



Insert applicable LWB project numbers

Tłıchǫ All-season Road Quarry Operations Plan

March 2016

Version 1

Government of
Northwest Territories



REVISION HISTORY

Version	Date	Notes/Revisions
1	March 2016	First draft of plan



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DEFINITIONS AND ACRONYMS

AIA	Archaeological impact assessment
AN	Ammonium nitrate
D&B	Drill and blast
DCLP	Department of Culture and Lands Protection, Tłchq Government
DOT	Department of Transportation
GNWT	Government of the Northwest Territories
LUP	Land use permit
NWT	Northwest Territories
PDR	Project Description Report
PPE	Personal protective equipment
PWNHC	Prince of Wales Northern Heritage Centre
QOP	Quarry Operations Plan
RMO	Local Resource Management Officer
TASR	Tłchq All-season Road
WL	Water licence
WLWB	Wek'èezhì Land and Water Board



1 INTRODUCTION

Contractor responsible for blasting and will review the draft QOP to ensure the details are correct. It is expected that the planning and operational details described within will change to reflect contractor requirements and the supplemental information that will be available after final borrow selections have been made. QOP will follow Lands' Guidelines. THIS DRAFT IS FOR ILLUSTRATION PURPOSES ONLY and provides an example of what is expected from DOT QOPs.

QOPs are required if the volume being applied for is greater than 1000 m³ and/or the site is being operated by multiple users. QOP must include: north arrow; map scale at 1:50,000; NTS map sheet or acceptable alternate at 1:50,000; coordinates of quarry sites – 4 corners (NE, NW, SE, SW); total area of the identified quarry resource; areas of existing clearing; area of proposed quarrying; topsoil/overburden storage area; access roads/trails; camp locations identifying all infrastructure to be established on the site; when applicable, blast pattern details must be indicated; closure and reclamation plan including camp reclamation, if applicable; abandonment of active quarry face; waste disposal; stockpile removal; road closure; soil remediation for contaminated soils.

1.1 INTRODUCTION

Under the quarry application process with the Department of Lands, a Quarry Operations Plan (QOP) is necessary for all applications where a volume greater than 1,000 m³ is requested. In order to meet the application requirements, the Department of Transportation (DOT) has developed the following QOP with the help of the *Northern Land Use Guidelines: Pits and Quarries* (Lands 2015). The QOP will be used in conjunction with additional management plans that have been developed for use with the proposed Tłıchq All-season Road (TASR) construction project. This project has recently been submitted to the Wek'èezhì Land and Water Board (WLWB) in application for a Land Use Permit (LUP) and Water Licence (WL) and is further described below.

1.2 PROJECT DESCRIPTION

The proposed Tłıchq all-season road (TASR) involves changing the location of the existing Tłıchq Winter Road System between Highway 3 and the community of Whatì to the overland all-season alignment illustrated in Map 1. The proposed TASR is defined as an all-season road approximately 94 km in length and 60 m in width with a cleared driving surface of approximately 8.5 m in width to accommodate a two lane gravel road with culverts and/or two lane bridges over water crossings as necessary.

The project is located within Mqwhì Gogha Dè Nıttèè, the traditional territory of the Tłıchq Dene. The proposed TASR is intended to provide improved service to the Tłıchq community of Whatì, which is currently serviced by the existing winter road.



The route is within the Taiga Plains and is within the zone of discontinuous permafrost (ECG 2007). The region provides habitat for a wide range of wildlife, fish and vegetation species. A description of environmental conditions within and surrounding the proposed TASR corridor is included in the Project Description Report (PDR).

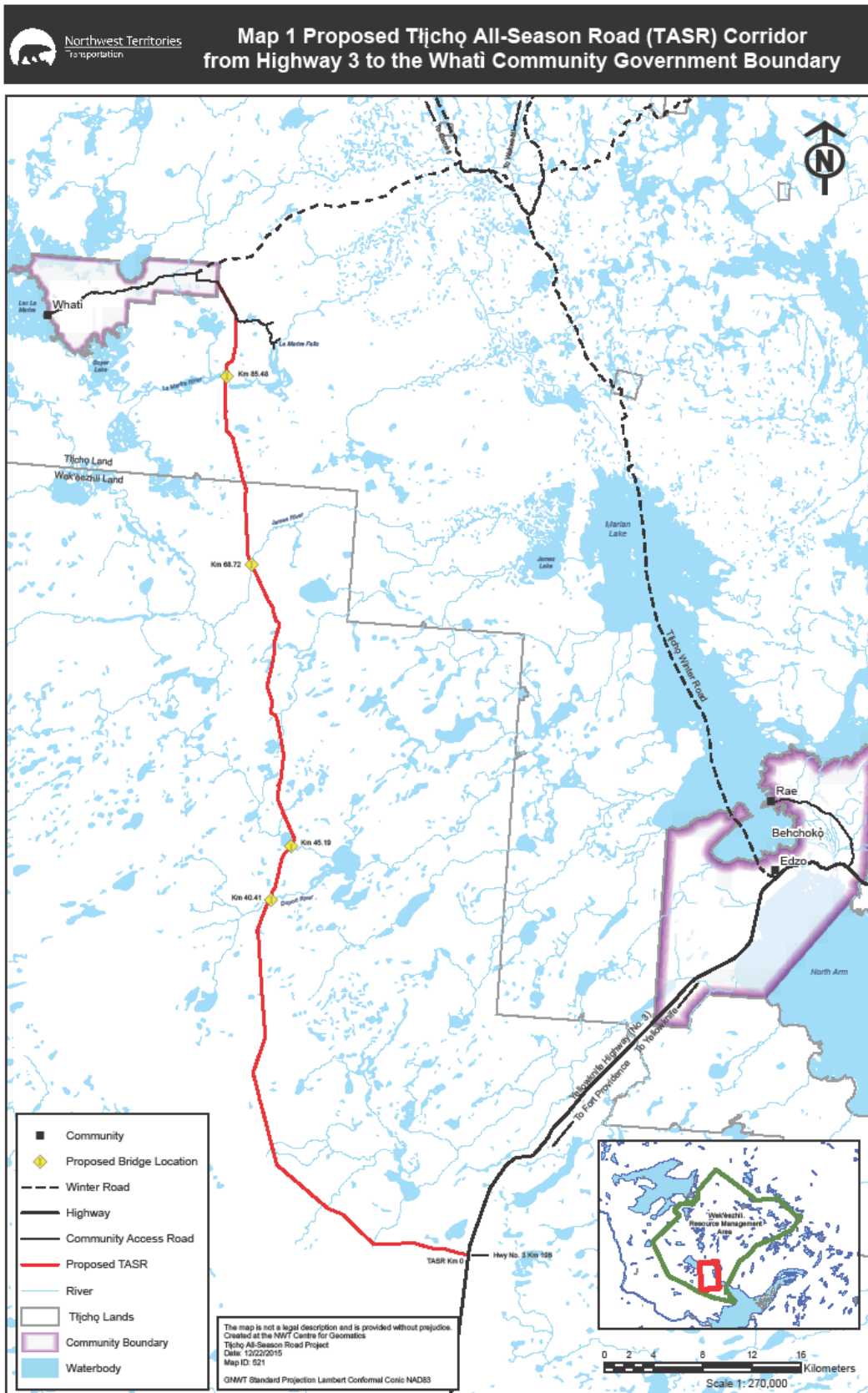
The location of the 94 km all-season road begins at KM 196 along Highway 3 and continues in a northwesterly direction to the community government boundary of Whatì. The alignment is situated within the geographic coordinates 62°28'54" to 63°10'37" N latitude and 116°29'07" to 117°00'05" W longitude. The proposed footprint is entirely contained within the Wek'èezhì area and begins approximately 40 km southwest of Behchokò off Highway 3. Approximately 17 km of the road is located on Tłıchq lands.

