APPENDIX C

MINING STUDY

NOTE TO READER
APPENDIX C

In April 2015, Treasury Metals submitted an Environmental Impact Statement (EIS) for the proposed Goliath Gold Project (the Project) to the Canadian Environmental Assessment Agency (the Agency) for consideration under the Canadian Environmental Assessment Act (CEAA), 2012. The Agency reviewed the submission and informed Treasury Metals that the requirements of the EIS Guidelines for the Project were met and that the Agency would begin its technical review of the submission. In June 2015, the Agency issued a series of information requests to Treasury Metals regarding the EIS and supporting appendices (referred to herein as the Round 1 information requests). The Round 1 information requests included questions from the Agency, other federal and provincial reviewers, and members of Indigenous communities, as well as interested stakeholders. As part of the Round 1 information request process, the Agency requested that Treasury Metals consolidate the responses to the information requests into a revised EIS for the Project.

Appendix C to the revised EIS (Mining Study) presents a preliminary framework to be used for the extraction of ore at the Goliath Gold Project. The information provided in this appendix was used in the evaluation of alternatives presented in Section 2 and Appendix X, as well as in the Project description (Section 3) used as the basis for the revised EIS. No changes have been made to this appendix from the original EIS issued in April 2015.

As part of the process to revise the EIS, Treasury Metals has undertaken a review of the status for the various appendices. The status of each appendix to the revised EIS has been classified as one of the following:

- **Unchanged**: The appendix remains unchanged from the original EIS, and has been re-issued as part revised EIS.
- **Minor Changes:** The appendix remains relatively unchanged from the original EIS, and has been re-issued with relevant clarification.
- **Major Revisions**: The appendix has been substantially changed from the original EIS. A re-written appendix has been issued as part of the revised EIS.
- **Superseded:** The appendix is no longer required to support the EIS. The information in the original appendix has been replaced by information provided in a new appendix prepared to support the revised EIS.
- **New**: This is a new appendix prepared to support the revised EIS.

The following table provides a listing of the appendices to the revised EIS, along with a listing of the status of each appendix and their description.

List of Appendices to the Revised EIS		
Appendix	Status	Description
Appendix A	Major Revisions	Table of Concordance
Appendix B	Unchanged	Optimization Study
Appendix C	Unchanged	Mining Study
Appendix D	Major Revisions	Tailings Storage Facility
Appendix E	Minor Changes	Traffic Study
Appendix F	Major Revisions	Water Management Plan
Appendix G	Superseded	Environmental Baseline
Appendix H	Minor Changes	Acoustic Environment Study
Appendix I	Unchanged	Light Environment Study
Appendix J	Minor Changes	Air Quality Study
Appendix K	Minor Changes	Geochemistry
Appendix L	Superseded	Geochemical Modelling
Appendix M	Minor Changes	Hydrogeology
Appendix N	Unchanged	Surface Hydrology
Appendix O	Superseded	Hydrologic Modeling
Appendix P	Unchanged	Aquatics DST
Appendix Q	Major Revisions	Fisheries and Habitat
Appendix R	Major Revisions	Terrestrial
Appendix S	Major Revisions	Wetlands
Appendix T	Unchanged	Socio-Economic
Appendix U	Minor Changes	Heritage Resources
Appendix V	Major Revisions	Public Engagement
Appendix W	Unchanged	Screening Level Risk Assessment
Appendix X	Major Revisions	Alternatives Assessment Matrix
Appendix Y	Unchanged	EIS Guidelines
Appendix Z	Unchanged	TML Corporate Policies
Appendix AA	Major Revisions	List of Mineral Claims
Appendix BB	Unchanged	Preliminary Economic Assessment
Appendix CC	Unchanged	Mining, Dynamic And Dependable For Ontario's Future
Appendix DD	Major Revisions	Indigenous Engagement Report
Appendix EE	Unchanged	Country Foods Assessment
Appendix FF	Unchanged	Photo Record Of The Goliath Gold Project
Appendix GG	Minor Changes	TSF Failure Modelling
Appendix HH	Unchanged	Failure Modes And Effects Analysis
Appendix II	Major Revisions	Draft Fisheries Compensation Strategy and Plans
Appendix JJ	New	Water Report
Appendix KK	New	Conceptual Closure Plan
Appendix LL	New	Impact Footprints and Effects

MINING SECTION FOR
ENVIRONMENTAL IMPACT STATEMENT ("EIS")
ON THE
GOLIATH GOLD PROJECT

FOR

TREASURY METALS INC.

By

P&E Mining Consultants Inc.

Report Date: June 3, 2014

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

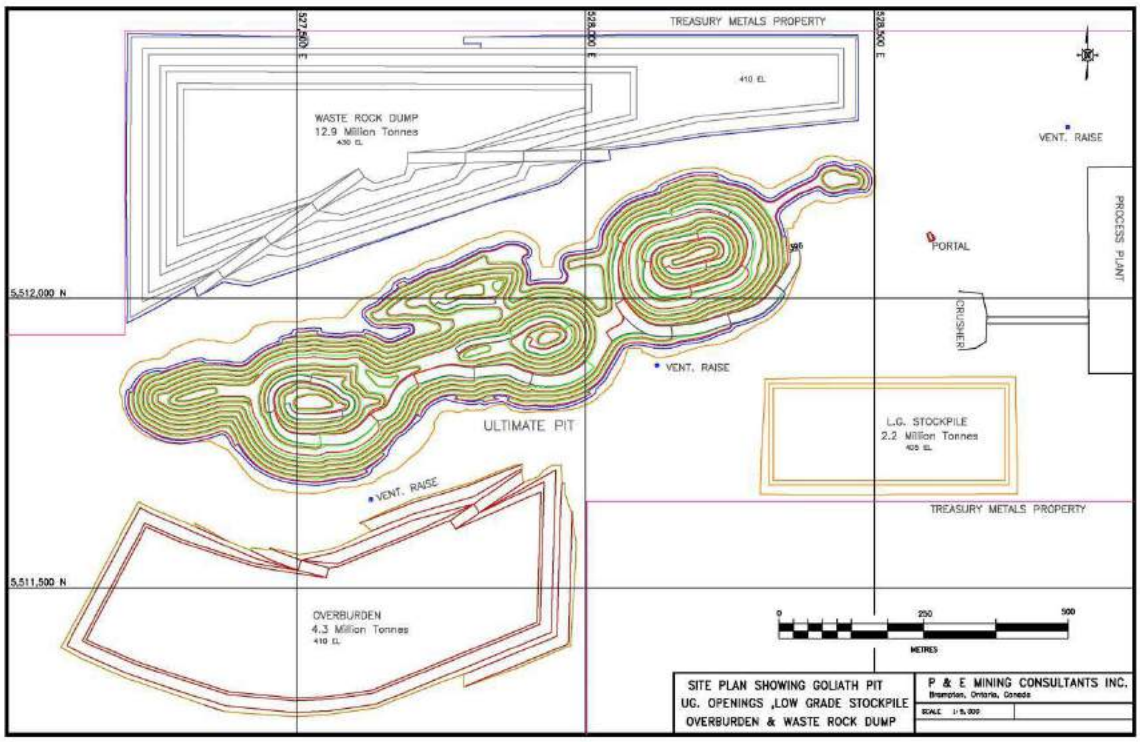
Mining of the Goliath Project involves the extraction of mineable mineralized rock from the ground by a combination of surface and underground methods and delivering it to a crusher located near the processing facilities. Included in this process is the removal of surrounding rock with either low grade, or no mineralization ("waste rock"), in order to provide access to the Mineable Mineral Resource.

