Control Directives and/or the Ground Control Log Book. Typical verification checks may include:

- Confirm screen overlap is sufficient.
- Visual check of adherence to bolting pattern as per ground support standard.
- Check that adequate scaling is carried out prior to ground support installation.
- Check that bit size is within recommended size range.
- Check of Swellex/Python pump pressures.
- Check that correct resin cartridges are being used (fast vs slow).
- Observe resin spin time and delay time prior to tensioning.
- Check of rebar tensioning torque.

11 Review of the Ground Control Plan

11.1 Review and Updates

The Mine Manager will ensure a review of the Ground Control Management Plan at the following milestones/occurrences:

- Immediately following a ground control related injury to any employee/contractor/visitor;
- Immediately following a ground control related near miss incident;
- As soon as possible following any significant change in mine design, ground conditions or excavation stability; and,
- Annually.

Following a review of the Ground Control Plan, the Mine Manager (or designate) will ensure the review outcomes are communicated to the workforce and the Ground Control documentation is updated in a timely manner.

11.2 Random Audits

Random audits of ground control are conducted by the Mine Manager, or nominee to monitor compliance with the requirements of the Ground Support Standards and Safe Work Procedures.

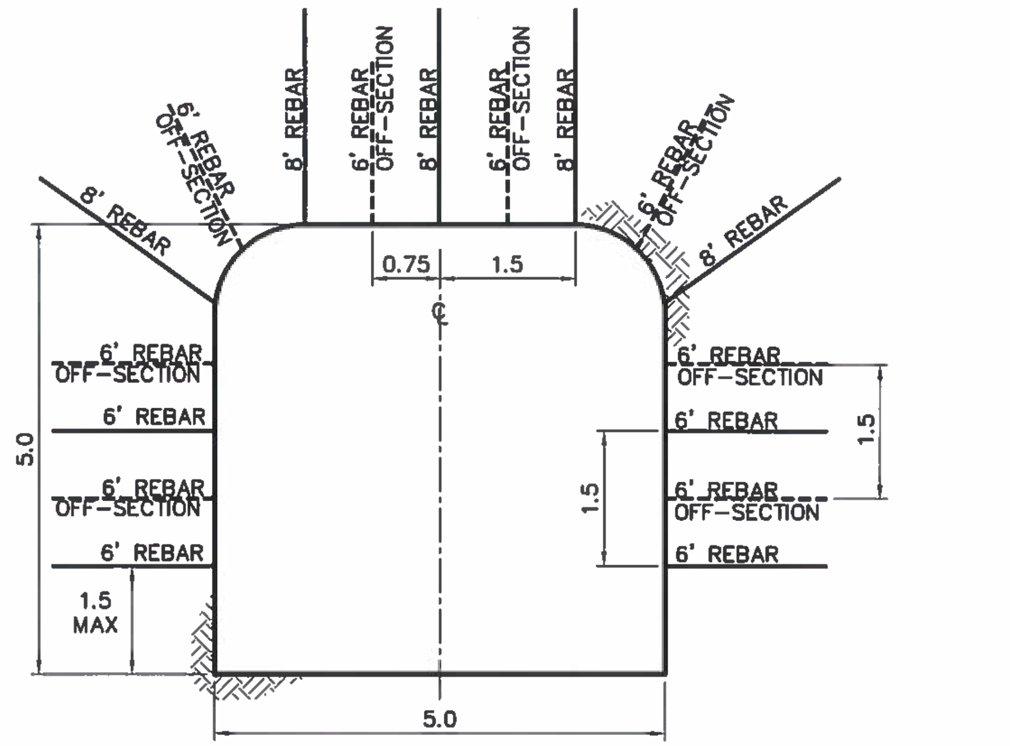
11.3 External Audits

An independent audit of the Ground Control Plan is required at least every two years. Initially this independent review is to include an external consultant, but later could be an internal consultant accompanied by an appropriate person that is familiar with the use of the GCP.

11.4 Conformance to Regulatory Requirements

The Geotechnical Engineer is to ensure that any new legislation or developments that affect Best Practice in ground control are taken into account and where relevant, incorporated into the revised GCP. Mining legislation requires that the emphasis is on keeping track of new developments and design tools. This will involve liaison with internal and external consultants.

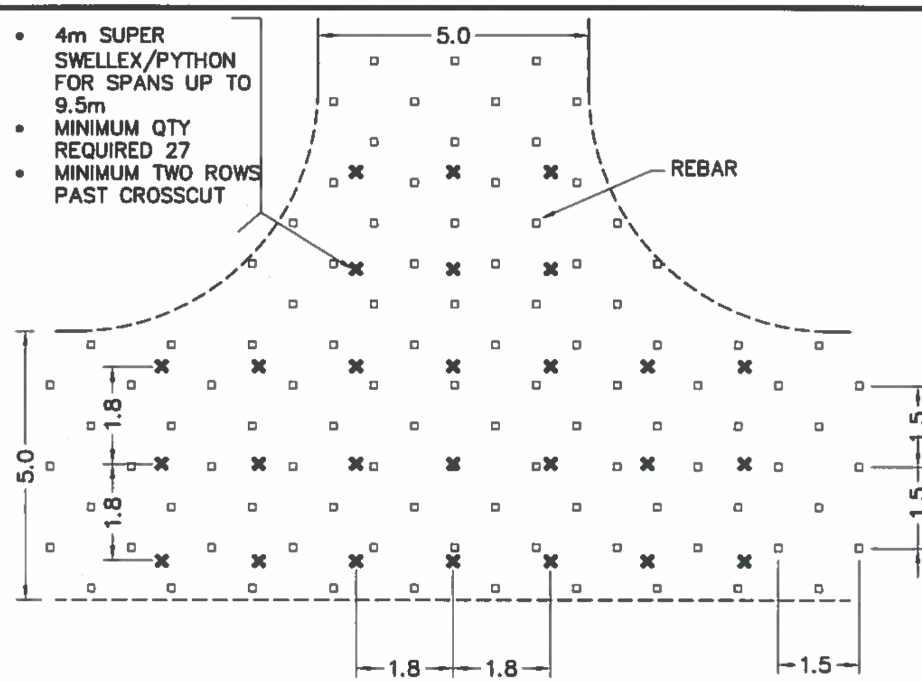
GROUND SUPPORT TYPE 1



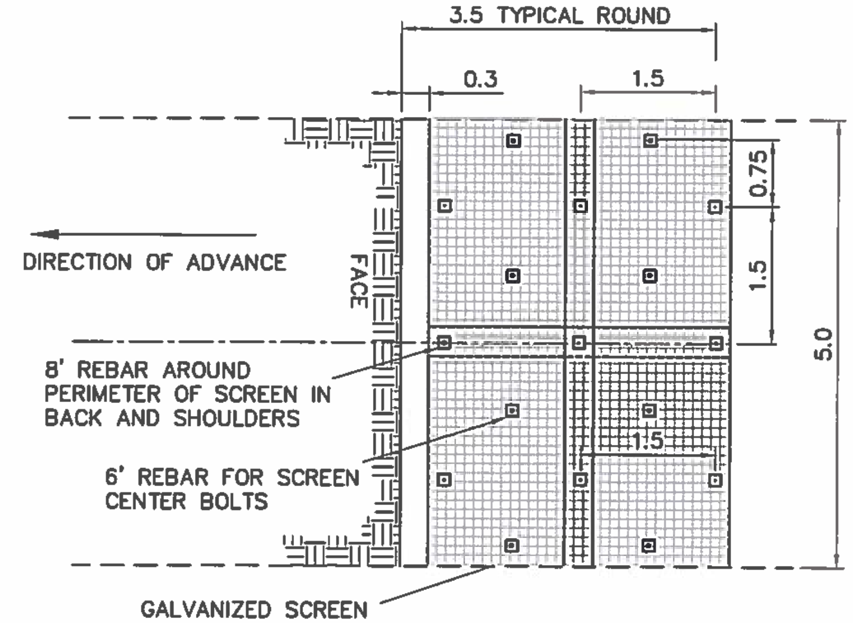
(EXCAVATIONS WITH 5m SPANS)
- 8' REBAR IN BACK FOR SCREEN PERIMETER BOLTS
- 6' REBAR IN BACK FOR SCREEN CENTER BOLTS
- GALVANIZED SCREEN BACK AND WALLS
- LAST ROW 6' REBAR MAXIMUM 1.5m FROM BASE OF RAIL
- 3 SQUARE OVERLAP OF SCREEN. BOLT IN SECOND SQUARE FROM EDGE.

5mX5m TYPICAL DEVELOPMENT OPENING

- 4m SUPER SWELLEX/PYTHON FOR SPANS UP TO 9.5m
- MINIMUM QTY REQUIRED 27
- MINIMUM TWO ROWS PAST CROSSCUT



5mX5m TYPICAL DEVELOPMENT INTERSECTION

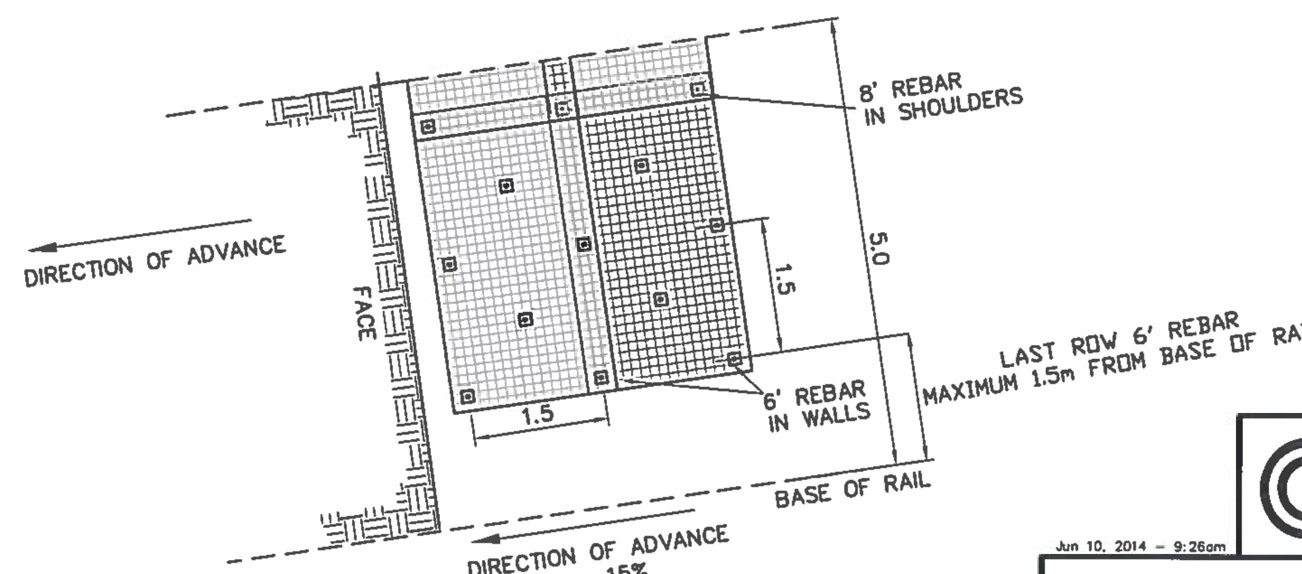


TYPICAL DRIFT – PLAN VIEW

QUANTITIES

TOTAL PER 3.5M ROUND
(8) 6' X 11' WELDED WIRE MESH
(15) 8' 20mm REBAR
(28) 6' 20mm REBAR

NOTE:
- REPORT ABNORMAL CONDTIONS
- MINIMUM STANDARD



TYPICAL DRIFT – SECTION ALONG WALL

0 0.5 1 2
METRES

CAPSTONE MINING CORP.
MINTO MINE

Jun 10, 2014 – 9:26am

GROUND SUPPORT TYPE 1
PERMANENT DEVELOPMENT

June 9/14	Jun 11, 2014	Jun 10/2014	10-6-14	June 10 2014
CLIMAS PROJECT MANAGER	MINTO PROJECT MANAGER	MINTO ...	GROUND CONTROL ENGINEER	MINTO GEOLOGY