Granular resource requirements for the road will be met using granular material and sand from selected borrow sources and possibly hauled from sources along Highway 3 and/or within the Whatì area. An effort will be made to utilize borrow sources located within the right-of-way of the proposed TASR; however, potential sources have been identified at a distance of up to 2 km from the right-of-way. It is expected that four to five borrow sources will be required for road construction and an effort will be made to select borrow sources that are located on Territorial lands rather than Tłıchq lands. If it is necessary to utilize borrow sources located on Tłıchq lands, the Department of Transportation and the Department of Culture and Lands Protection (DCLP) with the Tłıchq Government will work closely together to ensure borrow sources are not located in areas that are culturally or environmentally critical. The Department of Transportation and the Tłıchq Government have already signed a joint letter indicating access to Tłıchq lands will be granted (see PDR for further details).

At this time, borrow sources with respect to quarry permit applications cannot be identified as geotechnical investigations have not been conducted. Once funding for the proposed TASR has been procured and geotechnical investigations have been completed, the necessary details required for each borrow source will be provided in an updated QOP. This draft QOP has been created in order to accompany the proposed TASR LUP and WL applications to the WLWB.

1.3 PROJECT CONTACTS

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2 QUARRY LOCATIONS

The locations of the proposed quarries are illustrated in **Figures XXX** at a 1:5,000 scale. Table 1 provides the coordinates for each quarry site. **Figure XX** illustrates the locations of all **4/5** borrow sources, their applicable access roads and the proposed TASR corridor on a 1:50,000 NTS map sheet.

Table 1. Quarry Site Coordinates and Total Area

Quarry Site	Total Area (m ²)	Latitude	Longitude	Extent
				Northwest corner
				Southwest corner
				Northeast corner
				Southeast corner

2.1 RESOURCE DESCRIPTION AND QUANTITIES

2.1.1 Quarry XX

The proposed quarry is... **DESCRIBE.** (Including total area of the identified quarry resource; area of existing clearing; area of proposed quarrying; topsoil/overburden storage area; access roads/trails.) Repeat for each quarry associated with the proposed TASR project. The geochemical characterization of each source will be attached to the Plan, including the consultant’s assessment of the material.

3 STOCKPILE SITES AND ACCESS

3.1 STOCKPILE SITES

The planned gradation of the blast materials in stockpiles will be less than 450 mm. It is assumed blasted stockpiles will be continually depleted as material is loaded and hauled away for road construction advancement and/or crusher feed supply.

3.2 ACCESS

The initial winter access will be trued during the initial opening along the route shown on **Figure XX**. Clearing width of the access route will be based on safety concerns due to site distance or adverse gradients. The width of the clearing for the initial winter access will be sufficient to accommodate the future all-season haul road. The clearing debris will be windrowed along the edge of the cleared area.

Access roads will be constructed using material produced from the quarry.



3.3 TIMBER REMOVAL

Access roads and quarry sites are expected to be machine cleared utilizing D6R Crawler Cats and slashing crews (up to six personnel) equipped with chain saws and slashing equipment/tools. Salvageable timber with a butt size greater than 150 mm will be stockpiled adjacent to the cleared area in staging areas for the public to utilize for fire wood or other purposes. Local Resource Management Officer (RMO) and Environmental and Natural Resources staff will be kept informed of the activities and scheduling of clearing operations.

3.4 VEGETATION RETENTION

Construction activities are expected to commence when ground is frozen and conditions exist to support the equipment and resources to be used. During machine clearing operations, great care will be undertaken not to denude the terrain particularly in sensitive areas prone to permafrost conditions.

3.5 CLEARING AND GRUBBING

As described above, work will commence when conditions are at an optimum during frozen conditions. The equipment being utilized will ensure ground disturbance is minimized.

3.6 SALVAGE AND STORAGE OF TOPSOIL OR DISPOSAL OF OVERBURDEN

Stripped materials will be stockpiled at either side of the proposed quarry footprint for future pit restoration. The borders of the quarry footprint will remain treed with a 5.0 m buffer positioned around the stripping stockpiles. Since this is a rock quarry/drilling and blasting operation, disposition of granular deposits under the stripping piles will not apply here. Upon closure of the quarry, these materials can be used to contour the open cut sideslopes of the quarried area.

3.7 BRUSH DISPOSAL

The quarry development will be machine and hand cleared for salvageable timber. Small brush, willows and debris will be windrowed to the outer edge of the staging area for either burning or future pit restoration.

3.8 SCALES, BUILDINGS OR OTHER FACILITIES

A lunchroom/wash car combination trailer will be set up outside the blast zone. It will be equipped with supplies, radio communication and a grey water system which will be trucked out to an approved sewage disposal site. Fuel for the project equipment will be hauled in by an approved fuel truck not exceeding 10,000 litres (capacity).