The mining operations will employ industry standard open pit and underground mining methodologies. The primary activities will involve drilling and blasting holes in the rock in order to liberate it from the host rock mass and make it easily transportable to other locations using heavy equipment. The broken rock will be excavated and loaded into trucks which will deliver the Mineable Mineral Resource to a Crushing Facility ("the Crusher") near the processing facility. Waste rock is taken to appropriate Waste Storage Facility areas ("WSF") or disposed of into underground mined out openings. Lower grade material will be transported to a temporary storage site for processing later in the mine life.

Additional activities in the mine will include water removal from the mining operations using pumps and piping; electrical power distribution to the electrical equipment and lighting; ground control to protect personnel and associated operations from falling rock; provision of adequate ventilating air to the underground openings where personnel are working; and the movement of men and materials around the mining site.

The locations of the proposed open pit, underground access portal and ventilation raises, lower grade stockpiles and the WSFs are presented in Figure 1.1.

Figure 1.1 Site Plan - Mine and Related Facilities

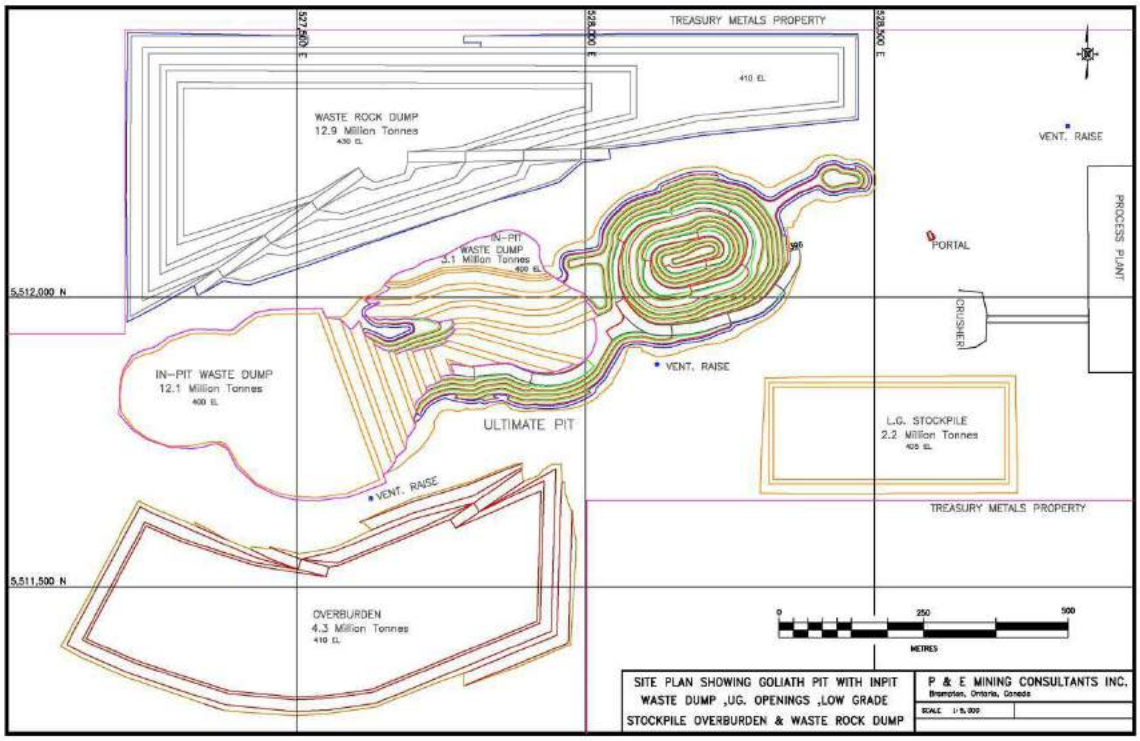


Higher grade material will be delivered directly to the Crusher or to a temporary storage pile (the Run-of-Mine Pad or "ROM Pad") near the Crusher. Low Grade ("LG") material will be stored in a stockpile that will be located close to the crusher. These two stockpiles will be constructed during the initial years of mine production and will be reclaimed and transported to the Crusher on an as-needed basis.

Three WSF areas have been identified for broken waste rock storage. The area immediately north of the open pit is the primary location for waste rock. The waste rock storage facility has been designed at a maximum height of 30 metres from surface topography. The secondary location is south of the open pit, at the western end, for overburden material. The third location, for waste rock, is within the open pit, in the western half of the pit once it is mined out. It is expected that all waste rock produced by the mining operation will be contained within these three locations.

The in-pit waste rock storage at the end of the open pit mine life is presented in Figure 1.2.

Figure 1.2 Site Plan – Open Pit at End of Mine Life



The mining operations will use mobile heavy equipment, as well as various support equipment units to maintain and service the operation. The mining operation requires the presence of personnel at all work sites to operate or maintain the equipment, and also to provide supervision and support.

Considerable quantities of explosives and diesel fuel will be used in the mining operation, in addition to other consumable materials.

2.0 MINERAL RESOURCES

The mineral resources identified at the Goliath Project contain significant quantities of gold as well as other non-economic minerals. The mineral resources are reported in a 3D block model format for easier analysis and manipulation and become the basis of the economic assessments that have supported moving toward a production decision. The mineralized block model used for the preliminary design of the mine was reported in a Preliminary Economic Assessment of the Goliath Gold Project for Treasury Metals Inc. by A.C.A. Howe International Limited effective July 19, 2012, with an update on October 30, 2013.

Economic assessments of the potential of the Project were based on this mineralized block model as well as detailed surface topographical information. A preliminary mine plan has been developed based on this mineralized block model and topographical information.

A portion of the mineral resource has been determined to be economically recoverable using open pit and underground mining methods and standard processing methods. This economic portion of the mineral resource is called the Mineable Mineral Resource. The designs and schedules described in this report are based on mining the identified Mineable Mineral Resource.