NO.	DESCRIPTION	DATE	BY
0	ISSUED FOR CONSTRUCTION	10JUNE14	KC

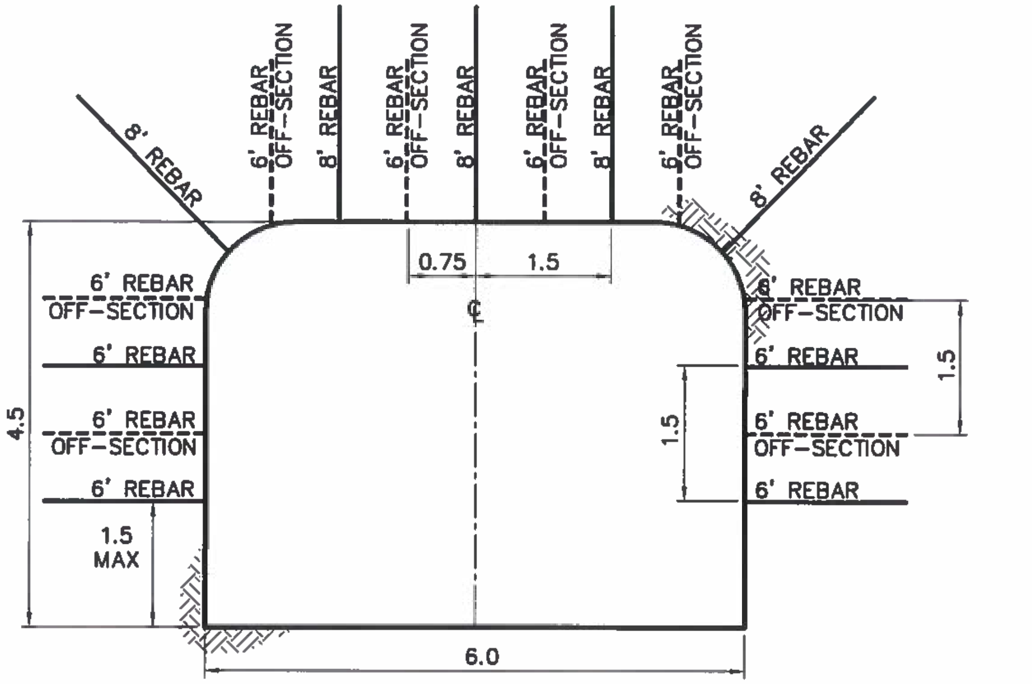
REVISIONS

PROJ. NO.		
SCALE: AS NOTED		DATE
DESIGNED:	KC	10JUNE14
DRAWN:	KC	10JUNE14
CHECKED:	.	.
APPROVED:	.	.

UNDERGROUND
GROUND SUPPORT
STANDARDS – PERMANENT DEVELOPMENT
PLAN & SECTIONS

SIZE	DRAWING NUMBER	REV.
D	MINTO-001RMP-GRD-TYPE1	0

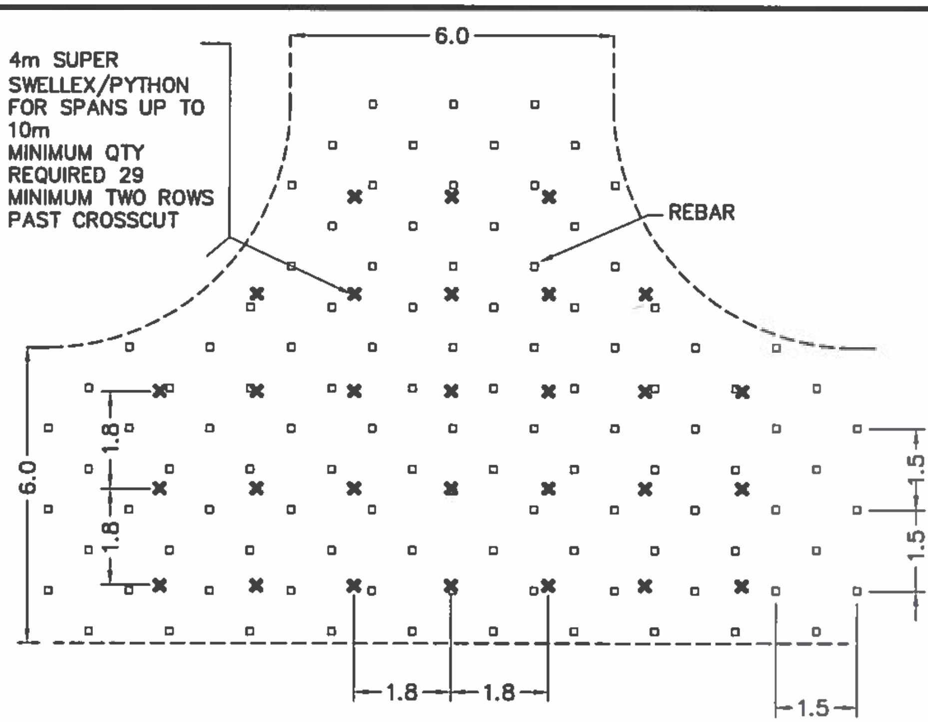
GROUND SUPPORT TYPE 2



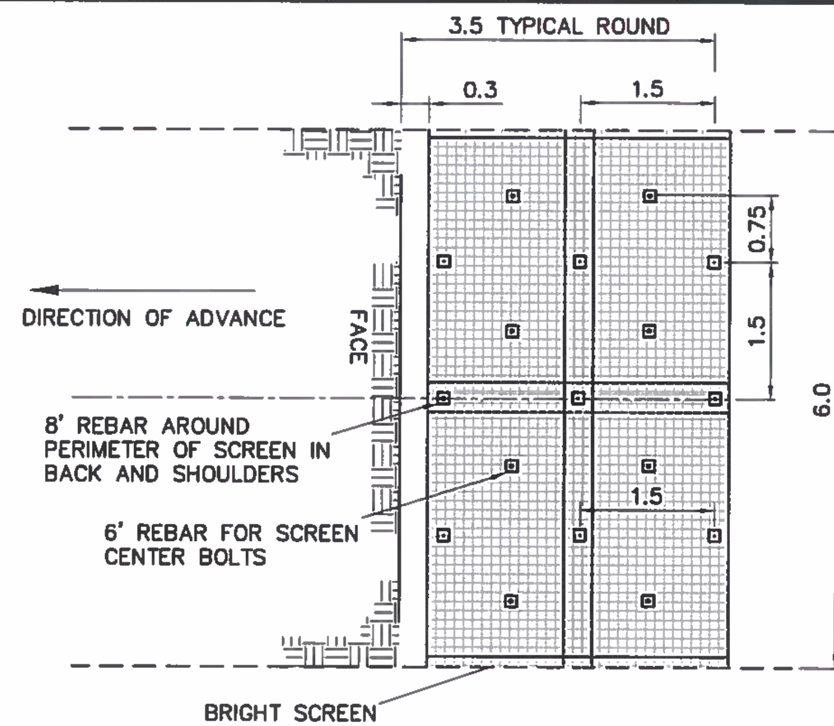
(EXCAVATIONS UP TO 6m SPANS)
- 8' REBAR IN BACK FOR SCREEN PERIMETER BOLTS
- 6' REBAR IN BACK FOR SCREEN CENTER BOLTS
- BRIGHT SCREEN BACK AND WALLS
- LAST ROW 6' REBAR MAXIMUM 1.5m FROM BASE OF RAIL
- 3 SQUARE OVERLAP OF SCREEN. BOLT IN SECOND SQUARE FROM EDGE.

6mX4.5m TYPICAL OPENING

- 4m SUPER SWELLEX/PYTHON FOR SPANS UP TO 10m
- MINIMUM QTY REQUIRED 29
- MINIMUM TWO ROWS PAST CROSSCUT



6mX6m TYPICAL INTERSECTION

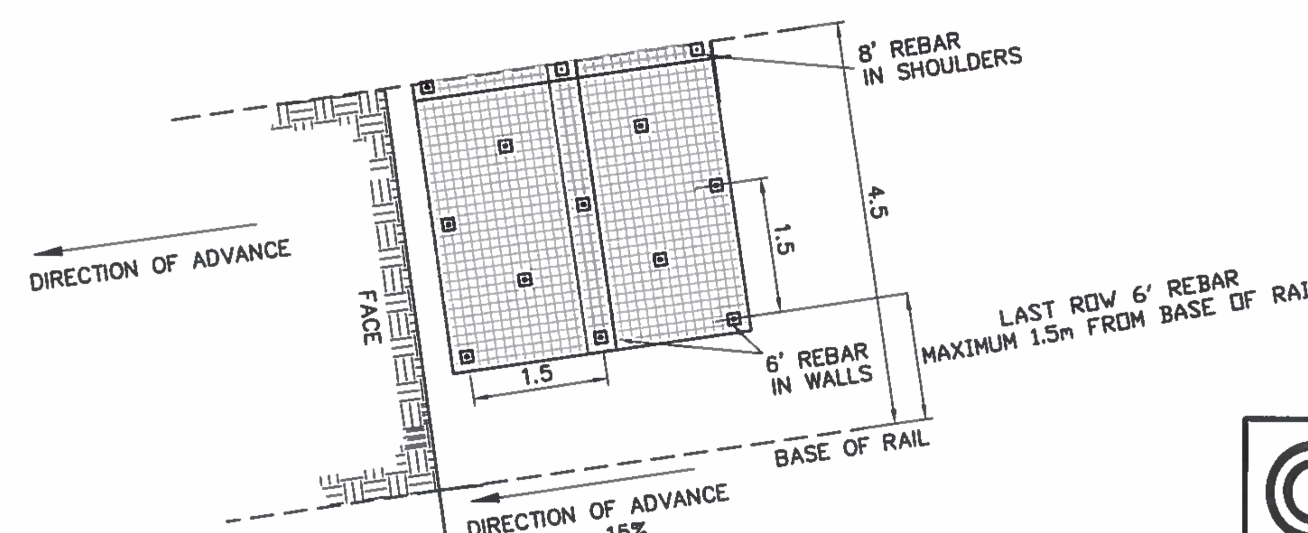


TYPICAL DRIFT – PLAN VIEW

QUANTITIES

TOTAL PER 3.5M ROUND
(8) 6' X 11' WELDED WIRE MESH
(15) 8' 20mm REBAR
(28) 6' 20mm REBAR

NOTE:
- REPORT ABNORMAL CONDTIONS
- MINIMUM STANDARD



TYPICAL DRIFT – SECTION ALONG WALL

0 1 2 METRES

CAPSTONE MINING CORP. MINTO MINE

Jun 10, 2014 – 9:45am

GROUND SUPPORT TYPE 2
NON-PERMANENT DEVELOPMENT
e.g. Stope/Level Access

REVISIONS	0 ISSUED FOR CONSTRUCTION 10JUNE14 KC
PROJ. NO.	
SCALE: AS NOTED	DATE
DESIGNED: KC	10JUNE14
DRAWN: KC	10JUNE14
CHECKED:	
APPROVED:	