3.9 TOPOGRAPHIC SURVEY FOR FUTURE VOLUME CHECKS

Qualified services will be contracted to perform all survey requirements for the quarry site development. They will use the most up to date technology of satellite surveying/imagery, AutoCAD and end area method for calculations of the survey volumes. Once the quarry development is set into place, the surveying team will be brought in to set up the control sections, bench marks, base lines and the pit development for the benching. On the completion of the material production for the proposed TASR, they will survey the excavated area within the pit. This quantity which will be recorded as Banked Metres Cubed (BM3) or in-situ volume will be submitted to the RMO on the appropriate reporting form.

4 PIT OPERATION

4.1 SEQUENCE OF DEVELOPMENT, EXTRACTION AND RECLAMATION

The quarry site development will be a drill and blast (D&B) (rock) site and the pit will be developed uniformly up the face of the deposit. There will not be a need to defer or chase the deposit and it is anticipated that the deposit is consistent through the quarry perimeters. Extraction will be consistent with the drilling pattern and bench design working up the face of the ridge.

4.2 TYPE OF EQUIPMENT

The types of equipment for the development of quarry and the proposed TASR are summarized in the following table:

Table XX Construction Equipment List

Equipment Description	Quantity	Estimated Size/Weight
36x48 Crusher	1	12,000 to 42,000 kg (per component)
Cat D6 Dozer	2	21 T
Cat D8 Dozer	2	52 T
Cat 330 Excavator	1	36,000 kg
Cat 345 Excavator	2	50,000 kg
Cat 14 Grader	1	30 T
Cat 740 Articulated Trucks	6	40,000 kg
Tractor End Dumps and/or Belly Dumps	8	21,000 kg
Cat 980 Loaders	2	38,000 kg
Hox Box	1	N/A
Light Towers	2	N/A
Crewcab	6	4,500 kg
Mechanics Trucks	1	5 T
Mulcher	1	N/A
Fuel Truck	1	10 T



Water Truck	1	21,000 kg
Atlas Copco F9 Rock Drills	2	18,000 kg

4.3 GRADES OF THE PIT FLOOR

The grades of the pit floor will be sufficient to be free draining. Once the pit is developed to the stage where the engineering survey team is brought on stream, base lines and survey elevations will be set into place to ensure proper drainage for the design applications. This will remain consistent through the quarry development and particularly when the quarry operation is finished in a given season.

4.4 EROSION PREVENTION

The quarry development consists of a blasted rock face with design benching to ensure consistency in development. With this type of development, the rockface will not likely present long term erosion problems. Areas around the perimeter of the blasted area may have minor degradation due to erosion, but a monitoring process will be in place to capture and address these remote circumstances. The remedial action will include using on-site gradations of appropriate quarry rock materials to stabilize and enhance erosion concerns.

4.5 PERMAFROST DEGRADATION

As noted above, the quarry development is a rock development and permafrost conditions are unlikely to be encountered. Should permafrost be detected, plans will be set into place to deal with this occurrence. These plans will include removal and avoidance.

4.6 LOCAL WATER MANAGEMENT

The proposed quarry site is located on a ridge with a natural sloping terrain from the bottom to the crown. A natural buffer zone of approximately 100 m at the top of the ridge will remain. Positive drainage will be incorporated in the quarry design and benching approach as development progresses. The pit floor will also have a positive grade applied for drainage to flow and to minimize ponding effects. Grades will not exceed 4% to avoid adverse flow and erosion problems. The drainage will exit the pit floor to natural ground elevations at or near the entrance of the haul road to the quarry.

4.7 GRADES OF THE SIDESLOPES AND BENCHES

The bench will be placed at a design width of 10 m ensuring stability for the rock with 0.25:1 back slopes, if required.

4.8 STORAGE AREA FOR COURSE REJECTS

During the blasting operation it is expected to have oversized rock gradations (greater than 1,000 mm in size). As a result, the oversized material will be placed adjacent to or at the edge of the staging area. The



oversized material will be dealt with by a drilling and blasting crew by “popping” the material with a small charge to break it down into usable material to be processed at the crushing plant or for riprap or heavy armour materials. The material may also be used to secure the pit perimeter. Other reject material is not anticipated during the quarrying operation.

4.9 STORAGE AREA FOR FINISHED PRODUCTS

It is expected that all of the processed quarry materials will be hauled off site and consumed in the construction of the proposed TASR. The crushing operation will entail the various products being produced at intervals that when the desired product reaches the volume required, the crusher screens will be changed to meet the next gradation. Ongoing maintenance requirements for the proposed TASR may require some stockpiling of material at the quarry site in the future.

5 PROCESSING

5.1 PROCESSING LIMITS

The aggregate crushing plant will be set up outside the blast zone if crushing is required prior to blasting activities being completed.

6 ENVIRONMENTAL MANAGEMENT PLAN

6.1 SETBACKS

Buffer zones of 100 m or greater will be established between quarry areas and adjacent fish bearing waterbodies, if any.

Indicate distance of each quarry site to any possible waterbody.

6.2 CULTURAL AND HERITAGE RESOURCES

An archaeological overview and/or archaeological impact assessment (AIA) may be required to assess the archaeological potential amongst the selected borrow sources. DOT will work in conjunction with PWNHC in assessing the suitability of the proposed borrow sources. Borrow source locations will also be compared to the details outlined in the Tłıchq traditional knowledge report (TG 2015) to ensure borrow sources do not impact any culturally significant areas.

If a relevant archaeological site is identified during the course of the operations, all work will cease and employees will implement the Archaeological Site Chance Find Protocol set up for the proposed TASR (see PDR).



6.3 EXPLOSIVES USAGE

High quality pre-packaged emulsion explosives have been selected for blasting operations. The pre-packaged explosives utilize an optimally mixed hydrophobic emulsion compound that works to repel water and keep ammonium nitrate (AN) out of the surrounding ecosystem. Industry best practices will be adopted to maximize source control and to minimize the potential for AN dissolution to downstream waters. The following protective measures will be taken:

- When handling, transporting or storing explosives, care will be taken to avoid any spillage. Any spilled product will be promptly reported, cleaned up, and properly disposed in accordance to approved site waste management practices. A Spill Report detailing the incident will be submitted to the contractor's Safety and Environment Manager. A follow-up report will be provided that details basic cause of the spill and any corrective actions taken to minimize the type of incident from reoccurring.
- Prior to loading explosives, blast holes will be inspected for the presence of water. If water is detected, plastic liners will be installed prior to the loading of holes. This will minimize deterioration and dissolution of the explosives within the blast hole.
- Stand time for explosives will be minimized and the lag time between load and blast will be kept to a minimum.
- If there is a miss hole resulting in incomplete detonation of explosives, the event will be reported to the contractor's Safety and Environment Manager. If the residual blasted material in the vicinity of the miss hole represents a potential source of nitrogen compounds, this material will be appropriately stored and managed to minimize the potential for soluble compounds from entering fish bearing waters.
- Upstream overland flows that impinge on quarry operations and have the potential to contaminate clean upstream water will be diverted around the active pit area by means of berms, check dams, or minor diversions. Based on the site drainage plan, the upstream flows from the quarry development area are anticipated to be minor.
- In the event that there is the potential for nitrogen compounds to adversely impact downstream fish bearing waters, contingency actions will be taken that could include:
 - Storage of impacted water within the pit in constructed sumps.
 - Pumping of water into tanker trucks for disposal in holding ponds or the sewage treatment plant.
 - Other treatment options such as the careful discharge to the tundra or where there is abundant surface vegetation (approval may be required) after meeting regulatory requirements for water quality.