3.0 MINING

Mining operations will commence with the preparation and operation of an open pit to access the Mineable Mineral Resource located close to surface. The open pit will be developed to a maximum depth of 140 metres over a period of approximately three years. A portal and underground decline ramp will be constructed during the open pit mining schedule, to provide access to the underground Mineable Mineral Resource. This work will be scheduled to maintain a constant tonnage to the processing plant.

The location of the underground mine and open pit interface (depth of the open pit) has been determined by valuing and comparing the economics of mining incremental mineralized tonnes that would be produced from each method.

3.1 MINE PRE-PRODUCTION DEVELOPMENT

There will be pre-production development in the mine area prior to commencing full production at a rate of 945,000 tonnes per year. A layer of topsoil will be removed by the civil construction contractors on site and stored in a common location with other top soil removed from other areas (See Figure 1.1).

Removal of waste rock in the open pit area to expose a portion of the Mineable Mineral Resource will be carried out. This operation will also produce relatively small tonnages of mill feed which will report to the ROM pad and the LG Stockpile.

3.2 MINE DEVELOPMENT PLAN AND SEQUENCE

The potentially mineable portion of the mineral resources in the Goliath mine area is presented in Table 3.1 and has been estimated using a gold price of US$1,350/ounce and a silver price of US$22/ounce. The table contains all mineralized blocks that are above the marginal cut-off grades of 0.43 grams gold per tonne of open pit rock and 2.50 grams gold per tonne of underground rock.

TABLE 3.1
POTENTIALLY MINEABLE PORTION OF THE MINERAL RESOURCES

Source	(Mt)	Au (g/t)	Ag (g/t)	AuEq (g/t)	Overburden (Mt)	Waste Rock (Mt)
Open Pit Direct Mill Feed	2.98	2.17	5.0	2.23	5.90	24.36
Open Pit Low Grade Stockpile	2.29	0.65	4.3	0.70	n/a	n/a
Underground Direct Mill Feed	3.70	3.38	12.3	3.53	0	2.20
Total	**8.97**	**2.28**	**7.8**	**2.38**	**5.90**	**26.56**

3.3 OPEN PIT

The optimized pit shell was used as a guide in designing a practical pit with an access ramp. The pit wall slopes were not verified by geotechnical analysis. An operating bench height of 5 m in mineralization and 10 m in waste has been used in the pit design. Mine roads and ramps have been designed for two way haulage truck traffic with a width of 18 m and maximum ramp grade of 10%.

The Goliath open pit production schedule and capacity was derived from optimized economic results in relation to capital spending and revenue streams. A daily plant capacity of 2,700 tonnes

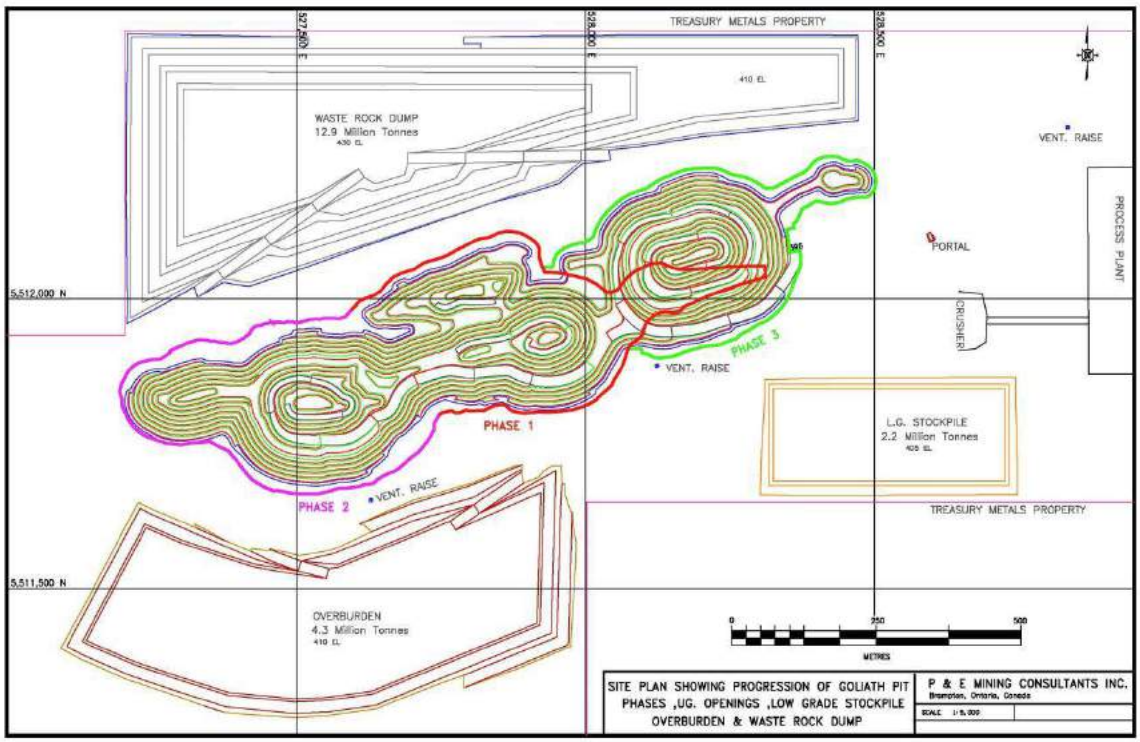
was assumed. The annual processing capacity of the plant, based on 350 days per year of mechanically available operation, is approximately 945,000 tonnes of material.

The overall mine development and production schedule by pit phases is summarized in Table 3.2. The production schedule includes a 12 month pre-production period which will include pre-stripping of the pit area. The Goliath Open Pit has a 3 year operating life and will be operated as one single operating unit, employing one set of operating practices, equipment and infrastructure. The various phases of the mining operation as shown in Figure 3.1 will be operated at times concurrently.