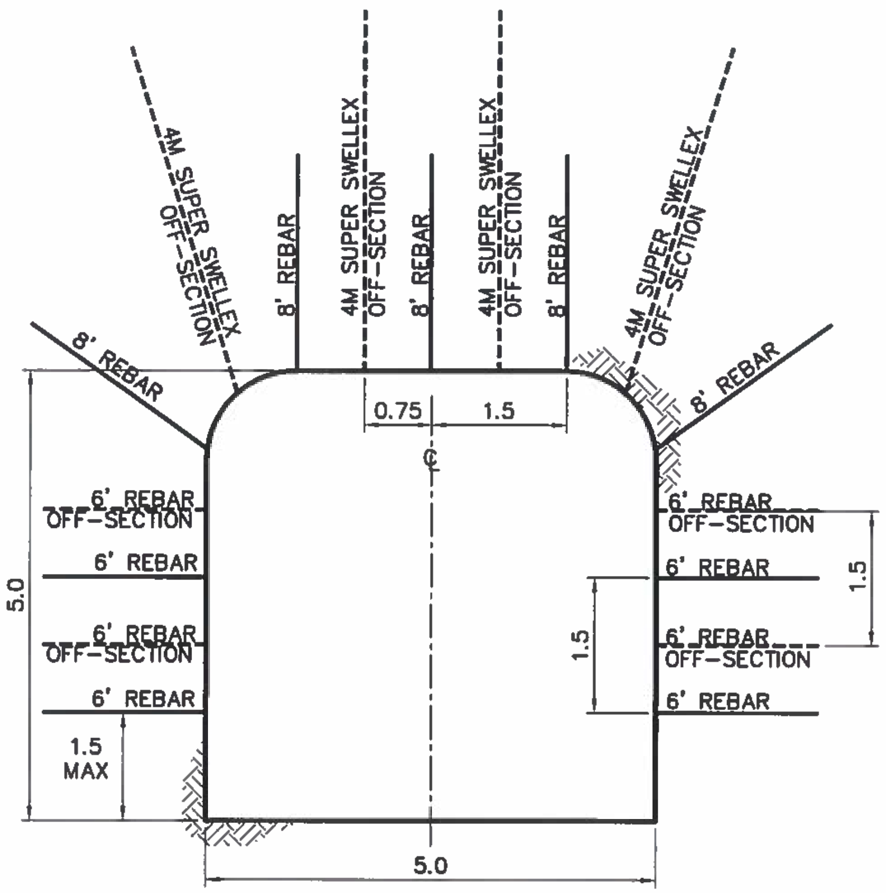
MINTO PROJECT MANAGER / GROUND CONTROL ENGINEER (signatures) Jun 10 2014; 10-6-14; June 10 2014

UNDERGROUND GROUND SUPPORT STANDARDS – NON-PERMANENT DEVELOPMENT PLAN & SECTIONS

SIZE D DRAWING NUMBER MINTO-001RMP-GRD-TYPE2 REV. 0

GROUND SUPPORT TYPE 3

POOR GROUND - UNDER DIRECTION OF MINE TECHNICAL

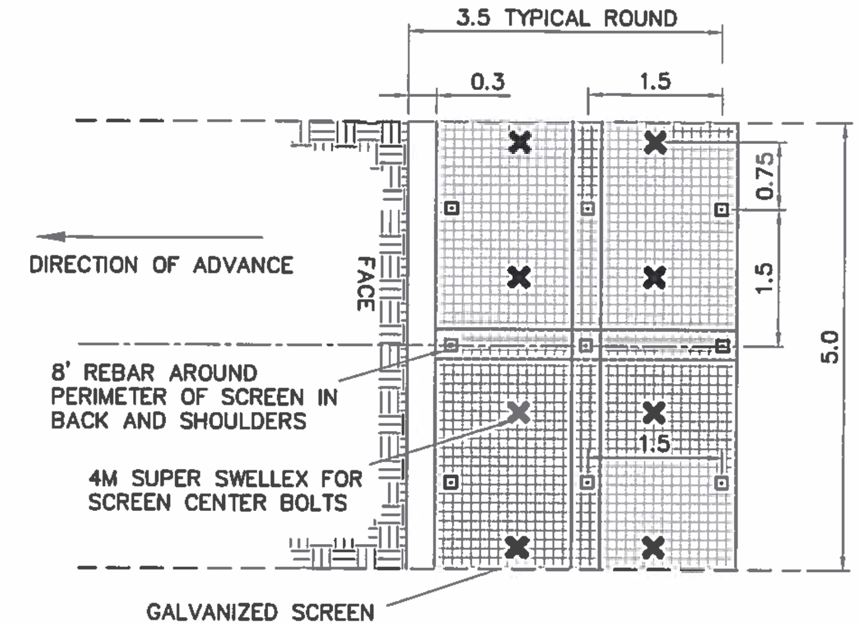


(EXCAVATIONS WITH 5m SPANS)
- 8' REBAR IN BACK FOR SCREEN PERIMETER BOLTS
- 4M SUPER SWELLEX IN BACK FOR SCREEN CENTER BOLTS
- GALVANIZED SCREEN BACK AND WALLS
- LAST ROW 6' REBAR MAXIMUM 1.5m FROM BASE OF RAIL
- 3 SQUARE OVERLAP OF SCREEN. BOLT IN SECOND SQUARE FROM EDGE.

5mX5m TYPICAL DEVELOPMENT OPENING

INTERSECTIONS WILL BE PREFERENTIALLY LOCATED IN HIGHER QUALITY GROUND. IF INTERSECTIONS ARE REQUIRED IN POOR GROUND CONDITIONS A GROUND CONTROL DIRECTIVE WILL BE ISSUED WITH SPECIFIC SUPPORT BY THE GEOTECHNICAL ENGINEER

INTERSECTIONS

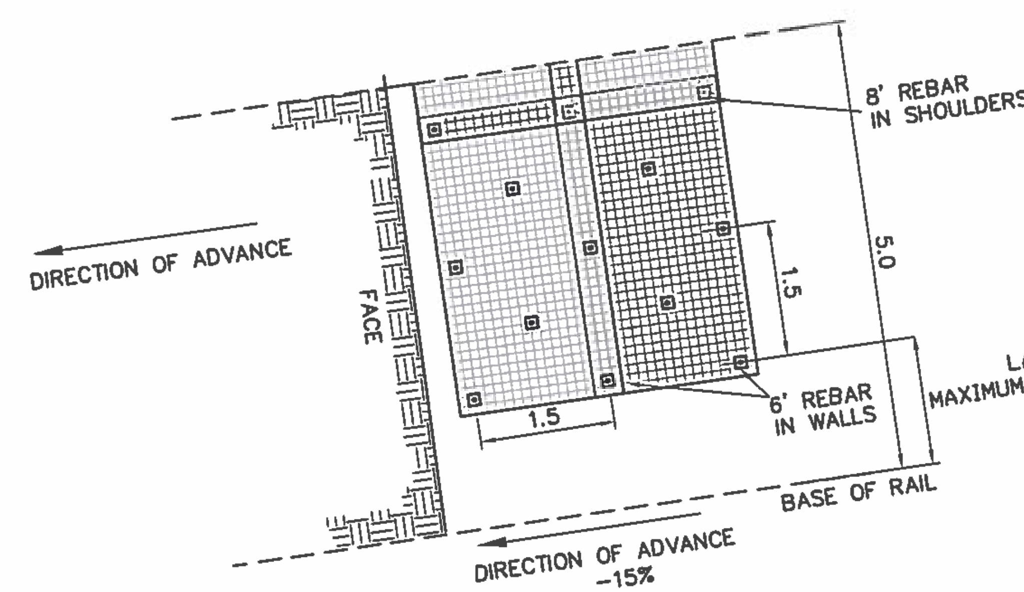


TYPICAL DRIFT – PLAN VIEW

QUANTITIES

TOTAL PER 3.5M ROUND
(8) 6' X 11' WELDED WIRE MESH
(8) 4m SUPER SWELLEX
(15) 8' 20mm REBAR
(20) 6' 20mm REBAR

NOTE:
- REPORT ABNORMAL CONDTIONS
- MINIMUM STANDARD



TYPICAL DRIFT – SECTION ALONG WALL

0 1 2 METRES

CAPSTONE MINING CORP. MINTO MINE

Jun 10, 2014 – 9:52am

GROUND SUPPORT TYPE 3 PERMANENT DEVELOPMENT POOR GROUND

June 9/14	Jun 11th 2014	June 10/ 2014	10-6-14	June 10 /2014	
DUMAS PROJECT MANAGER	MINTO PROJECT MANAGER	MINTO MINE GEN.	GROUND CONTROL ENGINEER	MINTO GEOLOGY	