6.4 TRAINING

Training is seen as a key element in the safe usage and proper environmental management of explosives and blasting. All employees working on or around blasting operations will undergo rigorous employee orientation and training procedures for: managing, transporting and loading explosives into blast holes. Experienced competent employees are an essential part of blasting best management practices.

6.5 MANAGEMENT OF GRUBBING AND DISPOSAL OF RELATED DEBRIS AND CONTAMINANTS

The principal concerns associated with grubbing and disposal of related debris are:

- Potential effects on water quality caused by erosion and sedimentation; and
- Disturbance of the permafrost leading to ground failure (slumping and erosion).

All grubbing and disposal of related debris near watercourses will comply with project authorizations. At a minimum, measures to be undertaken to minimize the effects on aquatic habitat and resources are as follows:

- Grubbing of the organic vegetation mat and/or the upper soil horizons will be minimized and left in place where possible due to the sensitivity of arctic soils.
- If needed, the organic vegetation mat and upper soil horizon material, which has been grubbed, will be spread in a manner that attempts to cover exposed areas. Any surplus of such material will be stored or stockpiled for site rehabilitation and revegetation purposes elsewhere in the project area. Topsoil will be stockpiled.
- During grubbing, care will be taken to ensure that grubbed material will not be pushed into areas which are to be left undisturbed.
- Contaminates associated with hydrocarbons, antifreeze, etc. will be disposed of and follow suit according to the approved Spill Contingency Plan for the proposed TASR.

6.6 STORM RUNOFF AND SNOW MELT

The final quarry configuration will consist of flat surface graded at approximately 1% in the down slope direction, adjoining a steeper angle rock surface that forms the transition to natural ground on the ridge above. Storm and snow melt water will be diverted away from the quarry by a small 0.5 m berm on the upslope edges of the excavation.

6.7 BLASTING NEAR WATER

Particular care must be taken when blasting near waterbodies. This includes proper explosives handling, selection of the correct explosive, and utilization of best management practices. The proposed quarry site is sufficient distance from waterbodies to avoid impact.



7 BLAST PATTERN DESIGN PROCEDURE

7.1.1 Objective

The objective of the following sections is to provide a procedure for the safe design of blasting patterns. This procedure was developed to ensure that parties responsible including subcontractors, are aware of their safety responsibilities while designing and staking blast patterns. All personnel involved in the engineering and survey of blast patterns are to follow the responsibilities outlined in this procedure.

7.1.2 Tasks

Table XX Requirements and Responsibilities for Blast Pattern Design

Task	Person Responsible
All borehole locations designed by engineering are to be placed at a distance of 1 m or greater from any bootleg locations.	Site Engineer
If any holes designed by engineering cannot be drilled in the design location due to ground conditions, then a new location can be used only if it is picked up by survey and found to be 1 m or further away from any bootleg locations.	Surveyor, Site Engineer
Holes are not to be designed in a location within 5 m of a misfired hole.	Site Engineer
Prior to firing any blast, all borehole locations loaded with explosives are to be picked up by survey and entered into the engineering database by the Site Engineer. This will be called the as-built map of each blast pattern.	Surveyor, Site Engineer

7.1.3 Blasting Parameters – Burden and Spacing

To produce a rock gradation profile suitable for specified use, the final blast hole spacing will need to be determined from field testing. The initial plan is a 3 m x 3 m pattern.

7.1.4 Blasting Parameters – Bench Height and Wall Slopes

The quarry location has been selected in an area that presents stable geological characteristics. The benches will be designed according to the topography of the natural grade at the quarry site. A 10 m bench height with a minimum 8 m catchment will be used based on safety and the capabilities of our loading equipment.



8 DRILL AND BLAST EMPLOYEE RESPONSIBILITIES

8.1 BLAST HELPERS

8.1.1 Objective

The objective of the following sections is to provide drill and blast (D&B) supervisors, blasters and blast helpers with a procedure for assisting a blaster in the preparation of a blast. This standard operation procedure is to be used for D&B operations.

8.1.2 Scope

The D&B Supervisor is responsible to ensure that Blast Helpers assisting in the preparation of a blast are trained and understand the procedure.

8.1.3 Definitions

D&B Supervisor: Drill and Blast Supervisor

8.1.4 Preparation

Tools: personal protective equipment (PPE)

Hazards: slips, trips and falls, personal injury or death, premature detonation

8.1.5 Tasks

Table XX Direction and Supervision of Blast Helpers

Task	Person Responsible
The D&B Supervisor will train the Blast Helper on the safe handling and preparation of the explosives used during the loading procedure.	D&B Supervisor
The D&B Supervisor or the Blaster will explain duties to the Blast Helper before the work begins.	D&B Supervisor, Blaster
The D&B Supervisor or the Blaster will direct the Blast Helper at all times.	D&B Supervisor, Blaster
The D&B Supervisor or the Blaster will ensure that the Blast Helper only conduct the part of the work that they have been directed to do.	D&B Supervisor

8.2 DRILL AND BLAST SUPERVISORS' DAILY DUTIES

8.2.1 Objective

The objective of the following sections is to provide the D&B Supervisors with a comprehensive inventory of duties to be completed on a daily basis. NT/NU Mine Health and Safety Act and Regulations



require a supervisor to ensure his charges are working safely in a safe environment and in compliance with the regulations, company policy and procedures.

8.2.2 Scope

The Site Supervisor is responsible to ensure all D&B Supervisors are trained and understand this procedure. The D&B Supervisor is responsible to follow this procedure as directed by the Site Supervisor.