TABLE 3.2
PRODUCTION SCHEDULE SUMMARY BY PIT PHASE

Cut-off Grade AuEq g/t	Pit Phase	Mineralized Tonnes	Au g/t	Ag g/t	AuEq g/t	Contained Ounces Au
1.5	1	920,000	2.12	6.2	2.19	64,900
1.0	2	1,375,000	2.35	2.7	2.38	105,100
1.0	3	684,000	1.88	8.0	1.98	43,500
Total		**2,979,000**	**2.17**	**5.0**	**2.23**	**213,500**
Cut-off Grade AuEq g/t	**Pit Phase**	**LG Stockpile Tonnes**	**Au g/t**	**Ag g/t**	**AuEq g/t**	**Contained Ounces Au**
1.5	1	1,044,000	0.75	5.3	0.82	27,500
1.0	2	561,000	0.60	2.9	0.63	11,400
1.0	3	690,000	0.53	4.1	0.58	12,800
Total		**2,295,000**	**0.65**	**4.3**	**0.70**	**51,700**
Cut-off Grade AuEq g/t	**Pit Phase**	**Overburden Tonnes**	**Waste Rock Tonnes**	**Total Tonnes Incl. Mineralized**	**High Grade Strip Ratio**	**Overall Strip Ratio**
1.5	1	1,835,000	7,214,000	11,012,000	9.8	4.6
1.0	2	2,522,000	8,466,000	12,925,000	8.0	5.7
1.0	3	1,544,000	8,678,000	11,596,000	15.0	7.4
Total		**5,901,000**	**24,358,000**	**35,532,000**	**10.2**	**5.7**

Figure 3.1 Goliath Open Pit Operational Phases



Stockpiles of low grade mineralized rock from the pit will be constructed and reclaimed over the course of the mine life. The stockpiles will store all material produced in the open pit that is determined to have a cut-off grade lower than the grades indicated in Table 3.2, by phase. Higher grade material will be delivered to the Crusher and ROM Pad. During the first three years of production, mineralized material determined to have a grade lower than the cut-off grade will be considered to have no value.

3.4 UNDERGROUND

The Goliath underground mine will be operated as one single operating unit, employing one set of operating practices, equipment and infrastructure. The access and support development will be carried out by external contractors and followed by company mining crews who will extract the mineable resources and deliver it to surface. A portal will be established at a location at the eastern end of the open pit, near the mill primary crusher, as indicated in Figure 3.1. Underground development will be scheduled to ensure continuous mineralized material is delivered to the mill once the open pit feed has been mined out. Various phases of the underground mining operation, as presented in a long section in Figure 3.2 and in a typical level plan in Figure 3.3, will be operated at times concurrently.

Figure 3.2 Goliath Underground Operational Long Section

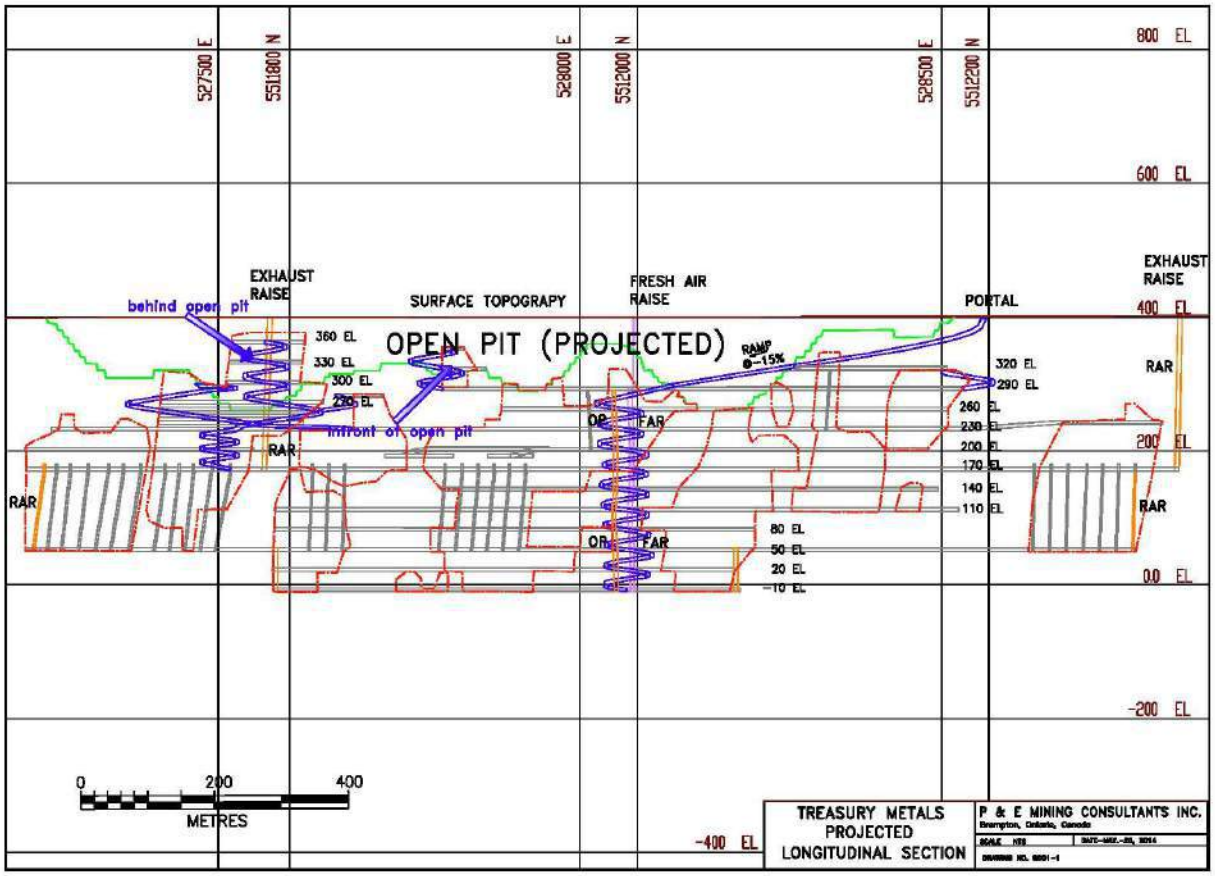
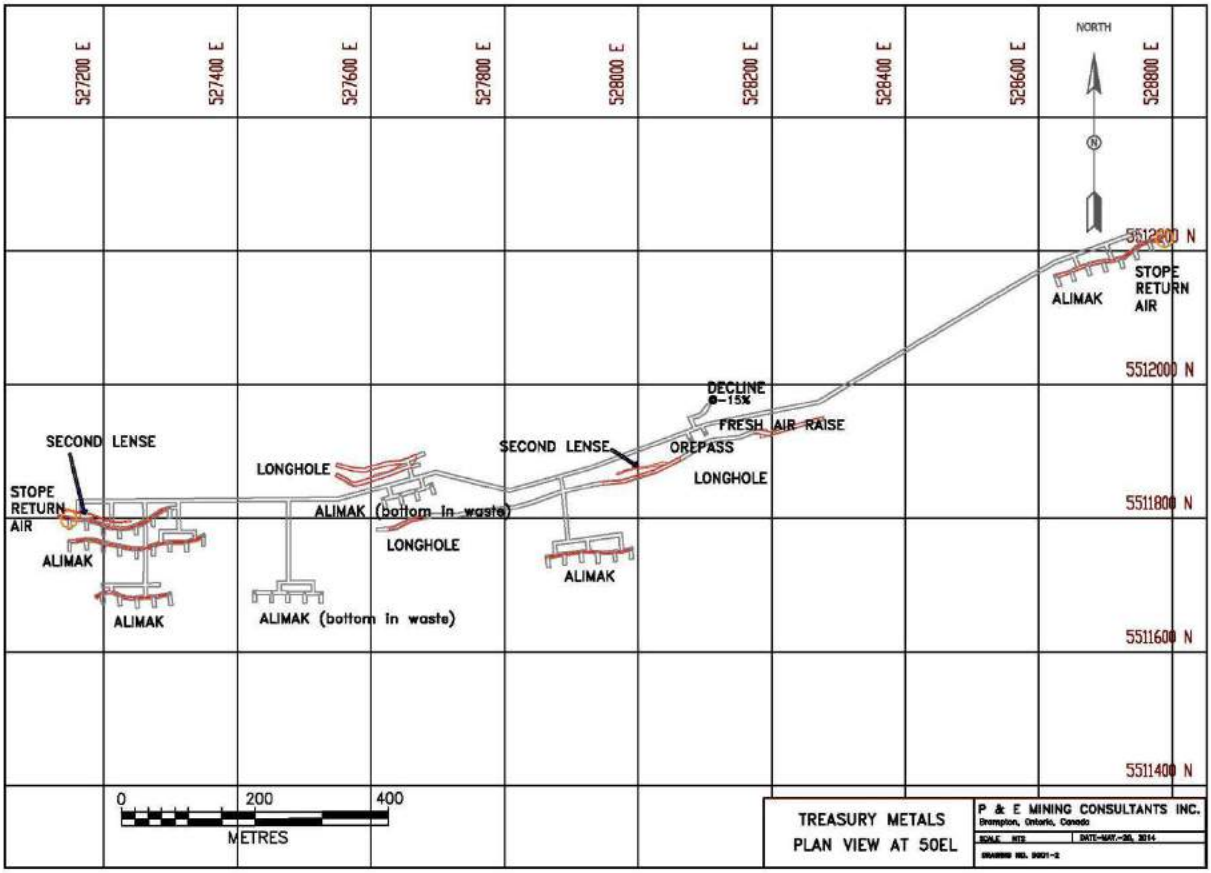