NO.	DESCRIPTION	DATE	BY
0	ISSUED FOR CONSTRUCTION	10JUNE14	KC

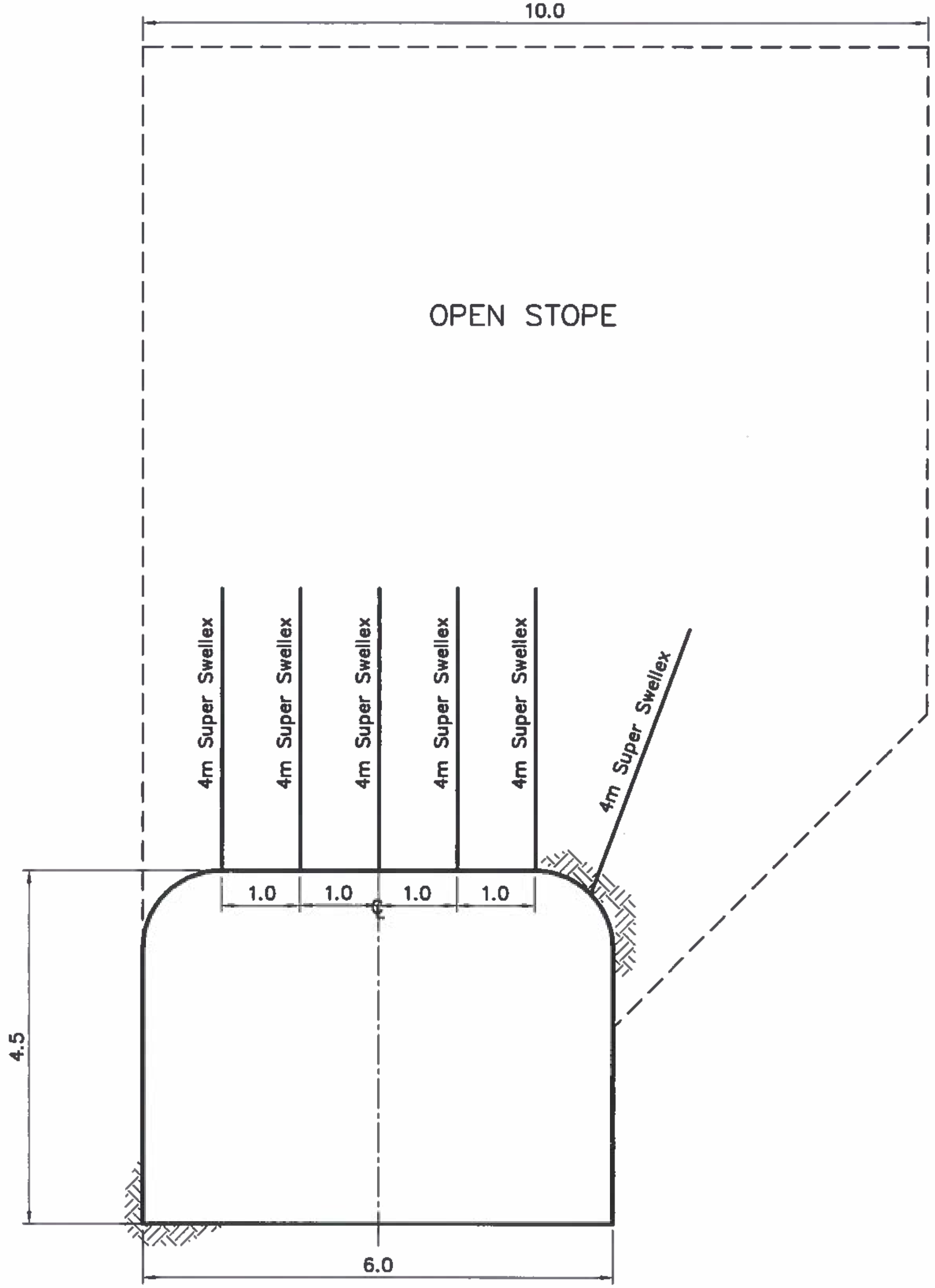
REVISIONS

PROJ. NO.
SCALE: AS NOTED — DATE
DESIGNED: KC — 10JUNE14
DRAWN: KC — 10JUNE14
CHECKED:
APPROVED:

UNDERGROUND GROUND SUPPORT STANDARDS – PERMANENT DEVELOPMENT PLAN & SECTIONS

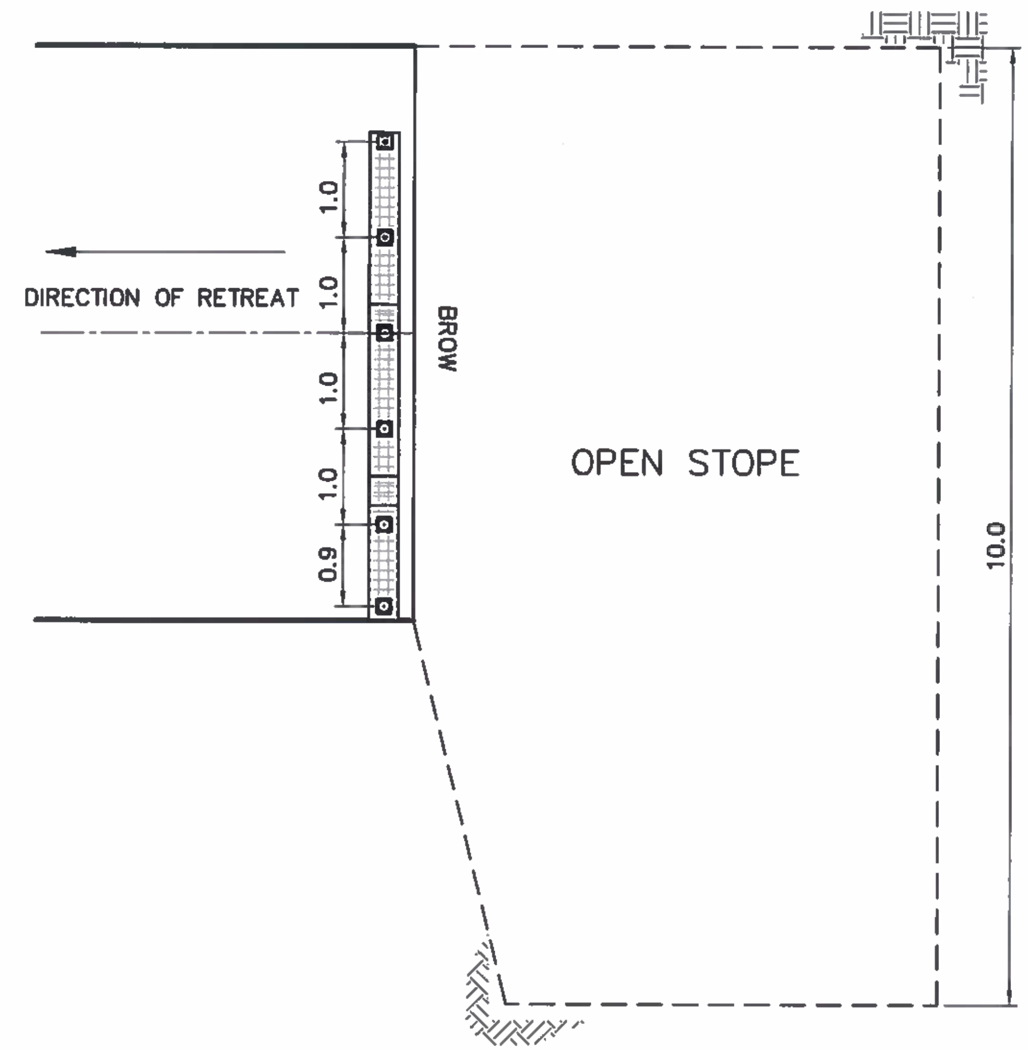
SIZE: D — DRAWING NUMBER: MINTO-001RMP-GRD-TYPE3 — REV. 0

STOPE BROW SUPPORT TYPE A



-ONE ROW OF 4m SUPER SWELLEX
-0-GAUGE STRAPS BETWEEN SUPER SWELLEX

CROSS SECTION



PLAN VIEW

QUANTITY
EXCAVATIONS WITH LESS THAN <6m SPANS
TOTAL PER BROW
(3) 0-GAUGE MESH STRAPS
(6) 4M SUPER SWELLEX

NOTE:
- REPORT ABNORMAL CONDTIONS
- MINIMUM STANDARD

CAPSTONE MINING CORP.
MINTO MINE

Jun 08, 2014 – 8:08am

STOPE BROW PRE-SUPPORT - TYPE A
NORMAL CONDITIONS

0 0.5 1 2
METRES

DUMAS PROJECT MANAGER	MINE MANAGER	CHIEF ENGINEER	GROUND CONTROL ENGINEER	MINE PLANNER
June 9/14		08-06-14	08-06-14	June 8, 2014

NO.	DESCRIPTION	DATE	BY

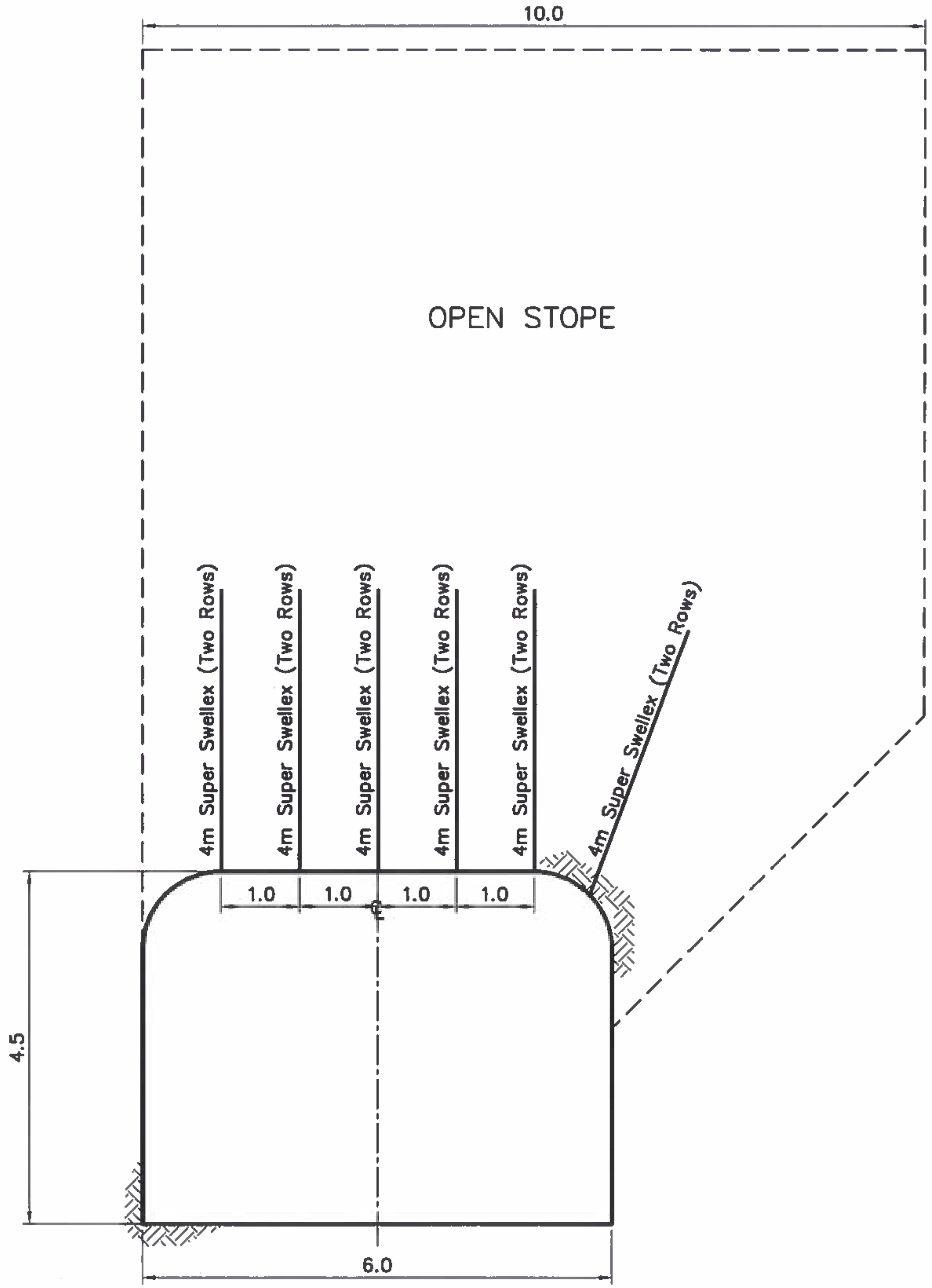
REVISIONS

PROJ. NO.
SCALE: AS NOTED DATE
DESIGNED:
DRAWN: KC 08MAY14
CHECKED:
APPROVED:

UNDERGROUND
GROUND SUPPORT
STOPE DEVELOPMENT LESS THAN <6M SPAN
SECTIONS

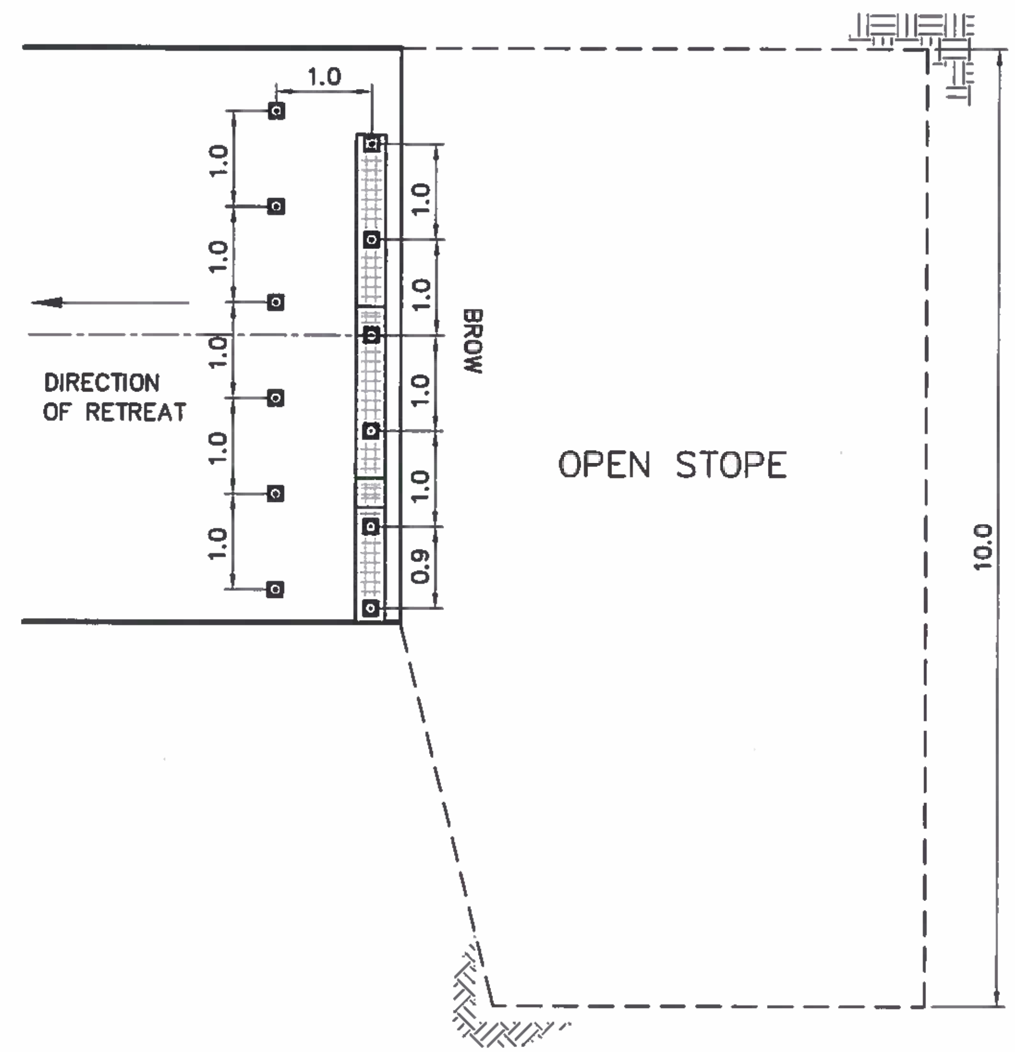
SIZE D | DRAWING NUMBER MINTO–001STP–GRD–BROW | REV. 0

STOPE BROW SUPPORT TYPE B



–TWO ROWS OF 4m SUPER SWELLEX
–0–GAUGE STRAPS BETWEEN SUPER SWELLEX IN BROW ROW

CROSS SECTION



PLAN VIEW

QUANTITY
EXCAVATIONS WITH LESS THAN <6m SPANS
TOTAL PER BROW
(3) 0–GAUGE MESH STRAPS
(12) 4M SUPER SWELLEX

NOTE:
- REPORT ABNORMAL CONDTIONS
- MINIMUM STANDARD

CAPSTONE MINING CORP.
MINTO MINE

Jun 08, 2014 – 8:12am

STOPE BROW PRE-SUPPORT - TYPE B
FRACTURED/FAULTED GROUND

0 1 2
METRES

OLIMAS PROJECT MANAGER	MINE MANAGER	CHIEF ENGINEER	GROUND CONTROL ENGINEER	MINE PLANNER
June 9/14		07-06-14	08-06-14	June 8, 2014

REVISIONS

NO.	DESCRIPTION	DATE	BY

PROJ. NO.
SCALE: AS NOTED DATE
DESIGNED:
DRAWN: KC 08MAY14
CHECKED:
APPROVED:

UNDERGROUND
GROUND SUPPORT
STOPE DEVELOPMENT LESS THAN <6M SPAN
SECTIONS

SIZE D DRAWING NUMBER MINTO–001STP–GRD–BROW REV. 0

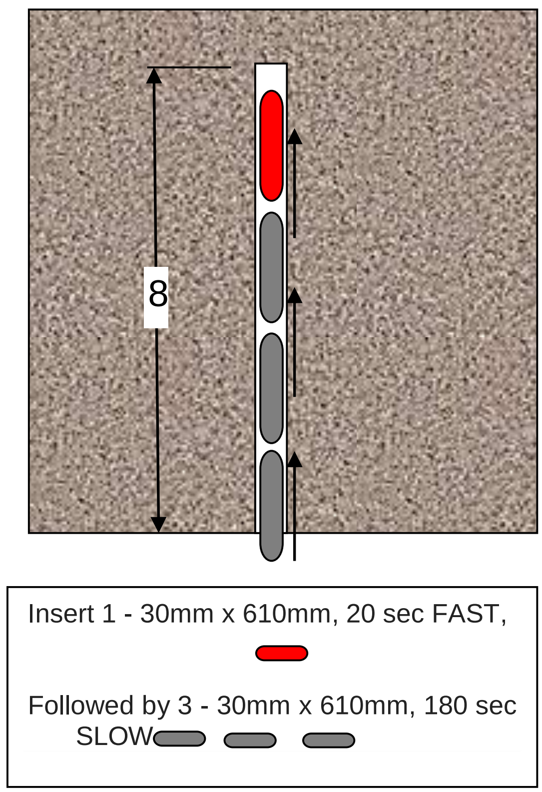
Resin/Rebar Installation Procedures

1. Drill a hole at the diameter and length corresponding to the rebar size. The drill hole diameter should be ¼" – ½" larger than the rebar. For headed bolts, the drill hole should be slightly longer than the bolts. For threaded bolts, however, the drill hole should be approximately 4" shorter than the bolts.

2. Drill hole should be perpendicular to rock surface as much as possible. Wall bolt holes should be drilled slightly upwards inclined to remove standing water and cuttings.

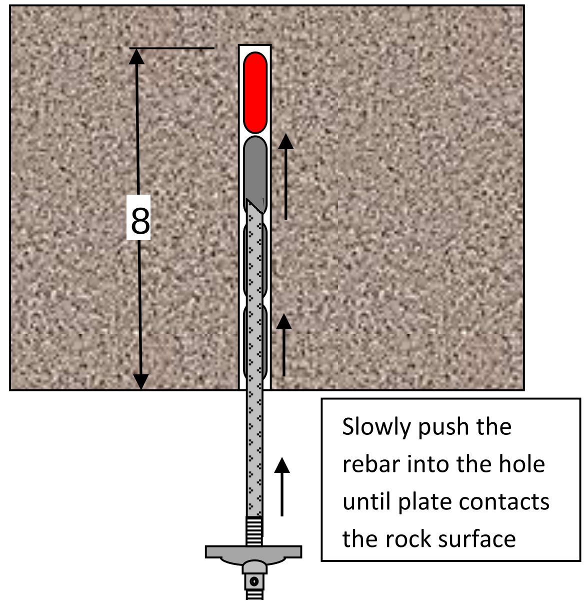
3. Drill hole should be flushed up to remove drilling cuttings and rock debris.

4. It is critical that proper resin sizes and combinations are used as per the site specific ground control design. For a typical installation of an 8' rebar in a 33mm borehole with 28mm to 30mm resin; Insert an 18" long fast resin cartridge (Gel time = 20 to 30 sec.) to the toe of the hole, followed by appropriate number of slow resin cartridges. A "resin loading tube" is recommended to help inserting the cartridges into the hole smoothly.

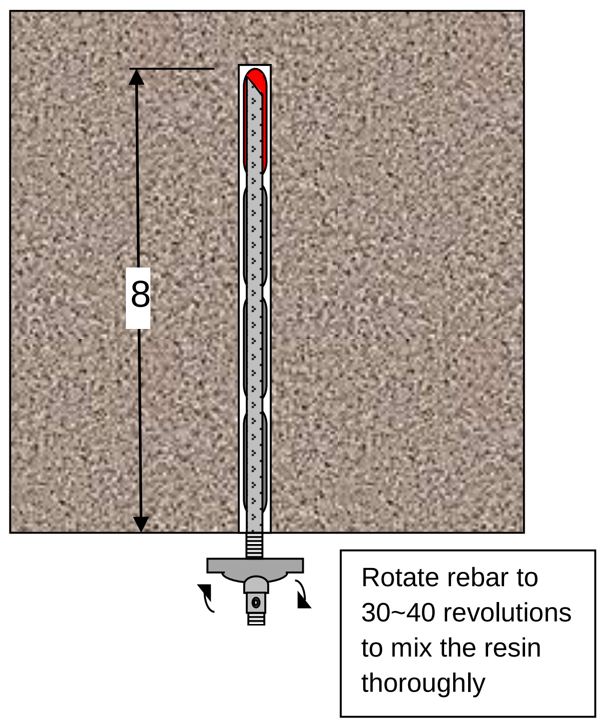


5. Slowly push the bolt into the hole. A "rebar pusher" is recommended.

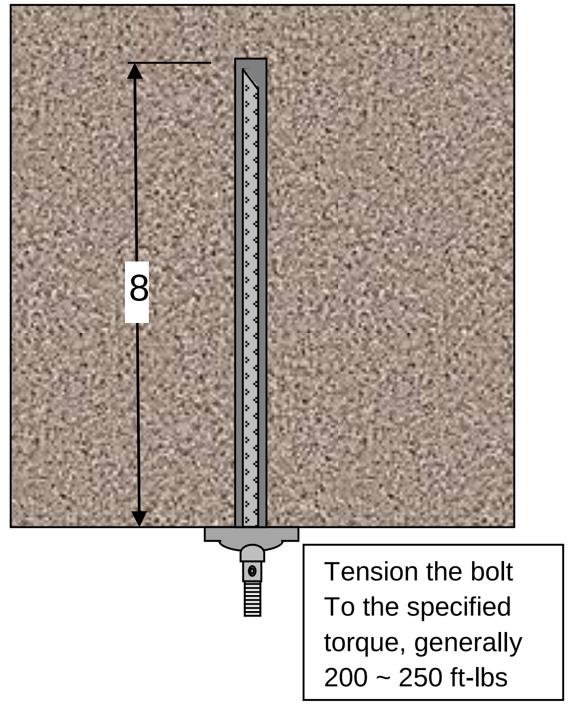
   For headed rebar, push the bolt until the plate contacts the rock surface.
   For threaded rebar, leave about 4" of thread outside of the hole.