8.2.3 Preparation

Tools: Blasters Certificate, Supervisor Level I Certificate, PPE

Hazards: work near charged drill holes, work with explosives, falling rock, slips, trips and falls

8.2.4 Tasks

Table XX Requirements and Responsibilities of a D&B Supervisor

Task	Person Responsible
<p>The D&B Supervisor will:</p> <ul style="list-style-type: none"> • Do a pre-shift site tour. • Read and sign the daily logbook from the previous shift prior to line up. • Review maintenance problems and equipment down time with the Site Supervisor and previous shifter. • Prepare D&B crews work assignment with the Site Supervisor. • Prepare daily safety toolbox meeting notes. • Provide instructions to the D&B crew for the daily work assignments. • Directs the Blaster and helper to prepare all explosives for the day's activities. • Drill crew are transported to the drill locations. Review previous shift with the off-going driller. • The area is inspected and the drillers' duties are reviewed. • The night shift crews are transported to the line-up area. • Record all information in the D&B Daily logbook. Completed the required document for the night-shift crews. • Participate and provide information during the daily production meeting for all Supervisors and Managers. 	D&B Supervisor
<p>In the quarry, the D&B Supervisor will:</p> <ul style="list-style-type: none"> • Inspect the area of his/her responsibility, identifying and correcting hazards, substandard conditions or non-compliance of procedures or regulations. • Provide on the job observations and instructions to the D&B crews. • Ensure the quarrying plan is followed regarding D&B patterns as directed by the D&B Superintendent. • Ensure the D&B crew has the required supplies to complete their daily tasks. • Ensure the Site Supervisor is informed of any hazards that may affect the safety of the site employees or equipment. • Provide directions and instructions to all employees during the blasting operations regarding the notification and guarding during the blast. 	D&B Supervisor
Miscellaneous Duties:	Site Supervisor, D&B



<ul style="list-style-type: none"> • Develop and present timely safety topics at the regular crew safety meetings. • Provide developmental training for D&B crews. • Under the direction of the Site Supervisor, provide up-to-date information regarding manpower, production targets or delays, order and track consumables, complete special assignments, ensure that explosives are handled properly and security is maintained. 	Supervisor, Safety Officer
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9 DRILLING AND LOADING PROCEDURES

9.1 RE-DRILL AND EXPLOSIVES LOADING PROCEDURE

9.1.1 Objective

The objective of the following sections is to provide Supervisors and workers with a procedure, which will ensure the safety of all personnel on or near a drill pattern where re-drilling of caved or frozen holes on a loaded pattern is necessary. This procedure was developed to ensure the safety of all personnel involved or close to the blast area.

9.1.2 Scope

The D&B Supervisor shall be responsible to ensure that the workers are trained and follow the procedures. The driller is responsible to ensure that the procedures are followed as directed by the D&B Supervisor.

9.1.3 Definitions

D&B Supervisor: Drill and Blast Supervisor

9.1.4 Preparation

Tools: Blasters Certificate, Supervisor Level I Certificate, drill, PPE

Hazards: charged holes, slips, trips, falls, explosions, noise

9.1.5 Tasks

Table XX Re-Drill and Explosive Loading Procedure

Task	Person Responsible
All holes shall be jigged and visually checked in patterns that have the potential for frozen or caved holes, before loading operations commence.	Blaster, Blast Helper, D&B Supervisor
Drill holes that are caved and/or frozen and that require re-drilling are to be marked out with flagged stakes.	Blaster, Blast Helper, D&B Supervisor
Holes noted for re-drilling will be immediately brought to the attention of the Blaster in charge and the D&B Supervisor.	Blaster, D&B Supervisor
The holes requiring re-drilling will be marked in the daily log and noted on the daily blast hole sheets as re-drilled.	D&B Supervisor



No loading of holes closer than 8 m to the re-drilling operation shall be permitted except under the direct supervision of the D&B Supervisor.	Blaster
The re-drilling shall take place in a retreat direction; all loading operations shall take place away from the travel direction of the drill.	D&B Supervisor
Only personnel directly involved with the drilling and blast hole loading activities are to be within 30 m of re-drilling operations.	Blaster, D&B Supervisor
No surface delays or detonating cord is to be present within the blast pattern during re-drilling operations.	D&B Supervisor
All down hole Nonel delay detonator ends are to be neatly bundled and tied to the blast hole stake to ensure visibility and minimize the potential of any inadvertent machinery contact.	Blaster
The D&B Supervisor will ensure that the drill operator and Blaster walk through the drill pattern prior to moving the drill onto the pattern. The drill operator will be made aware of any loaded blast holes that come within 2 m of the machine.	D&B Supervisor
The D&B Supervisor will advise the drill operator which Blaster will guide the drill onto the loaded pattern for the purpose of re-drilling.	Blaster, D&B Supervisor
The D&B Supervisor will ensure that the drill is guided to the re-drill location and when drilling is complete, ensure a guide is provided for route of travel out of the loaded pattern.	D&B Supervisor

9.2 EXPLOSIVES MANAGEMENT

9.2.1 Objective

The objective of the following sections is to provide Supervisors with a safe and effective standard which will ensure the safety of all employees and equipment. The NT/NU Mine Health and Safety Act and Regulations require the Site Supervisor to ensure his charges are working safely in a safe environment and in compliance with the regulations, company policy and procedures.

9.2.2 Scope

The Site Supervisor shall appoint a person(s) who is/are qualified, certified and authorized under the NT/NU Mine Health and Safety Act and Regulations to conduct/supervise all blasting operations on the site. The Site Supervisor shall also be responsible for authorizing persons to enter the explosive magazine for inspection, receiving and issuing of all explosives materials.