Figure 3.3 Goliath Underground Typical Level Plan



4.0 OPEN PITOPERATIONS

4.1 OPEN PIT SUMMARY

Standard truck and shovel open pit mining methods are envisaged for extracting the Mineable Mineral Resource in the Goliath Mine. Horizontal catchment berms have been included in the pit design to help prevent rock falls continuing down the entire face of the pit wall. In some instances, additional ground support will be required such as rock bolts, cable bolts and shotcrete. De-watering holes drilled horizontally into the pit wall may also be used to relieve water pressure which could be instrumental in causing wall failure.

The bench faces of the pit will be generally excavated at a 75° angle to prevent or minimise damage to the face of the wall. The overall wall angle of the pit will be approximately 45°. These angles will be refined in future geotechnical studies based on a detailed assessment of the degree of weathering of the rocks, the type of rock being exposed and also on the frequencies of structural weaknesses within the rocks, such as a faults, shears, joints or foliations.

Haul roads will be situated at the side of the pit, forming a ramp which trucks can drive up, carrying Mineable Mineral Resource and waste rock to their respective dump locations.

Mineable Mineral Resources are delivered either directly to the primary crushing facility located beyond the exit from the pit or to a nearby temporary storage facility (the ROM Pad), from which it is taken to the crusher at a later date. Material that is determined to have a lower value per tonne in terms of its contained metals will be stored in a long term low-grade storage pile near the crushing facility. This material will be fed to the primary crusher when the higher grade mineralized rock has been fully depleted from the open pit and underground material containing higher grade material can be blended.

Waste rock will be piled up at designated waste dump locations. The walls of the waste dumps are also tiered in benches to minimise degradation and assist in future reclamation.

4.2 OPEN PIT MINING OPERATIONS

4.2.1 Drilling and Blasting

The proposed open pit production drilling and blasting activities include:

- The preparation of drill and blast designs taking the geology, rock properties and characteristics, fragmentation requirements, regulatory requirements, blast design criteria, dry and wet conditions, establishment of drilling and blasting operating practices, and safety and environmental protection measures into account. The work will be carried out by qualified technical mine staff;
- Specification of blast hole drilling requirements in the blast plans. Blast hole cuttings will be sampled and assayed to provide additional grade control data and help define low grade/waste contacts. This work will be carried out under the direction of the mine grade control geologist;
- Drilling blast holes using track-mounted ITH drills that will be obtained from established suppliers. It is envisaged that diesel powered ITH production drills will be used. The drills will be operated by trained personnel in the Mine Operations Department and maintained by qualified personnel in the Mine Maintenance Department;

- The use of a licensed explosives supplier for explosives and blasting accessories that will deliver the materials to the blast holes. The blast holes will be loaded according to the blast plan and blast hole loading procedures. It is anticipated that the blast holes will typically be loaded using ANFO (Ammonium Nitrate and Fuel Oil) prill or emulsion, and that the blasts will be initiated using a conventional non-electric or electronic blast initiation system. Loading and blasting activities will be supervised by a qualified trained person. The explosive supplier will store its equipment and materials in secure locations on the mine property;
- Secondary blasting. The blasted mill feed will be excavated and hauled to the crusher/stockpile. Blasted rocks that are too large to be excavated in the pit will be set aside and broken into manageable pieces by secondary blasting and/or a mobile rock breaker. The blasted waste rock will be excavated and hauled to the appropriate waste rock disposal area; and
- Pre-shearing with decoupled charges or such other means of controlled blasting as may be necessary to complete the final pit walls.

The proposed drilling and blasting program includes environmental protection controls (e.g. strategies and measures that are proactively taken to eliminate or mitigate potential environmental impacts) and occupational health and safety measures. The project-specific environmental and health and safety controls that are currently envisaged for the Project are summarized in Table 4.1.