6. Rotate the bolt at full speed 30~40 revolutions to mix the resin thoroughly. Hold the bolt in place for at least the gel time noted on the case, until the fast resin sets. Do not re-spin during this curing process, and do not break the bond of the resin.



7. For threaded rebar, tension the bolt to the specified torque, generally 200 ~ 250 ft-lbs.



8. If the nut breaks prematurely within 15 revolutions, keep spinning until the nut bottoms on thread then spin for 15 revolutions. The bolt cannot be tensioned as usual.

   If the nut breaks after 15 revolutions but before 30 revolutions are achieved, stop spinning and wait at least gel time of the slow resin for curing, then tension the bolt as usual.

9. General causes for the failure of inserting resin cartridge into the hole:
   - Drill hole is too small
   - Drill hole is jammed with debris
   - Cartridge is too long or too soft

10. General causes for the failure inserting rebar into the hole:
    - Drill hole is undersized
    - Put too many fast resin, or put the fast resin behind the slow resin
    - Rapidly rotating the rebar during insertion
    - High temperature
    - Underpowered machinery

11. General causes for longer curing time of resin:
    - Low temperatures
    - Insufficient resin mixing
    - Over drilling and pushing the fast resin too deep at the toe
    - No fast resin at the toe
    - Drill hole filled with water

12. General causes for the failure of resin performance:
    - Oversized drill hole
    - Insufficient resin mixing
    - Over spinning and mixing
    - Re-spinning during resin curing
    - Dried out or outdated resin

Application Guidelines

1. Resin rebar is a durable and reliable reinforcement system for almost all kinds of rock conditions except for the extremely soft conditions.

2. Resin rebar bolts provide immediate, active and permanent support.

3. For threaded rebar bolts, the combination of an 18" fast resin followed by slow resin helps to create the pre-stress reinforcement condition, and to form the stable rock arch.

4. Fully grouting prevents the rebar from corrosion induced by ground water.

5. The resin bonding capacity of fully grouted rebar is greater than the ultimate tensile of most typical rebar.

6. Resin rebar is not suitable for the holes with continuous flow of water.

Storage and Handling of Resin

1. Resin products should be stored, transported and applied following the specifications of the manufacturer.

2. Resin should be stored in warehouse in a cool and dry location, avoiding direct sunlight and rain. Excessive heat reduces the shelf life of the resin. Stock must be rotated. The resin that is first in should be first out. The out dated resin should not be used.

3. Underground, resin boxes should be laid flat, not stood on end. The resin should be moved from storage directly to the machine.

4. Frozen cartridges must be thawed before being used. Freezing and thawing does not affect the performance of the resin. However, resin boxes should not be left on top of hot locations for extended periods.

5. Wear gloves and glasses when working with resin products. Upon contact with skin, wash exposed area immediately. If there is contact with the eyes, flush thoroughly and seek immediate medical counsel and treatment.

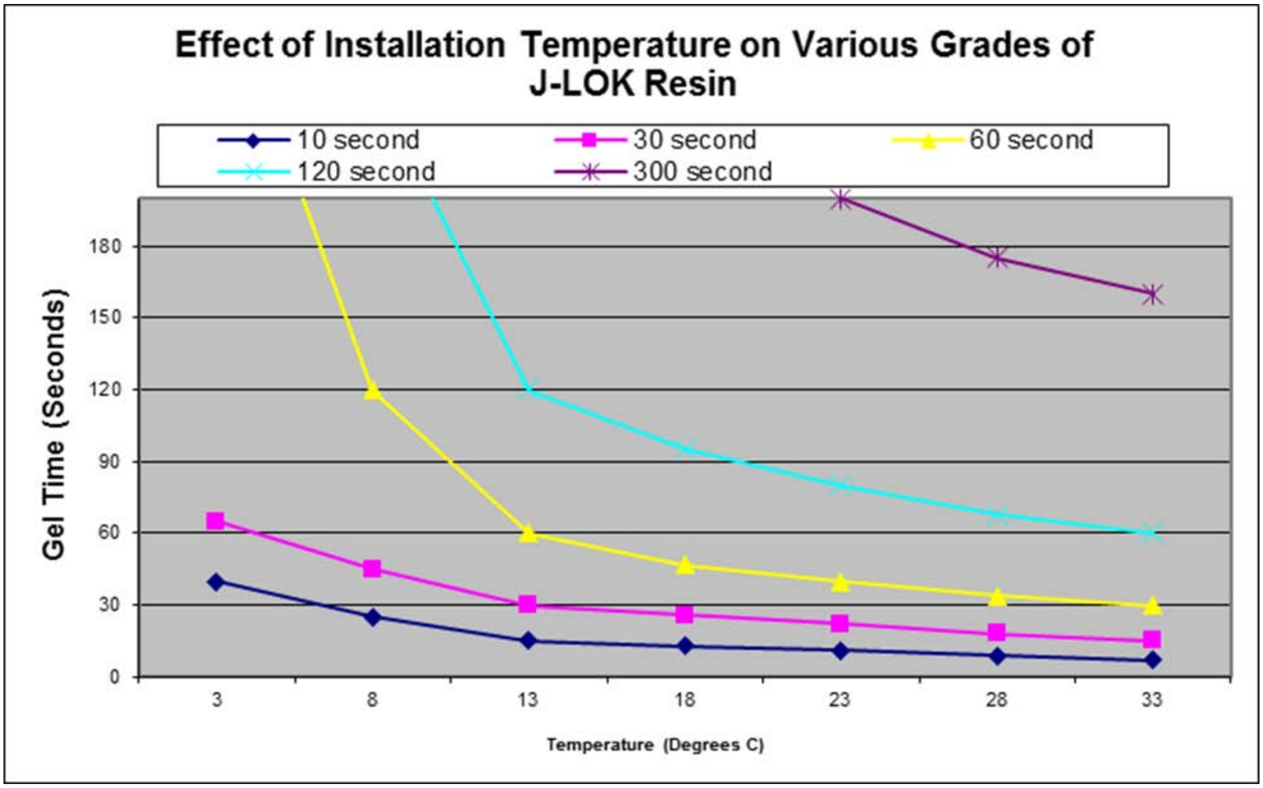
6. Any out-dated resin should be treated according to the local environmental regulation and laws.

Temperature Effects on J-LOK Resin

When J-LOK resin was first introduced to the market, several tests were conducted regarding frozen resin. In one test we froze and then thawed out samples of J-LOK 30 times. We then conducted strength tests to see if product performance was compromised. No decrease in anchorage strength was noted. The resin installed normally. It should be noted that the samples were thawed and brought up to "normal" installation temperature before the tests were conducted. The resin was not installed in a frozen state.

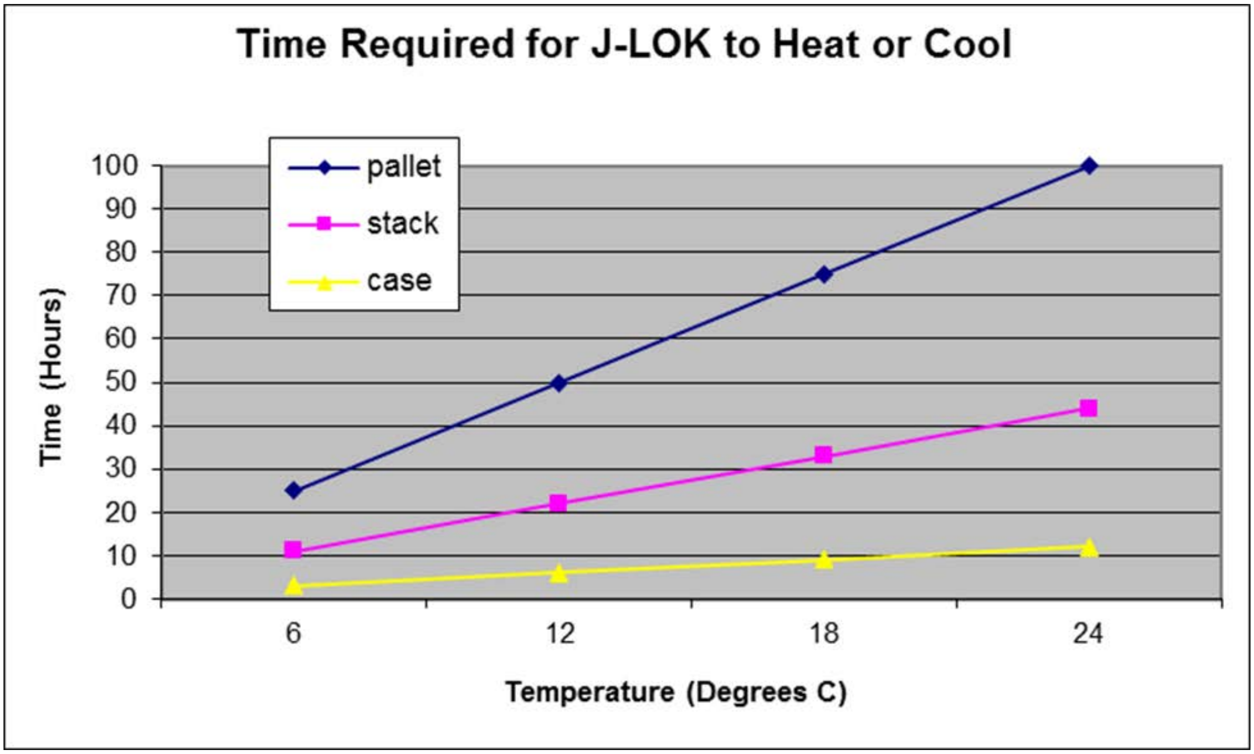
Maintaining resin in a frozen state actually preserves the product. J-LOK resin normally has a one year shelf life if stored under ideal conditions (cool, dry environment). But if frozen, the shelf life can be 18 months or longer. Despite the extended shelf life with storing resin in a frozen state, maintaining reasonable (1-2 month) inventories and stock rotation is the best way to manage J-LOK. Resin over one year old, even J-LOK that has been stored in a frozen state, should be tested to ensure that product performance is still within design parameters.

While there is no degradation in performance due to storing J-LOK in unheated conditions in winter, it must be noted that J-LOK resin reacts quicker with an increase in temperature and slower at as the temperature is decreased. This is reflected in the following chart.



It should be noted that J-LOK resin requires long periods of time to heat up or cool down. Full pallets of J-LOK, with the stretch wrapped outer cover still intact, requires 24 hours to change 6 degrees C. So if a pallet is stored for a long period of time at minus 5 Degrees C, and then moved to an environment at 13 Degrees C (a change of 18 Degrees), it would take 72 hours (3 days) for that pallet to warm up to 13 Degrees C. Breaking pallets down into columns or individual cases can decrease warm up times.

Temperature variation time is indicated in the following chart:



In general, moderate storage temperatures work the best for resin products. An ideal situation would be as follows:

1. Maintain 2-4 weeks of product at the mine site. Rotate new product to the back of the storage area so that oldest resin is consumed first. Keep the stretch wrapping intact as long as possible.

2. Keep resin in unheated storage building, ideally between 0 and 13 °C, however freezing does not adversely affect the performance of the resin.