9.2.3 Preparation

Tools: Blasters Certificate, Supervisor Level I Certificate, Log Book, broom, Mag key, PPE

Hazards: explosives, detonators, delays

9.2.4 Tasks

Table XX Explosives Management

Task	Person Responsible
Ensure a copy of the explosives magazine permit is posted inside the magazine.	D&B Supervisor
Carry out a weekly inspection of the magazine and record the results in a logbook.	D&B Supervisor



Ensure a record of all explosives issued and received and the inventory of the magazine is kept and that authorized persons sign all entries.	Blaster, D&B Supervisor
Ensure the magazine is kept clean, dry and free from grit at all times.	Blaster, D&B Supervisor
Ensure the stock of explosives is rotated so that the oldest stock is used first.	Blaster, D&B Supervisor
Ensure all signage is visible and in good condition.	Blaster, D&B Supervisor
Ensure that the magazine is locked at all times except when an authorized person is present.	Blaster, D&B Supervisor
Ensure all mobile equipment transporting explosives meets or exceeds requirements as set out in the NT/NU Mine Health and Safety Act and Regulations.	Blaster, D&B Supervisor
Ensure appropriate records of each primary blast are kept.	Blaster, D&B Supervisor
Ensure all warnings, guarding of access routes and clearance of areas has taken place prior to initiating any blasts.	Blaster, D&B Supervisor
The appointed person has the authority to safely conduct and direct all activities within the blasting area. All employees must support the Blaster in exercising this authority.	Blaster, D&B Supervisor
Ensure all Blasters have a valid blasting certificate issued by the Chief Inspector of Mines.	Blaster, D&B Supervisor
Ensure all persons who are assisting in the preparation or firing of charges are under the direct supervision of a person who is a valid holder of a blasting certificate.	Blaster, D&B Supervisor
All Blasters shall deliver their blasting certificates to the Site Supervisor. The certificate will be returned upon termination with the company.	Blaster, D&B Supervisor

10 BLASTING PROTOCOL AND PROCEDURE

10.1 GENERAL PROTOCOL

- All blasting operations will follow all protocol of the NT/NU Mine Health and Safety Act and Regulations, as well as standard operating procedures from contractors and subcontractors, whichever is more stringent.
- All records of blasting shall be kept by the contractor.
- All blasts will be numbered according to location (i.e. quarry number, bench elevation at grade and individual blast).
- All loaded boreholes will be recorded by survey prior to blasting and as-built mapping entered into survey database to eliminate possibility of drilling into bootlegs on benches at lower elevations.
- Daily records of all holes loaded and explosive products used will be maintained, recorded and submitted with blast reports.
- All blast design will be subject to change and improvement as site specific geological conditions dictate.



- Wall control issues will be negligible with the plan of day lighting all benches.
- Standard Operating Procedures regarding drilling proximity to bootlegs or misfired holes will be reviewed with all drilling and blasting crews and adhered to for all drilling and blasting operations.
- All production holes are to be drilled vertically to ensure the integrity of project bootleg locations.
- Borehole liners are to be used for wet or fractured areas.

10.2 GUARDING TYPICAL QUARRY EXCAVATION

It is imperative that the guards follow the instructions and not leave their assigned area until told so by the D&B Supervisor. The positions assigned will be outside the Blast Danger Area as determined by the D&B Supervisor or the Blaster.

In addition to the guards posted at strategic locations around the blast area, flashing strobe light warnings signs are recommended to be placed at the outer perimeter of the blasting danger area. The signs shall be deployed prior to the initiation of each blast and collected afterwards.

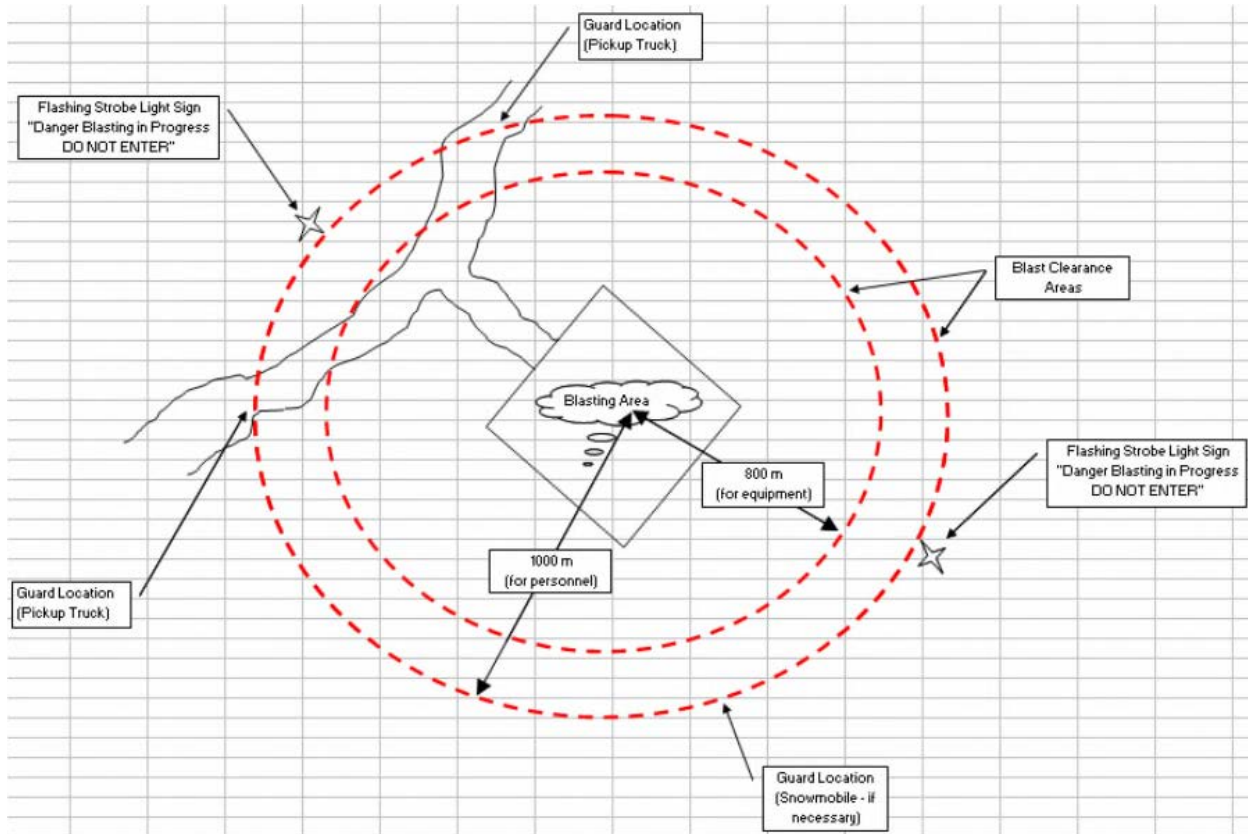
While guarding a blast area, the vehicle window facing away from the blast must be rolled down slightly. The vehicle must be turned off and put in auxiliary such that the radio remains functional (alternatively: use a hand held radio).

All blasting will be scheduled during daylight hours. Due to the possibility of shallower cuts, the blasting clearance zones have been increased to 1,000 m and 800 m for personnel and equipment respectively.