TABLE 4.1
PRODUCTION DRILLING AND BLASTING ENVIRONMENTAL ASPECTS AND CONTROLS

Activity	Environmental Aspect	Potential environmental impact	Environmental controls for production drilling and blasting activities
Blast hole drilling	Dust	Air emissions Worker's health and safety	Dust collector unit provided with new drills, shift inspection reports and scheduled maintenance
	Diesel fuel consumption	Air emissions	Emission controls provided on new drills, shift inspection reports and repairs and scheduled maintenance
	Re-fuelling and chemical handling	Surface and ground water contamination	Use of appropriate fuel and chemical storage and handling equipment, spill clean-up (see also support activities below).
	Engine noise	Noise	Exhaust system supplied on new drills, Occupational health and safety noise controls for workers include noise attenuation in the operators cab, shift inspection reports and scheduled maintenance
	Used oil	Surface and ground water contamination	Used oil collection and recycling and spill clean-up
	Drill pipe lubricants	Soil, surface water and groundwater contamination	Use appropriate lubricants , avoiding overuse and spill clean-up

TABLE 4.1 PRODUCTION DRILLING AND BLASTING ENVIRONMENTAL ASPECTS AND CONTROLS			
Activity	**Environmental Aspect**	**Potential environmental impact**	**Environmental controls for production drilling and blasting activities**
Blasting	Explosive consumption, dust, NOx	Air emissions. Vibration and noise. Flyrock. Soil, surface and groundwater contamination. Worker's health and safety. Public safety	Blasts are designed to: consume the explosives loaded into the blast holes; reduce air emissions including noise; and control flyrock and vibration. Blast hole dewatering truck. The use of ANFO prill and emulsion. The use of a commercially available blast initiation and sequencing system. Spill clean-up. Blasthole liners and emulsion explosive will be used in wet holes. Blast are "guarded" to prevent accidental access to the blast sites.
Support activities	Blast site clearing (when the land surface is cleared to expose rock)	Vegetation, wildlife, wildlife habitat, valued ecological and cultural components, topsoil	Blasting is conducted within areas defined by the approved mine plan. Valued ecological and cultural components that are to be protected are identified in the field and protected. Top soil is separately removed and stockpiled when present in sufficient quantity.
	Fugitive dust from support vehicles	Dust emissions to atmosphere	Road dust reduction controls including the use of water trucks and commercially available dust suppressants.
	Re-fuelling and chemical handling	Soil, surface and ground water contamination	Use of appropriate fuel and chemical storage and handling equipment and spill clean-up
	Drilling and blasting equipment maintenance	Air emissions and soil, surface and ground water contamination	Scheduled maintenance. Qualified and trained personnel. Parts, filters, etc. are available. Waste disposal procedure and spill clean-up
	Explosive supplier equipment and materials	Air emissions and soil, surface and ground water contamination	Scheduled maintenance. Qualified and trained personnel. Parts, filters, manufacturer-specified lubricants are available. Waste disposal procedure and spill clean-up.
	Used oil and waste	Soil, surface and	Employee training and

TABLE 4.1 PRODUCTION DRILLING AND BLASTING ENVIRONMENTAL ASPECTS AND CONTROLS			
Activity	**Environmental Aspect**	**Potential environmental impact**	**Environmental controls for production drilling and blasting activities**
	disposal	ground water contamination. Workers and public health and safety	awareness. Standard Operating Procedures. Labelling. Spill clean-up and proper disposal. Spill response plan. Emergency response plan and equipment. Inspections and internal audits.
	Recycling of materials and equipment such as including used oil, batteries, engine coolant, drill bits	Soil, surface and ground water contamination. Workers and public health and safety	Appropriate containers and labelling, and storage and transportation. Spill clean-up and proper disposal. Disposal to appropriate facilities. Driver training. Inspections and internal audits.
Post-blast inspections	Unexploded explosives	Surface and groundwater, worker's health and safety	Post blast inspections and established procedures for dealing with unexploded explosives (if any).

4.2.2 Loading and Hauling

The envisaged open pit loading and hauling activities include:

- The excavation of blasted Mineable Mineral Resources, low grade material and waste rock from production and development benches in the pit area with suitable loading and haulage equipment procured from reputable vendors. The blasted rock will be loaded into haulage trucks for transport to specified destinations according to material type. The selection of suitable equipment for these activities takes into account the rock types, fragmentation from blasting, bench configuration, selectivity and other factors. The blasted Mineable Mineral Resource, including low grade material, will be excavated using diesel powered hydraulic excavators. The blasted waste rock will be excavated using larger diesel powered hydraulic face shovels. The mine will use 50-70 tonne class haul trucks exclusively for the rock handling. The haul trucks will employ diesel powered mechanical drives. The excavation will follow detailed mines plans and schedules and will be carried out under the supervision of qualified and experienced technical mine staff and supervisors;
- The haulage of excavated materials along pre-engineered and regularly maintained mine haulage roads to storage or processing locations. This includes the crusher facility, the ROM Pad, the low grade stockpile, the waste storage facilities or any other location that may require material for construction purposes;
- Direct dumping in the crusher area. An estimated 85% of the material reporting to the crusher facility will be directly dumped into the crusher. The other 15% will be temporarily stored at the ROM pad. The re-handling of the ROM Pad material to the crusher will be accomplished with a diesel powered wheel loader;
- The design, construction and maintenance of suitable haul roads for the size and class of equipment selected for the loading and hauling operations. The haul road designs will be developed according to standard industry practice and will conform to regulatory requirements. The initial haul roads may be constructed by a contractor using smaller construction equipment;
- Activities carried out in support of the loading and hauling operation, including regular road maintenance and WSF slope control and surface levelling. The major support equipment will include suitable sized diesel-powered motor graders, wheel dozers and track type dozers for haul road construction and maintenance, loading unit support and dump area maintenance as well as mine site construction tasks.
- The maintenance of the loading and hauling equipment as well as the support equipment fleet in an adequately equipped maintenance shop. Additional equipment maintenance activities will be carried out by field crews. In all cases, attention will be focused on the employment of safe work practices and ecological protection. All maintenance work will be carried out under the supervision of qualified and experienced technical mine staff and supervisors and will follow applicable standards and regulations;
- Application of comprehensive strategies to eliminate or reduce impacts on the safety, health and the environment from noise, dust, fumes, waste materials and other relevant impacts. Strategies will include scheduled maintenance on diesel equipment to help reduce emissions, haul road watering for dust suppression and in general, the application of established industry practices. Waste material collection and treatment will be carried out by qualified mine personnel;

After the higher grade material is depleted from the mine by the end of year 3, material stored in the LG Stockpiles will be reclaimed together with the mined underground mineral resource. The ROM pad re-handle, as well as the recovery of material from the LG Stockpiles to the crusher, will be conducted with one wheel loader dedicated to these tasks.

A second wheel loader will provide additional rock loading capacity in the pit. This will be required during the peak production levels in the early stages of the mine, as well as during maintenance downtime with the diesel hydraulic excavators.

Additional material movement requirements will arise from construction of mine site facilities such as topsoil removal, tailings management facilities (dyke construction), mine haul roads and crusher and rock storage pads. These construction material movements may be handled by contractor equipment and not by the main mining equipment fleet.

Waste Storage Facilities will be designed with certain slope angles, berm widths and other constraints in order that the storage piles can be easily remediated at mine closure.

The excavator loading sites as well as major intersections, the dump locations and the crusher pad will be illuminated by diesel powered mobile lighting plants.