3. Move resin to working area as needed, allow full pallets two days to warm up to mine temperature (assuming 12 degree temperature change). Less time is needed for cases.

4. Consume each box of resin as it is opened. Consume oldest dated resin first.

5. Don't leave resin behind in idle areas of the mine, move resin to working areas.

CAPSTONE MINING CORP.
MINTO MINE

Minto Mine
Safe Work Practice

Underground Intersection Development and Ground Support Installation

Purpose:

To ensure underground intersections are developed and supported safely.

Scope:

This Safe Work Practice pertains to all Mine personnel and contractors involved with the mining of, and ground support installation in underground intersections. This primarily applies to underground miners, shifters and supervisors. The procedures in this document pertain to typical three- or four-way underground intersections in both development and ore.

Definitions:

- Driving Layout – Design print showing surveyed and planned excavations, provided to underground crews for each heading. Ground support standards are provided on the back of the driving layouts.
- Long Support – Additional, or secondary, ground support installed in intersections in addition to the minimum ground support standards for drifts.
- Super Swellex – Inflatable rock bolts typically having an approximate capacity of 24 tonnes. May refer to equivalent bolts by other manufacturers such as the Python or Omega.
- Cross-cut – Drift(s) developed perpendicular to a heading, resulting in a three or four way intersection.

Responsibilities:

Employer / Supervisor Responsibilities

- Ensure all relevant employees are trained and competent to follow the procedures laid out in this SWP and maintain records of qualified individuals.
- Provide up-to-date, signed driving layouts with ground support standards for all active headings.
- Review ground conditions and ground support performance regularly.
- Maintain an updated Ground Control Management Plan.

Safety Department Responsibilities

- Ensure the original signed-off copy of this SWP is kept and stored with all site SWP's and accessible to all employees.

Worker Responsibilities

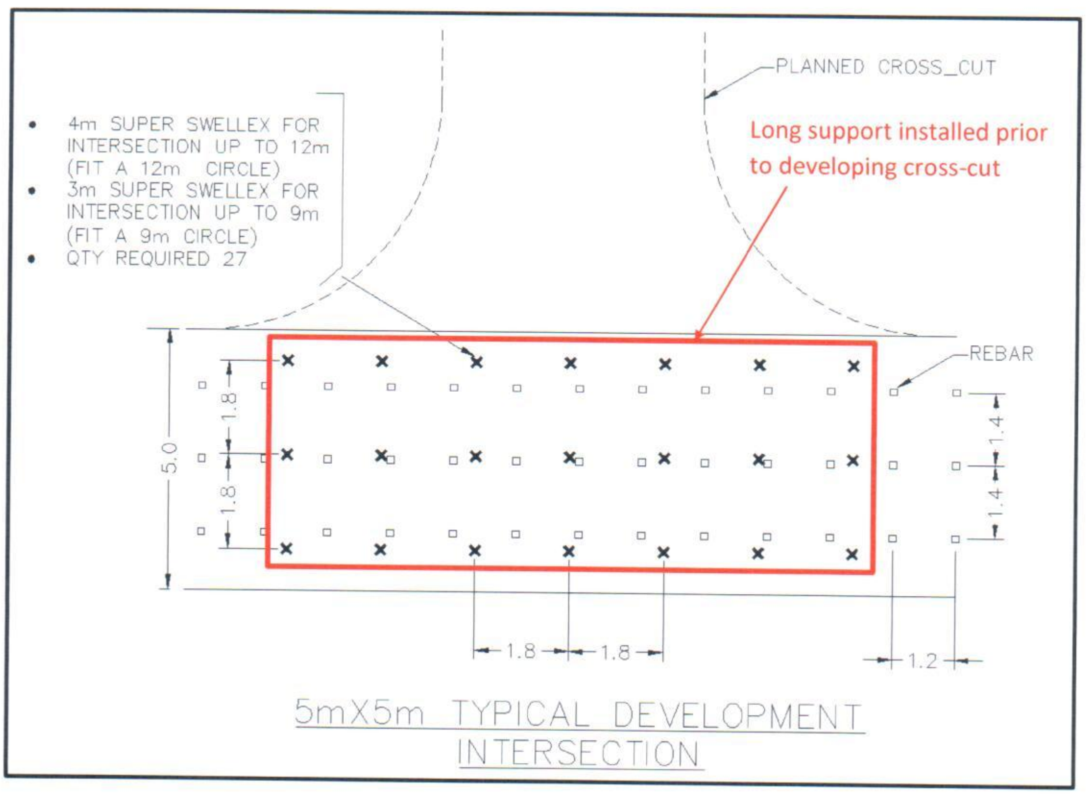
- Understand and adhere to the driving layouts and ground support standards provided on the back of the driving layouts.
- Notify the underground supervisor or geotechnical engineer of any unusual ground conditions observed at the planned intersection location.

Reference to Legislative and Site Requirements

- YWCHSB Section 15.48:
    - Underground support (1) - Every adit, tunnel, stope, or other underground opening, where a worker may be exposed to the danger of rock fall or rock burst while working or passing through, shall be supported by wooden or steel support structures, casing, lining, rock-bolts or combination of any of these to make the openings secure and safe.
- Minto Mine Underground Ground Control Plan – Underground Operations (July, 2013) Section 2.4.4:
    - It is a requirement that permanent support, suitable to the final excavated dimensions, be installed prior to a cross-cut being taken. This would require the existing access drift to be mined two to three rounds past the planned location and the appropriate intersection support installed prior to taking the cross-cut. Once it has been taken, additional intersection support is installed within the area of the first two rounds of the cross-cut.

Safe Work Practice:

1. **Advance Face Past the Intersection Location**
   - **1.1.** The face is advanced a minimum of two rounds past the intersection location prior to any development of the cross-cut.
   - **1.2.** Standard ground support for the heading is installed as the face is advanced. Permanent support is not required in the wall where the planned cross-cut will be developed – this wall can be spot-bolted at the discretion of the bolter.
   - **1.3.** Any unusual ground conditions observed in the planned intersection location are reported to the supervisor/geotechnical engineer.
2. **Install Intersection Support ("Long Support") at the Planned Intersection Location**
   - **2.1.** Intersection ground support, as specified on the driving layout and typically consisting of 3m, 4m or 6m Super Swellex, is installed a minimum of two rows past the planned cross-cut location. An example of a typical development intersection is shown below.

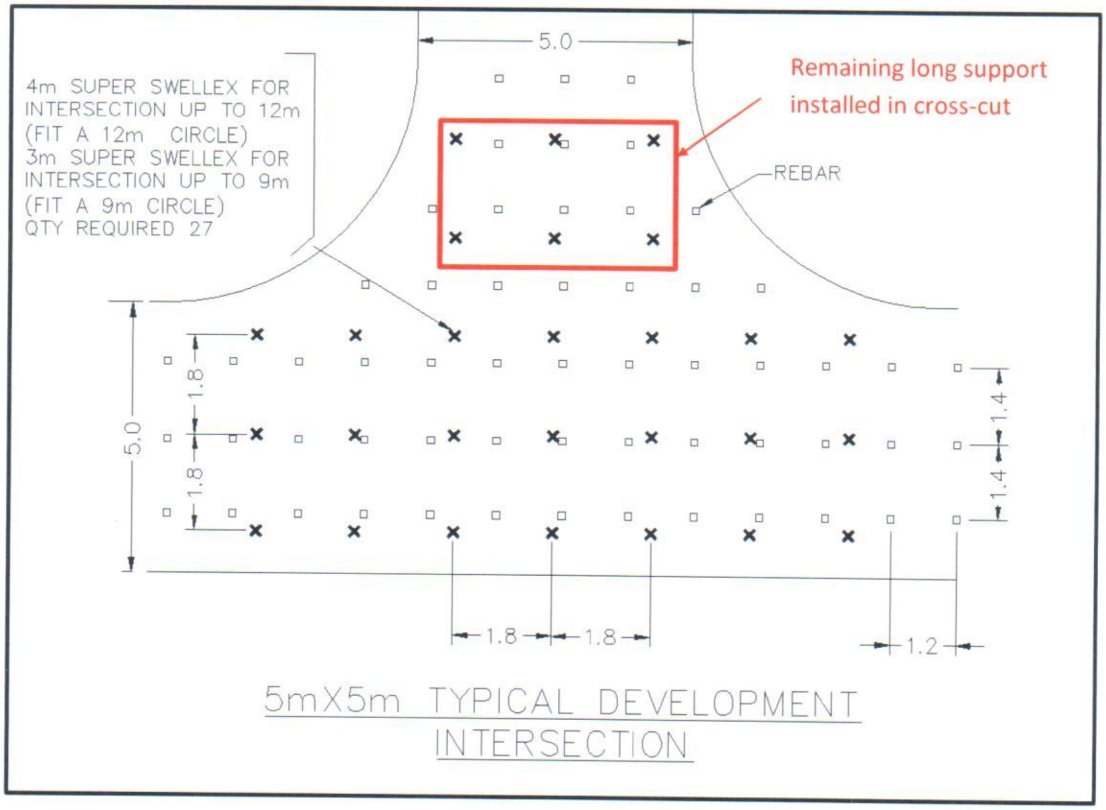


3. Develop Cross-Cut

3.1. The intersection is developed a maximum of one slash plus one round into the cross-cut, typically 4-6m.

4. Install Remaining Intersection Support ("Long Support") in the Cross-Cut

4.1. The remaining long support, typically two rows, is installed in the cross-cut. An example of a typical development intersection is shown below.



CAPSTONE MINING CORP. MINTO MINE

Minto Mine Safe Work Practice

SWP Development and Approval

	Developed / Revised by: (Print)	**Date:**
Worker:	Kevin Cymbalisty	**Nov 18, 2013**
Worker:	Michael Danielson	**Nov 24, 2013**
Worker:		
Supervisor:		
Supervisor:		
Supervisor:		
Supervisor:		
JOHSC Representative:	Roisin Kerr	**Nov 24, 2013**
JOHSC Representative:		
Senior Supervisor:	Bruce Loney	**Nov 19, 2013**
Senior Supervisor:		
Departmental Manager:		
	Reviewed By: (Print & Sign)	
Safety Department:	Mark Goebel	Dec 16/2013
Safety Department:	N/A	
	Approved By: (Print & Sign) Determined by Safety Dept., enter NA if not applicable.	
Departmental Manager:	S.D. TOLGYESI	DEC 16 2013
General Manager:	FOR RK. LIGHT	DEC 16 2013

Clarification of this safe work practice can be directed to the Safety Department.

Last revision date: November 24, 2013

SUBJECT: PROCEDURE FOR SCALING

ADMINISTERED BY: U/G Supervisors **NUMBER OF PAGES: 2**

REVIEWED: Feb. 7, 2007, March 4/08 - March 18/09 – Mar. 4/10 – Apr. 14/11, July 19 2011

Scaling requires experience and judgement. Your safety and the safety of others depends on how well you scale. You must be continually on the lookout for conditions which others have overlooked. Be particularly careful in your examination of the roof and walls for slips and cracks in the rock.

All employees must conduct a field level risk assessment using the Dumas Zero Harm Safety Card before commencing work and whenever conditions change.

At Dumas all employees are prohibited from performing or assigning work that is thought to be unsafe.