A typical guarding schematic is as follows:



Figure XX: Typical Blast Guarding Layout



10.3 GUARDING PROCEDURE

10.3.1 Objective

The objective of the following sections is to provide the D&B Supervisor with a safe and effective procedure for guarding of a blasting operation. These precautions are required as per the NT/NU Mine Health and Safety Act and Regulations.

10.3.2 Scope

The D&B Supervisor is responsible to ensure that all employees engaged in the guarding procedure are trained and understand their duties.

The employees assigned the task of guarding are responsible to follow this procedure as directed by the D&B Supervisor.

10.3.3 Preparation

Tools: PPE

Hazards: slips, trips, falls, personal injury or death, noise



10.3.4 Tasks

Table XX: Requirements and Responsibilities for Guarding a Blast

Task	Person Responsible
The D&B Supervisor, in consultation with the Operations Supervisor, will be responsible for appointing all guards and ensuring each guard is fully versed in their responsibilities.	D&B Supervisor, Operations Supervisor
The D&B Supervisor is responsible for establishing the limits of the danger zone and the guard post locations.	D&B Supervisor
Upon notification from the D&B Supervisor, all guards will ensure their assigned areas are clear of all personnel and equipment and proceed to their designated guard posts.	D&B Supervisor, Guards
All guards will notify the D&B Supervisor when they have arrived at their assigned positions and give a status report of their assigned area.	D&B Supervisor, Guards
No guard shall leave their position or allow any person to enter the blast area until the D&B Supervisor gives the "All Clear".	D&B Supervisor
The D&B Supervisor will ensure all guards are in their assigned locations.	D&B Supervisor
The D&B Supervisor will then proceed with the blast as per the standard operating procedures.	D&B Supervisor
Following the blast, the D&B Supervisor will announce on the radio, the "All Clear" message. All guards will be removed, crews can return to work in the blast area and regular communications can recommence.	D&B Supervisor

10.4 BLASTING PROCEDURE

10.4.1 Objective

The objective of the following sections is to provide the D&B Supervisor with a Pre-Blast, Guarding and a Post Blast procedure that will ensure the safety of all personnel and equipment. This standard operating procedure is to be used to ensure all employees involved are trained to understand the blasting procedure.

10.4.2 Scope

The D&B Supervisor shall ensure that all workers who are assigned the duties of a guard during the blasting operations are trained and understand this procedure.

The workers who are assigned guarding duties during the blasting operations will follow this procedure as directed by the D&B Supervisor.

10.4.3 Definitions

D&B Supervisor: drill and blast supervisor

10.4.4 Preparation

Tools: PPE, portable radio, electric blasting cap, detonating cord, blasting wire, blasting machine

Hazards: slips, trips, falls, personal injury or death, premature detonation, noise



10.4.5 Tasks

Table XX: Requirements and Responsibilities for Initiation of a Blast Pattern

Task	Person Responsible
The D&B Supervisor will notify all employees of the impending blasting times during the daily crew line up at the beginning of each shift.	D&B Supervisor
The D&B Supervisor will ensure that the daily blasting times are posted at quarry entrances 2 hours before the blasting operation is conducted.	D&B Supervisor
The D&B Supervisor will give a 2 hour blast warning, by radio, to the following people: Medic, Site Supervisor and Safety Supervisor. Each of these people will acknowledge, by radio, that they have received and understood the 2 hour blast warning.	D&B Supervisor
The D&B Supervisor will notify the Norman Wells Airport of the pending blast.	D&B Supervisor
The Site Supervisor will instruct all workers and equipment operators to evacuate the blasting area at the appropriate time.	Site Supervisor
The D&B Supervisor, in consultation with the Blaster, will determine the "Blast Danger Zone".	D&B Supervisor, Blaster
The D&B Supervisor, in consultation with the Site Supervisor, will assign required personnel the duties of Guards during the blasting procedure.	D&B Supervisor, Site Supervisor
The D&B Supervisor, in consultation with the Site Supervisor, will designate the areas to be guarded.	D&B Supervisor, Site Supervisor
The Guards will follow the instructions of the D&B Supervisor as per the standard operating procedures.	Guards
The D&B Supervisor will give a 10 minute blast warning, by radio, to the following people: Medic, Site Supervisor and Safety Supervisor. Each of these people will acknowledge, by radio, that they have received and understood the 10 minute blast warning.	D&B Supervisor
The D&B Supervisor will inspect the Blast Danger Zone and instruct the Blaster to begin the pre-blast procedure when the Blast Danger Zone has been cleared of personnel and equipment. The Blaster will lay out the shooting line (detonating cord) from the pattern initiating point to a location approximately 100 m from the Blaster's firing location.	D&B Supervisor
The Blaster will connect an electric blasting cap to the detonating cord and then roll out the 100 m of blasting wire from the blasting cap to a safe firing location, ensuring that the blasting wire is kept clear of electrical sources. The Blaster will notify the D&B Supervisor when the blast is ready to be initiated.	Blaster
The D&B Supervisor will give a 2 minute blast warning, by radio, to the Site Supervisor. The Site Supervisor will acknowledge, by radio, that he has received and understood the 2 minute blast warning.	D&B Supervisor, Site Supervisor
The D&B Supervisor will ensure that the blast warning signal siren is sounded for 1 full minute.	D&B Supervisor
At the completion of 1 minute siren warning, the D&B Supervisor will instruct the Blaster to proceed with the initiation of the blast.	D&B Supervisor, Blaster
The D&B Supervisor will ensure that the all-clear siren is sounded for 20 seconds and announce that regular radio communications may resume.	D&B Supervisor
The D&B Supervisor will notify the following people of completion of blasting activities: Medic, Site Supervisor and Safety Supervisor. Each of these people will respond that they have received and understood the blasting activities are complete.	D&B Supervisor
The D&B Supervisor will instruct all Guards to resume their regular duties.	D&B Supervisor



10.5 MISFIRES OR CUT-OFF HOLES

10.5.1 Objective

The objective of the following sections is to establish a procedure to ensure all misfires/cut-off holes are handled safely and all blasting personnel are fully trained prior to commencing this task. The NT/NU Mine Health and Safety Act and Regulations require all personnel be adequately trained to do their jobs safely, inspect their worksite or machinery and understand the lock out procedure and fire prevention apparatus and use.

10.5.2 Scope

The D&B Supervisor shall be responsible for ensuring the Blaster follows all safe work practices when performing work on misfired or cut-off holes. These procedures will be reviewed annually or updated when required. The Blaster is responsible to follow this procedure as required by the D&B Supervisor.