Minor service and refuelling of the hydraulic excavators will take place at the site of the equipment location in the mine. Major overhauls of hydraulic excavators will be conducted in the mine maintenance facility.

The planned loading and hauling operation will involve environmental protection controls (e.g. strategies and measures that are proactively taken to eliminate or mitigate potential environmental impacts) and occupational health and safety features. Major project-specific environmental and health and safety controls are summarized in Table 4.2.

TABLE 4.2
LOADING AND HAULING ENVIRONMENTAL ASPECTS AND CONTROLS

Activity	Environmental Aspect	Potential Environmental Impact	Environmental controls for Production Loading and Haulage Activities
Loading and hauling operation	Dust	Air emissions. Worker health and safety.	Haul road watering program and use of dust suppressant. Shift inspection reports. Scheduled maintenance.
	Diesel fuel consumption	Air emissions.	Emission controls provided on new equipment/ Shift inspection reports and repairs. Scheduled maintenance.
	Re-fuelling and chemical handling	Ground water contamination.	Use of appropriate fuel and chemical storage and handling equipment. Spill clean-up (see also support activities below).
	Engine noise	Noise.	Occupational health and

TABLE 4.2 LOADING AND HAULING ENVIRONMENTAL ASPECTS AND CONTROLS			
Activity	**Environmental Aspect**	**Potential Environmental Impact**	**Environmental controls for Production Loading and Haulage Activities**
			safety noise controls for workers include personal noise attenuation equipment. Scheduled maintenance.
	Used oil	Ground water contamination.	Used oil collection and recycling.
	Lubricants	Soil, surface water and groundwater contamination.	Use appropriate lubricants. Avoiding overuse. Spill clean-up.
Support activities	Fugitive dust from support vehicles	Dust emissions to atmosphere.	Road dust reduction controls including the use of water trucks and commercially available dust suppressants.
	Re-fuelling and chemical handling	Ground water contamination.	Use of appropriate fuel and chemical storage and handling equipment. Spill clean-up.
	Equipment maintenance	Air emissions and ground water contamination.	Scheduled maintenance. Qualified and trained personnel. Parts, filters, etc. are available. Waste disposal procedure. Spill clean-up.
	Used oil and waste disposal	Ground water contamination. Worker and off-site public health and safety.	Employee training and awareness. Standard Operating Procedures. Labelling. Spill clean-up and proper disposal. Spill response plan. Emergency response plan and equipment. Inspections and internal audits.
	Recycling of materials and equipment such as including used oil, batteries, engine coolant, scrap metal, general maintenance shop refuse, packing and shipping materials.	Soil, surface and ground water contamination. Worker and off-site public health and safety.	Appropriate containers and labelling, and storage and transportation. Spill clean-up and proper disposal. Disposal to appropriate facilities. Inspections and internal audits.

5.0 UNDERGROUND MINING OPERATIONS

5.1 UNDERGROUND ACCESS DEVELOPMENT

The underground mineable mineral resources will be accessed initially by a decline ramp excavated at a grade not exceeding -15%. This ramp will be 5 m high by 5.5 m wide and will be fully secured with adequate rockbolts, screen and other ground support. At increments of 30 m, down the ramp and below the final open pit bottom elevation, level access cross-cuts will be established to provide access to the mineable mineral resource.

Additional underground infrastructure will be established as required, including excavations and equipment related to the distribution of ventilating fresh and exhaust air; secondary access/egress to and from the underground mine; water collection and pumping to surface; equipment maintenance areas; emergency refuge stations; and material storage.

Wherever possible, waste rock produced by the underground mining process will be disposed of in exhausted stopes or unused development headings. If no deposition sites are available underground, the material will be hauled up the ramp to surface and disposed of in the open pit WSF.

A variety of production stoping methods will be used, depending on stope configurations and conditions in different parts of the underground mine. These include:

- Longitudinal longhole open stoping, with delayed backfill;
- Alimak mining with delayed backfill;
- Cut and fill mining with ramp access and diesel mobile equipment. This will be employed in the recovery of the crown pillar at the bottom of the open pit; and
- Shrinkage mining, in locations with narrow hanging wall to footwall widths.

5.2 UNDERGROUND DRILLING AND BLASTING

The proposed underground production drilling and blasting activities for the mineral resources include:

- The preparation of drill and blast designs taking the geology, rock properties and characteristics, fragmentation requirements, regulatory requirements, blast design criteria, dry and wet conditions, drilling and blasting operating practices, and safety and environmental protection measures into account. The work will be carried out by qualified technical mine staff;
- Drilling blast holes using mobile longhole or development jumbo drills that will be obtained from established suppliers. The drills will be operated by trained personnel in the Mine Operations Department and maintained by qualified personnel in the Mine Maintenance Department;
- The blast holes will be loaded according to the blast plan and blast hole loading procedures. It is anticipated that the blast holes will typically be loaded using ANFO emulsion and that the blasts will be initiated using a conventional non-electric or electronic blast initiation system. Loading and blasting activities will be carried out by experienced and qualified crews. The explosive supplier will store its equipment and materials in secure locations on the mine property. This material will be taken underground to the workplace or to a temporary secure storage magazine.

- The proposed drilling and blasting program includes environmental protection controls (e.g. strategies and measures that are proactively taken to eliminate or mitigate potential environmental impacts) and occupational health and safety measures. The project-specific environmental and health and safety controls that are currently envisaged for the Project are essentially the same as those for the open pit, as summarized in Table 4.1.

5.3 UNDERGROUND LOADING AND HAULING

The envisaged underground loading and hauling activities include:

- The excavation of blasted Mineable Mineral Resources and waste rock from production stopes and development headings with suitable loading and haulage equipment procured from reputable vendors. In the longhole stopes, mill feed will be extracted from drawpoints located below the blasted rings in the stope. In the cut and fill stopes, the mill feed will be hauled from the development face directly. The blasted rock will be loaded into haulage trucks for transport to specified destinations according to material type. The selection of suitable equipment for these activities takes into account the rock types, the required fragmentation from blasting, and other factors. The blasted material will be excavated and loaded with scooptrams. The mine will use low profile haulage trucks exclusively for the rock handling. The excavation will follow detailed mine plans and schedules and will be carried out under the supervision of qualified and experienced technical mine staff and supervisors;
- The haulage of excavated materials along the lateral drifts and the access ramp to surface. Mill feed will be delivered to the Crusher or the ROM pad. Waste rock will be stored underground in available long term storage sites wherever possible. Otherwise, waste rock delivered to surface will be deposited in an established WSF. As required, some waste rock may be used in any surface location that may require material for construction purposes;
- Directed dumping in the crusher area. An estimated 85% of the material reporting to the crusher facility will be directly dumped into the crusher. The other 15% will be temporarily stored at the ROM pad. The re-handling of the ROM Pad material to the crusher will be accomplished with a diesel powered wheel loader;
- The design, construction and maintenance of suitable haul roads for the size and class of equipment selected for the loading and hauling operations. The haul road designs will be developed according to standard industry practice and will conform to regulatory requirements;
- Activities carried out in support of the loading and hauling operation, including regular drift and ramp maintenance. The major support equipment will include suitable sized diesel-powered motor graders.
- The maintenance of the underground loading and hauling equipment will be performed both in the surface maintenance shop and in a shop established at a suitable underground location. Additional equipment maintenance activities will be carried out by field crews working at underground locations. In all cases, attention will be made to the employment of safe work practices and ecological protection. All maintenance work will be carried out under the supervision of qualified and experienced technical mine staff and supervisors and will follow applicable standards and regulations;
- Application of comprehensive strategies to eliminate or reduce impacts on the safety, health and the environment from noise, dust, fumes, waste materials and