1. Tools and Equipment:
   Supervisors and workers must make sure that sufficient supplies of sharp scaling bars of suitable lengths for scaling must be on hand. All equipment must be in good condition. DO NOT use scaling bars that are worn or bent.

2. Picks and shovels or wrenches must NEVER be used for scaling.

3. DO NOT wait for the Supervisor to tell you to scale. Use your own initiative and scale as required.

4. From the Occupational Health and Safety Act, 1990 and Regulations for Mines and Mining Plants, Section 66 – (1):

   "Before work is begun in a workplace in an underground mine, the ground conditions of the workplace shall be examined for dangers and hazards and, if required, made safe."

4. All work areas must be thoroughly washed following blasting operations as scaling progresses.

5. Choose the proper length scaling bar with which to sound the back and walls.

6. The six Points of Safe Scaling:
   a) Be sure you have good footing at all times. Flat, if possible, and clean.
   b) Be sure of clear space behind you for retreat.
   c) Be sure that the scaled material will have a bed to fall on and will not roll your way.
   d) Sound and scale from good ground to bad ground.
   e) Watch for unexpected falls of ground.
   f) Use the proper length of scaling bar. Do not attempt to over-reach when scaling

7. Start at the entrance of the workplace and check scale through the travelway and workplace, making the areas safe if required.

8. Keep other workers at a safe distance when scaling and where 2 workers are scaling together ensure good communication at all times.

9. DO NOT hold the point of the bar in front of the body when scaling; hold the bar to the side of the body.

10. If prying down on a scaling bar; there is danger you will lose your balance. Ensure good footing at all time.

11. A) Make a visual inspection of the back and walls and test by sounding with a scaling bar, at the start of the shift and at intervals throughout the shift including whenever someone visits your workplace.

    B) To sound the rock, tap with the point end of the scaling bar. Solid ground gives a ringing sound. All other dull, drummy sounds must be considered as unsafe ground.

12. Where you encounter loose that cannot be scaled down with a scaling bar or where the risk level of taking the loose down with a bar is greater than low; workers shall stop, make the area safe by barrier and contact a Dumas supervisor for direction.

13. A supervisor who is called upon to provide direction will use field level risk assessment principles to evaluate risk levels and where direction to proceed is given that direction shall be in writing using the Dumas Zero Harm Card.

14. Where a supervisor feels that risk levels cannot be controlled adequately by using alternative equipment such as a jumbo, blasting or other means, the supervisor will direct in writing that the area be made safe by barrier and then request assistance from ground control and/or his superiors before permitting work to proceed.

15. Do a thorough job scaling. Lives depend on you doing so.

DUMAS
Your project. Our expertise. Common ground.

SUBJECT: SCREENING WITH MECHANIZED ROCK BOLTER

ADMINISTERED BY: U/G Supervisors **DATE: Feb. 7/07** **NUMBER OF PAGES: 4**

DATE REVIEWED: March 7/08 – Mar. 20/09 - Mar. 15/10 – Mar. 3/11

All employees must conduct a field level risk assessment using the Dumas Zero Harm Safety Card before commencing work and whenever conditions change.

At Dumas all employees are prohibited from performing or assigning work that is thought to be unsafe.

JOB STEPS	POTENTIAL HAZARDS	CONTROLS
Inspect your Workplace	1) General	Apply the “Dumas Zero Harm Safety System” & Safe Scaling practices.
	2) Poor housekeeping	Ensure that they work area is kept in a neat and orderly fashion.
	3) Rough roadway that could make the positioning of the bolter difficult	Maintain good roadways when mucking and ensure that the “Roadway” is clear prior to moving in the bolter.

JOB STEPS	POTENTIAL HAZARDS	CONTROLS
Inspect your equipment Bolter, Water Hose, Electrical Supply, Scaling Bars, Rock Bolts and Plates, Wooden Washers, Screen	Bolter 1) Improper servicing or failure to service prior to moving the bolter into the work area.	Ensure that you take the time to inspect and service the vehicle in accordance with the Operator's Daily Maintenance Report.
	2) Pinch points	Do not over reach while servicing the machine and take necessary precautions to avoid pinch points.
	3) Spillage and Leaks	When filling with oil or fuel, use a funnel when necessary and avoid over filling. Visually inspect hydraulic hoses. Remove excess grease from the machine.
	4) Slips and Falls	Clean up any fuel/oil spills. Do not over reach and use the means of access that is provided. ie. Steps - Avoid jumping onto or down from the machine. Clear platform of unnecessary equipment and debris.
	5) Over Filling with Lubricants	Be conscious of the fact that if the machine is not on level ground, you have to account for this when adding fluids. ie. Hydrostatic tank compressor pump engine oil.
	6) Electrocution, shocks or fire	Whenever possible, service the machine on level ground. Inspect all electrical services such as trailing cable, plug and the main electrical panel on the machine. Report any defects to the electrical dept. Do not attempt to repair electrical problems yourself.

JOB STEPS	POTENTIAL HAZARDS	CONTROLS
	WATER HOSE 1) Leaks in hose. 2) Insufficient length of hose. 3) Insufficient water pressure	Visually inspect for damage. Ensure that you have enough hose to complete the job. Use a 1" water hose and repair any leaks or crimps in the hose.
	ELECTRICAL SUPPLY 1) Electrical supply too far from work area. 2) Damaged electrical panel or cable.	Move the cable extension or obtain another extension cable. Contact electricians to move the electrical panel if necessary. Contact the Electrical Dept. Do not attempt to repair electrical equipment yourself.
	SCALING BARS 1) Improper length or number of bars. 2) Bars in poor condition ie. Bent	Ensure that your scaling bars are in good order.
	ROCK BOLTS & PLATES 1) Insufficient supply to carry out the job. 2) Damaged bolts (ie. Bent Bolt or Damaged Shell)	Maintain an adequate supply of bolts and store these where they won't get damaged.
	SCREEN 1) Damaged screen 2) Improper screen size	Ensure proper handling and storage of screen. Use 4" or smaller mesh to ensure good achorage of the screen, by the plate. Ensure

JOB STEPS	POTENTIAL HAZARDS	CONTROLS
Positioning the Bolter and Preparing to Rock Bolt	1) Machine won't start.	Ensure the operating controls are in the proper position. Ie. Gear lever and emergency brake. Ensure that the main switch is on. Be aware of the possibility of a dead battery. Check Fuel Level. If unable to trouble shoot the problem yourself, contact the Mechanical Department.
	2) Poorly balanced machine when preparing to move.	Ensure that the boom and platform are in the traveling position prior to raising the jacks off the ground.
	3) Brakes won't release	90 P.S.I. is required. Allow the machine to run in order to build up pressure. If this fails, contact the Mechanical Department.
	4) Inoperable service brakes resulting in movement of the machine after releasing emergency brakes	Test the service brake and if it does not operate, re-apply the emergency brakes, lower jacks and shut down the machine. Contact the Mechanical Department.
	5) Post start-up problems.	Service the vehicle and check the operation of the controls in accordance with the operator's daily maintenance report.
	6) Damage to equipment or people while moving the bolter into position.	Travel at a safe speed and ensure that all people in the area are clear of the machine, if visibility is a problem, get someone to guide you as you move the machine into position. Avoid hitting the wall, pipe, vent tubing etc. and ensure that the trailing cable feeds off evenly from the reel. Ensure that lights are in working order when moving the machine.

JOB STEPS	POTENTIAL HAZARDS	CONTROLS
	7) Positioning the work platform ahead of unsupported ground.	Avoid advancing the leading edge of the work platform ahead of unsupported ground that could possible expose the workman to the hazard of loose ground.

SUBJECT: SWELLEX BOLT INSTALLATION

ADMINISTERED BY: U/G SUPERVISION **NO. OF PAGES: 3**

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PURPOSE: To establish correct procedures for the installation of swellex to be used as ground support when changes in ground conditions and structure warrant it.

All employees must conduct a field level risk assessment using the Dumas Zero Harm Safety Card before commencing work and whenever conditions change.

DUMAS CARDINAL RULE

At Dumas all employees are prohibited from performing or assigning work that is thought to be unsafe.

Swellex bolt is a friction stabilizer help in place by the pressure of the swollen tube against the wall of the drill hole. Its anchorage is continuous over the whole length of the hole.

The swellex friction bolt consists of 1 steel tube with a diameter of 41mm (1.6”) and walls 2mm (0.08) thick that is mechanically deformed to obtain a diameter of 25.4 mm (1”). The tube is inserted into a drill hole and then inflated by 20 to 30 mpa’s (2900-4350 psi) water pressure.

All persons installing ground support shall meet the definition of competent person or shall be in the process of being trained by a competent person; meaning that the person is qualified because of knowledge, training and experience to organize the work and its performance; is familiar with the Act and Regulations for the jurisdiction, and the regulations that apply to the work being performed; and has knowledge of any potential or actual danger to health and safety in the workplace.

All ground support is to be installed as per the specifications on the Driving Layout.

Where ground conditions require additional support, as identified either by the crew undertaking the work, the supervisor or ground control, the additional support shall be installed and the need/change recorded.

The driving layout must be available and reviewed prior to commencing the work. Area preparation and scaling must be conducted as per the scaling procedure.

Always work from under supported ground that has been thoroughly scaled. Check scale often.

Related Procedures:

1. Scaling Procedure G-5
2. Drilling with a Stoper
3. Drilling with a Jackleg
4. Install Rebar
5. Install Rock Strap
6. Install Split Set

PROCEDURE:

1. Locate hole position, based on required bolt spacing and length. Check scale the installation site.

2. Drill hole with proper sized bit. For standard swellex bolts, drill with a 1 ¼ inch bit. (for the larger super swellex bolts, drill with a 1 ¾ inch bit)Drill the hole at least two inches longer than the bolt length.

   An air driven high pressure pump is used to expand the swellex tube once it has been installed into the hole. A hose connects the pump to the bolt through a wand, on the end of a special water injection fitting which is pushed over the collar end of the bolt.

3. Place plate onto bolt and insert swellex into hole. Insert bolt into chuck of installation wand. Push bolt fully into hole, until the plate makes contact with the rock.

4. Press down on the pump trigger to expand the bolt. Keep trigger pressed down until the pump has stalled and the correct pressure has been reached.

   Note: Pump pressure is critical. It is essential that the pump be taken to the stall pointy to ensure the full length of the bolt has been expanded. Stopping pumping once the collar area has popped is no guarantee the back end of the bolt has expanded.

5. Release the trigger

6. **Caution:** Be alert for the creation of loose rock at the bolt collar. Never stand immediately underneath a hole when installing a bolt. Radial fracturing at the bolt collar may occur as the swellex bolt is expanded.

7. Although Swellex requires high water pressure, there is no great danger should a hose burst or bolt rupture, since only small volumes of fluid are pressurized. In the event of a rupture the pressure will dissipate quickly.

PUMP INSPECTION

Before installing swellex bolts:

(a) Check that all connections on the high pressure hoses are effectively tight and that none of the hoses are damaged.
(b) Connect water and compressed air hoses onto the pump.
(c) Switch on water and then air. Pump will build up.
(d) Check that pump is delivering the correct water pressure by watching the water gauge.
(e) Check that the installation chuck is not dirty and that all the seals in the chuck are correctly in position

Note: Never run the pump dry.