10.5.3 Definitions

Bootleg: part of a drilled blast hole that remains when the force of the explosion does not break the rock completely to the bottom of the hole

D&B Supervisor: drill and blast supervisor

10.5.4 Preparation

Tools: PPE

Hazards: slips, trips and falls, personal injury or death

10.5.5 Tasks

Table XX: Requirements and Responsibilities for Misfires or Cut-off Holes

Task	Person Responsible
All workers on a blast pattern will be fully trained in all procedures associated with misfires/cut-off holes.	Workers
Before drilling is commenced, the Blaster shall walk the complete pattern to check for any misfire/cut-off holes. The Blaster will look for any signs of explosives or lack of ground movement that might indicate a misfire or cut-off hole.	Blaster
No person shall drill in loose rock produced by blasting unless the rock has been thoroughly examined by the Blaster for explosives, the pattern has been designed to prevent the overlaying of holes and where a hole is discovered containing explosives, drilling will not be closer than 5 m from the hole.	Driller, Blaster
The D&B Supervisor and driller shall not drill or allow drilling to be conducted within 1 m of any part of a bootleg on a blasting pattern or within 5 m of a misfired hole, a cut-off hole or a hole containing explosives.	D&B Supervisor, Blaster
Where an explosive charge has been misfired or cut-off, no work may be performed in the area other than that required making the area safe.	D&B Supervisor, Blaster



All holes must be inspected for detonators or explosives, the blasting area will remain guarded and hole re-blasted.	Blaster
Once the hole has been cleaned out, the hole may be re-charged, re-stemmed and blasted.	Blaster
A hole may be re-drilled for the purpose of re-blasting a missed hole once the D&B Supervisor has determined, after consultation with the driller, the location angle and depth of the hole to be drilled.	D&B Supervisor, Driller
The D&B Supervisor shall supervise the drilling of the hole.	D&B Supervisor
The new hole shall not be closer than 5 m to any part of the missed hole.	Driller
The only explosives that can be removed by washing or lancing from a misfired or cut-off hole include ANFO or slurry/emulsion.	D&B Supervisor, Blaster
The blast pattern shall not be abandoned until it has thoroughly been examined for the presence of explosives in misfired or cut-off holes.	Blaster
If the Blaster suspects a misfire, wait ten minutes and then proceed to check the blast area.	Blaster

11 EXCAVATING FOR BLASTED MUCK

11.1 DIG LIMITS FOR LOADING EQUIPMENT

11.1.1 Objective

The objective of the following sections is to provide Supervisors and Equipment Operators with a procedure that will enhance safe-working conditions when mucking to a Loaded Blast Face. NT/NU Mine Health and Safety Act and Regulations require all personnel be adequately trained to do their jobs safely, inspect their work site or machinery and understand the lock out procedure and fire prevention apparatus and use.

11.1.2 Scope

The Supervisor is responsible to ensure that all Loading Equipment Operators (Backhoe, Face Shovel and Wheel Loaders) are trained and understand this procedure.

11.1.3 Preparation

Tools: metric measuring tape, red fluorescent paint, survey instrument, stakes, hammer, PPE

Hazards: slips, trips, falls

11.1.4 Tasks

Table XX Requirements and Responsibilities for Mucking into a Loaded Blast Face

Task	Person Responsible
Prior to loading material from any blasted muck pile, the Site Supervisor will inspect the blasted area. He will consult with the D&B Supervisor to ascertain if there is a charged blast pattern adjacent to the Blasted Material.	Site Supervisor
The D&B Supervisor will measure 8 m perpendicular in front of each charged blast hole in the direction of the blasted material that is to be loaded and position red fluorescent pylons (construction cones)	D&B Supervisor, Surveyor



parallel to the charged blast holes.	
The Site Supervisor is responsible for ensuring that the “Dig Limits” Pylons are in place before loading operations commence.	Site Supervisor
When facing up the Loading Equipment Operators must stop at the pylons. If a pylon falls down the muck pile the operator must inform the Supervisor immediately. The Loading Equipment will then move laterally to continue progressive loading of the muck pile.	Operator

12 RECLAMATION

12.1 DESIRED FUTURE CONDITION

Operation of the proposed quarry is anticipated to continue until the material is depleted. In the initial stages, the operation will be limited to the needs of the construction of the proposed TASR and subject to the operational time frames and conditions of the Land Use Permit from the Wek’èezhì Land and Water Board. The active quarry site will be kept clean, tidy, trimmed and free of any garbage and debris during the operational time frames of the Land Use Permit. Upon the final completion of the quarrying operation, the active quarry area will be:

- Trimmed and sloped along the active areas of the pit.
- Grubbing/top soil materials along the perimeters of the pit edge will be placed along the pit floor in an appropriate manner to promote revegetation and proper drainage.
- All equipment, seasonal storage shed/trails, etc. will be removed off site.

12.2 AESTHETICS

The quarry site at completion of the life of the development will be reclaimed using appropriate equipment to trim, level and replace reclamation materials aesthetically correct over the required areas of the pit floor and sideslopes.

12.3 WILDLIFE HABITAT ENHANCEMENT

Working in conjunction with the RMO, wildlife habitat enhancement will be considered in the restoration plan. This includes specifics related to the enhancement of revegetation using locally stored materials and if required, reseeding and fertilization using the appropriate and approved mixtures.

12.4 WATER DIVERSION OR PROTECTION

As previously described, the quarry development includes a positive drainage management plan for the pit floor and excavated/extraction areas. On completion of the operations and final clean-up of the quarry, positive drainage will be maintained or improved to enhance the drainage requirements. Disruption of drainage courses will not be encountered in the development of the quarry.



12.5 SLOPING/BENCHING

A progressive maintenance program will be maintained to ensure that the quarry is kept sloped and contoured throughout the operation. At the end of the quarry life, stripping piles and organic sources stockpiled in the pit staging area will be spread at even intervals on the pit floor and surrounding quarry perimeter. Where the blasting/excavation took place, the benching effect/design will be left to promote enhancement to nesting birds and other wildlife.

12.6 PERMAFROST STABILIZATION

Permafrost conditions in the quarry are not anticipated. At the end of the quarry life, the general appearance of the quarry will be of exposed rock, not prone to movement or erosion.

12.7 VEGETATION

If needed, as part of restoration, plans will be set into place to promote revegetation of the site. This may include an approved seed mixture and fertilizer to promote revegetation.

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