other relevant impacts. Strategies will include scheduled maintenance on diesel equipment to help reduce emissions and in general, the application of established industry practices.

5.4 MINE SUPPORT EQUIPMENT, AUXILIARY EQUIPMENT AND SUPPORT OPERATIONS

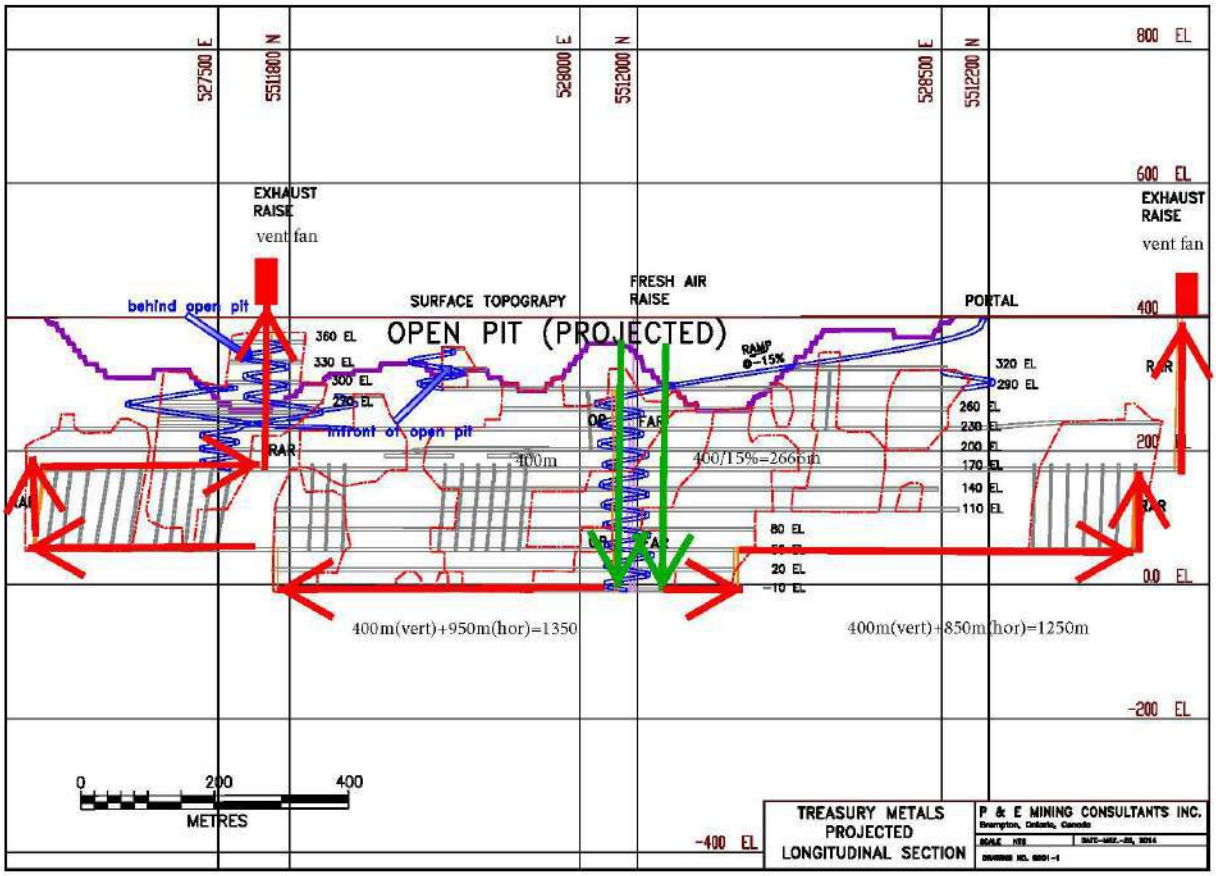
The major mine support equipment fleet for the project includes graders, service trucks, personnel carriers and small vehicles. The main application of the graders is in the maintenance of the underground haul roads.

5.5 MINE VENTILATION AND AIR HEATING

The airflow throughout the underground workings is illustrated in Figure 5.1. Two exhaust fans will be utilized, located at surface, on top of ventilation raises. The electrical power load for the underground mine operation is estimated at 4.0 MW. An airflow of 742,000 cfm has been estimated as the volume necessary to safely ventilate the underground workings.

Natural gas will be used to heat the mine during the winter months, and is estimated to require 72 million cu.ft. of gas over a period of the six coldest months of each year.

Figure 5.1 Longitudinal Section Of Goliath Underground With Ventilation



6.0 MINE WORKFORCE

The mine department workforce will consist of three principal groups:

- The Mine Management and Planning Group which will be responsible for planning and managing the operation. This group includes the Mine Manager, the Executive Assistant and technical staff involved directly with the Underground and Open Pit mine including geologists, mining engineers, surveyors and technicians.
- The Mine Operations Group will be subdivided into two groups, one for the underground operations and one for the open pit operations. These will include the mine shift supervisors and equipment operators.
- The Mine Maintenance Group includes the maintenance supervisors, maintenance planners, and maintenance personnel such as mechanics, electricians, welders and technicians.
- It is expected that the mine operations personnel will rotate on a three 8 hour shifts per day schedule, 365 days per year, however certain management and administration will work on a 5 day per week, dayshift only basis.
- It is expected that the company will be successful in attracting and training many of its personnel from local area communities.

7.0 HEALTH AND SAFETY

The Goliath Mine will be constructed and operated in a manner that protects the health and safety of workers on the project, as well as members of the local communities. The Company will abide by all measures and procedures prescribed by acts and regulations pertaining to this project. All employees and contractors on the project will also work in compliance with these regulations.

Where commonly accepted international health and safety standards exceed the standards described in local acts and regulations, the Company will employ the more stringent measures and procedures.